WETLAND ASSESSMENT IN THE ROCHESTER EMBAYMENT AREA OF CONCERN IN SUPPORT OF THE LOSS OF FISH AND WILDLIFE HABITAT BUI REMOVAL EVALUATION

FINAL REPORT

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EXECUTIVE SUMMARY

The U.S. Fish and Wildlife Service (USFWS) New York Field Office (NYFO) conducted a focused assessment of wetlands within and adjacent to the Rochester Embayment Area of Concern (REAOC) in support of Area of Concern (AOC) delisting evaluations. This wetland assessment project is one of two current NYFO projects related to wetland management at the REAOC[1]. The assessment project provides to decision-makers an analysis and synthesis of wetland status and trends, and identifies wetlands most in need of rehabilitation or protection. The wetland assessment project is complete, and this document is the final report.

The 2011 REAOC Remedial Action Plan (RAP) Stage II Addendum describes the current status of the Loss of Fish and Wildlife Beneficial Use Impairment (BUI) as –impaired”. Among delisting criteria and recommended actions for removing the habitat loss BUI are requirements to assess trends in wetland size and condition, and rank wetland habitats for preservation and restoration. In February 2012, the U.S. Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO) requested that NYFO conduct those assessments.

The wetland assessment at the REAOC was focused with objectives specified by USEPA GLNPO, and described in REAOC documents including the RAP Stage I and Stage II documents and their Addenda, and a strategic plan for AOC delisting. The project area includes wetlands associated with 18 waterbodies, including Lake Ontario, bays, ponds, streams, and the Genesee River. Each waterbody is either within the REAOC, or immediately upstream of, and with direct surface water connection to, Lake Ontario at the REAOC. The REAOC wetland assessment objectives are:

1. Determine whether (a) wetland extent or (b) wetland quality is in decline at the REAOC.
2. Rank habitat condition of the wetlands for restoration and preservation prioritization.

Change in Wetland Extent

Wetland acreage has declined within the project area as a whole, and within 11 of the 14 individual waterbodies considered in the analysis of wetland extent. Change in wetland extent was evaluated by comparing emergent marsh delineations from 1951 aerial imagery with 2011 delineations. Apparent causes of observed changes to or from emergent wetland were summarized. Delineations and interpretations using aerial imagery were conducted consistent with methods used by the National Wetlands Inventory (NWI). A total net loss of approximately 280 acres of emergent wetland occurred within the project area between 1951 and 2011. Both losses and gains in wetland area were observed in different areas of each waterbody evaluated. Net losses ranging from 1 to 121 acres were seen among the waterbodies evaluated. Net gains ranging from 11 to 40 acres were observed in three of the waterbodies. Causal analysis attributed most of the wetland acreage loss to fill for roads and other development, erosion, and natural dynamic shifts at wetland margins.

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[1] The second project is a restoration recommendation project. It is in process and will provide recommendations for specific restoration actions in wetlands previously identified as most in need of rehabilitation. Preliminary recommended restoration actions have been developed and communicated to the REAOC RAC and USEPA, building directly on results of the wetland assessment project. Two pilot restorations will be conducted in 2014 to determine whether preliminary recommended restoration actions result in anticipated improvements.

Change in Wetland Quality

No overall temporal trend in wetland quality was observed in the project area as a whole, although obvious trends were discernible within individual waterbodies. Change in wetland quality was evaluated in terms of 19 metrics characterizing structural habitat condition, water quality, and animal communities. Trend analysis of time series data was conducted for water quality (1991-2009) and animal community (1995-2011) metrics developed from published documents and existing datasets. Changes in wetland structural habitat quality were interpreted from a comparison of 1951 to 2011 aerial imagery. Both improvements and declines in quality were observed in structural habitat, water quality, and/or animal community metrics in each waterbody considered. Water quality improved in seven of the eight waterbodies considered, but absolute nutrient levels remained very high in a few of those waterbodies despite the improving trend. Patterns in structural habitat and animal community trends were less clear, except in a few waterbodies. Among the clearest patterns were net declines in wetland quality across the suite of metrics considered in Irondequoit Creek and West Creek, and a broad improving tendency in Irondequoit Bay, Buck Pond, and Cranberry Pond. Specific metrics that declined most consistently across waterbodies were patch mosaic complexity, bird species diversity, bird focal species richness, and bird Index of Biological Integrity (IBI).

Ranking Current Wetland Quality

Wetlands were ranked for restoration and preservation prioritization using metrics of structural habitat condition and stress, water quality, and/or animal communities derived from data NYFO collected in 2012 and 2013 at a total of 112 sampling stations distributed across the project area. Standardized field methods were selected that are designed for extensive sampling across large areas, are rapidly implemented, and are readily repeatable. Cranberry Pond is the best candidate for wetland protection, as it ranked relatively high across waterbodies in each of the analyses. The principal candidate waterbodies for wetland habitat restoration are Braddock Bay and its tributaries, Long Pond, Genesee River, Irondequoit Bay, Irondequoit Creek, and Buck Pond, based on a weight-of-evidence ranking evaluation of structural habitat, water quality, and animal community metrics. Factors most frequently responsible for driving down wetland quality scores included four metrics related to habitat structural complexity, as well as ammonia, total phosphorus, and dissolved oxygen (DO) levels in the water column.

ACKNOWLEDGEMENTS

The NYFO is grateful for suggestions, and communication and material support, provided throughout this project by Mr. Charles Knauf, the REAOC RAC Coordinator. NYFO thanks technical advisors to the RAC for their time, insight, and suggestions, many of which were incorporated into the sampling design and implementation: Louise Hartshorn, Doug Wilcox, Stevie Adams, Heidi Kennedy, and John Waud.

The NYFO is also grateful to Mr. Ralph Tiner, USFWS NWI Wetlands Specialist, for excellent hands-on training in National Wetlands Inventory techniques for wetland interpretation using aerial imagery and for providing continued advice and suggestions to NYFO staff. NYFO would like to thank Ms. Amy McGovern, USFWS GLNPO liaison, for communication support and thoughtful encouragement.

BACKGROUND

The Great Lakes Water Quality Agreement (GLWQA) between the United States and Canada addresses the degradation of the physical, chemical, and biological integrity of the Great Lakes. In the agreement, first signed in 1972, each country committed to work toward restoration of the Great Lakes Basin. The GLWQA of 1987 (Annex 2) identified locations that have serious contamination and degradation issues to a greater degree than in the rest of the Great Lakes, and designated these locations as Areas of Concern (AOCs). In total, 43 AOCs have been identified to date – 26 located entirely within U.S. borders, 12 located entirely in Canada, and five with shared jurisdiction. Of these, three Canadian AOCs and two U.S. AOCs have been delisted (International Joint Commission [IJC] 2013 and USEPA 2013a; 2013b).

The GLWQA defines 14 “beneficial uses” related to human and intrinsic values of the ecological system. AOCs are being assessed to determine which of these beneficial uses remain impaired, and to identify actions that will restore beneficial uses. Remedial Action Plans (RAPs) were developed by AOC-specific Remedial Action Committees (RACs) to guide rehabilitation of AOC ecological integrity. RAPs include criteria to remove beneficial use impairments (BUIs), and have undergone several updates.

The RAP for the Rochester Embayment Area of Concern (REAOC) identifies and provides the rationale and remediation plans for 12 BUIs including the “Loss of Fish and Wildlife Habitat” BUI (Beal and Stevenson 1997, MCDPD 1993, USEPA 2014). An update of BUI-specific status, delisting criteria, and recommended actions for BUI removal was prepared in December 2011, associated with the REAOC RAP Stage 2 Addendum (MCDPH 2011). According to that report, the current status of the Loss of Fish and Wildlife Habitat BUI at the REAOC is “impaired.” Among delisting criteria and recommended actions for the habitat loss BUI are requirements to assess trends in wetland size and condition, and rank wetland habitats for protection and restoration. In February 2012 the U.S. Environmental Protection Agency (USEPA) Great Lakes National Program Office (GLNPO) requested that the U.S. Fish and Wildlife Service (USFWS) New York Field Office (NYFO) conduct those assessments.

This report provides a description of the project scope (objectives, study area, general approach, etc.), methods, results, and interpretation. Additional relevant details are provided in attachments.

PROJECT SCOPE

PURPOSE

Purposes of this REAOC wetland habitat assessment include the following:

1. Provide focused information to the REAOC RAC for BUI removal and action prioritization decisions regarding wetland habitat;
2. Provide information to wetland managers in various agencies about historical changes and the current state of coastal and riparian wetlands in the Rochester, NY, vicinity; and
3. Provide comprehensive baseline data generated with standardized methods that may be readily repeated to monitor future changes in extent and condition of emergent coastal wetlands in the Rochester area.

OBJECTIVES

Wetland habitat assessment objectives were developed based on guidance documents (e.g., MCDPD 1993, Beal and Stevenson 1997, MCDPH 2011, Ecology and Environment, Inc. [E&E] 2011) and professional judgment, as instructed by USEPA GLNPO at the outset of the project, and with consideration to numerous communications with the REAOC RAC Coordinator and wetland experts. NYFO has consistently reported these objectives throughout the project in work statements, presentations, an interim report provided to GLNPO in March 2013, and other communications.

Objective 1. Determine whether either (a) wetland extent or (b) wetland quality is in decline.

Objective 2. Rank habitat condition of wetlands for use in restoration and preservation prioritization.

Objective 1 is based on one of the delisting criteria for the Loss of Fish and Wildlife Habitat BUI, as identified in the E&E *Interim Rochester Embayment Area of Concern (AOC) Strategic Plan for Beneficial Use Impairment (BUI) Delisting* (E&E 2011). Objective 2 is identified in the *December 2011 Addendum to Stage 1 and 2 Remedial Action Plans, Rochester Embayment Area of Concern, New York State* (MCDPH 2011) as an ―Action Needed for BUI Removal" (i.e., one of a ―series of project-specific actions, either regulatory or non-regulatory, needed to accomplish the remedies and to ultimately justify re-designation of the BUI").

The role of the USFWS NYFO in accomplishing these objectives was to design and conduct focused assessments that address BUI removal criteria and rank wetland condition.

PROJECT AREA

The current extent of the REAOC is described on the AOC web site (USEPA 2014). The northern boundary of the Rochester Embayment is depicted as a straight line between Bogus Point in Parma, NY, and Nine Mile Point in Webster, NY, both in Monroe County. The southern boundary is the shoreline between those points, including the open water portion of Braddock Bay and the lower 6 miles of the Genesee River between the river mouth and the Lower Falls. The drainage area of the embayment is extensive, and includes the entirety of the Genesee River Basin and parts of both the Lake Ontario West Basin and the Lake Ontario Central Basin (USEPA 2014).

For determinations of change in wetland extent and quality related to Loss of Fish and Wildlife Habitat BUI removal, E&E (2011) suggested that a 0.5-mile buffer line landward of the current boundary (USEPA 2014) be determined, and wetlands within that buffer line be assessed. However, RAP documents have indicated that the geographic extent of the REAOC was once considerably larger than the current definition, as depicted on the AOC website. MCDPD (1993) identified the southern boundary of the Rochester Embayment as ―those points from which water drains directly into the lake without first entering a stream." This would include all of the ponds adjacent to the current AOC, Braddock Bay, Genesee River, Irondequoit Bay, and some wetlands near Bogus Point. The 2002 Addendum to the Stage I and II RAP documents (Beal 2002) identified the southern boundary of the study area for the Loss of Fish and Wildlife BUI as ―the contributing area to the north of the historical Lake Iroquois shoreline (approximately Ridge Road)."

The 2011 Addendum to the Stage I and Stage II RAPs (MCDPH 2011) indicated that ranking critical habitats in the AOC was an *Action Needed for BUI Removal*. Ranking critical habitats was also recommended in Beal and Stevenson (1997) and E&E (2011). These sources recommended the following areas within the Rochester Embayment watershed, including areas outside of the current REAOC boundary, in which critical wetlands should be identified and ranked for restoration and protection:

- Monroe County Environmental Management Council (EMC)
    - Irondequoit Bay ecosystem
    - Braddock Bay ecosystem
    - Lake Ontario Wetlands ecosystem
    - Round Pond – Island Cottage complex
- NYS Department of State Significant Coastal Fish and Wildlife Habitats program
    - Irondequoit Creek/Bay
    - Genesee River
    - Slater Creek
    - Braddock Bay / Salmon Creek
- U.S.-Canada Agreement - North American Waterfowl Management Plan (Lake Shore Marshes Focus Area Plan)
    - Payne Beach wetlands
    - Braddock Bay wetlands
    - Cranberry, Long, Buck, & Round Ponds and wetlands
    - Slater Creek wetlands
    - Genesee River
    - Irondequoit Creek wetlands
    - Irondequoit Bay

NYFO did not locate a written rationale for the change in the REAOC boundary to its current configuration in any of the RAP documents consulted (MCDPD 1993, Beal and Stevenson 1997, Beal and Fuller 1999, Beal 2002, MCDPH 2011). In an effort to reconcile these apparently contradictory sources of information, and recognizing the natural contiguity of wild populations, habitats, and ecosystem processes, NYFO defined the project area based on a synthesis of information provided in RAP documents (MCDPD 1993, Beal and Stevenson 1997, Beal 2002), suggestions provided in E&E (2011), and professional judgment.

Shapefiles of wetlands mapped by either National Wetlands Inventory (NWI) or New York State Department of Environmental Conservation (NYSDEC)[2] were used to define the initial geographic scope of the assessment. The entirety of mapped wetlands that were either (a) entirely within the AOC boundary 0.5-mile buffer line (E&E 2011), (b) intersected the buffer line, or (c) were contiguous with intersecting wetlands were included (gaps between wetlands ≤ 30m are considered contiguous for this assessment). Excluded were wetlands associated with waterbodies that are not contiguous with the REAOC proper or that are associated with constructed water bodies (e.g., wetlands around Durand and Eastman Lakes). Additionally, relatively small wetlands associated with minor water bodies were excluded (e.g., mapped NWI wetlands on small streams near the east end of the REAOC) in order to focus limited project resources on the more extensive wetland areas.

The spatial distribution of project wetlands is provided in Figure A. These wetlands are associated with 18 waterbodies within the project area. Lentic waterbodies included in the analysis were: Bogus Point Pond, Rose Marsh Pond, Braddock Bay, Cranberry Pond, Long Pond, Buck Pond, Round Pond, and Irondequoit Bay. Lotic waterbodies included in this assessment were: Salmon Creek, West Creek, Buttonwood Creek, Northrup Creek, Larkin Creek, Round Pond inlet, Genesee River, Irondequoit Creek, and an unnamed Irondequoit Bay tributary. An additional waterbody, Slater Creek, was included in the evaluations of change in wetland extent and quality, but excluded from the ranking of current wetland habitat quality because it is unlikely restorations of significant size or impact could occur there.

OVERALL APPROACH

NYFO adopted the classic wetland definition provided in Cowardin et al. (1979):

> *"Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water…Wetlands must have one or more of the following three attributes:*
>
> - *At least periodically, the land supports predominantly hydrophytes,*
> - *The substrate is predominantly undrained hydric soil, and*
> - *The substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year."*

Both NYSDEC and NWI consider all of these attributes in developing delineations for mapped regulatory wetlands (NYSDEC 1986, NYSDEC 1995, Tiner 1996, and Tiner 1999) and for other agency applications. For this assessment, NYSDEC and NWI mapped wetlands were the basis for defining the project area for wetland delineations, identifying subject wetlands, and distributing sampling stations for habitat quality assessments. A number of factors that can affect wetland habitat quality for fish and wildlife were accounted for in the assessment design (Figure B). Assessment endpoints for wetland quality were grouped into habitat structure, water

[2] NYSDEC has recently remapped wetlands in the vicinity of Rochester, NY, but data were not available for public release at the time of this study (J. Stevens, NYSDEC-Bureau of Habitat, pers. comm.).

quality, and animal communities. The project scope does not include potential effects from chemical contamination[3].

There are three major technical components of this assessment:

1. Assess the direction and nature of changes in wetland size;
2. Assess the direction and nature of changes in wetland quality; and
3. Rank wetland quality and identify wetlands for restoration or protection.

This report is comprised of three chapters to address these topics. Each chapter provides methods, results and interpretation, and a summary.

[3] Although contaminants are clearly an important consideration in characterizing wetland quality, this project's budget and timeline were insufficient to study contaminants in wetlands across the project area as a component of ranking wetland habitat or evaluating trends in wetland habitat quality.

Figure A. Project Area for the USFWS Wetland Assessment Project at the Rochester Embayment Area of Concern. The yellow line indicates a boundary beyond which no NYSDEC or NWI mapped wetlands were included. Excluded areas are circled in red (see text for exclusion rationale).

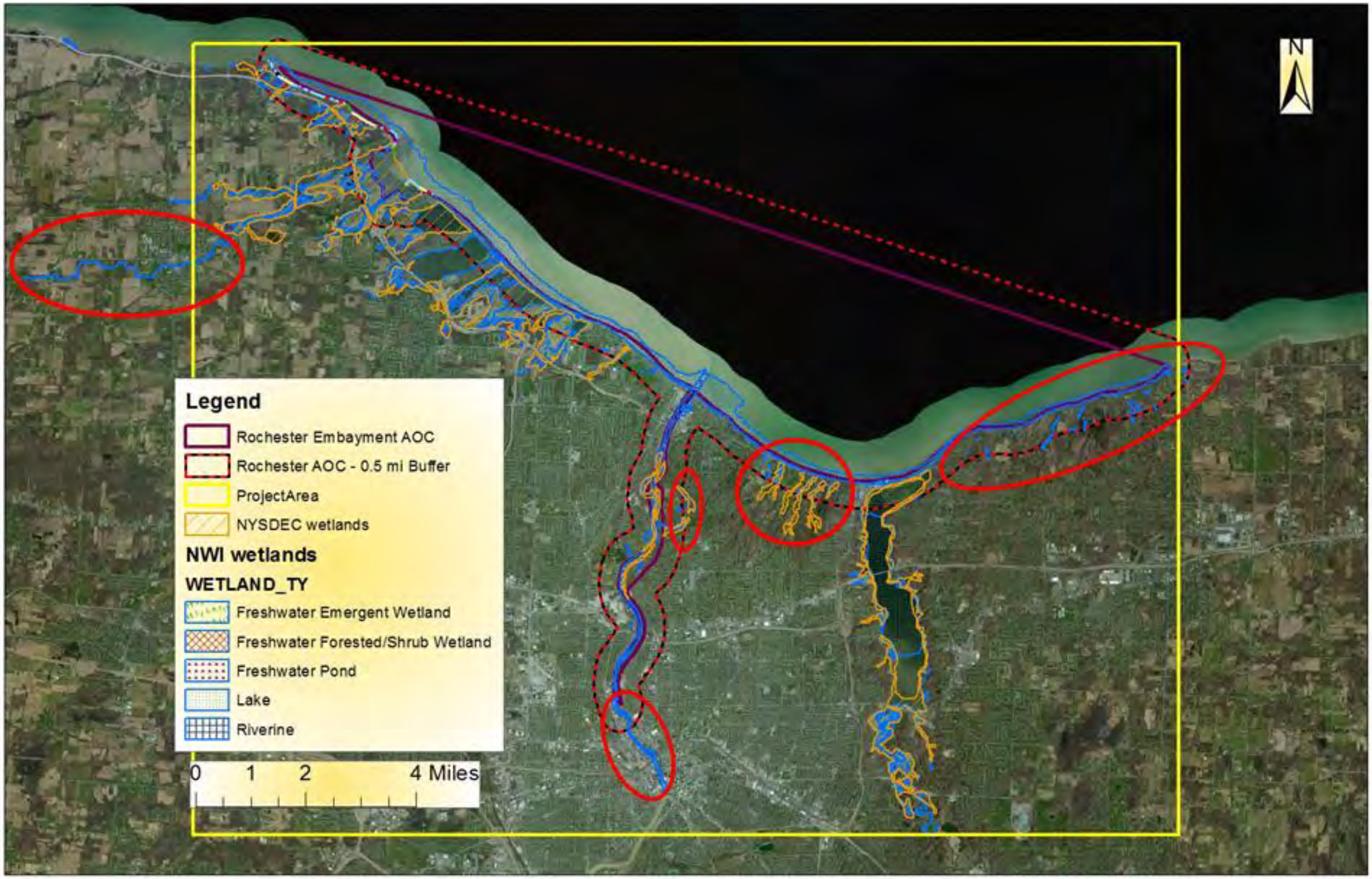
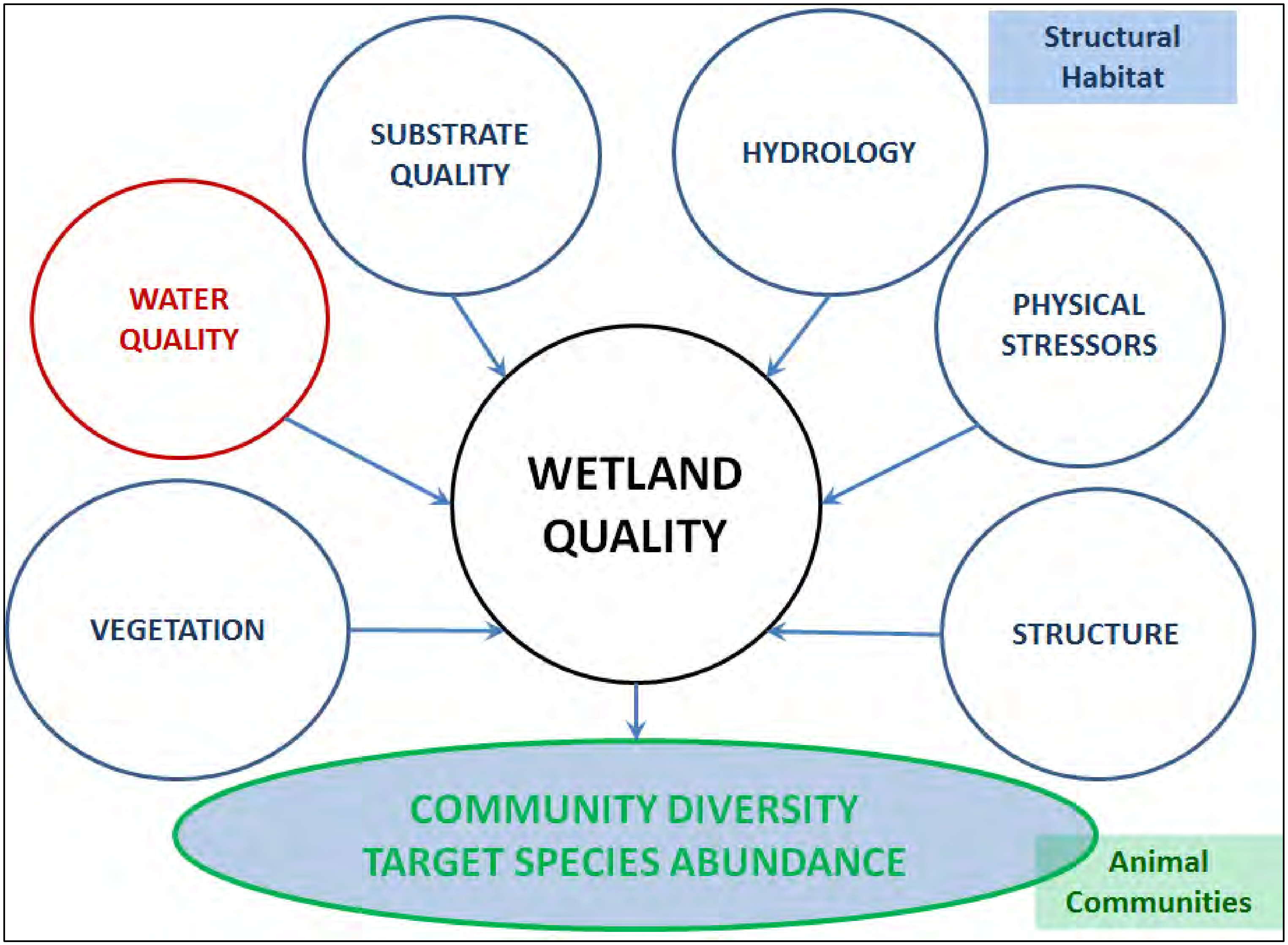


Figure B. Ecosystem elements relevant to wetland habitat quality that were included in the USFWS Wetland Assessment Project at the Rochester Embayment Area of Concern were water quality, habitat structure (vegetation, substrate quality, hydrology, physical stressors, and physical structure), and animal communities.



CHAPTER ONE – CHANGE IN WETLAND EXTENT

METHODS

Change in wetland extent within the project area was evaluated using aerial imagery from the years between 1930 to 2011. This analysis focused on emergent wetlands, since delineation of the historical extent of submerged and many wooded wetlands was not possible using historical aerial photographs.

NYFO's delineation of current emergent wetland boundaries (Figures 1-1 to 1-11) expanded on an existing delineation from 2011 color infrared (CIR) imagery. Prior wetland delineations based on this imagery were performed by the University of Massachusetts (UMass) on behalf of NWI (Tiner et al. 2011). The U.S. Army Corps of Engineers (USACE), Buffalo provided NYFO with the CIR imagery, shapefiles of the UMass delineations, and a project report. NYFO delineated areas within the project area that had not previously been delineated by UMass using the same 2011 CIR imagery where coverage allowed. Large areas of the wetland assessment project area were not covered by 2011 CIR imagery. Where the 2011 CIR coverage was incomplete, NYFO used 2011 orthographic true color imagery to fill in gaps (ArcGIS 10.0 Bing base map, June 2011). The most recent, clear, leaf-off imagery (2009 orthographic aerial, 2005 CIR, or 1994 CIR) was used for reference in areas where 2011 imagery did not provide a readily visible wetland signature in leaf-on condition.

Historical imagery was obtained from black and white 9"x9" stereo pairs of photographs produced from flights flown in 1988, 1978, 1976, 1966, and 1951. Black and white 7"x9" stereo pairs were obtained for the 1930s. Historical imagery was sourced from Cornell's Institute for Resource Information Sciences (IRIS) Historical Aerial Imagery archive and Monroe County Department of Health's archive. Photos were scanned on-site using a CanoScan LiDE210 at 600dpi and saved to electronic files. Control points were identified and historical images were georeferenced using the 2011 Bing base map in ArcGIS 10 (North American Datum [NAD] 1983, Universal Transverse Mercator [UTM], Zone 18N). The Bing base map is a web mapping service that interfaces with ArcGIS 10 to provide worldwide orthographic imagery, and was updated regularly. The orthographic imagery provided in the Bing base map covering the wetland assessment project area had been updated in June 2011.

The historical emergent wetland delineations (Figures 1-1 to 1-11) were developed from black and white aerial photographs from flights flown in October 1951[4]. Historical wetland signatures were delineated at a resolution of 1:5000. Interpretation of areas in the 1951 imagery that were unclear was enhanced by bracketing with reference imagery from 1930 and the next

[4] E&E (2011), based on Beal (2002), specifies using a survey conducted in 1996 as the baseline year for comparison of change in wetland extent and quality. NYFO did locate a report (Korfmacher et al. 2005) that summarized methods and results of delineations and limited quality assessments conducted in the summer of 2003 at six local wetlands, only 4 of which were in the project area. However, NYFO was not able to obtain any data or shapefiles from the 2003 survey. Likewise, NYFO did not locate reports or data from a wetland survey purportedly conducted in the late 1990s, as referenced and dismissed as inadequate in Korfmacher et al. (2005). The year 1951 was selected as the historical reference year based on discussions in a REAOC technical advisory meeting, held in January 2013, and subsequent discussions. The 1951 imagery shows wetland extent prior to regulation of Lake Ontario water levels. Delineations of historical coastal wetlands based on this imagery can provide useful information for designing restoration projects within the area currently influenced by regulated lake levels. Attribution of causes of subsequent acreage changes allows managers to tally gain/loss since a particular event (such as road construction).

subsequent imagery that was adequate for clear interpretation (1966, 1976, 1978, or 1988). In areas where the 1951 imagery did not clearly identify wetlands and there has been no development to date (hence, reasonable to expect no change in extent), the earliest available CIR imagery was also used to aid in the historical delineation by providing a clearer wetland signature[5]. The Lake Ontario coast was subject to greater water level fluctuations in 1951, which was prior to lake level regulation, than in 2011 (Wilcox et al. 2005). Clear emergent wetland signatures visible in 1951 imagery that were adjacent to open water, but not delineated as emergent wetland in 2011, were included in the historical delineation in areas where there has been no development. Hydric soil GIS layers and LiDAR topographic data were consulted in locations of uncertainty.

NYFO's interpretations of wetland signatures from historical aerial photographs, and techniques used to perform delineation of historical wetland boundaries closely adhered to methods used by expert NWI personnel[6].

In order to identify direction (gain/loss), locations, potential causes, and acreage of apparent changes in extent, the delineation derived from 1951 imagery was overlain by the current delineation. Areas of overlap and non-overlap between the 1951 and 2011 emergent wetland delineations were identified (Figures 1-12 to 1-22). Polygons were digitized on-screen defining locations where a change in extent – either a loss or gain – was apparent. Over 2,300 of these polygons were evaluated across the project area.

Polygons within which emergent wetland is currently present, and where there clearly had not been wetland in 1951, were identified as gains. Conversely, polygons within which the current delineation clearly indicated an absence of wetland, and where there clearly had been emergent wetland present in 1951, were identified as losses. Small areas of embedded open water, tree islands, and shrublands were treated as part of the emergent wetland, and were included in the gain/loss analysis. Larger areas of embedded open water were excluded.

Polygons that included areas of unresolved uncertainty in either the current or 1951 delineations were not included in the net gain/loss analysis. Unless there was a clear and readily interpretable difference between 1951 and 2011 delineations, it was assumed that no wetland change occurred and the polygon was discounted from gain/loss tallies. Minor delineation discrepancies (e.g., apparently due to inherent limitations of georeferencing, or to differences in scale at which delineations were developed) were also excluded from gain/loss tallies.

Each polygon was examined to ascribe apparent cause of change[7] (detailed explanations of causes are tabulated in Attachment 1-1). Additional years of historical imagery were referenced as necessary to enhance interpretability of causes. Emergent wetland gain was assigned one of three types and one of nine causes, while losses were attributed to one of eight types and one of 19 causes.

[5] R. Tiner, pers. comm.
[6] R. Tiner, intensive hands-on training at NYFO, February 2013
[7] As recommended during REAOC technical advisory meeting, January 2013

RESULTS AND DISCUSSION

There has been a significant overall net loss of coastal Lake Ontario emergent wetlands within the project area, during the second half of the 20th century (Table 1-1). A total of approximately 493 acres of emergent wetland were lost from 1951 to 2011, but this loss was partially offset by about 211 acres gained in other locations, for a net loss of 282 acres (approximately -12.4%) of emergent wetlands present in 1951. Within the project area, losses were due primarily to fill and hydrological changes as a result of transportation and residential development, erosion, stream channelization, and natural dynamic shifts at the water-emergent vegetation boundary, among other proximate causes (Table 1-2). Major ultimate causes of loss in Great Lakes coastal wetland acreage include development (including shoreline hardening) associated with urban sprawl (USFWS 1981a), draining for agriculture (USFWS 1981a), and lake water level regulation (Wilcox et al. 2005).

Most of the waterbodies considered in this assessment experienced net losses, but a few showed gains in emergent wetland acreage (Table 1-1; Figures 1-12 to 1-22). Lentic systems with the greatest net loss in emergent wetland acreage were Buck Pond (-121.5 acres) and Braddock Bay (-67.2 acres). However, as a percent of 1951 acreage, Long Pond (-27.2%) experienced the greatest impact, followed by Braddock Bay (-23.1%), Buck Pond (-19.4%), Irondequoit Bay (-16.8%), and Rose Marsh (-15.1%). Among lotic systems within the project area, the Genesee River experienced the greatest losses in wetland area, both as net loss in acreage (-46.4 acres) and percent loss (-35.6%).

Although the overall net change in acreage was negative, there were also localized significant gains in emergent marsh acreage. Gains were principally attributed to relative lowering of water levels between 1951 and 2011 and dynamic shifts at the water-vegetation interface, although a significant number of incidental gains was observed at the margins of developed areas (Table 1-3).

None of the lentic systems in the project area showed a net gain in emergent wetland acreage, but three lotic systems did show significant gains. Net gains in emergent wetland occurred in Salmon Creek (+40.46 acres; +40.5%), West Creek (+10.95 acres; +44.3%), and the combined acreage in Irondequoit Creek and an unnamed eastern tributary to Irondequoit Bay (+13.5 acres; +6.9%).

It may be argued that these apparent gains in emergent wetland area are an artifact of unusually high water levels in the tributaries at the time of the October 1951 aerial photography flights, relative to water level at the time of acquisition of the 2011 imagery. If this hypothesis is true[8], then not only are this study‘s estimated gains overestimates, but the reported losses are likely underestimates, and the actual overall net loss in emergent wetland is considerably greater than reported here. Another potential explanation is that the current tributary and regulated lake levels are higher on average than the historical average water levels. This could potentially increase the water quantity and reduce the energy of flowing water in the lowest reaches of tributaries, making broad areas more suitable for emergent vegetation today than in 1951.

[8] NYFO attempted to acquire water level data from 1940 through the present from USACE and the National Oceanic and Atmospheric Administration (NOAA) in order to evaluate this hypothesis, but raw data prior to 1960 were not made available to this project due to concerns of the providers about poor relative data quality in the earlier years.

However, this second hypothesis would not explain any of the gains in emergent wetland in upper reaches, such as in West Creek.

Tallies of loss and gain of wetland acreage by type and cause were obtained for the entire project area, and also by waterbody. Assigning direction and cause of change to individual polygons provides REAOC decision-makers the flexibility to include only specific subsets of causes in the tallies of change in wetland acreage, depending on the specific management question at hand. Because this study tallied losses and gains by causal attribution and waterbody (Attachment 1-2), the corresponding loss and gain acreages could be used to adjust tallies of acreage change in a given waterbody, or across the project area. For instance, areas where there have been losses of wetland acreage due to certain types of development (such as road construction) may not be considered candidate locations for restoration in the near future. Particularly major roads may not be considered an on-going cause of current changes in wetland extent.

Consider Rose Marsh for an illustration of using this report's data to interpret the findings of net change in wetland acreage. Emergent wetland acreage in Rose Marsh declined by approximately 15.9 acres (-15.1%) since 1951 (Table 1-1). Approximately 13 acres of that loss is attributed to road construction, and 2.9 acres to erosion (Attachment 1-2). Within Rose Marsh, there were no locations were wetlands were gained. Figure 2 illustrates that all of the loss attributed to road construction is due to installation of the Lake Ontario Parkway, and all of the erosional losses occurred along the shore of Lake Ontario. The acreage loss due to Parkway construction is not on-going and is practically irreversible. However, the erosional loss may be ongoing, and may be affected by factors such as sequestering of sand at Hamlin Beach State Park and increased shoreline hardening, both up-current of Bogus Point, and possibly also lakewide influences such as lake level regulation.

SUMMARY

Wetland acreage has declined within the project area as a whole, and within 11 of the 14 individual waterbodies considered in the analysis of wetland extent. Change in wetland extent was evaluated by comparing emergent marsh delineations from 1951 aerial imagery with 2011 delineations. Delineations and interpretations using aerial imagery were conducted consistent with methods used by the National Wetlands Inventory (NWI). Between 1951 and 2011, there was a net loss of approximately 280 acres of emergent wetland within the project area. The greatest net losses in acreage were in Buck Pond (-121 acres), Braddock Bay (-67 acres), and the Genesee River (-46 acres). The greatest losses as a percent of 1951 acreage were seen in Slater Creek (-43%), Genesee River (-35%), Long Pond (-27%), and Braddock Bay (-23%). There were apparent gains in emergent wetland in Salmon Creek (+40%), West Creek (+44%), and Irondequoit Bay tributaries (+7%)[9]. Losses of emergent wetland acreage were due principally to fill and hydrological changes as a result of transportation and residential development, erosion, stream channelization, and natural dynamic shifts at the water-emergent vegetation boundary.

[9] It is possible these apparent gains are artifacts - see RESULTS and DISCUSSION.

TABLES

Table 1-1. Summary of changes in emergent wetland extent from 1951 to 2011, by waterbody.

Wetland Complex	Waterbody	Emergent Wetland Acreage in 1951	Emergent Wetland Acreage in 2011	Net Change since 1951 in Emergent Wetland Acres*	Acres Lost	Acres Gained	% Change since 1951 in Emergent Wetland Extent
Braddock Bay							
	Braddock Bay	290.63	223.42	-67.21	-100.13	32.92	-23.13%
	Salmon Creek**	99.80	140.26	40.46	-8.63	49.09	40.54%
	West Creek**	24.70	35.65	10.95	-1.77	12.72	44.32%
	Buttonwood Creek	151.08	136.34	-14.74	-15.85	1.10	-9.76%
Buck/Round							
	Buck Pond	626.90	505.43	-121.47	-124.25	2.78	-19.38%
	Round Pond	222.22	201.25	-20.98	-29.76	8.79	-9.44%
Cranberry/Long							
	Cranberry Pond	209.13	193.85	-15.28	-16.93	1.65	-7.31%
	Long Pond	88.13	64.16	-23.97	-30.83	6.87	-27.20%
Genesee River		130.25	83.85	-46.40	-59.10	12.70	-35.62%
Irondequoit							
	Irondequoit Bay	63.24	52.62	-10.62	-37.29	26.68	-16.79%
	Irondequoit Creek and Eastern Trib**	195.08	208.53	13.45	-36.59	50.05	6.90%
Rose Marsh							
	Bogus Pond Marsh	36.16	35.26	-0.90	-2.88	1.98	-2.49%
	Rose Marsh	105.48	89.57	-15.91	-15.91	0.00	-15.08%
Slater Creek		20.59	11.65	-8.94	-12.90	3.96	-43.43%
REAOC Overall		**2263.38**	**1981.83**	**-281.55**	**-492.84**	**211.29**	-12.44%

*Submerged aquatic vegetation was not considered due to the difficulty of accurately measuring historic extent of aquatic beds. Only areas of high certainty of total acreage in both sets of imagery were considered.

**Water level in 1951 imagery for Salmon, West, and Irondequoit Creeks appeared higher than in 2011 imagery, leading to calculated wetland gains.

Table 1-2. Loss in wetland acreage across entire project area, tallied by attributed cause (see Attachments 1-1 and 1-2 for a more detailed breakdown of losses).

Loss Type	**Loss Cause**	**Acreage by Cause**	**Count of Polygons by Cause**
Mowed	Development	0.42	1
Fill	Development	57.31	49
	Field Check	2.17	1
	Road	63.15	140
	Stream Channelized	5.03	8
Hydrological shift	Development	0.47	1
	Road	15.48	26
Hydrological change with Fill	Field Check	26.21	6
Made Land	Development	30.04	19
	Road	24.29	61
Residential	Development	6.39	12
	Stream Channelized	3.90	5
Shift	Delineation	0.03	1
Shoreline	Erosion	2.89	5
Conversion of wetland to water	Development	26.72	37
	Dredge	16.11	5
	Dynamic shift	93.38	200
	Erosion	82.85	16
	Road	20.76	6
	Stream Channelized	3.25	10
	Water Level	11.99	24
TOTAL of LOSSES		**492.84**	**633**
Ignore	Ignore	9.15	21
NO LOSS	Delineation	9.49	146
	No Change	48.59	123
	Overinclusive	81.47	146
	Size Threshold	0.42	232
	Surrounding Loss	11.12	11
	To PFO	9.38	11
	Uncertainty	22.24	48
TOTAL EXCLUDED		191.85	738

Table 1-3. Gain in wetland acreage across entire project area, tallied by attributed cause (see Attachments 1-1 and 1-2 for an explanation of terms and a more detailed breakdown of gains).

GainType	Gain Cause	Acreage by Cause	Count of Polygons by Cause
Conversion from water to wetland	Development	10.3	12
	Dredge Fill in	5.4	3
	Dynamic Shift	84.5	172
	Road	5.6	8
	Stream Channelized	4.3	9
	Water Level	87.8	66
Hydrological shift	Development	3.9	9
	Road	9.1	17
Reclaimed	Removal	0.3	2
TOTAL of GAINS		**211.3**	**298**
Ignore	Delineation	7.5	23
No Gain	Delineation	7.0	179
	Interior Water	1.3	5
	No Change	14.3	91
	Overinclusive	8.7	27
	Size Threshold	0.6	314
	Uncertainty	15.6	63
TOTAL EXCLUDED		55.0	702

Figure 1-1. Delineated boundaries of emergent wetlands associated with Bogus Point pond in 1951 and 2011.

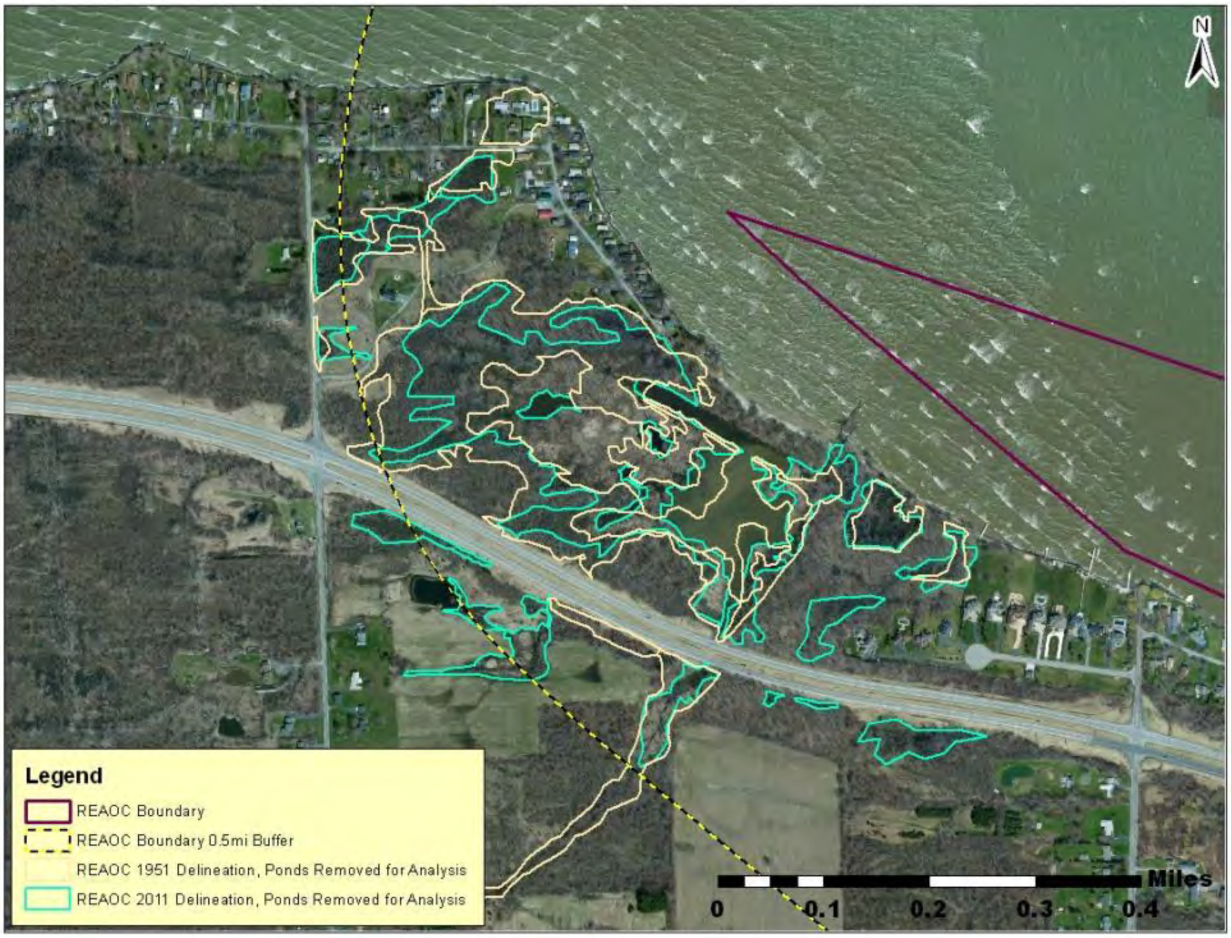


Figure 1-2. Delineated boundaries of emergent wetlands associated with Rose Marsh in 1951 and 2011.

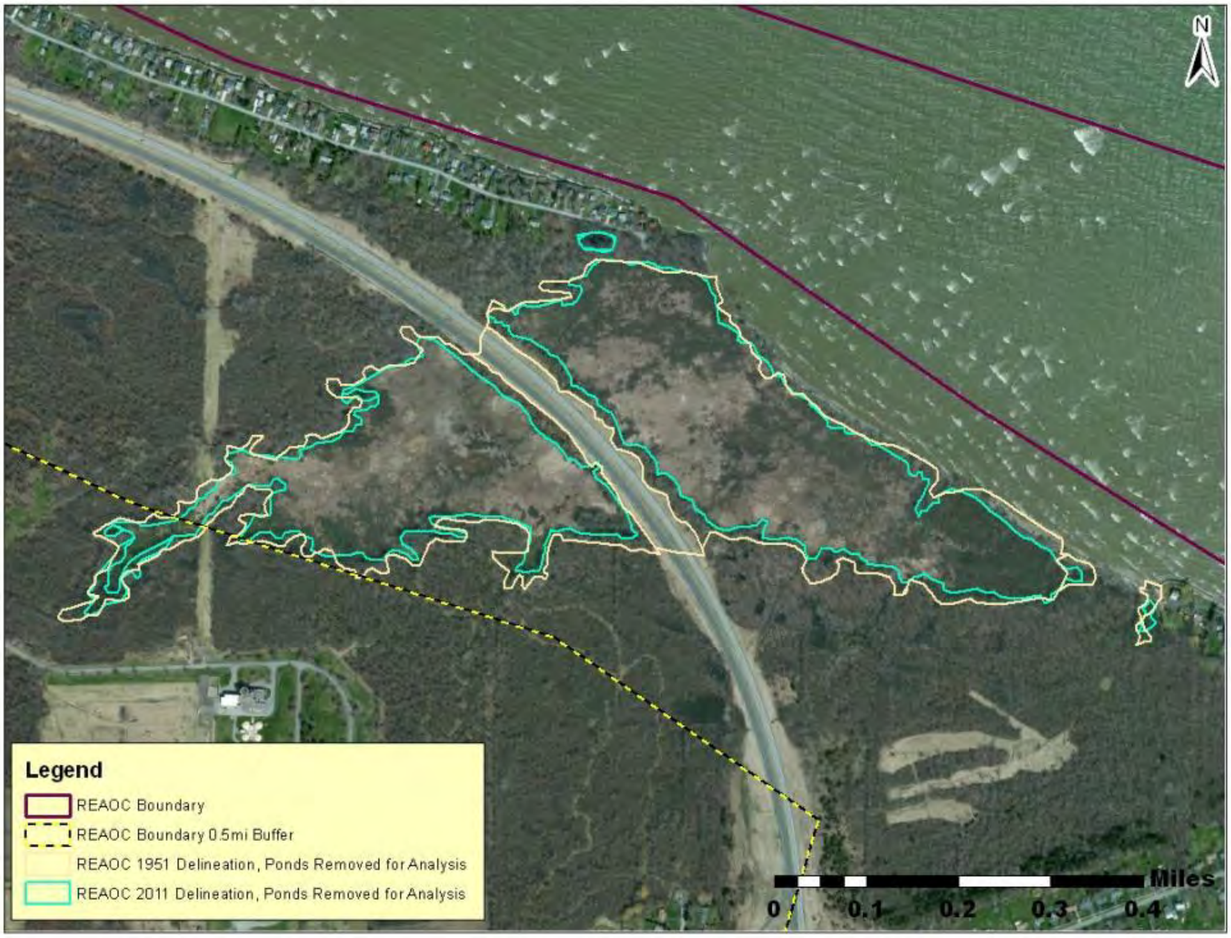


Figure 1-3. Delineated boundaries of emergent wetlands associated with Braddock Bay in 1951 and 2011.

Figure 1-4. Delineated boundaries of emergent wetlands associated with Braddock Bay tributaries in 1951 and 2011.

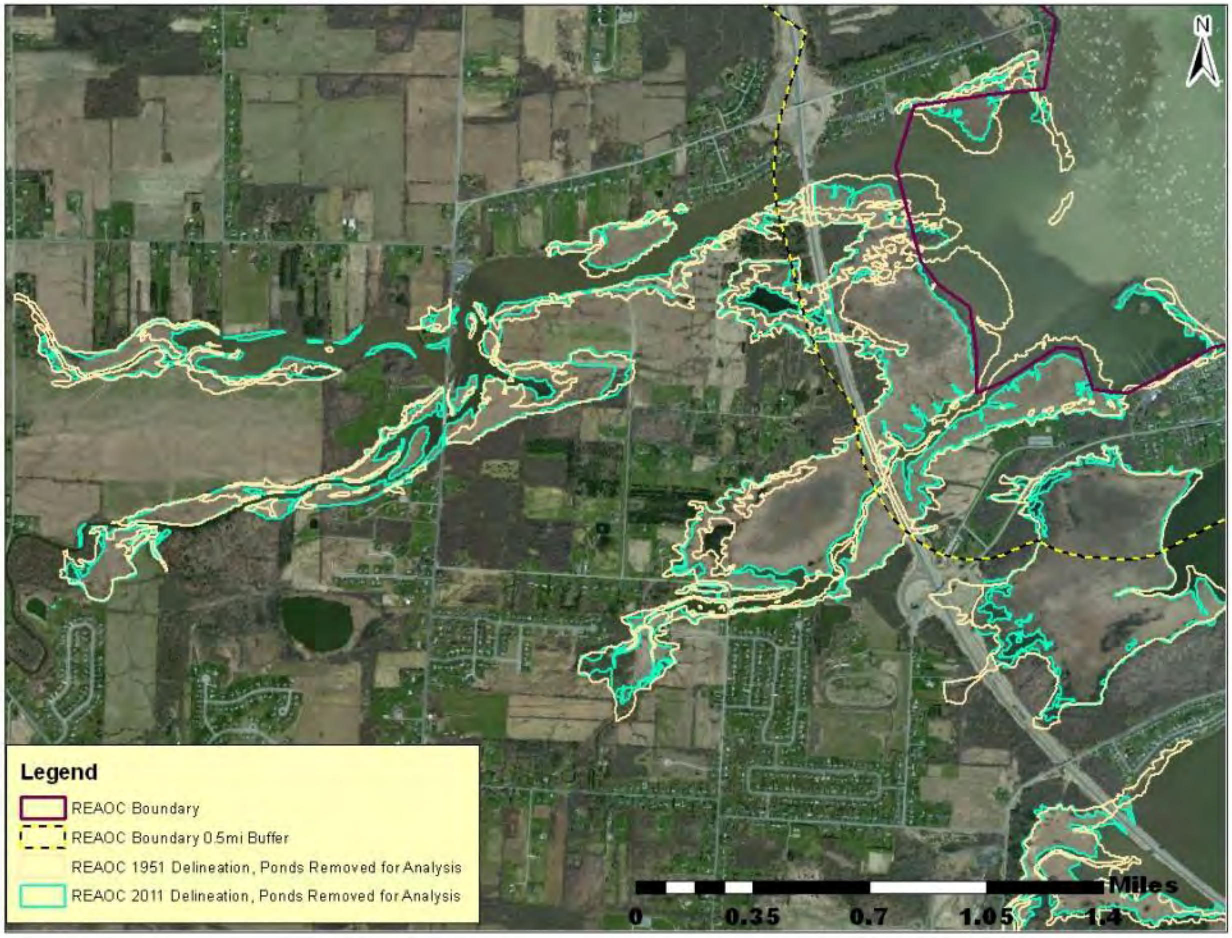


Figure 1-5. Delineated boundaries of emergent wetlands associated with Cranberry Pond (center) in 1951 and 2011.

Figure 1-6. Delineated boundaries of emergent wetlands associated with Long Pond and lower Northrup Creek in 1951 and 2011.

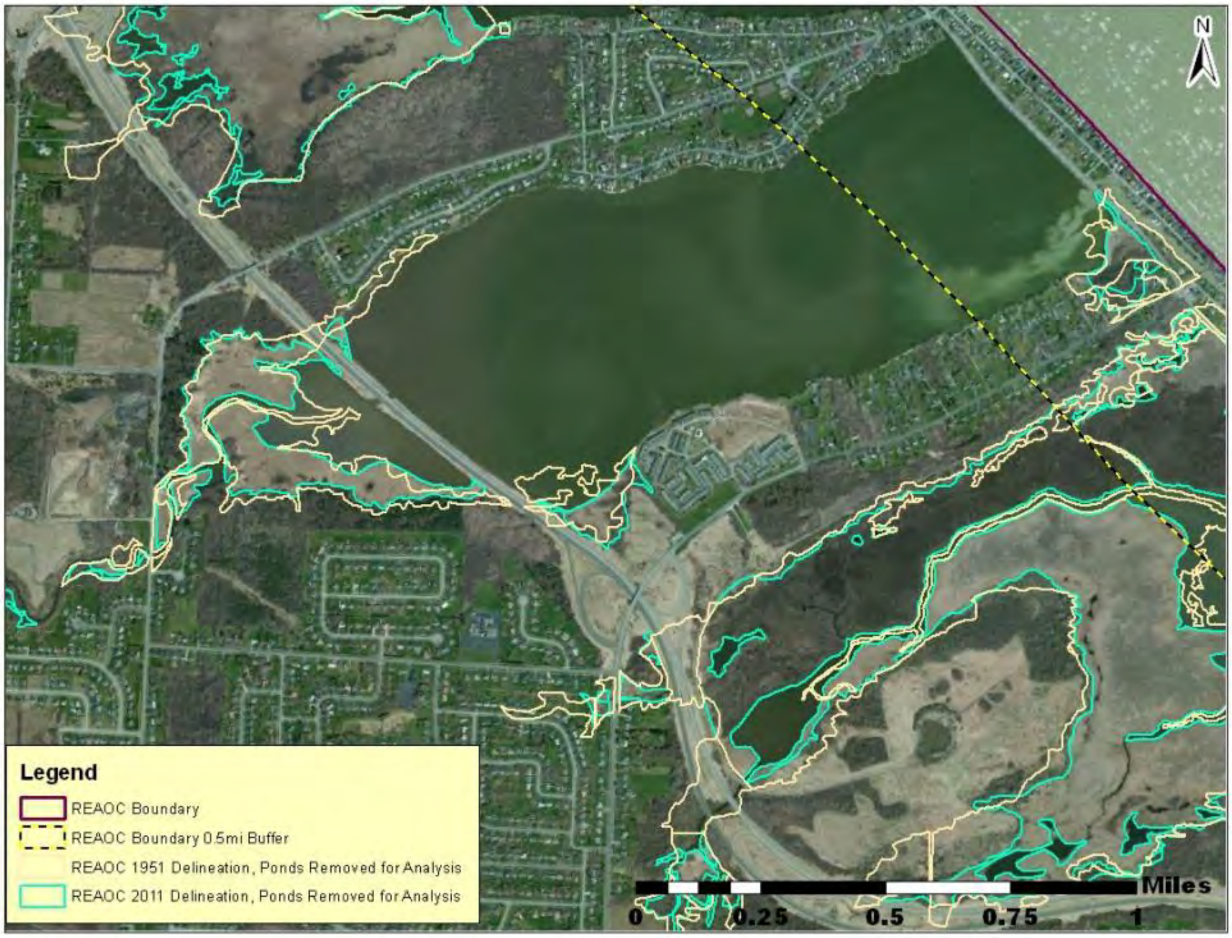


Figure 1-7. Delineated boundaries of emergent wetlands associated with Buck Pond and lower Larkin Creek in 1951 and 2011.

Figure 1-8. Delineated boundaries of emergent wetlands associated with Round Pond and lower Round Pond Creek (left center) and Slater Creek (right) in 1951 and 2011.

Figure 1-9. Delineated boundaries of emergent wetlands in 1951 and 2011 associated with the Genesee River (A) downstream and (B) upstream (both images are in the Lower River below the Lower Falls).

Figure 1-10. Delineated boundaries of emergent wetlands in 1951 and 2011 associated with (A) north and (B) south Irondequoit Bay.

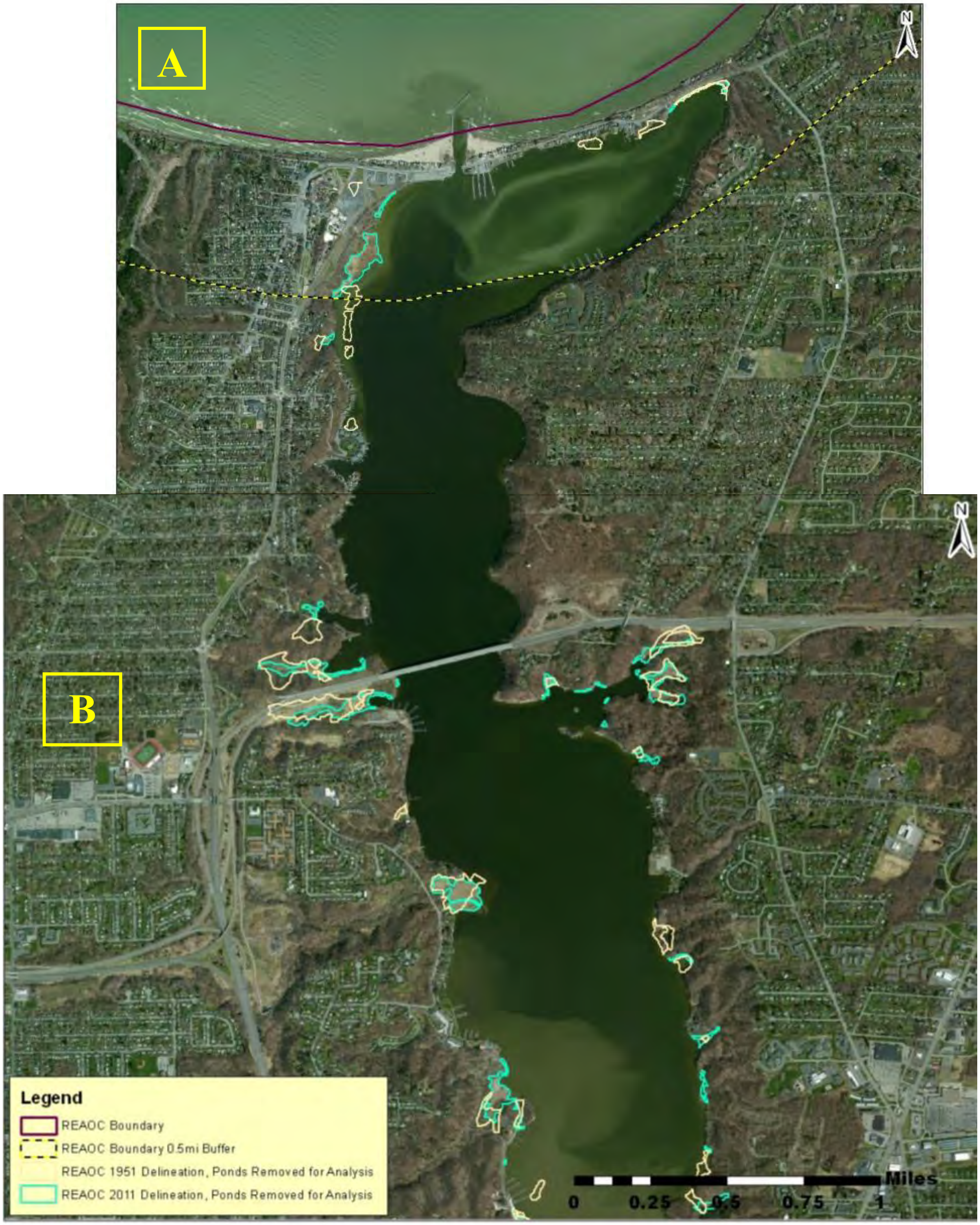


Figure 1-11. Delineated boundaries of emergent wetlands in 1951 and 2011 associated with lower Irondequoit Creek and the southernmost end of Irondequoit Bay.

Figure 1-12. Change in wetland extent between 1951 and 2011 associated with the Bogus Point pond.

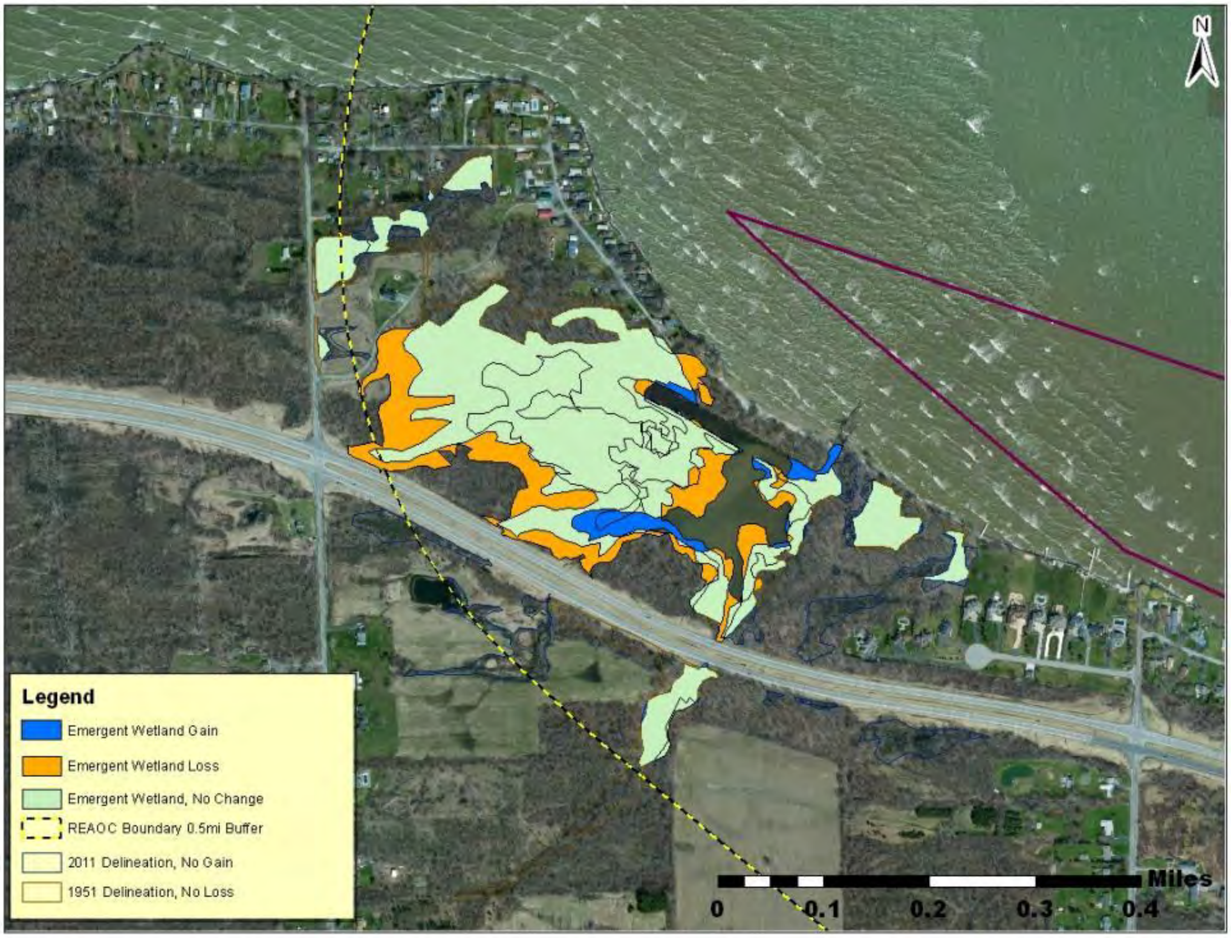


Figure 1-13. Change in wetland extent between 1951 and 2011 associated with Rose Marsh.

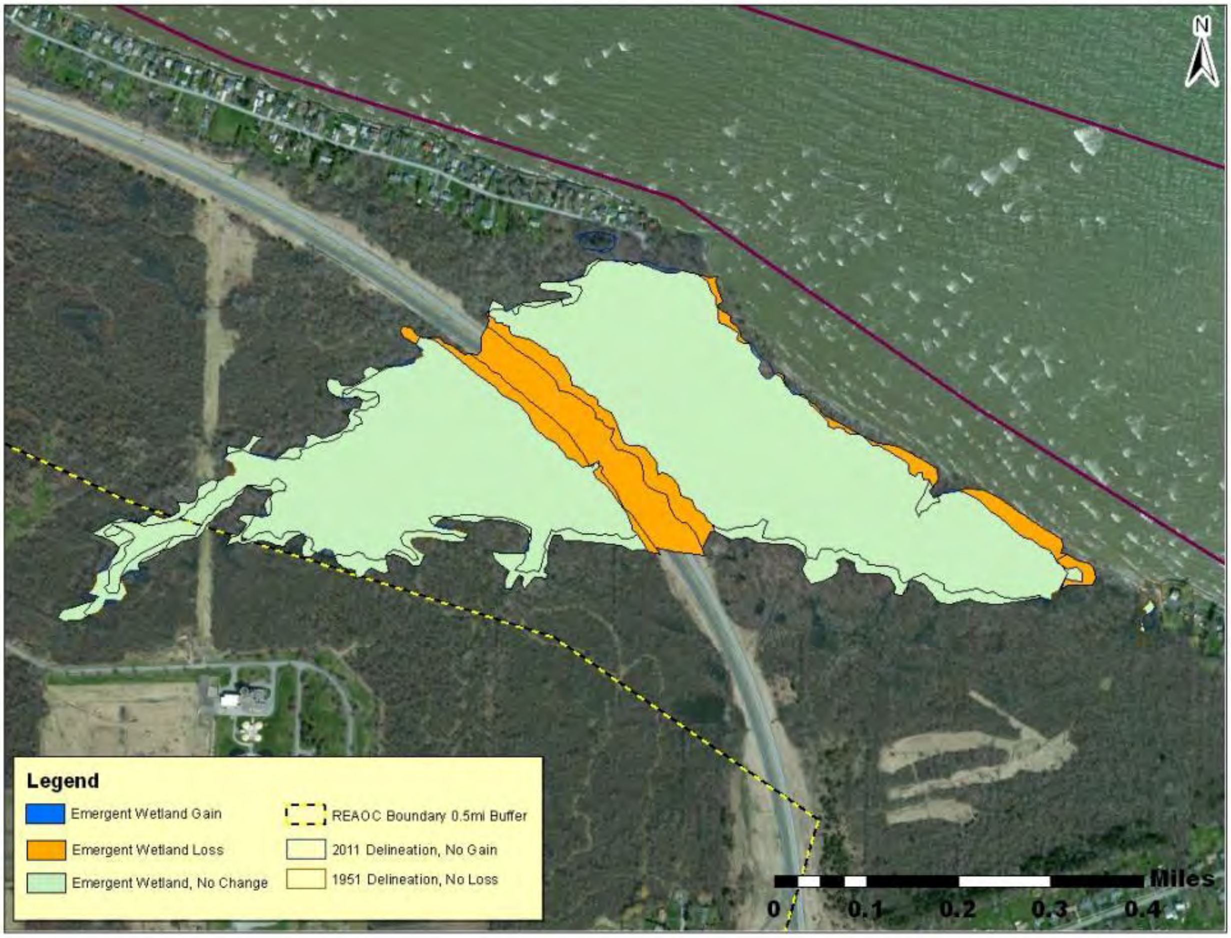


Figure 1-14. Change in wetland extent between 1951 and 2011 associated with Braddock Bay.

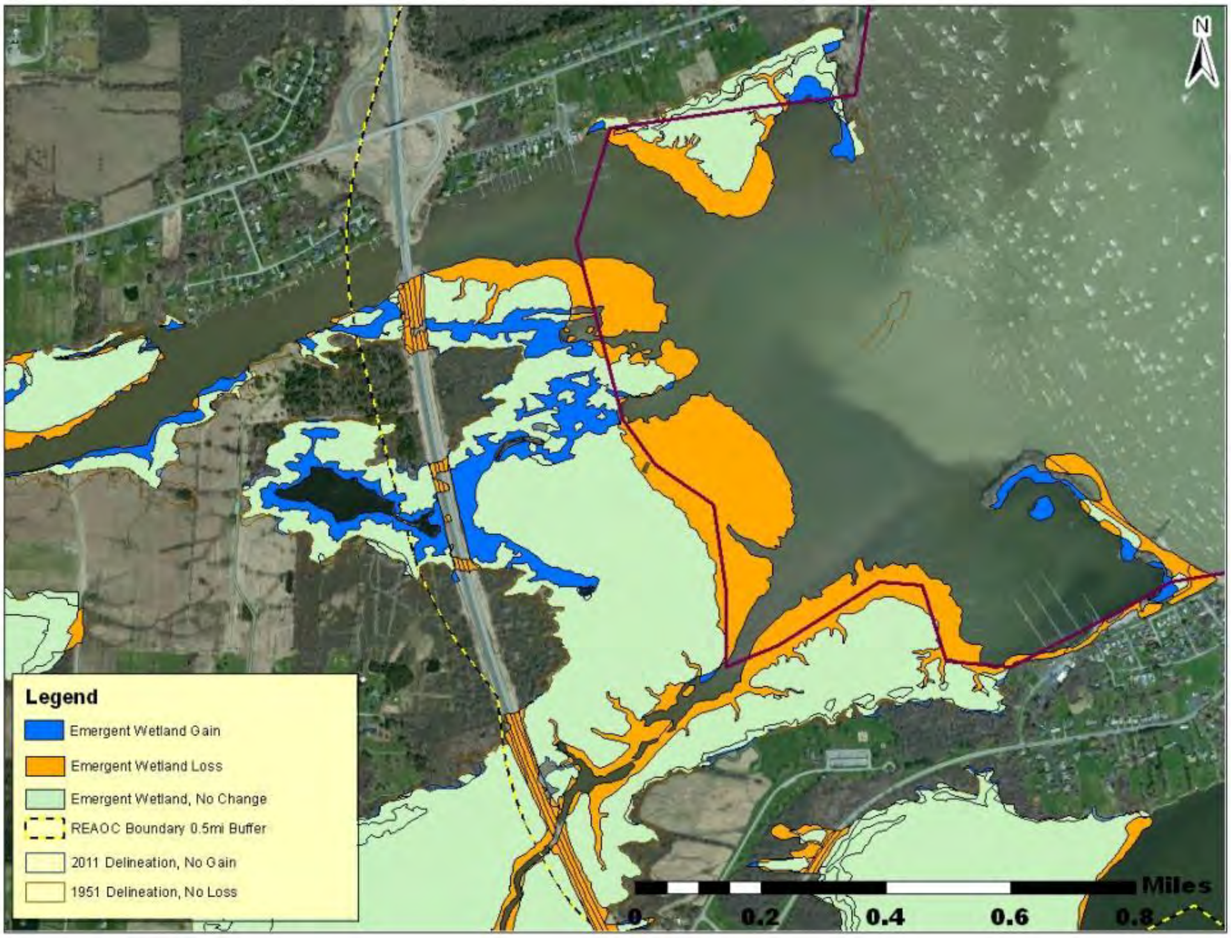


Figure 1-15. Change in wetland extent between 1951 and 2011 associated with tributaries of Braddock Bay.

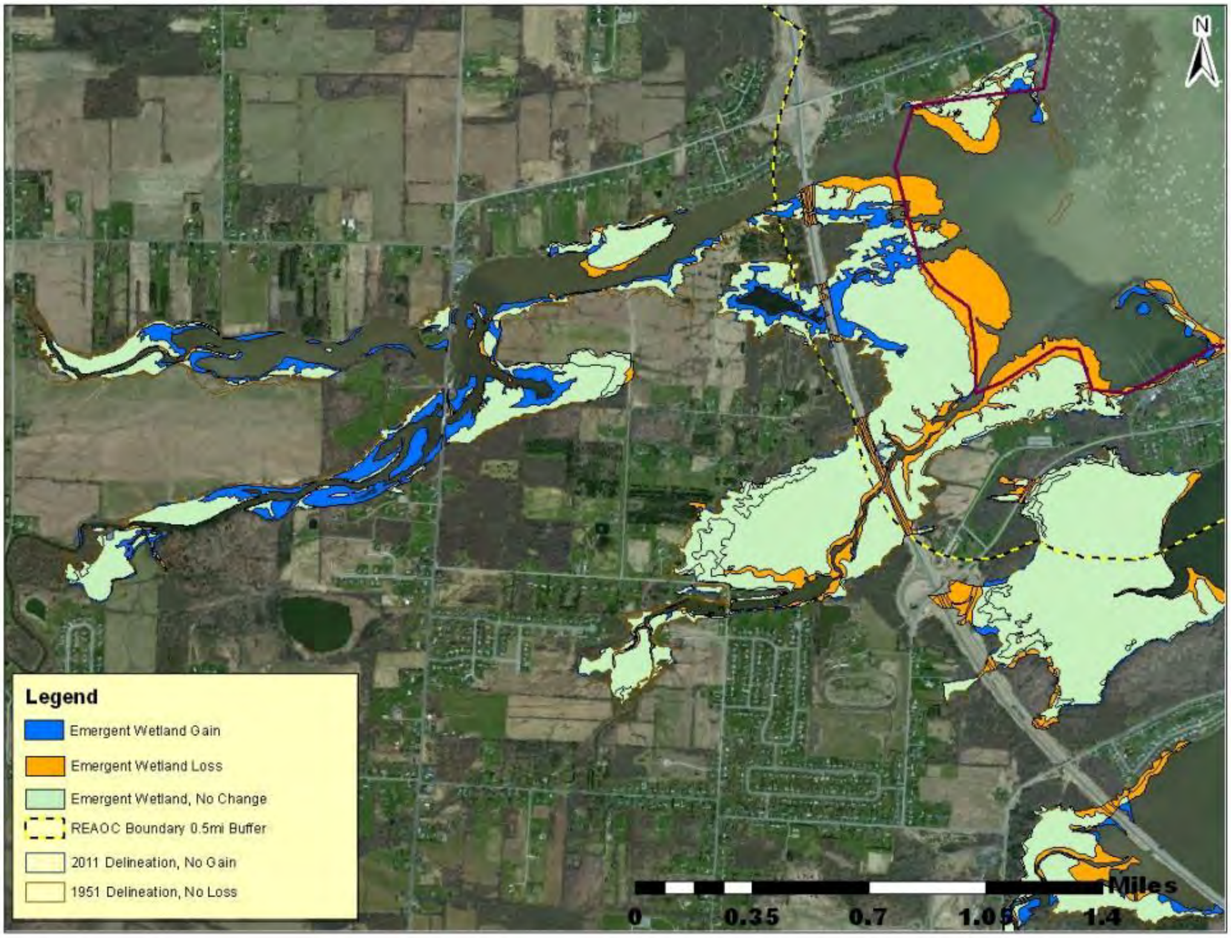


Figure 1-16. Change in wetland extent between 1951 and 2011 associated with Cranberry Pond (center of figure).

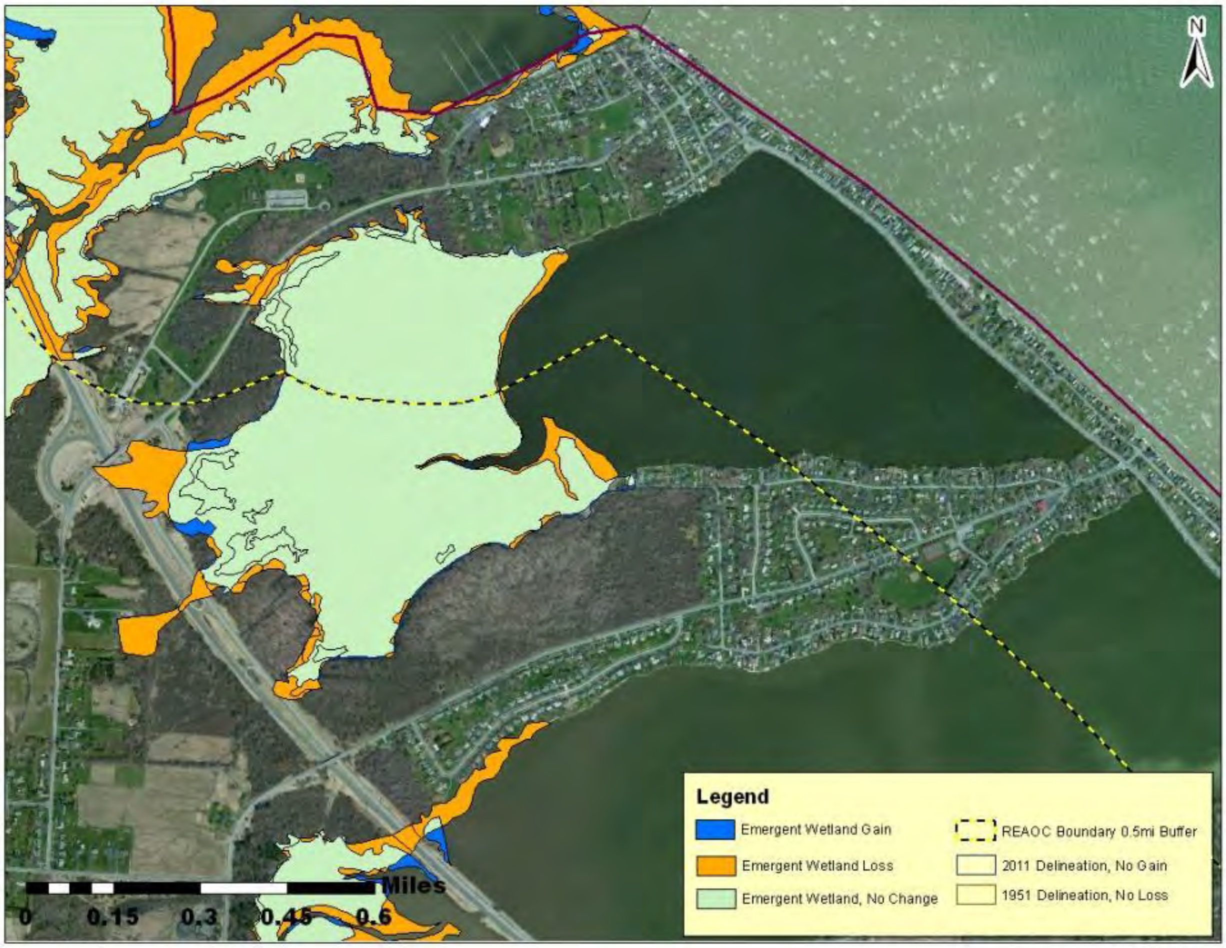


Figure 1-17. Change in wetland extent between 1951 and 2011 associated with Long Pond (center of figure) and lower Northrup Creek (left of pond).

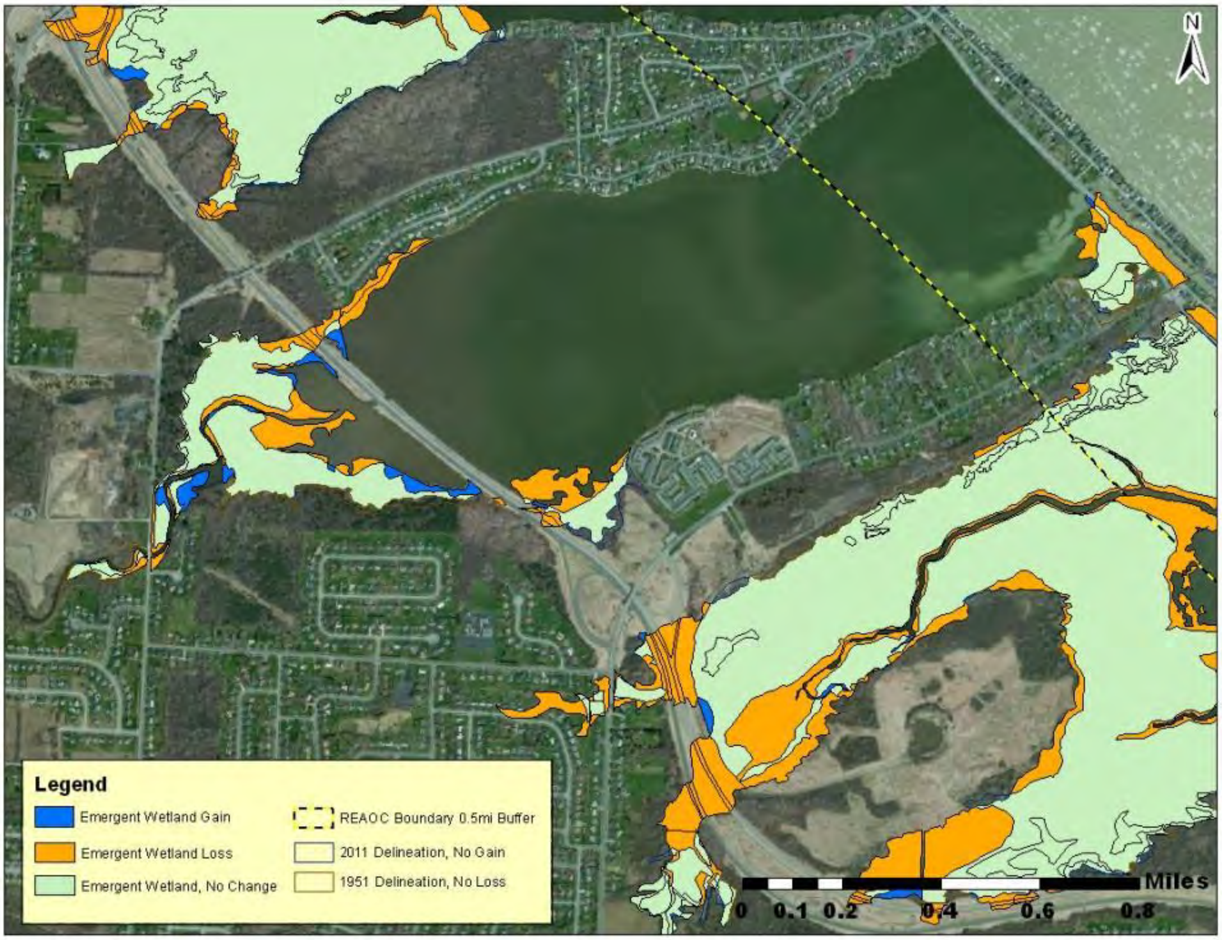
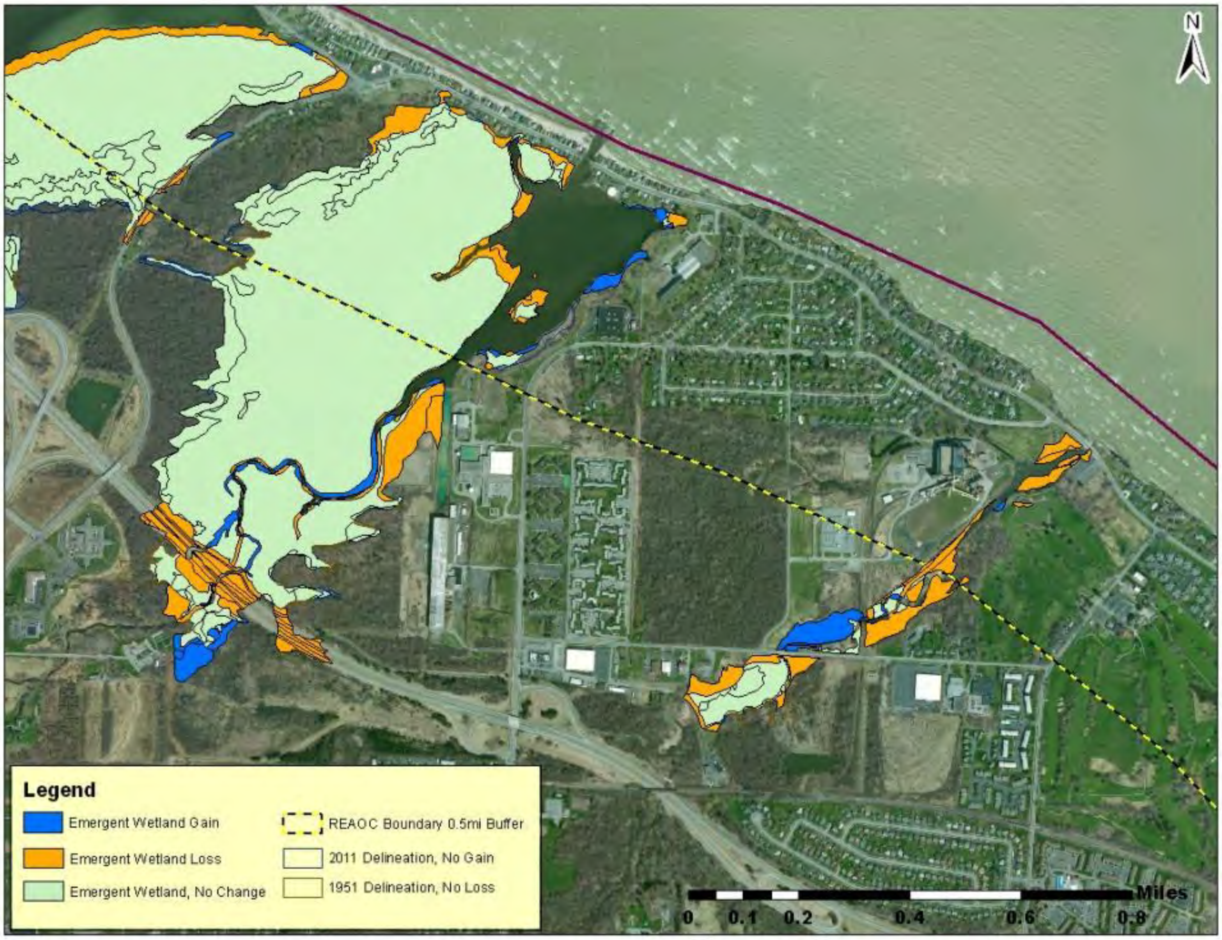
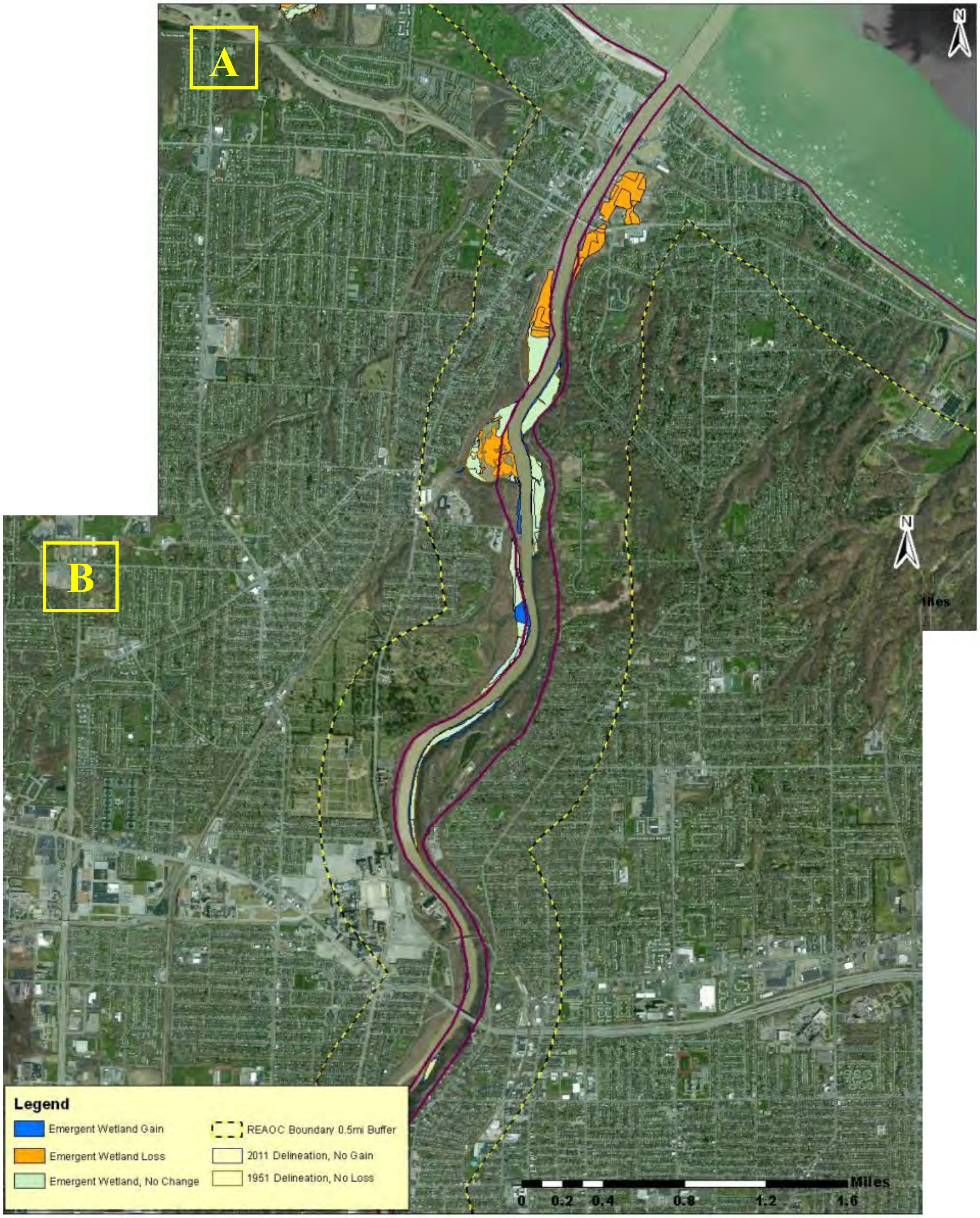


Figure 1-18. Change in wetland extent between 1951 and 2011 associated with Buck Pond (center of figure) and lower Larkin Creek (left of pond).

Figure 1-19. Change in wetland extent between 1951 and 2011 associated with Round Pond (left center) and also lower Slater Creek (right).



Figures 1-20. Change in wetland extent between 1951 and 2011 associated with the Genesee River (A) downstream and (B) upstream (both images are in the Lower River below the Lower Falls).



Figures 1-21. Change in wetland extent between 1951 and 2011 associated with Irondequoit Bay (A) north and (B) south.

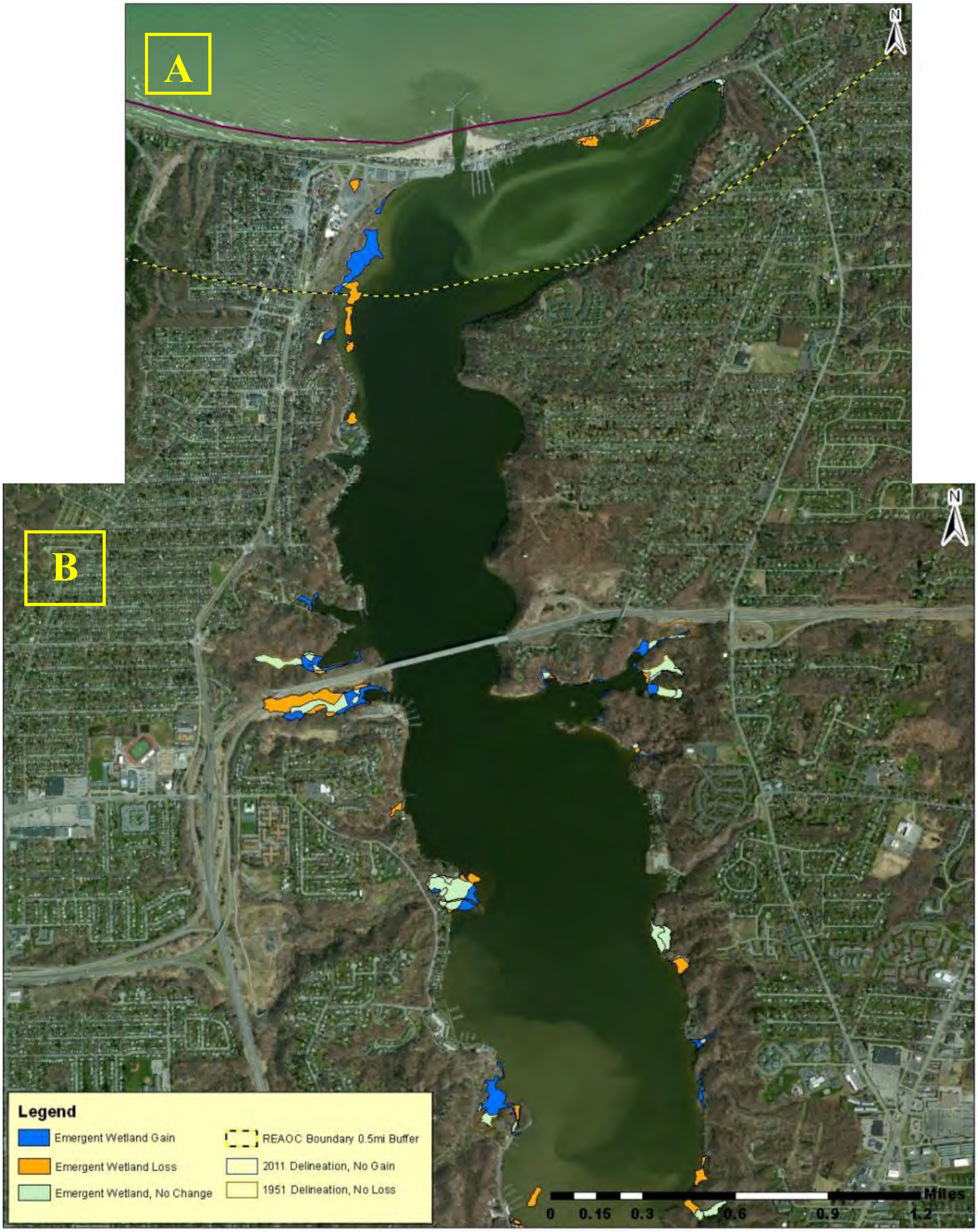


Figure 1-22. Change in wetland extent between 1951 and 2011 associated with lower Irondequoit Creek and the southernmost end of Irondequoit Bay.

ATTACHMENT 1-1: Explanation of Wetland Gain/Loss Categories

Wetland Gain Categories
Causal attribution of areas identified as emergent wetland in 2011
that were not emergent wetland in 1951

Gain Type	Gain Cause	Explanation
I. Types/Causes Included in Acreage Tallies		
From Water	Development	Accretion around fill
	Dredge Fill in	Accretion into an area that had previously been dredged
	Dynamic Shift	Accretion of emergent vegetation around the water's edge, likely natural variation
	Road	Accretion around road berm
	Stream Channelized	Stream channel artificially moved, old channel filled in
	Water Level	Expansion of emergent vegetation into 1951 high water (areas indundated in 1951 imagery, but not in 2011 imagery)
Hydro	Development	Hydrological shift due to development
	Road	Hydrological shift due to road construction (e.g. change in hydrological connectivity or flooding behind road berm)
Reclaimed	Removal	Structure removed, emergent wetland regrowth
II. Types/Causes Excluded from Acreage Tallies		
Ignore	Delineation	Areas delineated that were ultimately determined to be outside the focal area of the study
No Gain	Delineation	Minor delineation discrepancies (e.g., long linear discrepancies only a couple of pixels offset)
	Interior Water	Areas of open water that were once connected to the larger waterbody but were cut off due to emergent growth.
	No Change	Polygons where the final attribution is no observable change in emergent wetland status after reference layers were consulted. Originally, the polygon was excluded as wetland in the 1951 delineation but included in the 2011 delineation, and so originally would be interpretted as gain. It is still excluded in the final 1951 delineation shapefile for the purposes of this report, but it is not tallied in the reported acreage for either 1951 or 2011. In subsequent reference to other project imagery, it was concluded that there is less certainty about excluding this polygon from the 1951 delineation, and so this poygon is assigned to the No Gain - No Change category. The 1951 delineation could be slightly refined by future users of this information by adding these small polygons to the 1951 delineation.
	Overinclusive	Areas in U Mass 2011 delineations where a wetland signature was not present in reference imagery (including 1994 and 2005 CIR, and LiDAR 2ft contours and hydric soils map)
	Size Threshold	Polygons below size threshold (25 m2) were removed from analysis
	Uncertainty	Uncertainty as to the changed wetland status, often due to limits in image quality.

Wetland Loss Categories

Causal attribution of areas identified as not emergent wetland in 2011 that were emergent wetland in 1951

Loss Type	Loss Cause	Explanation
I. Types/Causes Included in Acreage Tallies		
To Water	Development	Development cut through emergent wetland (e.g. docks, marina, shoreline hardening)
	Dredge	Emergent vegetation dredged out for boat traffic
	Dynamic shift	Loss of emergent vegetation around the water's edge; likely natural movement/variation
	Erosion	Primarily in Braddock Bay, where wave action is reducing extent of emergent vegetation.
	Road	Hydrological change due to road construction resulting in pooling of water
	Stream Channelized	Stream channel artificially moved, new channel replaced historic emergent wetland
	Water Level	Areas assigned this loss type had higher water level at the time imagery was taken in comparison to reference years. These areas were highly variable over the years of available imagery.
Hydro	Development	Drying caused by a hydrological shift that is a result of development
	Road	Drying caused by a hydrological shift that is a result of road construction
Hydro/Fill	Field Check	Polygons in Buck Pond on the eastern side of Beatty Point. Substantial change in wetland signature and LiDAR contours do not match historic shape of upland. Likely dumping of fill from road construction and some hydrological change due to road construction
Residential	Development	Delineated loss associated with residential development
	Stream Channelized	Delineated loss associated with stream channelized for the purpose of residential development
Shoreline	Erosion	Shoreline erosion and deposition of sediments
Mowed	Development	Wet, mowed field.
Fill	Development	LiDAR and visual cues indicate fill has been placed in association with residential or other development; the portion of the (non-road) constructed area that is not paved
	Road	LiDAR and visual cues indicate fill has been placed associated with road construction; the portion of the constructed road bed in former wetland that is not paved
	Stream Channelized	LiDAR and visual cues indicate fill has been placed associated with a channelized stream
Made Land	Development	Pavement and parking lots; the portion of the (non-road) constructed area that is paved
	Road	Paved roadways; the portion of the constructed road bed in former wetland that is paved
II. Types/Causes Excluded from Acreage Tallies		
Ignore	Delineation	Areas delineated that were ultimately determined to be outside the focal area of the study
NO LOSS	Delineation	Minor delineation discrepancies (e.g., long linear discrepancies only a couple of pixels offset)
	No Change	Polygons where the final attribution is no observable change in emergent wetland status after reference layers were consulted. Originally, the polygon was excluded as wetland in the 2011 delineation but included in the 1951 delineation, and so originally would be interpretted as loss. It is still excluded in the final 2011 delineation shapefile for the purposes of this report, but it is not tallied in the reported acreage for either 1951 or 2011. In subsequent reference to other project imagery, it was concluded that there is less certainty about excluding this polygon from the 2011 delineation, and so this poygon is assigned to the No Loss - No Change category. The 2011 delineation could be slightly refined by future users of this information by adding these small polygons to the 2011 delineation.
	Overinclusive	Areas in 1951 delineations where a wetland signature was not present in reference aerial imagery (including 1930 and 1966 aerial photos, and LiDAR 2ft contours and hydric soils map)
	Size Threshold	Polygons below size threshold were removed from analysis
	Surrounding Loss	Loss of emergent wetland surrounding 1951 interior water
	Uncertainty	Uncertainty as to the changed wetland status, often due to limits in image quality.
	To PFO	Emergent vegetation to forested wetland. Areas where wetland was not included in U Mass 2011 delineation because the wetland signature was difficult to interpret in leaf-on condition.

ATTACHMENT 1-2: Detailed Summary of Wetland Acreage Gain/Loss

By Gain/Loss Category and Waterbody

Wetland Gain Categories

Gain Type	Gain Cause	Project Area Totals		Gain of Acreage and Number of Polygons - By Catgeory and Waterbody																											
				Bogus		Rose		Braddock Bay		Salmon and West Creeks		Buttonwood Creek		Cranberry Pond		Long Pond		Buck Pond		Round Pond		Slater Creek		Genesee River		Irondequoit Bay		Irondequoit Creek		Irondequoit Trib	
From Water	Development	10.28	12					3.21	5	0.28	1	0.00	0							0.07	2			0.09	1	6.64	3				
	Dredge Fill in	5.41	3					0.00	0	0.00	0	0.00	0											5.41	3						
	Dynamic Shift	84.49	172	0.19	1			2.49	5	1.32	9	0.82	9	0.01	1	3.46	17	0.66	4	4.49	18			7.21	11	13.85	35	45.95	61	4.03	1
	Road	5.63	8					0.01	1	1.64	1	0.00	0			3.29	4			0.61	1					0.08	1				
	Stream Channelized	4.31	9					0.00	0			0.00	0							0.35	3	3.96	6								
	Water Level	87.82	66	1.78	8			26.76	6	58.56	43	0.29	4													0.43	5				
Hydro	Development	3.95	9					0.00	0	0.00		0.00								3.28	7					0.67	2				
	Road	9.13	17					0.25	3	0.00		0.00		1.64	4	0.12	1	2.12	6							5.01	3				
Reclaimed	Removal	0.28	2					0.21	1																					0.06	1
TOTAL GAIN		**211.29**	**298**	**1.98**	**9**	**0.00**	**0**	**32.92**	**21**	**61.81**	**54**	**1.10**	**13**	**1.65**	**5**	**6.87**	**22**	**2.78**	**10**	**8.79**	**31**	**3.96**	**6**	**12.70**	**15**	**26.68**	**49**	**45.95**	**61**	**4.09**	**2**
Ignore	Delineation	7.51	23	6.49	16	0.10	1	0.03	1	0.00	0	0.00	0									0.09	1			0.62	3	0.17	1		
No Gain	Delineation	6.96	179	0.06	4	1.07	18	0.91	26	0.74	22	0.46	16	1.01	14	0.02	1	0.53	24	0.16	5	0.02	1	0.77	13	0.69	20	0.49	12	0.02	3
	Interior Water	1.32	5					0.86	3	0.33	1	0.00																0.12	1		
	No Change	14.26	91	0.07	1			0.50	5	1.88	9	0.87	11	0.89	6	0.72	5	2.67	20	1.03	8			0.55	3	2.19	5	2.65	13	0.26	5
	Overinclusive	8.69	27	1.71	4			0.79	5			0.53	5	0.15	1	2.33	4	2.08	4	0.58	2							0.36	1	0.17	1
	Size Threshold	0.58	314	0.02	19	0.02	13	0.04	25	0.11	51	0.05	34	0.03	11	0.03	15	0.08	43	0.06	25	0.01	5	0.04	21	0.03	20	0.04	26	0.01	6
	Uncertainty	15.64	63	1.05	5	0.38	1	0.02	1	0.78	6	0.03	1	0.68	1			5.82	25	1.77	6			3.79	10	1.20	5	0.05	1	0.06	1
TOTAL EXCLUDED		54.98	702	9.41	49	1.58	33	3.16	66	3.85	89	1.94	67	2.74	33	3.09	25	11.19	116	3.59	46	0.13	7	5.16	47	4.72	53	3.88	55	0.53	16

Wetland Loss Categories

Loss Type	Loss Cause			Loss of Acreage and Number of Polygons - By Catgeory and Waterbody																											
		Project Area Totals		Bogus		Rose		Braddock Bay		Salmon and West Creeks		Buttonwood Creek		Cranberry Pond		Long Pond		Buck Pond		Round Pond		Slater Creek		Genesee River		Irondequoit Bay		Irondequoit Creek		Irondequoit Trib	
MOWED	Development	0.42	1							0.42	1																						
Fill	Development	57.31	49	0.36	1			3.05	3	0.18	1	0.11	2			0.31	1	2.03	4	10.44	7	3.08	5	18.63	9	5.50	8	12.08	7	1.53	1
	Field Check	2.17	1																									2.17	1		
	Road	63.15	140			5.62	3	3.16	22	0.81	9	1.34	4	6.98	15	5.06	5	24.59	43	6.09	25	1.71	3			7.34	8			0.46	3
	Stream Channelized	5.03	8																			5.03	8								
Hydro	Development	0.47	1									0.47	1																		
	Road	15.48	26					0.05	1	0.65	1	0.10	1	2.11	8	2.09	3	7.90	9	2.57	3										
Hydro/Fill	Field Check	26.21	6															26.21	6												
Made Land	Development	30.04	19					1.02	1									0.85	2			0.19	1	17.24	4	3.48	6	1.31	2	5.95	3
	Road	24.29	61			7.40	1	2.72	11	0.46	2	1.66	2	2.17	10	1.07	4	5.28	18	3.54	13										
Residential	Development	6.39	12									0.07	2			1.94	3	4.19	5	0.19	2										
	Stream Channelized	3.90	5															3.90	5												
Shoreline	Erosion	2.89	5			2.89	5																								
To Water	Development	26.72	37					2.23	4	0.01	1	0.44	3			4.76	5							6.08	4	13.20	20				
	Dredge	16.11	5																					16.11	5						
	Dynamic shift	93.38	200					6.16	10	7.87	54	11.66	16	5.67	6	0.60	2	34.37	6	6.27	26			1.04	8	6.65	17	13.10	55		
	Erosion	82.85	16					81.76	15																	1.09	1				
	Road	20.76	6													5.52	1	14.93	4	0.31	1										
	Stream Channelized	3.25	10																	0.35	5	2.90	5								
	Water Level	11.99	24	2.51	14											9.48	10														
TOTAL LOSS		**492.81**	**632**	**2.88**	**15**	**15.91**	**9**	**100.13**	**67**	**10.40**	**69**	**15.85**	**31**	**16.93**	**39**	**30.83**	**34**	**124.25**	**102**	**29.76**	**82**	**12.90**	**22**	**59.10**	**30**	**37.26**	**60**	**28.66**	**65**	**7.93**	**7**
Ignore	Delineation	9.15	21	4.78	9	0.39	2																			3.49	6			0.50	4
Shift	Delineation	0.03	1																							0.03	1				
NO LOSS	Delineation	9.49	146	0.18	8	0.17	7	0.78	9	0.65	21	0.22	9	0.13	5	0.20	4	1.10	18	0.64	7	0.05	1	4.44	31	0.15	7	0.67	14	0.13	5
	No Change	48.59	123	0.26	2	10.00	18	0.76	1	1.84	14	2.12	9	4.13	12	0.84	4	3.38	12	9.42	8	0.53	2	4.85	1	5.92	18	3.67	18	0.87	4
	Overinclusive	81.47	146	5.26	11	0.19	1	15.87	27	27.07	46	11.89	17	1.79	4	7.81	7	4.92	14	0.85	4	0.90	3	0.23	1	3.36	6	1.07	4	0.27	1
	Size Threshold	0.42	232	0.01	13	0.02	8	0.05	21	0.06	37	0.07	25	0.01	5	0.01	10	0.07	36	0.03	19	0.01	4	0.02	14	0.02	15	0.03	23	0.00	2
	Surrounding Loss	11.12	11					0.32	3									0.03	1	0.51	1			10.26	6						
	TO PFO	9.38	11	7.13	4									2.25	7																
	Uncertainty	22.24	48							2.57	7	0.36	1			3.79	5	4.51	14	2.36	6			1.73	6	5.86	6	1.05	3		
TOTAL EXCLUDED		191.89	739	17.61	47	10.76	36	17.77	61	32.20	125	14.65	61	8.31	33	12.65	30	14.01	95	13.81	45	1.48	10	21.53	59	18.83	59	6.51	62	1.76	16

CHAPTER TWO – TRENDS IN WETLAND HABITAT QUALITY

METHODS

NYFO evaluated trends in wetland quality at the REAOC using time series of historical data. While there are a number of studies providing good information on conditions at specific locations within the project area (e.g., Archer et al. 2006, Coon 1997, Coon et al. 2000, Coon 2004, Crewe and Timmermans 2005, Haynes et al. 2002, Korfmacher et al. 2005, Makarewicz 1989, Makarewicz et al. 2012a, Makarewicz et al. 2012b, Wilcox et al. 2005, Wilcox et al. 2008), reports are sparse that provide datasets sufficient to examine time trends in appropriate measurement endpoints at multiple locations across the project area. A literature review was conducted to identify readily available, appropriate, and reliable historical datasets, and local experts were consulted to obtain further information. Time series data were gathered from various sources, transformed into appropriate metrics of habitat quality, and synthesized into evaluations of trends in structural habitat, water quality, and animal communities.

NYFO selected datasets and methods for evaluating trends in wetland habitat quality for fish and wildlife that reflect the need to sample uniformly and extensively. A thorough analysis of trends required multiple samples in waterbodies distributed across the project area, and NYFO compiled datasets from the literature or relied on existing time series datasets, wherever readily available. While many valid methods exist for evaluating trends in wetland quality, it was not feasible to apply intensive sampling or intensive interpretive analysis methods throughout the project area within the one-year project period.

NYFO‘s methods, along with brief reviews of additional methods and sources of relevant historical data, are provided in the following three subsections: habitat physical structure (including patterns of vegetation cover), water quality, and animal communities.

Structural Habitat

Aside from information on historical wetland extent (see Chapter 1), historical habitat structure information is severely limited. The principal tool for assessing change in wetland structural habitat quality across the project area was the USA Rapid Assessment Method (RAM) (USEPA 2011), a visual multi-metric index used by the USEPA in their National Wetland Condition Assessment.

NYFO characterized current structural habitat quality at a total of 79 stations distributed across the project area, sampled either in the fall of 2012 and/or the early summer of 2013 (Figure 2-1). The number of RAM sampling stations per waterbody ranged from 2 to 12, depending on the relative size of the waterbody and relative importance of the waterbody for current decision-making (i.e., the greatest numbers of RAM stations were in Braddock Bay and Buck Pond, where wetland restoration projects are currently under consideration). A description of 2012-2013 RAM sampling station selection is provided in Chapter 3. The RAM develops an overall multimetric score of wetland condition derived from 12 metrics, each built from visual assessment of multiple field indicators (Figure 2-2). Each RAM metric was assigned one of four values (3, 6, 9, or 12; where 3 indicates poorest quality and 12 indicates highest quality), providing a ranking of wetland structural metrics as wildlife habitat at each sampling point.

Only three of the 12 RAM metrics were found to be interpretable using both current and historical aerial imagery: Percent of Assessment Area (AA) with a Buffer, Buffer Width, and Patch Mosaic (see Chapter 3, Table 3-1 for a complete list of metrics with descriptions). Current aerial imagery was used to interpret these metrics in NYFO's 2012-2013 assessment. Aerial photography is also the most abundant source of historical habitat structure data. NYFO acquired historical black and white imagery scanned from archives at Cornell University and Monroe County Health Department, and georeferenced the digital images using 2011 Bing base map in ArcGIS 10. Aerial imagery from 1951 was used to evaluate historical physical habitat quality at NYFO's current RAM sampling sites.

Change in physical habitat quality was calculated for each metric as the difference in scores between 2011 and 1951. At each sampling station, for each metric, the difference potentially ranged between -9 and 9. NYFO interpreted positive differences as improvements in habitat quality, and negative differences as declining habitat quality. Mean metric values were computed by waterbody across sampling stations for each year evaluated, and the difference in mean values between years was determined. This formed the basis for comparing structural habitat trends between waterbodies.

There are other potential methods of assessing historical wetland habitat quality, but these are summarized elsewhere (e.g., Wilcox et al. 2008), and/or are too labor intensive to apply satisfactorily across the project area. Quality of wetland habitat depends largely on the identity, diversity, distribution, and patchiness of plant species, and vertical complexity of plant strata. For instance, guidance resources for conducting wetland quality surveys typically recommend assigning a negative value to dominance by non-native (e.g., purple loosestrife) and invasive (e.g., Phragmites spp, cattail) species. Historical black and white aerial photographs are very difficult to interpret reliably for information on plant species' distributions[10]. NYFO did not locate an adequate ground-truthed set of imagery from which to conduct spatially extensive hindcasts about historical species distribution and composition in the project area[11].

Shoreline hardening is a widespread cause of wetland and littoral zone loss, declining wetland quality, and reduced connectivity at the interface between open water and upland. A thorough assessment of trends in shoreline hardening[12] was beyond the means of this project, but may be useful in further evaluations of historical declining trends in coastal wetland extent and quality, or for prioritizing wetlands for preservation or restoration within the REAOC and along the south shore of Lake Ontario. For example, shoreline hardening between Bogus Point and Manitou Beach Point, just to the west of Braddock Bay, illustrates a clear spatial relationship

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[10] This hindcasting approach was previously applied at 16 Lake Ontario coastal wetlands (Wilcox et al. 2008), including Round Pond and Braddock Bay within NYFO's project area.

[11] Detailed, spatially explicit historical surveys of wetland vegetation within the project area during the period 1930-1988 could be used to calibrate texture and gray scale patterns in historical aerial photos against known historical species composition and distribution, but NYFO did not locate such a vegetation data set. Hindcasting from current ground-truthed color-infrared imagery may also be conducted for certain categories of wetland vegetation (e.g., Wilcox et al. 2008), but NYFO did not locate data with sufficient coverage of the project area. Seed bed analysis of soil/sediment cores may be used to a limited degree to test hypotheses about historical species composition based on black and white historical aerial photo interpretation and thereby provide a gross calibration of texture and gray scale patterns. But, this method requires specialized knowledge of plant taxonomy based on seed anatomy, is accompanied by its own sources of error and uncertainties (such as seed transport in moving-water systems).

[12] Current shoreline condition may be obtained from readily available recent imagery (e.g., Bing.com, Google Earth). Figure 2-1 illustrates an example assessment of current shoreline condition between Bogus Point and Braddock Bay using these tools, as related to the positions of Bogus Pont and Rose Marsh wetlands. Stereo pairs of historical aerial photographs might be used to evaluate historical trends in the extent of shoreline hardening throughout the project area, but details about the specific nature of hardening would likely not be extractable.

between the absence of hardened shoreline and the existence of coastal wetland resources (Figure 2-3).

Tiner (2010) describes enhancements to the NWI database with the addition of wetland functional assessment descriptors that provide information for landscape-level analysis. New descriptors include landscape position, landform, water flow path, and water body type, which have been found to be correlated with surface water detention, nutrient transformation, shoreline stabilization, provision of fish and wildlife habitat, and other wetland functions. While outside the scope of this assessment, these data could augment information provided in this report for prioritizing wetlands for acquisition, restoration, or protection.

Water Quality

Water quality is widely monitored by environmental agencies for regulatory and other management purposes. High concentrations of nutrients and suspended sediment in a waterbody can significantly affect aquatic species composition by restricting taxa to species tolerant of low visibility, low oxygen levels, and low aquatic vegetation richness. Similarly, significantly elevated ammonia (or other toxic contaminant) concentrations or altered pH levels, affect certain species more than others.

Within the project area, the U.S. Geological Survey (USGS) and the State University of New York (SUNY) Brockport have conducted prolonged water quality monitoring in several of the water bodies, and NYFO used these datasets to evaluate trends in water quality as a component of habitat. Water quality parameters evaluated were total phosphorus, soluble reactive phosphorus, and total suspended sediment (additional parameters are available, but were not included in this assessment due to project limitations). Original raw datasets were not supplied to NYFO; estimates of values were obtained from tabulated data, or by inspection of graphs, provided in available documents. Extracted data were plotted over time by waterbody, time series plots were evaluated by inspection, and apparent trends were statistically confirmed using the Mann-Kendall non-parametric test, where data were sufficient (i.e., waterbodies with number of years ≥ 4)[13] (Gilbert 1987, Nielson 2006). A non-parametric trend test was used instead of regression since many of the water quality values were estimated from graphs.

Time series datasets were developed from USGS studies of water quality in Northrup Creek (Sherwood 1999, Sherwood 2004) and Irondequoit Creek (Coon et al. 2000, Coon 2004), studies of water quality in Braddock Bay, Long Pond, Irondequoit Bay, and the Genesee River by SUNY Brockport (Makarewicz and Nowak 2010a-d), and studies in Cranberry Pond, Long Pond, and Buck Pond conducted by The Cadmus Group (Cadmus 2010, Makarewicz and Lampman 1994).

Sampling locations in lentic waterbodies tended to be located near the center of the open water area (Makarewicz pers. comm.), whereas wetlands and wetland-dependent biota are at the periphery of the waterbodies. In the fall of 2012, NYFO collected grab samples and used YSI meters to obtain water quality information for both the approximate center of lentic waterbodies, as well as at the interface between open water and emergent wetland vegetation. In all of the lentic waterbodies in the project area and for all of the parameters analyzed (see Chapter 3 for complete list), there was no apparent difference between values at the center of the waterbody compared to values from the periphery at the time of sampling, as indicated by inspection of the

[13] Mann-Kendall probability tables start at n=4, S=0

dataset. This preliminary evaluation suggests that the Makarewicz data may reasonably be used as a surrogate for water quality trend evaluations in emergent wetlands that are located at waterbody margins.

Animal Communities

Animal species composition and community indices, including bioassessments and indices of biological integrity, are widely used as indicators of ecosystem or habitat condition. NYFO examined trends in animal community indices to evaluate trends in wetland habitat quality. Historical data of sufficient quality for trend evaluations are limited to a few taxa within the project area.

USFWS (1981b) conducted a comprehensive review of Great Lakes coastal wetland resources which included a number of the waterbodies in this project. The report indicated that, as of 1981, there were no known records of site-specific information concerning species composition of endangered species, or non-endangered vegetation, birds, amphibians, reptiles, mammals in wetlands associated with Irondequoit Bay, Round Pond, Buck Pond, Cranberry Pond, or Payne Beach. Likewise, no site-specific information concerning vegetation, birds, mammals, or endangered species was available for Braddock Bay. USFWS (1981b) indicates that the spiny softshell turtle and mudpuppy had been commonly observed in Braddock Bay during the first half of the 20th century, but no results of systematic surveys of amphibians or reptiles were located. Braddock Bay has long been recognized as an important passerine and hawk migration point on Lake Ontario, but was not identified among premier Great Lakes colonial nesting areas (USFWS 1979). An intensive survey in 1984 of natural resources in Irondequoit Bay reported species lists of vegetation at several strata and vertebrates observed along shoreline reaches surrounding the bay and the marshes near the mouth of Irondequoit Creek, however, relative abundance of species and delineations of wetlands were not provided (USGS 1984).

Animal community metrics of wetland habitat quality were selected based primarily on existing guidance (e.g., Great Lakes Commission [GLC] 2008). Community indices were developed using call count data for both birds and amphibians. For amphibians, GLC indicator recommendations (Burton 2008) include species richness (all species) and species richness of woodland species. For birds, Burton (2008) recommends abundance of non-aerial foragers (NAF), abundance of marsh nesting obligates (MNO), and species richness of area-sensitive marsh-nesting obligates (AMNO).

In addition, for both taxa, NYFO evaluated trends in the Shannon-Weiner diversity index (Ricklefs 1979) and an IBI. NYFO also added focal[14] species richness and total species richness for birds, and total call count for amphibians. IBI calculations were conducted following methods provided in Grabas et al. (2008) for birds and Timmermans et al. (2008) for amphibians, including defining and assigning species to guilds. The amphibian IBI method specifies computing the mean for each of three guild metrics across stations and/or years in a wetland, then using those wetland-specific mean metric values to calculate the IBI score.

In order to evaluate trends in wetlands associated with waterbodies in the project area, NYFO needed to derive a mean IBI score across stations within each waterbody, for each year. Due to variability in numbers of stations per wetland, NYFO modified the Timmermans et al.

[14] Focal species are bird species of particular conservation concern listed in Grabas et al. (2008), Appendix 7-2.

(2008) approach slightly[15] by first computing an IBI score for each station-year observation, then computing a mean IBI score across stations, by waterbody and year. For the purpose of standardizing guild metrics, NYFO specified the greatest possible amphibian richness (all species) to be 11, and the greatest possible number of woodland amphibian species to be five.

The Marsh Monitoring Program (MMP) protocol utilizes multiple listening sessions within the sampling season (three for calling amphibians and two for birds) at each sampling station. For species richness, NYFO tallied the total number of species heard across the listening sessions, by station, by year. As a surrogate for abundance used in the calculation of various indices, NYFO tallied the sum of calls[16] heard across listening sessions, by species, by station, by year. Abundance by guild, per Burton (2008), was computed as the sum of abundance of species within guilds, by station, by year.

The Great Lakes MMP has collected call count data using standardized methods (Bird Studies Canada [BSC] 2000) for decades at hundreds of sampling stations throughout the Great Lakes watershed, including the REAOC wetland assessment project area. NYFO obtained historical MMP spring call count data for birds and/or amphibians collected during the period 1995-2011 at waterbodies distributed throughout the project area (Tables 2-3 and 2-4). NYFO downloaded data for historical MMP using the NatureCounts database[17]. Exact coordinates of individual historical sampling stations were largely unrecorded in the database, but NYFO was able to assign most stations to a waterbody in the project area with assistance from BSC[18] and the Monroe County MMP Coordinator[19].

Mean community metrics were derived by waterbody-year (as described above), data were plotted over time by waterbody, timeseries plots were evaluated by inspection, and apparent trends were statistically confirmed using the Mann-Kendall non-parametric test for waterbodies with number of years ≥ 4 (Gilbert 1987, Nielson 2006).

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[15] The available historical MMP data in the project area varied in the total number of stations per waterbody used in any year (n=1 to 12), and the number of stations used per year within a waterbody (n=1 to 9); specific stations varied with time for most waterbodies. In order to evaluate trends, NYFO needed to derive a mean IBI score across stations within each waterbody, for each year. There were a number of waterbody-year observations where there was just one station. One of the guild metrics is pWOOD, which is the proportion of stations where a woodland guild species was heard. When there is only one station, this metric takes on a value of 1 or 0, giving waterbody-year observations with only one station more influence on IBI variability than waterbody-year observations with a higher number of stations. Hence, NYFO computed station-specific IBIs (pWOOD values were 1 or 0 for each station), and then found mean IBI scores across stations, by waterbody and year.

[16] MMP guidance instructs samplers to record ―chorus" for calling amphibians when the number of individuals heard is a large number and individuals are indistinguishable. Based on estimates by NYFO field crew who visited every sampling station in 2013, NYFO substituted a numeric value of ‗30' as a surrogate for ―chorus" in order to compute community indices requiring an abundance estimate.

[17] http://www.birdscanada.org/birdmon/default/searchquery.jsp

[18] D. Tozer, pers. comm.

[19] C. Knauf, pers. comm.

RESULTS

The trend analysis provided mixed results. There is no universal, over-riding trend across all habitat quality metrics utilized in this trend analysis to characterize the project area as a whole. However, clear declining trends were observed in certain sets of metrics and across metrics in certain waterbodies, while improving trends were seen consistently in other sets of metrics and waterbodies.

Trends must also be interpreted relative to the magnitude of values. For instance, a trend that indicates real, but slowly declining habitat conditions that is occurring at very high relative quality may not be as significant for management purposes as a relatively rapidly declining trend that crosses or is approaching a significant ecological or regulatory threshold.

Structural Habitat

No overall trend is apparent in the evaluation of changes in USA RAM scores between 1951 and the present (Table 2-1). Among 16 waterbodies sampled, Irondequoit Creek declined in all three metrics, while Buttonwood Creek and Cranberry Pond improved in all three metrics. Northrup Creek, Genesee River, and Irondequoit Creek, all lotic systems, declined in RAM metric scores with no improvement in any metric. Rose Marsh, West Creek, and Salmon Creek each improved in one metric, with no declines. In Braddock Bay, Buck Pond, and Round Pond, patch mosaic scores declined, while both buffer metrics improved. Patch Mosaic average score declined in 7 of 16 waterbodies, Buffer Width declined in four waterbodies, and Percent of Wetland Having a Buffer declined in only two waterbodies – Irondequoit Bay and Irondequoit Creek. No changes in the three metrics were observed in Bogus Pond, Larkin Creek, and Slater Creek.

Among the three metrics evaluated in this analysis, Patch Mosaic[20] is of particular concern because it declined in nearly half of the waterbodies assessed from mean scores that were already much lower than the other two metrics. NYFO identified the Patch Mosaic metric among the most consistently low-scoring RAM metrics in the wetland quality ranking assessment conducted across the entire project area (see Chapter 3).

Water Quality

Reliable sources of historical time series water quality data were identified for waterbodies distributed across the project area. Overall, water quality improved, with consistent declines in total phosphorus and soluble reactive phosphorus and no widespread change in total suspended solids (Table 2-2; Figures 2-4, 2-5, 2-6). The Genesee River was the only waterbody documented to improve in all three parameters, although the time series were limited to 2003-2009. The only apparent exception to the overall improving trend was an increase in mean soluble reactive phosphorus concentration in Irondequoit Creek, while Braddock Bay, Long Pond, Genesee River, and Irondequoit Bay all improved in this regard (Table 2-2). However, Irondequoit Creek time series (1991-2001) predated the time series of the other four waterbodies (2003-2009); it is possible Irondequoit Creek would also have shown improvement during the same time period.

[20] The Patch Mosaic metric reflects the complexity of patchiness of distinguishable vegetation stands, assemblages, or strata; greater complexity results in higher scores due to a greater quantity of edge habitats, greater variety of cover and food sources, and therefore presumably potential for greater species richness and diversity.

Animal Communities

Time series of MMP bird call data were obtained within the period 1995-2011 in five waterbodies (Table 2-3; Figures 2-7, 2-8, 2-9), and in two additional waterbodies for calling amphibians (Table 2-4; Figures 2-10 to 2-14). With a few exceptions, where significant trends were present there appeared to be a general pattern of increases in metrics related to abundance of birds and calling amphibians, including within each guild (Tables 2-3, 2-4). However, where significant trends were detected, there was a broad tendency for declines in species diversity and biotic integrity in birds (Table 2-5). For birds, total species richness tended to increase, but, with the exception of Irondequoit Bay, there was a declining tendency in richness of focal species and area-sensitive marsh-nesting obligates . Similarly, waterbodies showed a general decline in the four metrics related to amphibian species richness, diversity, and/or biotic integrity (with the exception of Buck and Cranberry Ponds).

In a few waterbodies, however, there was a net directional tendency discernible across the animal community metrics. For instance, there was a declining tendency in West Creek, which showed either declines or no trend among the 13 bird and amphibian community metrics considered in this trend analysis. There was an improving tendency in Irondequoit Bay, where the 13 metrics either improved over time or showed no trend. For Buck Pond, Cranberry Pond, and Irondequoit Creek where overall population levels were on the rise, indices of guild-specific bird species richness, bird species diversity, and/or bird biotic integrity generally declined.

These patterns in animal community trends were not obviously associated with water quality or structural habitat metric trend direction, nor were there consistent associations between observed animal community patterns and the magnitude of actual water quality concentrations. For example, there was a nearly universal improvement in water quality, but mixed responses in amphibian communities among waterbodies evaluated. Total phosphorus in Buck, Cranberry, and Long Ponds declined, indicating an improved habitat condition in each waterbody. Correspondingly, an improving tendency in amphibian abundance, species richness, diversity, and biotic integrity was evident in Buck Pond and Cranberry Pond. However, all of these animal community metrics declined in Long Pond. This apparent discrepancy can be resolved by examining the trends relative to absolute water quality quantities. Long Pond had at least twice the total phosphorus concentrations in the other two ponds throughout the period. Mean concentrations in Long Pond dropped from about 300 ug/L in 1993 to about 150 ug/L by 2011, but these are all above the threshold of 100 ug/L for hypereutrophic conditions (Wetzel 2001). Buck and Cranberry Ponds changed trophic states, declining from hypereutrophic conditions at about 150 ug/L in 1993 to a lower eutrophic state at 50 ug/L in 2011.

Similarly, there was no clear pattern relating changes in the structural habitat metrics to changes in animal community metrics (Table 2-5). For instance, Buck and Long Ponds showed the same pattern in structural habitat scores – increases in buffer-related habitat metrics and a decline in the Patch Mosaic metric score. But, all of the amphibian community metrics declined in Long Pond while improving in Buck Pond.

Irondequoit Creek, which was the only waterbody to decline in all three structural habitat metrics and the only one in which declining water quality was observed, followed the general pattern of increases in bird and amphibian abundance scores, but declined in community complexity scores (Table 2-5).

SUMMARY

No overall temporal trend in wetland quality was observed in the project area as a whole, although obvious trends were discernible within individual waterbodies. Change in wetland quality was evaluated in terms of 19 metrics characterizing structural habitat condition, water quality, and animal communities. Trend analysis of time series data was conducted for water quality (1991-2009) and animal community (1995-2011) metrics developed from published documents and existing datasets. Changes in wetland structural habitat quality were interpreted from a comparison of 1951 to 2011 aerial imagery. When the project area is regarded as a whole, available time series data indicated a general pattern of improving water quality, but no overall pattern in time trends were evident across structural habitat metrics or across animal community metrics. However, some patterns are evident for specific metrics and waterbodies. For example, mean patch mosaic score[21]declined in nearly half of the waterbodies assessed. Declines in structural habitat quality were apparent in Irondequoit Creek, Northrup Creek, and lower Genesee River, but habitat structure generally improved in Buttonwood Creek and Cranberry Pond. Time trends in mean total phosphorus showed improvements from hypereutrophic to eutrophic conditions in Braddock Bay, Cranberry Pond, Buck Pond, and Genesee River. However, there were a few exceptions to the overall improving pattern in water quality. The magnitude of nutrient pollution remained remarkably high in Irondequoit Creek, and, despite improving trends, also in Long Pond and Northrup Creek. Bird diversity and bird index of biological integrity (IBI) either declined or showed no trend in waterbodies where data were adequate for trend analysis, indicating a net negative tendency for these metrics within the project area. All animal community metrics either declined or showed no trend in Long Pond, Buttonwood Creek, and West Creek, while in Irondequoit Bay all statistically significant trends were increasing.

[21] The patch mosaic metric of the USEPA Rapid Assessment Method indicates diversity and interspersion of habitat types, hence quantity of edge habitat, and by implication, species richness and diversity. A low mean score for patch mosaic complexity indicates that increasing the diversity and interspersion of wetland habitat types would be an appropriate type of restoration.

Table 2-1. Changes in three USEPA Rapid Assessment Method metrics of structural habitat quality were identified using aerial imagery in 1951 and in 2012 at 79 sampling stations distributed throughout the project area. Green shading indicates improving habitat condition, and pink shading indicates a declining condition; the number indicates the relative magnitude of the change.

		SUM of Scores									AVERAGE Scores								
		CURRENT			1951			Difference			Current			1951			Difference		
Waterbody	N	Percent of AA Having Buffer Score	Buffer Width Score	Patch Mosaic Score	Percent of AA Having Buffer Score	Buffer Width Score	Patch Mosaic Score	Percent of AA Having Buffer Score	Buffer Width Score	Patch Mosaic Score	Percent of AA Having Buffer Score	Buffer Width Score	Patch Mosaic Score	Percent of AA Having Buffer Score	Buffer Width Score	Patch Mosaic Score	Percent of AA Having Buffer Score	Buffer Width Score	Patch Mosaic Score
Bogus Pond	3	36	36	21	36	36	21	0	0	0	12.00	12.00	7.00	12.00	12.00	7.00	0.00	0.00	0.00
Rose Marsh	2	24	24	12	24	24	9	0	0	3	12.00	12.00	6.00	12.00	12.00	4.50	0.00	0.00	1.50
West Creek	2	24	24	12	24	24	6	0	0	6	12.00	12.00	6.00	12.00	12.00	3.00	0.00	0.00	3.00
Salmon Creek	4	48	48	18	48	45	18	0	3	0	12.00	12.00	4.50	12.00	11.25	4.50	0.00	0.75	0.00
Braddock Bay	9	108	108	36	105	99	39	3	9	-3	12.00	12.00	4.00	11.67	11.00	4.33	0.33	1.00	-0.33
Buttonwood Creek	2	24	21	12	21	18	9	3	3	3	12.00	10.50	6.00	10.50	9.00	4.50	1.50	1.50	1.50
Cranberry Pond	11	126	117	48	123	111	42	3	6	6	11.45	10.64	4.36	11.18	10.09	3.82	0.27	0.55	0.55
Long Pond	6	72	60	24	63	60	30	9	0	-6	12.00	10.00	4.00	10.50	10.00	5.00	1.50	0.00	-1.00
Northrup Creek	2	24	18	9	24	21	12	0	-3	-3	12.00	9.00	4.50	12.00	10.50	6.00	0.00	-1.50	-1.50
Buck Pond	12	138	135	48	129	129	69	9	6	-21	11.50	11.25	4.00	10.75	10.75	5.75	0.75	0.50	-1.75
Larkin Creek	2	24	21	15	24	21	15	0	0	0	12.00	10.50	7.50	12.00	10.50	7.50	0.00	0.00	0.00
Round Pond	5	60	60	24	51	45	27	9	15	-3	12.00	12.00	4.80	10.20	9.00	5.40	1.80	3.00	-0.60
Slater Creek	1	12	9	6	12	9	6	0	0	0	12.00	9.00	6.00	12.00	9.00	6.00	0.00	0.00	0.00
Genesee River	6	72	66	24	72	69	27	0	-3	-3	12.00	11.00	4.00	12.00	11.50	4.50	0.00	-0.50	-0.50
Irondequoit Bay	9	99	93	48	105	102	39	-6	-9	9	11.00	10.33	5.33	11.67	11.33	4.33	-0.67	-1.00	1.00
Irondequoit Creek	3	24	24	9	36	36	18	-12	-12	-9	8.00	8.00	3.00	12.00	12.00	6.00	-4.00	-4.00	-3.00

Table 2-2. Results of Mann-Kendall non-parametric trend analyses of historical water quality data during 1991-2009[22] from wetlands in the project area in years for which sufficient data were obtained (i.e., n>=4)[23]; a single observation is a mean across samples in a waterbody for a given year. Trend direction in lower case indicates relatively low confidence. Waterbodies are listed in approximate order from west to east.

Water Quality Parameter	Braddock Bay	Cranberry Pond	Long Pond	Northrup Creek	Buck Pond	Genesee River	Irondequoit Bay	Irondequoit Creek
Mean Total Phosphorus (TP)								
Data Source	Makarewicz and Nowak 2010a	Cadmus 2010	Cadmus 2010	Sherwood 1999	Cadmus 2010	Makarewicz and Nowak 2010b	Makarewicz and Nowak 2010c	Coon et al. 2000, Coon 2004, USGS 2013
n	6	4	9	9	4	6	6	11
S	8	6	18	22	4	11	5	3
p	0.03<p<0.07	0.042	0.038	0.012	0.167	0.028	0.235	0.44
Trend Direction	DECLINING	DECLINING	DECLINING	DECLINING	DECLINING	DECLINING	declining	NO TREND
Mean Soluble Reactive Phosphorus (SRP) (Orthophosphorus)								
Data Source	Makarewicz and Nowak 2010a		Makarewicz and Nowak 2010d			Makarewicz and Nowak 2010b	Makarewicz and Nowak 2010c	Coon et al. 2000, Coon 2004, USGS 2013
n	6		6			6	6	11
S	7		11			9	7	19
p	0.136		0.028			0.068	0.136	0.082
Trend Direction	DECLINING		DECLINING			DECLINING	DECLINING	INCREASING
Mean Total Suspended Solids (TSS)								
Data Source	Makarewicz and Nowak 2010a		Makarewicz and Nowak 2010d			Makarewicz and Nowak 2010b	Makarewicz and Nowak 2010c	
n	6		6			6	6	
S	1		3			9	2	
p	0.5		0.36			0.068	0.36<p<0.5	
Trend Direction	NO TREND		NO TREND			DECLINING	NO TREND	

[22] A *declining trend* in these parameters indicates an increase in habitat quality; an *increasing trend* in these parameters would indicate declining habitat quality.
[23] The value ‗n‘ is the number of years for which the metric could be derived from available data; years with data are not necessarily consecutive, and vary in the number of stations incorporated into the mean.

Table 2-3. Results of Mann-Kendall non-parametric trend analyses of historical MMP bird data from wetlands in the project area for which sufficient data were obtained (i.e., n>=4)[24]; a single observation is a mean across stations in the indicated waterbody for a given year during 1995-2011. Trend direction in lower case indicates relatively low confidence. Waterbodies are listed in approximate order from west to east.

Community Integrity Parameter	West Creek	Cranberry Pond	Buck Pond	Irondequoit Bay	Irondequoit Creek
Mean Total Call Count					
n	8	11	13	5	14
S	20	34	16	4	23
p	0.0071	0.004	0.184	0.242	0.117
Trend Direction	DECLINING	INCREASING	increasing	increasing	increasing
Mean NAF Call Count					
n	8	11	13	5	14
S	11	49	36	4	14
p	0.089<p<0.138	>0.001	0.015	0.242	0.225<p<0.259
Trend Direction	declining	INCREASING	INCREASING	increasing	increasing
Mean MNO Call Count					
n	8	11	13	5	14
S	12	8	1	6	7
p	0.089	0.199	0.476<p<0.527	0.117	0.374
Trend Direction	DECLINING	increasing	NO TREND	increasing	NO TREND
Mean Total Species Richness					
n	8	11	13	5	14
S	1	21	11	4	0
p	0.5	0.06	0.255<p<0.295	0.242	>0.5
Trend Direction	NO TREND	INCREASING	increasing	increasing	NO TREND
Mean Focal Species Richness					
n	8	11	13	5	14
S	0	32	33	5	24
p	0.548	0.005<p<0.008	0.021<p<0.029	0.117<p<0.242	0.096<p<0.117
Trend Direction	NO TREND	DECLINING	DECLINING	increasing	declining
Mean AMNO Species Richness					
n	8	11	13	5	14
S	3	23	16	8	7
p	0.36<p<0.452	0.043	0.184	0.042	0.374
Trend Direction	NO TREND	DECLINING	declining	INCREASING	NO TREND
Mean Shannon-Weiner Diversity					
n	8	11	13	5	14
S	0	1	22	2	1
p	0.548	0.5	0.102	0.408	0.5
Trend Direction	NO TREND	NO TREND	declining	NO TREND	NO TREND
Mean Bird IBI					
n	8	11	13	5	14
S	0	23	6	4	17
p	0.548	0.043	0.383	0.242	0.194
Trend Direction	NO TREND	DECLINING	NO TREND	NO TREND	declining

[24] The value ‗n‘ is the number of years for which the metric could be derived from available data; years with data are not necessarily consecutive, and vary in the number of stations incorporated into the mean.

Table 2-4. Results of Mann-Kendall non-parametric trend analyses of historical MMP amphibian data from wetlands in the project area for which sufficient data were obtained (i.e., n>=4)[25]; a single observation is a mean across stations in the indicated waterbody for a given year during 1995-2011. Trend direction in lower case indicates low confidence. Waterbodies are listed in approximate order from west to east.

Community Integrity Parameter	West Creek	Buttonwood Creek	Cranberry Pond	Long Pond	Buck Pond	Irondequoit Bay	Irondequoit Creek
Mean Total Call Count							
n	7	7	7	5	16	4	7
S	3	1	19	4	68	1	11
p	0.386	0.5	0.001	0.242	0.001	0.38<p<0.63	0.068
Trend Direction	NO TREND	NO TREND	INCREASING	declining	INCREASING	NO TREND	INCREASING
Mean Total Species Richness							
n	7	7	7	7	16	4	7
S	4	3	1	6	13	2	5
p	0.28<p<0.39	0.386	0.5	0.117	0.28<p<0.31	0.375	0.281
Trend Direction	NO TREND	NO TREND	NO TREND	declining	increasing	NO TREND	declining
Mean Woodland Species Richness							
n	7	7	7	5	16	4	7
S	9	0	17	6	27	2	17
p	0.119	>0.5	0.005	0.117	0.11<p<0.13	0.375	0.005
Trend Direction	declining	NO TREND	INCREASING	declining	increasing	NO TREND	DECLINING
Mean Shannon-Weiner Diversity							
n	7	7	7	5	16	4	7
S	3	5	1	4	42	2	1
p	0.386	0.281	0.5	0.242	0.032	0.375	0.5
Trend Direction	NO TREND	NO TREND	NO TREND	declining	INCREASING	NO TREND	NO TREND
Mean Amphibian IBI							
n	7	7	7	5	16	4	7
S	9	4	13	7	42	4	5
p	0.119	0.28<p<0.39	0.035	0.04<p<0.12	0.032	0.167	0.281
Trend Direction	DECLINING	NO TREND	INCREASING	DECLINING	INCREASING	INCREASING	NO TREND

[25] The value ‗n‘ is the number of years for which the metric could be derived from available data; years with data are not necessarily consecutive, and vary in the number of stations incorporated into the mean.

Table 2-5. Summary of changes in mean values of wetland habitat quality metrics in wetlands within and adjacent to the REAOC (D=Decline, I=Increase, NT=No Trend, blank=data insufficient to evaluate trend). Time periods of data may differ between waterbodies, but all data used in this trend analysis fall within the following year ranges: Structural Habitat (1951, 2011), Water Quality (1991-2009), Amphibian Community (1995-2011), Bird Community (1995-2011). Waterbodies are listed west to east.

Waterbody	Structural Habitat			Water Quality			Bird Community								Amphibian Community				
	% AA with buffer	Buffer width	Patch mosaic	Total P	SRP	TSS	Total call count	NAF call count	MNO call count	Total Spp richness	Focal Spp richness	AMNO Spp richness	Diversity Index	Index of Biotic Integrity	Total call count	Total Spp richness	Woodland Spp richness	Diversity Index	Index of Biotic Integrity
Bogus Pond	NT	NT	NT																
Rose Marsh	NT	NT	I																
Braddock Bay	I	I	D	I	I	NT													
West Creek	NT	NT	I				D	D	D	NT	NT	NT	NT	NT	NT	NT	D	NT	D
Salmon Creek	NT	I	NT																
Buttonwood Creek[26]	I	I	I				NT	NT	D	D	D	D	D	NT	NT	NT	NT	NT	NT
Cranberry Pond	I	I	I	I			I	I	I	I	D	D	NT	D	I	NT	I	NT	I
Long Pond	I	NT	D	I	I	NT									D	D	D	D	D
Northrup Creek	NT	D	D	I															
Buck Pond	I	I	D	I			I	I	NT	I	D	D	D	NT	I	I	I	I	I
Larkin Creek	NT	NT	NT																
Round Pond	I	I	D																
Slater Creek	NT	NT	NT																
Genesee River[27]	NT	D	D	I	I	I									D	NT	NT	I	NT
Irondequoit Bay	D	D	I	I	I	NT	I	I	I	I	I	I	NT	NT	NT	NT	NT	NT	I
Irondequoit Creek	D	D	D	NT	D		I	I	NT	NT	D	NT	NT	D	I	D	D	NT	NT

[26] Bird community data were available, but insufficient for non-parametric statistical evaluation (n<4); trends reported in this table were interpreted by inspection of graphs.

[27] Amphibian community data were available, but insufficient for non-parametric statistical evaluation (n<4); trends reported in this table were interpreted by inspection of graphs.

Figure 2-1. Map of 68 sampling stations distributed across the project area, where NYFO applied the USEPA Rapid Assessment Method (USA RAM) for characterizing structural habitat quality in the fall of 2012 and/or the spring of 2013.

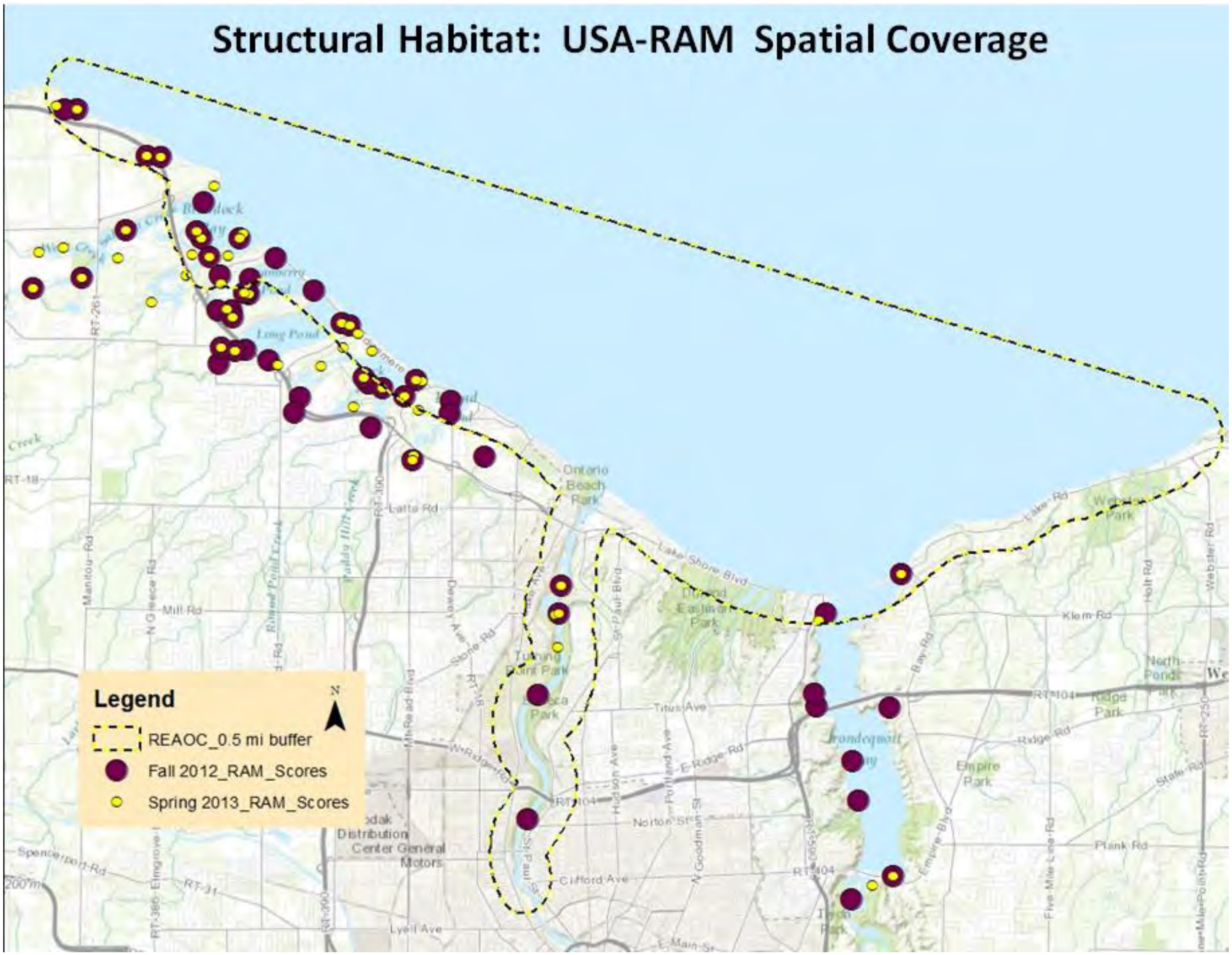


Figure 2-2. Schematic illustration of developing a multimetric index from visual observations of a large number of relevant field indicators.

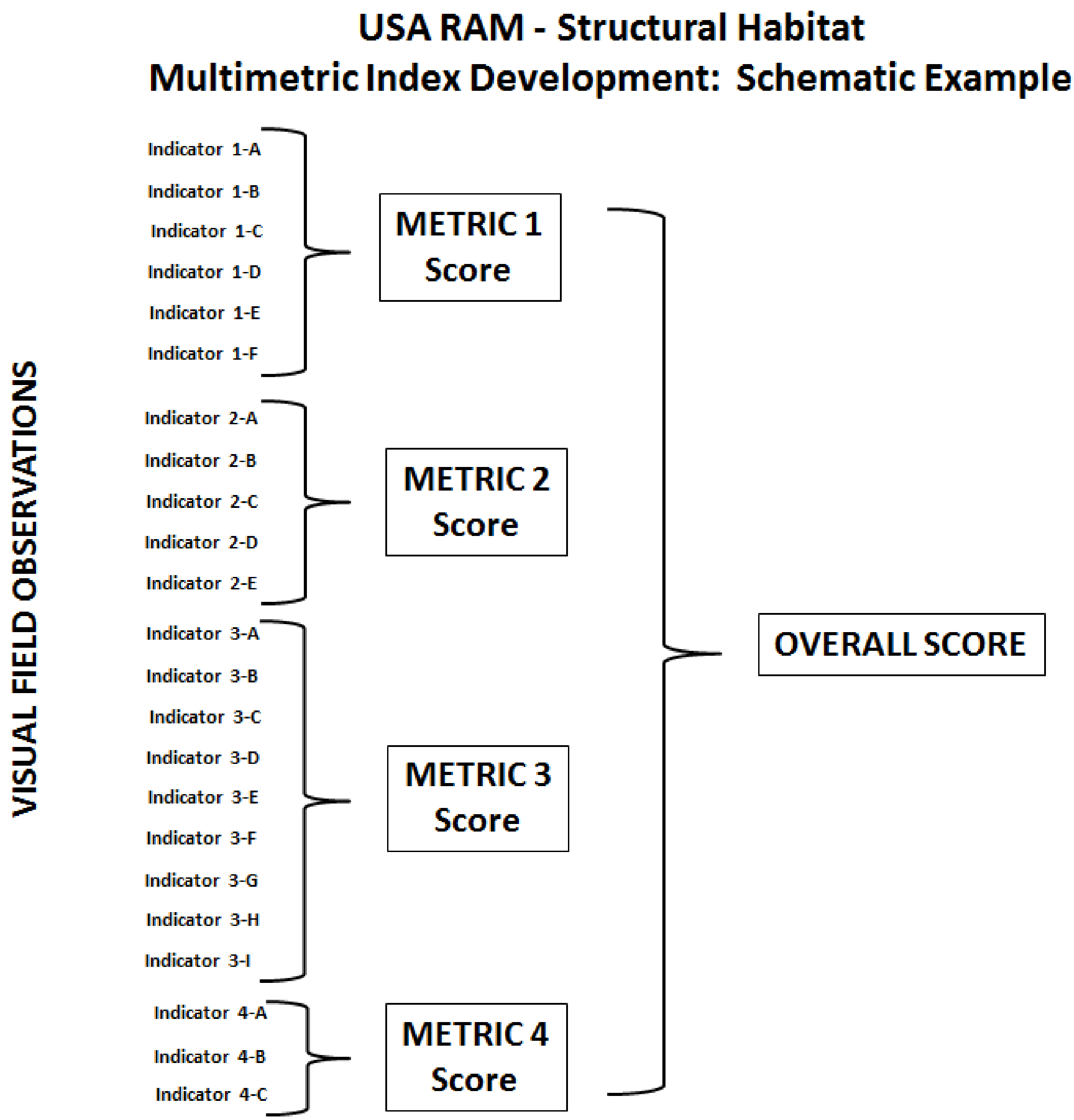


Figure 2-3. Example of Lake Ontario shoreline hardening analysis between Bogus Point and Manitou Beach Point, as related spatially to the positions of remnant coastal wetlands, indicated by the yellow circles, at Bogus Point (left) and Rose Marsh (right).

Figure 2-4. Time series of mean total phosphorus (TP) (ug/L) in eight project area waterbodies (1991-2009); trend analyses and data sources are provided in Table 2-2.

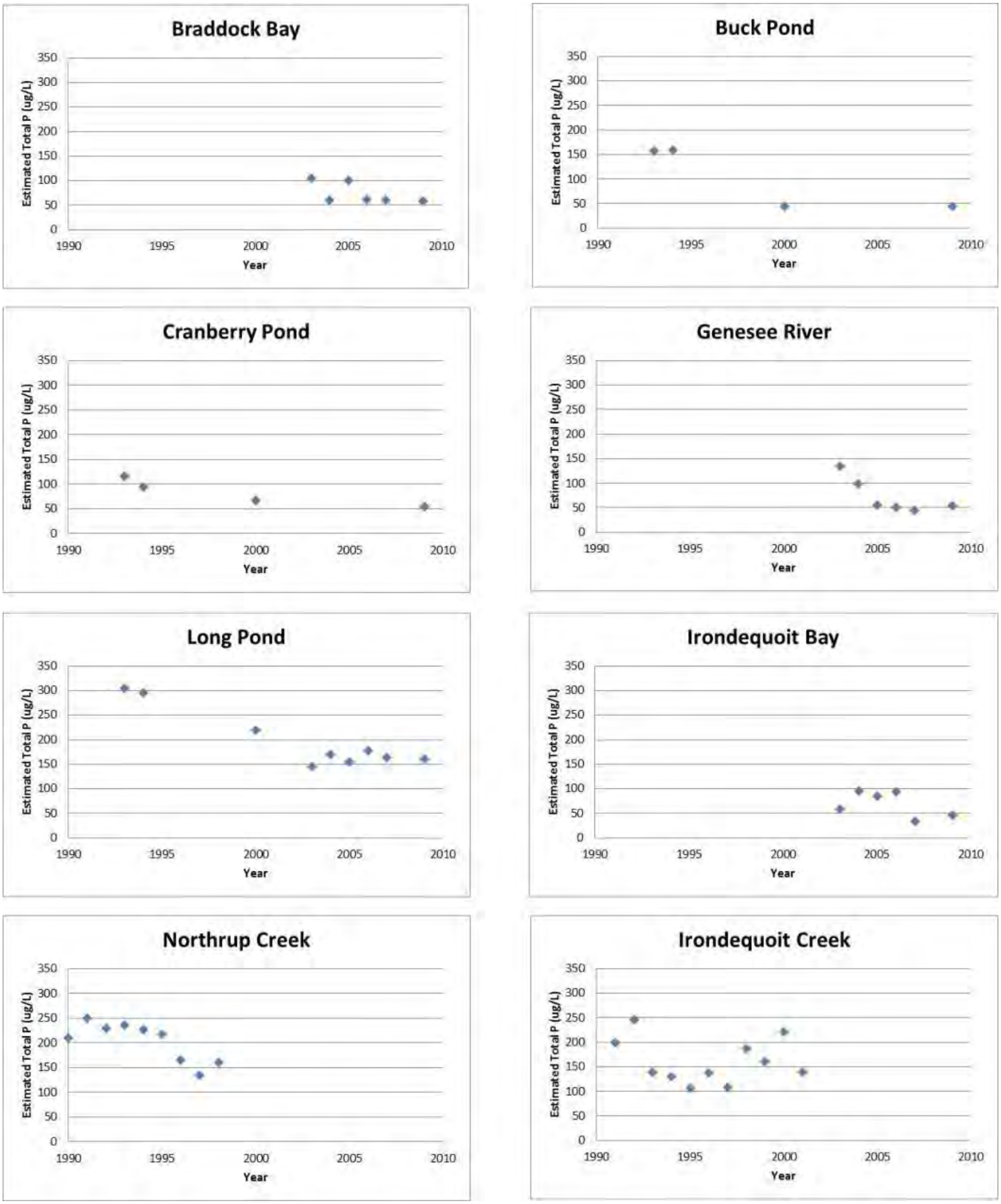


Figure 2-5. Time series of mean soluble reactive phosphorus (SRP; aka orthophosphorus) (ug/L) in five project area waterbodies (1991-2009); trend analyses and data sources provided in Table 2-2.

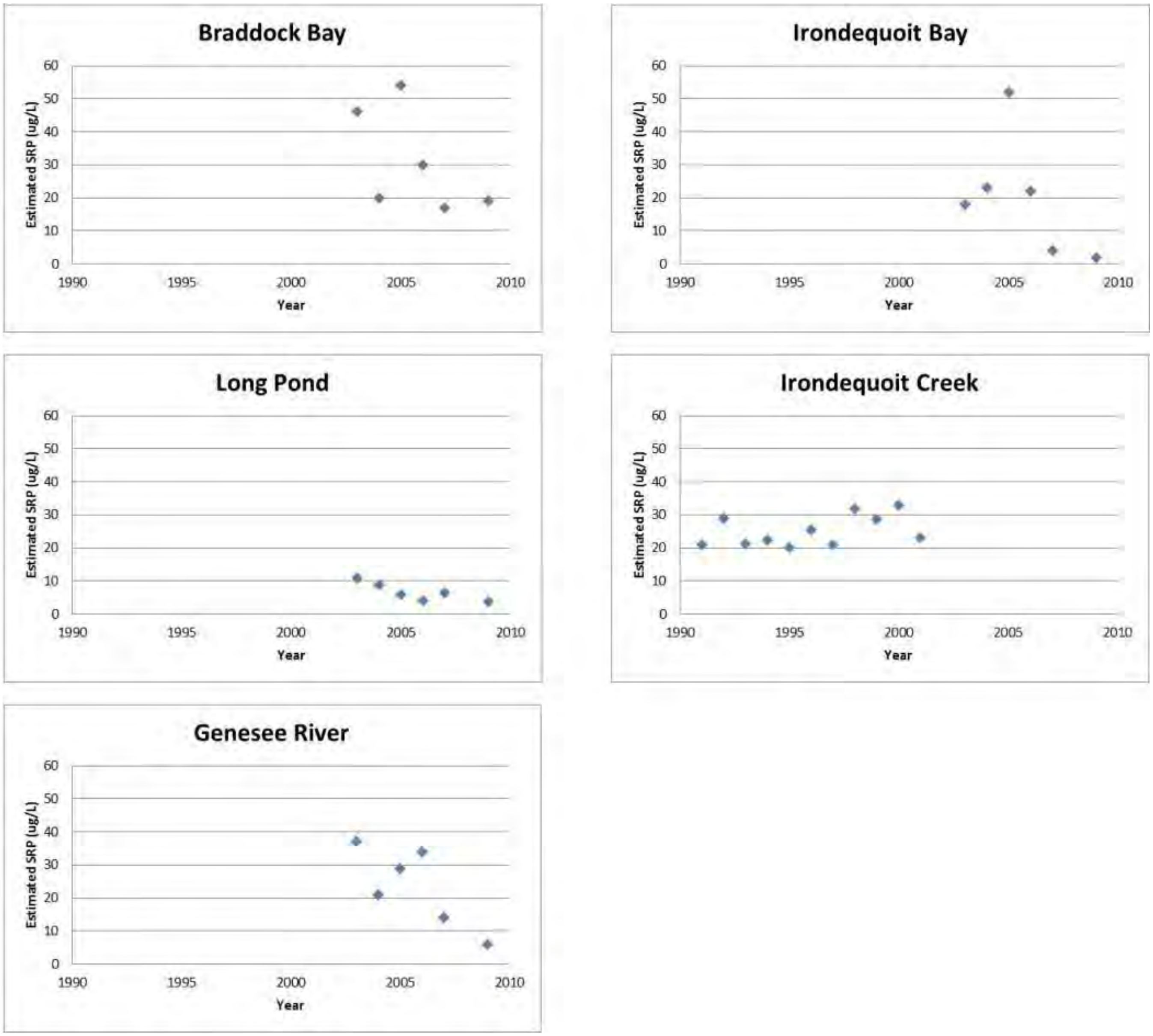


Figure 2-6. Time series of mean total suspended sediment (TSS) (mg/L) in four project area waterbodies (2003-2009); trend analyses and data sources provided in Table 2-2.

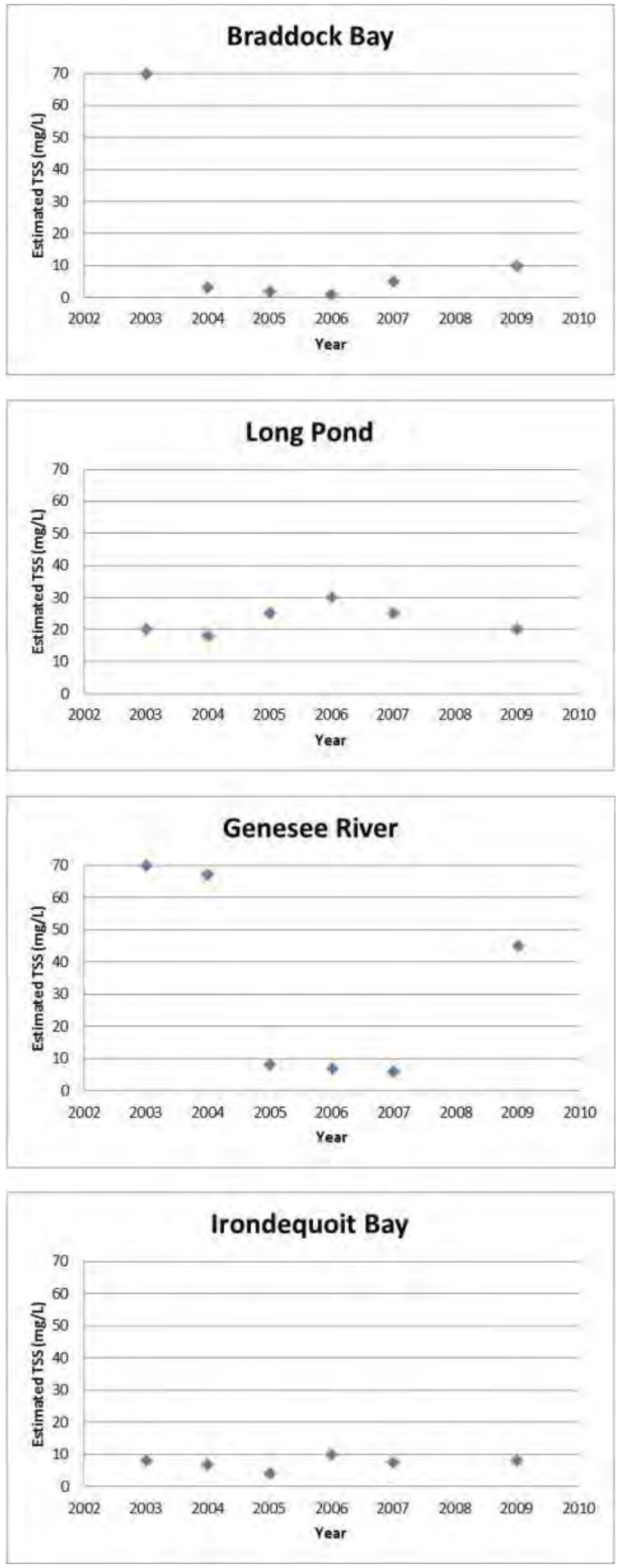


Figure 2-7. Time series of the means of three total bird abundance metrics derived from MMP data collected during 1995-2011 in six project waterbodies; trend analyses provided in Table 2-3.

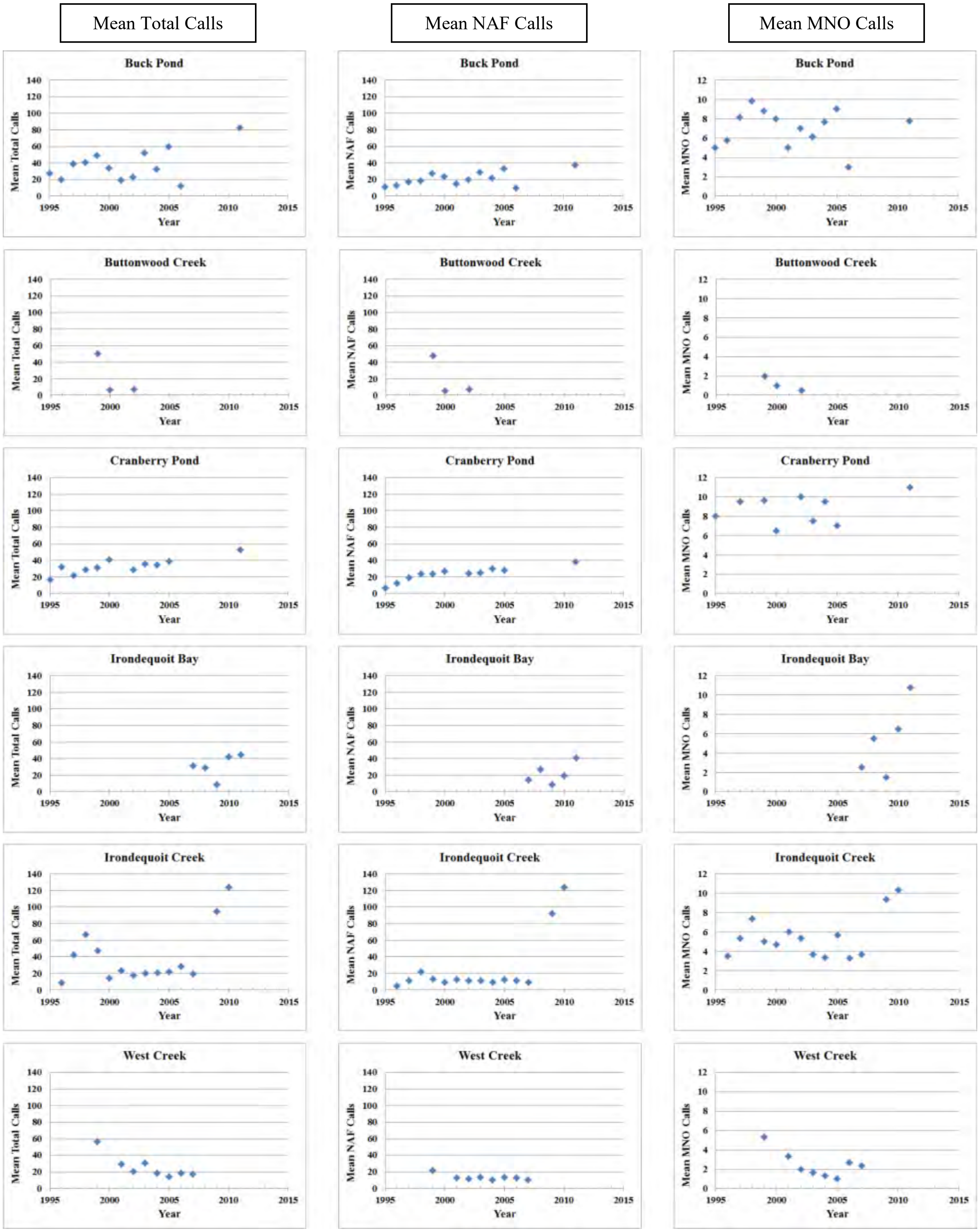


Figure 2-8. Time series of the means of three bird species richness metrics derived from MMP data collected during 1995-2011 in six project waterbodies; trend analyses provided in Table 2-3.

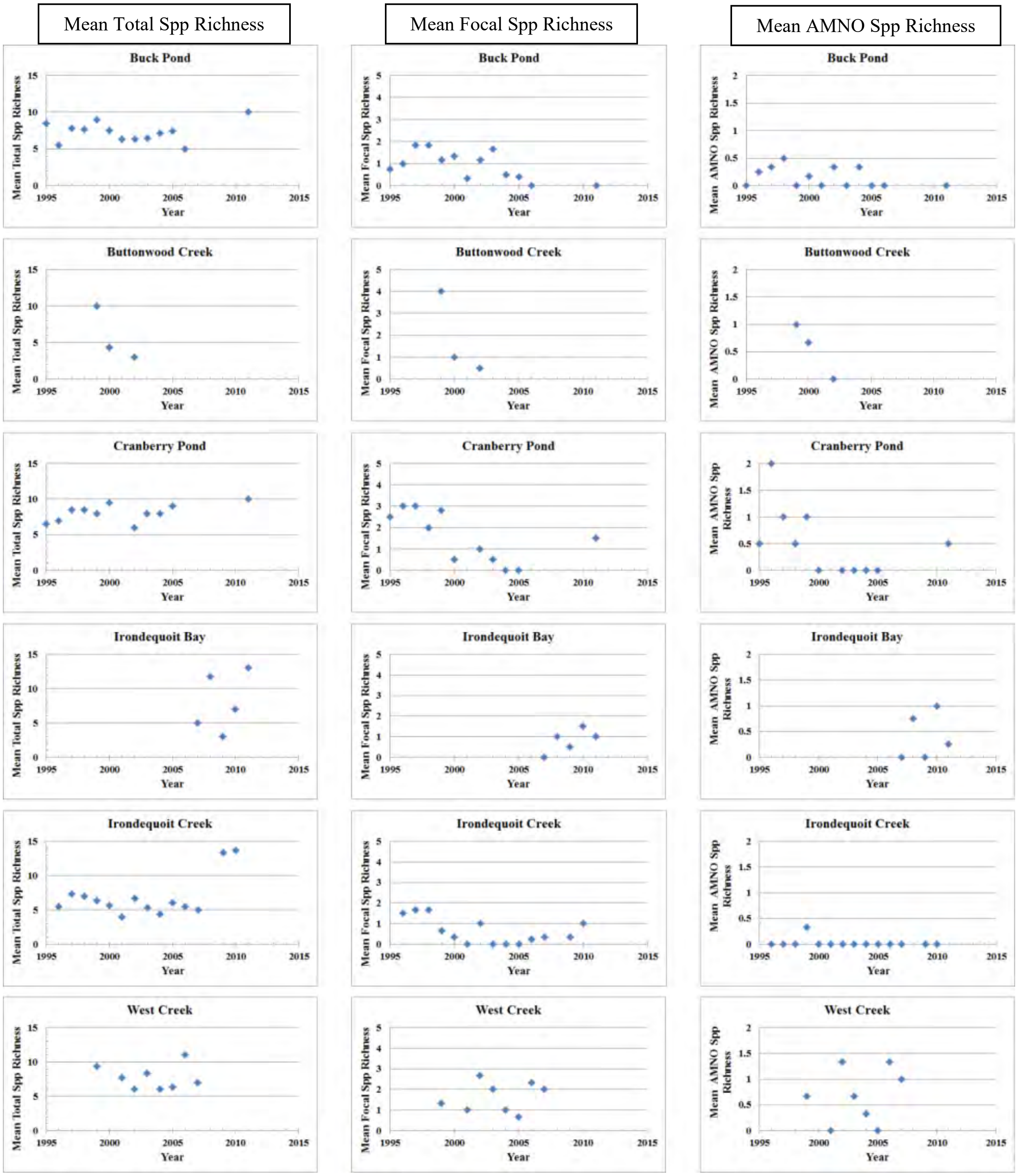


Figure 2-9. Time series of mean bird species diversity and mean bird biotic integrity metrics derived from MMP data collected during 1995-2011 in six project waterbodies; trend analyses provided in Table 2-3.

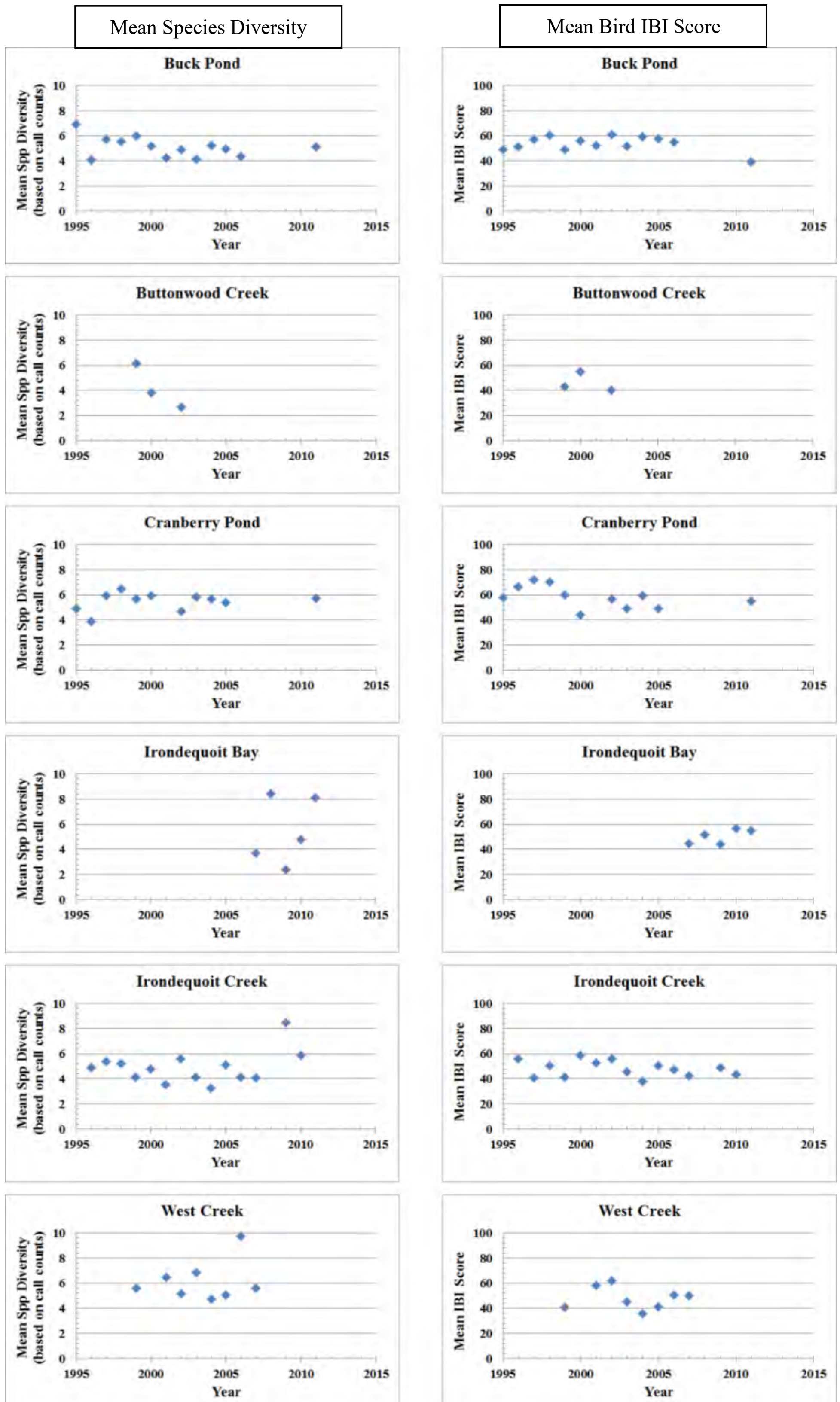


Figure 2-10. Time series of the mean total amphibian abundance metric derived from MMP data collected during 1995-2011 in eight project waterbodies; trend analyses provided in Table 2-4.

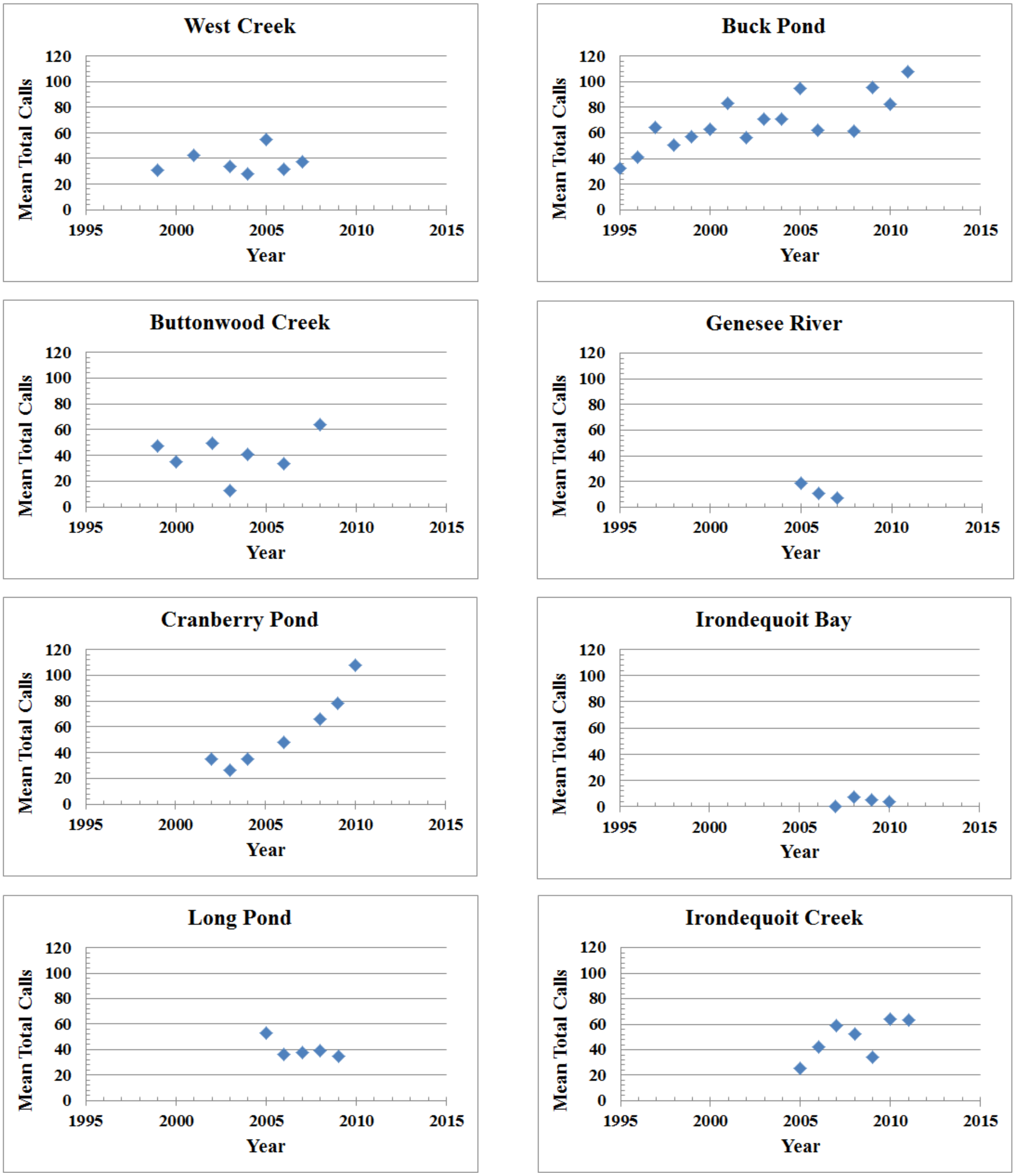


Figure 2-11. Time series of mean total amphibian species richness (rTOT) derived from MMP data collected during 1995-2011 in eight project waterbodies; trend analyses provided in Table 2-4.

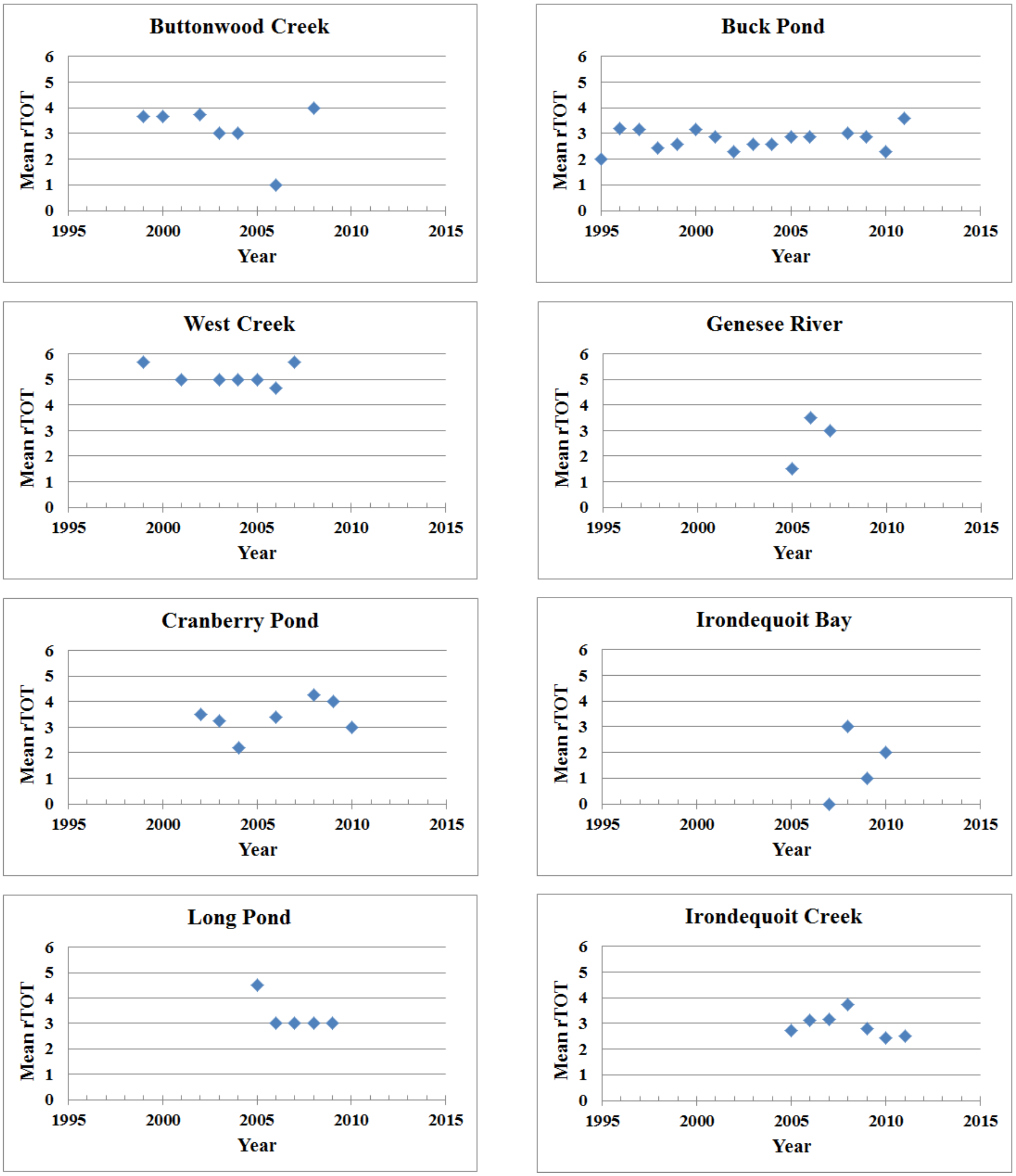


Figure 2-12. Time series of mean woodland amphibian species richness (rWOOD) derived from MMP data collected during 1995-2011 in eight project waterbodies; trend analyses provided in Table 2-4.

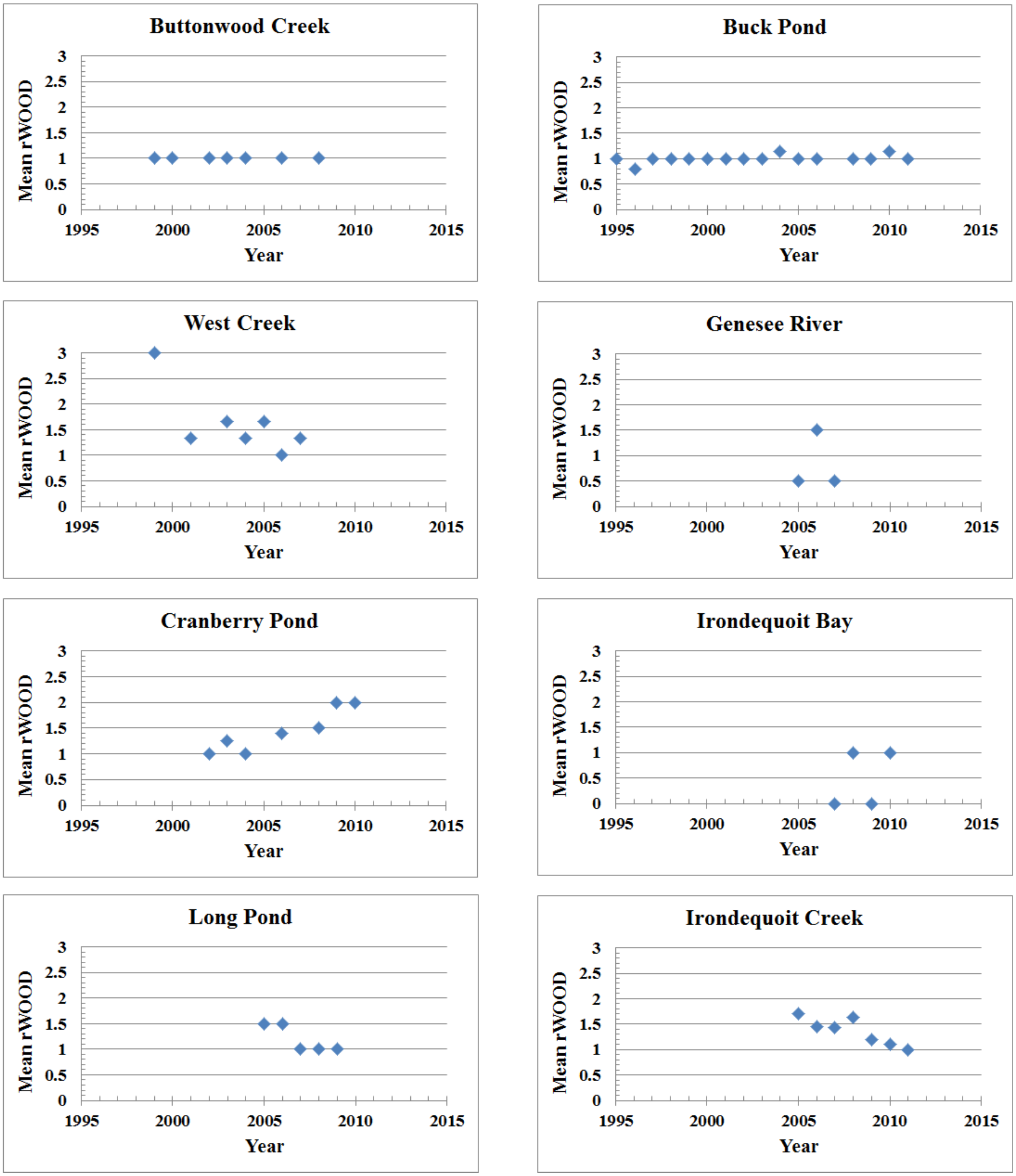


Figure 2-13. Time series of mean amphibian species diversity derived from MMP data collected during 1995-2011 in eight project waterbodies; trend analyses provided in Table 2-4.

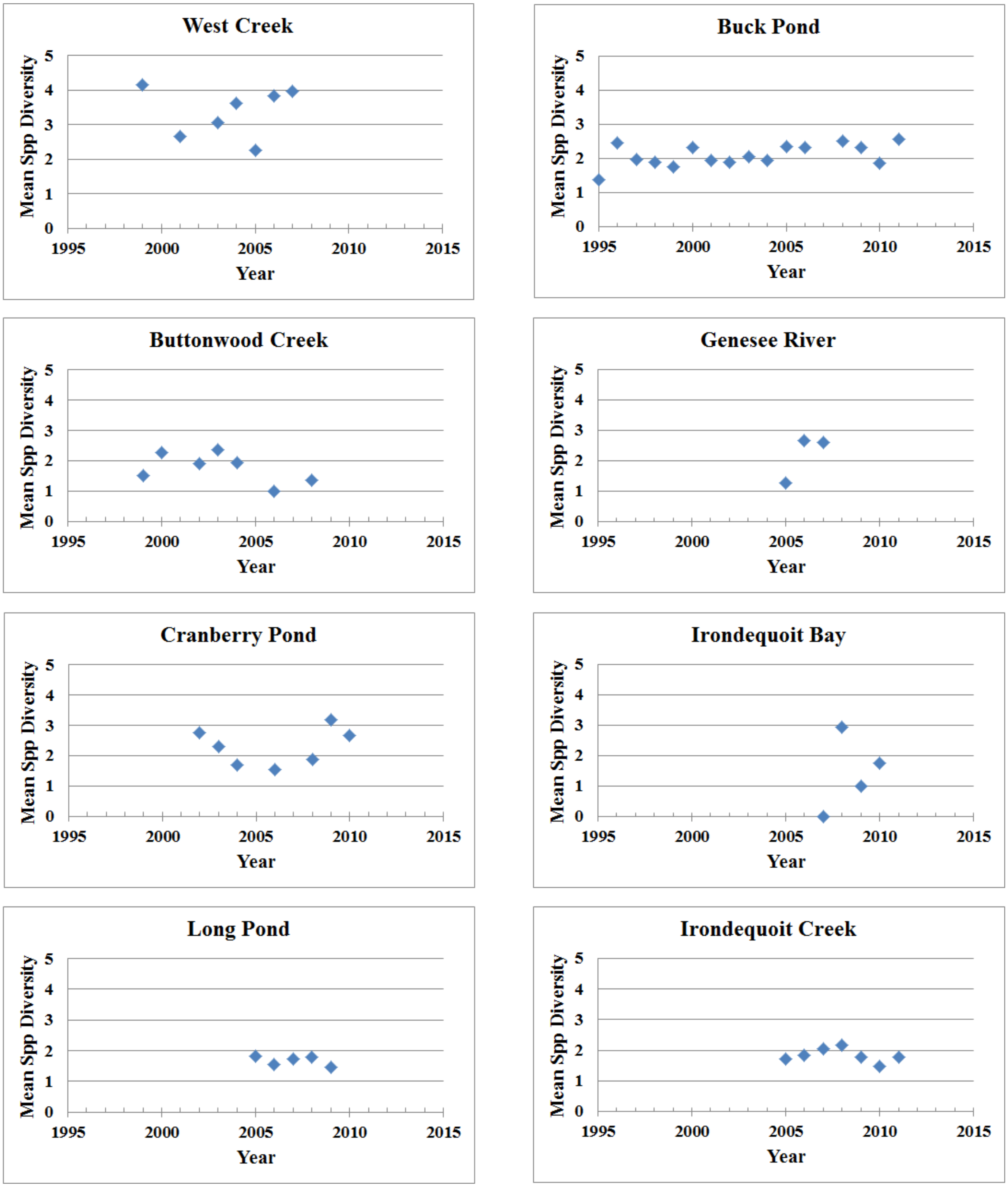
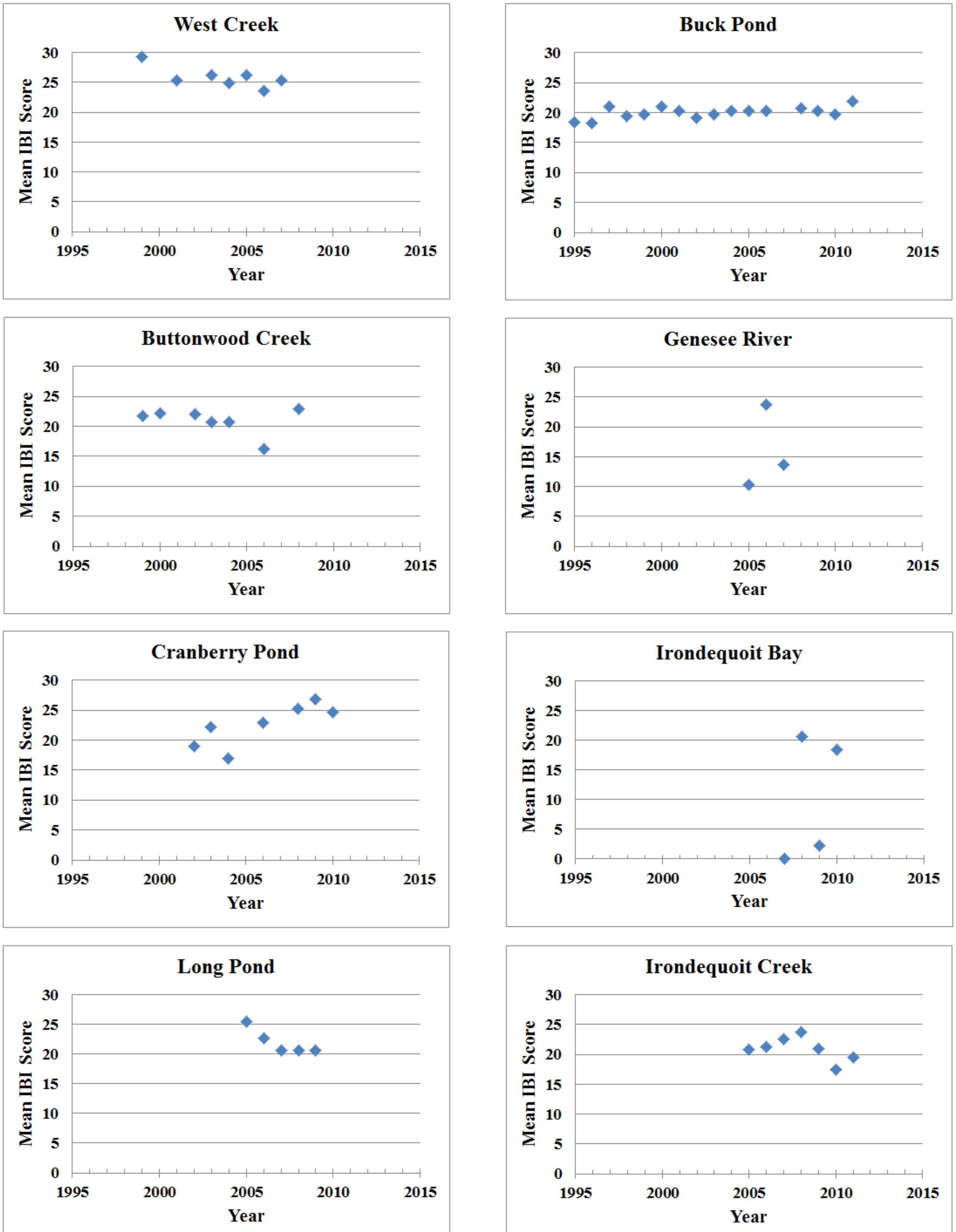


Figure 2-14. Time series of mean amphibian IBI scores derived from MMP data collected during 1995-2011 in eight project waterbodies; trend analyses provided in Table 2-4.



CHAPTER THREE - RANKING CURRENT WETLAND QUALITY

METHODS

NYFO ranked relative wetland quality among 15 waterbodies (seven lotic and eight lentic) using data collected at 112 individual sampling stations distributed across the project area, within and adjacent to the REAOC (Figure 3-1). Wetland habitat quality was assessed in the field in terms of structural habitat, water quality, and/or animal community metrics in the fall of 2012 and the spring of 2013 (Figure 3-2). Sampling for these categories of metrics was co-located where feasible.

Sample Site Selection

Field work in the fall of 2012 included sampling to characterize structural habitat and water quality (grab samples and YSI measurements). Sampling for structural habitat assessment at 53 wetland sites was planned using existing NWI and NYSDEC mapped wetlands within the project area. Structural habitat assessment sites were identified based on accessibility, safety, and spatial representativeness across the project area (Figure 3-3; Attachment 3-1). Numbers of sampling sites per waterbody were approximately proportional to waterbody size. Water quality sampling in the fall of 2012 included 68 surface water grab samples and 66 YSI water measurements (Figure 3-4; Attachment 3-2). In some cases, water sampling and structural habitat assessment sites could not be centered at precisely the same point due to the extent and depth of surface water, but were placed as closely as possible to one another. All 2012 field sampling was performed between mid-September and early November.

Spring 2013 sampling locations were identified using NWI and NYSDEC mapped wetlands, and a draft of NYFO's 2011 delineation of current wetland boundaries. Sampling in 2013 included 51 structural habitat stations (Figure 3-3; Attachment 3-1), YSI water quality measurements at 47 stations (Figure 3-4; Attachment 3-2), and added an animal community component at 30 amphibian listening stations and 36 bird listening stations (Figure 3-5; Attachment 3-3). All amphibian call count stations were co-located with bird count stations, divided among five routes of up to eight stations per route. Locations of 11 of the animal community sites in 2013 were randomly selected from among the 2012 structural habitat sampling sites. Locations for the remaining 25 animal community sampling sites were randomly identified within the project area. Structural habitat and water quality data were collected at each animal survey station in the spring of 2013. An additional 15 structural habitat sites were selected from among 2012 locations. All sampling sites in 2013 conformed to site selection criteria for marsh bird and amphibian call count surveys (BSC 2000). Field sampling was performed between mid-April and early June 2013 for the animal community surveys, and co-located YSI and RAM sampling was completed by early August 2013.

Structural Habitat

NYFO conducted a literature search and consulted with experts[28] to identify an appropriate tool for assessing wetland physical and structural quality that could be applied across a large project area at numerous sites during a 1-year field window, with limited resources. A number of rapid wetland assessment methods were identified that had already been developed by state environmental agencies (e.g., Apfelbeck and Farris 2005, Collins et al. 2006, Mack 2001, Michigan Department of Natural Resources (MDNRE) 2010). Other methods for wetland assessment are widely cited, but are not specifically designed for rapid implementation in the field (e.g., USACE 1991, Lopez and Fennessy 2002). New York State has not yet developed a wetland habitat rapid assessment protocol. USEPA's USA RAM (USEPA 2011) draws on the thinking and experience developed in the various states' existing programs.

NYFO assessed physical and vegetative structural habitat quality at the wetlands in the vicinity of the REAOC using the USEPA RAM (USEPA 2011). The RAM is a visual assessment method wherein an observer scores each of 12 metrics (Table 3-1) based on the presence/absence of field indicators and the intensity or extent of those indicators, and compiles a multi-metric score to represent the overall habitat condition (Figure 3-6). The assessment includes the following metrics: percent assessment area with buffer, buffer width, stress to buffer zone, topographic complexity, altered hydroperiod, altered substrate, water quality stress, vegetation disturbance, invasive species cover, vertical complexity, plant complexity, and quality of the patch mosaic. RAM metrics are associated either with a desirable condition or stressors, and scored either within a 40m diameter assessment area or within the surrounding 100m buffer area (Figure 3-7).

RAM wetland habitat assessment is not taxon-specific. The array of six RAM metrics related to wetland condition characterizes the extent to which the breadth of potential wetland functions and services is supported by the visible physical and vegetative structure. Greater variety of wetland form and structure is related to broader functionality as wetland habitat, which, in turn, presumably is related to richness and diversity of wetland plant and animal species. The six stressor-related metrics characterize the degree to which anthropogenic processes and events have degraded form and structure, thereby deteriorating the capacity of the wetland to support a diversity of plants and animals.

Assessment area and buffer area layout and field observations were conducted according to RAM guidance (USEPA 2011). An exception is for metrics where transects were recommended for field observations. Instead of using transects, NYFO staff conducted a thorough walk-over of the entire assessment area at each sampling station. Standard vegetation field guides (e.g., Hotchkiss 1970, Newcomb 1977, Peterson and McKenny 1996, and Tiner 1988) were used in plant identifications, as required. For the following metrics, field observations were supplemented with interpretation of recent aerial imagery: percent assessment area with buffer, buffer width, and patch mosaic. NYFO contacted the developers of the USA RAM protocol and were advised that this is an appropriate tool for ranking wetland habitat quality, but that the RAM was developed for national application and NYFO should consider adjusting the scoring to provide greater site-specific sensitivity in certain metrics, if needed. NYFO did not adjust the default scoring protocol.

[28] Including Ralph Tiner, USFWS Region 5, NWI Wetland Specialist

Each metric received one of four scores: 3, 6, 9, or 12, where 3 is poorest and 12 is highest value for habitat quality. The overall, multi-metric score was derived as the sum of the 12 component metric scores, with possible values ranging between 36 and 144 at each sampling station, for each sampling event.

NYFO performed two types of rankings using the RAM data. The first type of ranking was metric-specific, which ranked scores to identify metrics most responsible for driving down structural habitat quality across the project area. No *a priori* information was located concerning the potential for systematic differences in metric scores due to waterbody type or seasonality. Therefore, separate metric ranking analyses were conducted for four categories of RAM data. Within each observation set, metric scores were summed, and sum-of-scores were ranked by metric. Metrics that ranked low consistently across the four observation sets were identified in a weight of evidence synthesis. Observation sets were:

- Lentic waterbodies, Fall 2012;
- Lotic waterbodies, Fall 2012;
- Lentic waterbodies, Spring 2013; and
- Lotic waterbodies, Spring 2013.

The second type of ranking was waterbody-specific, which identified the waterbodies with wetlands most in need of structural habitat improvement[29]. Ranking of waterbody-specific structural habitat was based on both the mean overall RAM score and the mean of the five consistently lowest scoring metrics across the project area (see above). Due to a lack of information on potential seasonal effects in metric scores, RAM data were divided into the following four observation sets:

- Fall 2012, ranked using Mean of Overall Scores;
- Spring 2013, ranked using Mean of Overall Scores;
- Fall 2012, ranked using the Mean of the Five Lowest Scoring Metrics; and
- Spring 2013, ranked using the Mean of the Five Lowest Scoring Metrics.

Waterbodies that ranked among the lowest or borderline mean overall RAM scores in both years were identified. Waterbodies were also identified that ranked low or borderline in both years using the mean of the five lowest scoring metrics. Together, these lists comprised the wetlands most in need of structural habitat restoration.

Water Quality

NYFO analyzed grab samples and obtained YSI meter readings at locations distributed throughout the project area (Figure 3-4; Attachment 3-2). Surface water grab samples were taken at a total of 68 sites and the number of water samples per water body was approximately proportional to water body size.

In lentic waterbodies, one sample was collected near the center of the open water and the remaining samples were collected at the perimeter of the open water. All perimeter samples

[29] Slater Creek was not included among candidate wetlands for restoration at the recommendation of the RAC and its technical advisors, due to the very small area of remnant wetlands, and the impracticality of restoring areas that were formerly wetland. Similarly, Bogus Point Pond and Rose Marsh were dropped from further consideration because of their relatively small size compared to the other waterbodies.

were collected in approximately 1m water depth, no more than 5m from the water-emergent vegetation interface, and where submerged aquatic vegetation (SAV) coverage was approximately 40-60%. Water grab samples in lentic systems were collected at approximately 15cm below water surface.

In lotic systems, grab sampling was conducted at the approximate longitudinal midpoint of an emergent riparian wetland, as well as immediately upstream and downstream of the wetland. Composite vertical sampling (to a maximum depth of approximately 0.5 to 1 meter) was conducted across the width of the channel at each sampling station, to approximate cross-sectional average values.

Analysis of water grab samples was performed by Columbia Analytical Services, Inc. (dba ALS Environmental) at their lab in Rochester, NY. All grab sampling and analyses were subject to requirements of an established laboratory QA/QC plan (dated 10/03/2011). Grab samples were stored in a cooler on wet ice for transport to the laboratory where they were deposited each day after sampling. Upon receipt at the laboratory, samples were stored in a refrigerator at 1-6°C until analyses were performed within recommended holding times. Water samples were analyzed for the following:

- ammonia (USEPA Method 350.1),
- nitrite (USEPA Method 353.2),
- nitrate/nitrite (USEPA Method 353.2),
- total Kjeldahl nitrogen (TKN) (USEPA Method 351.2),
- total suspended solids (TSS) (SM 25400),
- total phosphorus and orthophosphorus (USEPA Method 365.1).

YSI measurements were taken using the YSI ProfessionalPlus multi-parameter water quality meter at 66 sites throughout the AOC in the fall of 2012. An additional 47 YSI measurements were taken in 2013, of which 17 were at locations previously sampled in 2012 and 30 were at new sites. Parameters measured by the YSI instrument were temperature, dissolved oxygen (DO), pH, oxidation-reduction potential (ORP), specific conductance, and conductivity. Derivative measurements computed by the instrument were salinity, total dissolved solids (TDS), and resistivity. Water quality meters were regularly inspected, cleaned, and calibrated according to manufacturer specifications to ensure proper usage and accuracy of the readings. Calibration was performed before the crew left the office for fieldwork for each sampling event. Duration of individual sampling events ranged from one to three days.

Wetland quality ranks using water quality data were developed, by waterbody, using the number of excursions of mean parameter values from screening values obtained from guidance values or regulatory criteria. NYFO selected screening values that were related to aquatic life uses. At least one screening value was identified for each of the following water quality parameters: ammonia, nitrite, total phosphorus (TP), total suspended solids (TSS), TDS, DO, and pH (Table 3-2). The remaining water quality parameters were excluded from this ranking because no criterion related to value for aquatic life was identified. For TDS and DO, fall 2012 and spring 2013 results were screened separately and tallied independently. Certain criteria are dependent on NYSDEC waterbody classification. With the exception of Class C waters in Slater Creek and Round Pond, and Class A waters in most of the REAOC portion of Lake Ontario, all waterbodies in the project area are NYSDEC Class B waters.

Waterbodies with the greatest number of excursions from screening values were ranked lowest, and identified as most in need of water quality improvement. Water quality parameters were also ranked by tallying the total number of excursions for each parameter, across waterbodies.

NYFO reduced the inherent spatial variability in water quality by screening *average* values across sampling stations within each waterbodies. However, the value of any of these water quality parameters is likely to be highly variable temporally as well, changing with season and possibly time of day. These analyses are based on a single sampling of water quality under low-flow conditions, and during or following vegetation senescence. NYFO acknowledges that these conditions are not representative of typical year-round water quality. However, this analysis was designed to evaluate *relative* habitat quality among the waterbodies, not develop representative values of water quality.

Animal Communities

NYFO selected the MMP protocol to evaluate relative wetland quality based on animal community metrics. BSC originally developed the MMP for very large-scale, long-term studies of spring bird and calling amphibian populations and communities. While previous BUI removal assessments at AOCs have used the MMP as a principal field tool (e.g., Macecek and Grabas 2011, Timmermans and Archer 2006), BSC has expressed concerns about using data developed with the MMP methods for site-specific, short-term evaluations. A study conducted at 20 sites on the north shore of Lake Ontario concluded that the sensitivity of community indices developed using the MMP is significantly enhanced by either adding an additional site visit or including stations in the wetland interior, or both (Meyer et al. 2006). NYFO‘s random assignment of MMP sampling locations satisfied the recommendation to include some sampling stations in the interior of the wetlands (Figure 3-5; Attachment 3-3).

A total of 30 amphibian and 36 bird surveys were conducted in the spring of 2013. Survey stations encompassed a 100m diameter semicircle. The orientation of semicircles relative to station center points was randomly determined for each station.

<u>Amphibians</u>

Amphibian call counts at each sampling location were conducted following the guidelines in the BSC Marsh Monitoring Program Participants Handbook for Surveying Amphibians (Revised 2008). Sampling stations were visited three times in early spring at least 15 days apart as weather allowed between early April and mid-June. Night time temperature was at least 5°C (41°F) for the first survey, at least 10°C (50°F) for the second survey, and 17°C (63°F) for the third survey. Site visits were conducted on evenings with minimal wind and rain. Survey routes began each evening one-half hour after sunset and were completed by midnight. Surveys for each route were conducted on separate evenings. The same pair of observers conducted all surveys.

Data used for analyses included all observations recorded within the 100m radius MMP semi-circular survey area. Observations outside the 100m radius semicircle were recorded, but were not included in analysis. Field data were used to compute the following metrics of amphibian community structure:

- species richness,
- modified Shannon-Wiener diversity index (call count as abundance), and

- IBI developed according to Great Lakes Coastal Wetlands Monitoring Plan methods (Timmermans et al. 2008).

Birds

Sampling stations were visited two times during the breeding season in early spring following MMP guidelines (BSC 2000). The same pair of observers conducted all surveys. All surveys were done starting 4 hours before sunset and were completed before dusk. Observations were conducted following the guidelines in the BSC Marsh Monitoring Program Participants Handbook for Surveying Birds (Revised 2008).

Field data were used to compute the following metrics of bird community structure:

- species richness (all species),
- focal species richness,
- modified Shannon-Wiener diversity index (call count as abundance), and
- IBI developed according to Great Lakes Coastal Wetlands Monitoring Plan methods (Grabas et al. 2008)

Ranking Based on Animal Communities

Waterbodies were ranked for relative wetland habitat quality based on MMP data. Mean values were computed for each animal community metric, by waterbody. Ranks were developed based on the mean values each metric individually, across all waterbodies, for a preliminary total of seven sets of ranks. Ranks were assigned according to methods typically used for non-parametric rank correlation analysis. An average of these seven metric-specific ranks was obtained for each waterbody.

Before assigning the final overall rank, the data were parsed into analysis categories, based on type of waterbody:

- Birds, Lentic
- Birds, Lotic
- Amphibians, Lentic
- Amphibians, Lotic

Overall ranks used to distinguish relative wetland quality among waterbodies were then developed within each of these analysis categories, based on averages of the seven metric-specific ranks by waterbody.

Call-count data are inherently highly variable due to a number of factors that may affect observability.. NYFO smoothed this inherent variability first by computing average values of each of the seven separate community metrics within waterbodies. Each metric was ranked separately. Variability in ranks between these metrics was further smoothed by taking the average of the metric-specific ranks to obtain an overall wetland quality rank of animal communities for each waterbody.

Summary of Overall Approach

There was, overall, an unbalanced sampling design with respect to spatial, temporal, and categorical distribution of samples[30] (Table 3-3). Due to this unbalanced sampling design, NYFO evaluated each of the three categories of metrics separately, and conducted a weight-of-evidence final evaluation of results to identify candidate wetlands for restoration and preservation (Figure 3-8).

The separate evaluations of habitat structural quality, water quality, and animal communities each consisted of the same four steps:

1. Assess wetland quality at stations distributed across the project area;
2. Take the average of quality metrics across stations within each waterbody;
3. Identify the metrics (and, where applicable, component indicators) that consistently drive down quality scores; and
4. Rank the quality of wetlands among the waterbodies, for each category of metrics (structural habitat, water quality, animal communities).

The fifth step was a weight-of-evidence synthesis to identify waterbodies ranking consistently low across analysis categories.

RESULTS

Structural Habitat

Both metrics and waterbodies were ranked. Metrics were ranked to identify which wetland structural factors were most deteriorated across the project area, in order to focus restoration methods. Waterbodies were ranked to identify which wetlands were most deteriorated structurally, in order to focus restoration locations.

Five RAM metrics were among the lowest ranked in at least three of the four observation sets (Table 3-4):

- Stress to the Buffer Zone,
- Topographic Complexity,
- Patch Mosaic Complexity,
- Vertical Complexity, and
- Plant Community Complexity.

All four of the twelve RAM metrics that explicitly measure habitat complexity were among the lowest ranked metrics. Habitat complexity is related to local diversity of wetland functions and services (as habitat), which in turn is related to the diversity of plant and animal wetland species that may inhabit the area. The implication is that deteriorated habitat complexity results in reduced biotic diversity and richness, and that improvement in these complexity factors would improve richness and diversity of inhabiting species.

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[30] The unbalanced sampling design resulted from the way the project evolved as affected by sampling protocol limitations, staffing, technical input from REAOC RAC advisors and the RAC coordinator, and strict budgetary and time constraints.

NYFO recommends that restorations in the vicinity of the REAOC should use methods that alleviate the degradation of at least some of the five wetland structural factors identified above.

In general, wetland structural habitat in lotic systems within the project area is more degraded than in the lentic systems (Table 3-5). Waterbodies that ranked either lowest or borderline in at least three of the four analysis categories are as follows:

- Lotic systems:
  - Braddock Bay tributaries
  - Genesee River
  - Irondequoit Creek
- Lentic systems
  - Buck Pond
  - Long Pond
  - Irondequoit Bay

NYFO recommends that structural habitat restoration efforts within the project area focus on wetlands within these waterbodies.

Waterbodies with wetlands that were consistently ranked among the least degraded were Cranberry Pond and Round Pond, which are the principal candidates for land protection among the project waterbodies.

Water Quality

Among the seven parameters used in the ranking process, excursions from aquatic life-related screening values were most frequently observed for TP, ammonia, and DO (Table 3-6). The TP screening values were exceeded in every lentic and lotic waterbody evaluated, and exceeded the threshold for hypereutrophic conditions in three of the seven lentic systems in which NYFO measured phosphorus. Low DO was observed in nearly all of the lotic systems in the fall of 2012, and most of the lentic systems in the spring of 2013. Nitrite and pH appeared to be the least troublesome among the parameters evaluated (Table 3-6).

Waterbodies were also ranked for relative wetland habitat quality based on water quality. The total number of excursions from water quality screening values varied between one and five among the waterbodies; all of the waterbodies had at least one excursion (Table 3-6). The following waterbodies had the most degraded overall water quality (4 or 5 excursions):

- Lotic systems:
  - Genesee River
  - West Creek
  - Irondequoit Creek
- Lentic systems:
  - Long Pond
  - Buck Pond
  - Round Pond
  - (Bogus Point Pond)

These results are based on one to three water quality samplings (at most, one grab sample and two YSI measurements) at 95 sampling stations distributed throughout the project area. They represent a snapshot of conditions sufficient to rank relative condition across the waterbodies at the time of sampling, but insufficient to recommend specific remediation actions. With the exception of excursions from ―at-no-time" screening criteria such as NYSDEC DO standards, results of NYFO's water quality sampling are generally insufficiently robust to stand alone. However, they are useful as a wetland habitat ranking tool when interpreted in combination with habitat structure and animal community results. They also contribute to the database of available water quality information (which now includes the water quality trend analyses provided in Chapter 2) that can be used to prioritize water quality improvement/protection actions in the watersheds of these waterbodies.

Animal Communities

There was a reasonably wide range of metric values in all four animal community observation sets for differentiating relative wetland quality between waterbodies (Table 3-7).

Waterbody-specific averages of bird and amphibian metric ranks ranged from 1 to 12. Waterbodies with average ranks in the lower half of that range (≤6) were identified as having the most degraded wetlands in terms of animal communities (Table 3-8):

- Birds
  - Lotic systems:
    - Irondequoit Creek
    - Buttonwood Creek
  - Lentic systems:
    - Braddock Bay
    - Irondequoit Bay
    - (Bogus Point Pond and Rose Marsh)[31]
- Amphibians
  - Lotic systems
    - Irondequoit Creek
    - Genesee River
  - Lentic systems
    - Braddock Bay
    - Long Pond
    - Irondequoit Bay
    - (Bogus Point Pond)

Waterbodies with wetlands that were consistently ranked high in terms of animal communities were Cranberry Pond, Round Pond, and Buck Pond. Bird communities were also - ranked high in Salmon Creek and West Creek, but amphibian communities were not evaluated in these waterbodies due to logistical and safety considerations.

[31] Rose Marsh and Bogus Point Pond were excluded from the restoration prioritization due to wetland size and logistical considerations.

Weight-of-Evidence

The ranking results are interpreted across assessment categories: habitat structure, water quality, bird communities, and amphibian communities. There was remarkable similarity among assessment categories in the specific waterbodies ranked as most degraded (Table 3-9).

Cranberry Pond, the only waterbody that was not identified among the lowest ranking waterbodies in any assessment category, is the best candidate for protection within the project area.

<u>SUMMARY</u>

Wetlands were ranked for restoration and preservation prioritization using metrics of structural habitat condition and stress, water quality, and/or animal communities derived from data NYFO collected in 2012 and 2013 at a total of 112 sampling stations distributed across the project area. Standardized field methods were selected that are designed for extensive sampling across large areas, are rapidly implemented, and are readily repeatable. Structural habitat quality was assessed using the USEPA's USA Rapid Assessment Method, which has been utilized in the National Wetland Condition Assessment. Water quality parameters were measured consistent with a 2011 QA/QC protocol of the analytical lab. Bird and amphibian communities were characterized using Bird Studies Canada's Marsh Monitoring Program protocol, which is widely used across the Great Lakes at Areas of Concern, including many years at the REAOC.

Both metrics and waterbodies were ranked. Low-ranking metrics provide guidance for restoration methods by identifying which wetland attributes scored lowest. For example, a low score for patch mosaic complexity indicates that increasing the interspersion of habitat types would be an appropriate type of restoration. Ranking the waterbodies identified where restoration and protection are most needed. Waterbodies with wetlands that ranked among the lowest scorers across quality assessment categories were Braddock Bay tributaries, Long Pond, Genesee River, Irondequoit Bay, and Irondequoit Creek. Braddock Bay and Buck Pond were also ranked low in multiple categories. Wetlands in these waterbodies are principal candidates for restoration. Cranberry Pond was the only waterbody that was not ranked among the lowest scorers in any of the assessment categories; it is the principal candidate for wetland preservation/protection.

Consistently low-ranked structural habitat metrics were patch mosaic complexity, stress to the buffer zone, topographic complexity, vertical complexity, and plant community complexity. This set of low-scoring habitat metrics indicates a degradation of overall habitat complexity, which translates into limited edge habitat and limited capacity for plant and animal species richness and diversity. This is borne out in the trend analysis of animal community metrics, which identified declining trends in bird diversity and bird IBI scores across waterbodies, wherever significant changes were detected. Activities for restoring structural habitat should focus on improving habitat complexity.

Mean values of total phosphorus, ammonia, and DO consistently showed excursions from screening values across waterbodies tested, while pH and nitrite were generally non-problematic. These data are insufficient by themselves to warrant water quality restoration measures, but contribute to the body of water quality data for the project area.

Table 3-1. USA Rapid Assessment Method (RAM) Metrics; descriptions of the 12 metrics are either direct quotes or paraphrased sections from the RAM manual (USEPA 2011).

Metric	Description
1. Percent of Assessment Area having a Buffer	Percent of the assessment area (AA) perimeter that adjoins a general type of buffer land cover, including: open water; wetlands; natural non-vegetated land surfaces; natural, non-impacted vegetated lands; trails. Non-buffer lands include: built structures; artificial, non-vegetated land surfaces; active mining areas; any active agriculture lands; recently burned lands; urban and recreational lawns and playing fields; roadways dangerous to wildlife; railroads; ATV trails. Land cover classes were obtained from the Anderson Land Cover Class system (Anderson et al. 1976). The estimated percent of AA perimeter with a buffer is the basis for scoring this metric.
2. Buffer Width	Mean distance from AA perimeter to the first intersection with non-buffer land, up to 100m maximum distance from AA. Distance is estimated along the four cardinal directions and four ordinal directions (a total of eight measurements), and the average is the basis of scoring this metric.
3. Stress to the Buffer Zone	Field indicators of hydrological, habitat/vegetation, urban/suburban/commercial, and agricultural stress are evaluated and the metric is scored based on presence/absence and relative severity of each indicator.
4. Topographic Complexity	The presence of any of 20 field indicators is positively related to final score. Indicators include berms, swales, natural channels, potholes, and other features that contribute to topographic relief.
5. Patch Mosaic Complexity	This metric is assessed based on visual comparisons between the AA and schematic diagrams of the full range of possible patch mosaic complexity provided on the field data sheets and in the manual.
6. Vertical Complexity	This metric addresses the vertical structure of the plant community in terms of its component number of plant strata. Different strata provide different physical and ecological services. Seven strata are defined: submerged plants, floating aquatic plants, tall emergents, short emergents, short woody, tall woody, and vines. Animal species tend to partition themselves vertically among wetland and riparian plant strata. The basic assumption is that more strata translates into more kinds of habitat and broader ranges in habitat condition.
7. Plant Community Complexity	This metric addresses the diversity of plant species that dominate the plant strata. Within a wetland class, the diversity and levels of ecological function of a wetland are expected to increase with the number and abundance of different plant species. The basic assumption is that greater diversity of co-dominant species translates into more kinds and higher levels of wetland functions.
8. Stress to Water Quality	Field indicators of stress to water quality related to point sources, sedimentation/pollutants, eutrophication, mining, and salinity are evaluated and the metric is scored based on presence/absence and relative severity of each of 13 indicators.
9. Alterations to Hydroperiod	Field indicators of stress to hydroperiod are evaluated within the AA and the metric is scored based on presence/absence and relative severity of each of 11 indicators.

Metric	Description
10. Habitat/Substrate Alterations	Field indicators of stress to substrate are evaluated within the AA and the metric is scored based on presence/absence and relative severity of each of 12 indicators. There is a range of anthropogenic events and activities that alter wetland habitats by disturbing their substrates, including grading, mining, off-road vehicle use, and vegetation control. Some urban wetlands are severely impacted by dumping of yard debris and other trash. Substrate alterations can cause changes in drainage and soil productivity that subsequently alter wetland plant communities.
11. Percent Cover of Invasive Species	This metric is assessed based on field observations of the percent cover of co-dominant invasive species (covering ≥10% of stratum) in each of the plant strata within the AA, for strata covering ≥10% of AA. Plant community composition provides clear and robust signals of human disturbance. Predictable changes in community structure, productivity, and other ecosystem properties are observed as anthropogenic disturbance increases.
12. Vegetation Disturbance	Field indicators of on-going disturbance to vegetation communities are evaluated within the AA with respect to and the metric is scored based on presence/absence and relative severity of each of 14 indicators. Indicators include mowing, clear cut, herbicide application, grazing, fire, and other disturbances. As vegetation communities shift in response to stress, important wetland services, such as biodiversity support and water quality improvement, may be affected.

Table 3-2. Threshold screening values used for ranking relative water quality across waterbodies in the project area.

WQ Parameter	Upper Threshold, Criterion, or Normal Range			Reference	Notes
	Lotic (Trout Stream/River)	Lotic (non-Trout Stream/River)	Lentic (Ponds, Bays)		
Total Phosphorus	15 ug/L	15 ug/L	15 ug/L	USEPA 2014	REAOC BUI Delisting Criteria – Eutrophication or Undesirable Algae
Total Phosphorus			30 ug/L	Wetzel 2001	Lentic systems only – mesotrophic/eutrophic threshold
Total Phosphorus			100 ug/L	Wetzel 2001	Lentic systems only – eutrophic/hypereutrophic threshold
Total Phosphorus			11.25 ug/L	USEPA 2000	Lentic systems - ―reference value”
Total Phosphorus	24.1 ug/L	24.1 ug/L		USEPA 2000	Lotic systems - ―reference value”
Total Phosphorus			20 ug/L	NYSDEC 1998	Lentic systems and Class B waters, only – NYS Guidance Value for Recreation/Aesthetics – applies only to ponds, lakes, and reservoirs
Total Suspended Solids	200 mg/L	200 mg/L	200 mg/L	USEPA 2014	REAOC BUI Delisting Criteria – Loss of Fish and Wildlife Habitat. [TSS should not exceed 200 mg/L more than 5 times per year]
Total Suspended Solids	30 mg/L	30 mg/L	30 mg/L	USEPA 2014	REAOC BUI Delisting Criteria – Loss of Fish and Wildlife Habitat. [TSS should not exceed 30 mg/L during 80% of the year]
Total Dissolved Solids	500 mg/L	500 mg/L	500 mg/L	NYSDEDC 1999	http://www.dec.ny.gov/regs/4590.html
pH	6.5-8.5	6.5-8.5	6.5-8.5	NYSDEDC 1999	http://www.dec.ny.gov/regs/4590.html
Dissolved Oxygen	(TS) ≥7.0 mg/L (T) ≥5.0 mg/L	≥4.0 mg/L	≥4.0 mg/L	NYSDEDC 1999	http://www.dec.ny.gov/regs/4590.html
Nitrite	20 ug/L	100 ug/L	100 ug/L	NYSDEC 1998	For lotic systems used ―cold-water” values; for lentic systems used ―warm-water” values
Ammonia	Site-specific	Site-specific	Site-specific	NYSDEC 1998	Temperature and pH specific. For lotic systems, used trout water values; for lentic systems used non-trout water values.

Table 3-3. Summary of overall field approach for ranking current wetland habitat quality among project area waterbodies. Sample size is the number of samples distributed among waterbodies. Due to issues related to sample scheduling and logistics, sampling of the three categories of assessment metrics was unevenly distributed across the 98 stations, resulting in an unbalanced statistical design.

Assessment Category	Wetland Factor	Field Method	Metric(s)	Schedule	Sample Size (N sampling stations)
1. Structural Habitat	*Vegetation (structure, invasive spp.)*	*EPA Rapid Assessment Method (RAM) (visual)*	*Vertical Complexity Plant Community Complexity % Cover Invasive Plant Spp Vegetation Disturbance*	*Fall 2012; Spring 2013 (~50% overlap)*	*Fall: 53 Spring: 51 Spatial Overlap: 26 Total Stations: 79*
	Substrate	*EPA RAM*	*Habitat/Substrate Alterations*	*ditto*	*ditto*
	Hydrology	*EPA RAM*	*Alterations to Hydroperiod*	*ditto*	*ditto*
	Physical/Chemical Stressors	*EPA RAM*	*Stress to Buffer Zone Stressors to Water Quality*	*ditto*	*ditto*
	Physical Structure	*EPA RAM*	*% Assessment Area with Buffer Mean Buffer Width Topographic Complexity Patch Mosaic Complexity*	*ditto*	*ditto*
2. Water Quality	*Nutrients, Turbidity*	*Grab*	*TP, ortho-P, TKN, NO_3, NO_4, Ammonia, TSS*	*Fall 2012*	*68*
	Classic WQ Parameters	*YSI*	*Temp, DO, pH, Sp Cond, ORP*	*Fall 2012 Spring 2013*	*Fall: 66 Spring: 43*
3. Animal Community	*Bird and Anuran Amphibian Community Structure*	*Marsh Monitoring Program Protocol*	*Species Richness, Species Diversity, & Index of Biotic Integrity*	*Spring 2013*	*Bird/Anuran: 30 Bird only: 6*

Table 3-4. Metric values were summed across sample sites within each of four observation sets. Lowest scoring metrics in each observation set are identified with red highlighting. Five metrics, identified in bold italics, were consistently low-ranking across observation sets.

LENTIC SYSTEMS — FALL 2012

Metric	Sum of Scores (N=42)	Fall 2012 Metric Rank
Patch Mosaic	195	1
Stress in the Buffer Zone	252	2
Topographic Complexity	270	3.5
Plant Community Complexity	270	3.5
Vertical Complexity	306	5
Invasive Species Cover	429	6
Altered Substrate	444	7
Water Quality Stress	453	8
Buffer Width	456	9
Altered Hydroperiod	459	10
Vegetation Disturbance	480	11
Percent of AA Having Buffer	489	12

LOTIC SYSTEMS — FALL 2012

Metric	Sum of Scores (N=11)	Fall 2012 Metric Rank
Stress in the Buffer Zone	42	1
Patch Mosaic	51	2
Plant Community Complexity	75	3
Topographic Complexity	84	4.5
Vertical Complexity	84	4.5
Altered Substrate	87	6
Water Quality Stress	102	7
Altered Hydroperiod	105	8
Species Cover	105	9
Vegetation Disturbance	108	10
Buffer Width	120	11
Percent of AA Having Buffer	132	12

LENTIC SYSTEMS — SPRING 2013

Metric	Sum of Scores (N=40)	Spring 2013 Metric Rank
Patch Mosaic	186	1
Topographic Complexity	195	2
Stress in the Buffer Zone	243	3
Invasive Species Cover	300	4.5
Vertical Complexity	300	4.5
Plant Community Complexity	303	6
Water Quality Stress	378	7
Altered Hydroperiod	396	8
Altered Substrate	441	9
Buffer Width	447	10
Percent of AA Having Buffer	462	11
Vegetation Disturbance	465	12

LOTIC SYSTEMS — SPRING 2013

Metric	Sum of Scores (N=12)	Spring 2013 Metric Rank
Stress in the Buffer Zone	57	1
Patch Mosaic	63	2
Topographic Complexity	69	3
Plant Community Complexity	75	4
Invasive Species Cover	84	5
Vertical Complexity	87	6
Water Quality Stress	96	7
Altered Substrate	120	8
Altered Hydroperiod	123	9
Vegetation Disturbance	135	10.5
Buffer Width	135	10.5
Percent of AA Having Buffer	144	12

Table 3-5. Ranking of waterbodies using overall mean RAM scores and the mean of the five negative driver metrics. Lowest scoring waterbodies are identified with red italics (overall mean score < 100; mean driver metrics < 6); borderline waterbodies are identified with shading (100 < overall mean score < 105; 6 < mean driver metrics < 6.5); and the highest scoring waterbodies are unformatted.

Ranking By Overall Mean Score

YEAR	Waterbody	Type	Number of Stations	Sum of Mean Metric Scores	Topographic Complexity	Altered Hydroperiod	Altered Substrate	Water Quality Stress	Vegetation Disturbance	Invasive Species Cover	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	% AA with Buffer	Buffer Width	Patch Mosaic
Fall 2012	***Genesee River***	***Lotic***	4	***93.0***	9.0	9.0	3.8	6.8	9.8	9.8	7.5	6.8	3.8	12.0	11.3	3.8
	Northrup Creek	***Lotic***	1	***99.0***	3.0	12.0	12.0	12.0	9.0	9.0	9.0	6.0	3.0	12.0	6.0	6.0
	Irondequoit Bay	**Lentic**	8	**102.4**	7.9	10.5	10.9	9.4	10.9	9.0	7.1	6.0	4.9	10.9	10.1	4.9
	Long Pond	**Lentic**	6	**102.5**	8.0	10.5	8.0	9.5	10.5	10.0	8.5	7.5	4.0	12.0	10.0	4.0
	Braddock Bay Tribs	**Lotic**	3	**104.0**	6.0	11.0	12.0	10.0	12.0	9.0	7.0	6.0	3.0	12.0	12.0	4.0
	Buck Pond	**Lentic**	7	**104.6**	6.0	10.7	10.3	11.1	12.0	10.3	6.4	6.0	4.7	12.0	11.1	3.9
	Cranberry Pond	Lentic	9	108.7	5.0	11.3	11.7	11.3	11.3	11.0	7.0	6.3	7.3	11.3	10.3	4.7
	Round Pond	Lentic	6	110.9	6.0	10.4	10.1	12.0	12.0	10.1	6.8	6.1	6.1	12.0	12.0	6.8
	Irondequoit Creek	Lotic	1	114.0	6.0	12.0	12.0	12.0	12.0	12.0	6.0	6.0	9.0	12.0	12.0	3.0
	Larkin Creek	Lotic	1	114.0	12.0	9.0	9.0	12.0	9.0	9.0	9.0	9.0	3.0	12.0	12.0	9.0
	Braddock Bay	Lentic	5	115.2	5.4	12.0	12.0	11.4	12.0	10.8	8.4	6.6	9.0	12.0	12.0	3.6
Spring 2013	***Genesee River***	***Lotic***	4	***93.8***	6.0	9.0	7.5	8.3	12.0	7.5	6.8	7.5	3.0	12.0	10.5	3.8
	Irondequoit Creek	***Lotic***	1	***96.0***	6.0	6.0	9.0	9.0	12.0	6.0	9.0	6.0	3.0	12.0	12.0	6.0
	Long Pond	**Lentic**	5	**100.8**	6.0	7.8	10.8	9.6	12.0	6.6	8.4	8.4	4.2	12.0	10.8	4.2
	Irondequoit Bay	**Lentic**	3	**101.0**	5.0	10.0	11.0	9.0	12.0	7.0	7.0	6.0	4.0	12.0	10.0	8.0
	Braddock Bay Tribs	**Lotic**	7	**102.4**	4.7	12.0	11.6	6.9	10.7	8.1	6.9	6.4	5.6	12.0	11.6	6.0
	Buck Pond	**Lentic**	10	**103.2**	4.7	10.7	11.2	8.8	11.5	8.0	7.3	6.8	6.0	11.8	11.6	4.8
	Braddock Bay	Lentic	9	107.0	5.0	11.0	11.0	9.3	12.0	9.0	8.0	7.0	6.7	12.0	12.0	4.0
	Cranberry Pond	Lentic	5	112.8	6.0	12.0	12.0	10.2	12.0	6.6	8.4	8.4	9.6	12.0	12.0	3.6
	Round Pond	Lentic	3	114.0	4.0	11.0	12.0	12.0	12.0	9.0	8.0	9.0	7.0	12.0	12.0	6.0

Ranking by Mean of Negative Driver Metrics

Waterbody	Type	Number of Stations	Mean of Driver Metrics	Topographic Complexity	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	Patch Mosaic
Braddock Bay Tribs	***Lotic***	3	***5.20***	6.0	7.0	6.0	3.0	4.0
Northrup Creek	***Lotic***	1	***5.40***	3.0	9.0	6.0	3.0	6.0
Buck Pond	***Lentic***	7	***5.40***	6.0	6.4	6.0	4.7	3.9
Irondequoit Creek	**Lotic**	1	**6.00**	6.0	6.0	6.0	9.0	3.0
Cranberry Pond	**Lentic**	9	**6.07**	5.0	7.0	6.3	7.3	4.7
Genesee River	**Lotic**	4	**6.15**	9.0	7.5	6.8	3.8	3.8
Irondequoit Bay	**Lentic**	8	**6.15**	7.9	7.1	6.0	4.9	4.9
Round Pond	**Lentic**	6	**6.35**	6.0	6.8	6.1	6.1	6.8
Long Pond	**Lentic**	6	**6.40**	8.0	8.5	7.5	4.0	4.0
Braddock Bay	Lentic	5	6.60	5.4	8.4	6.6	9.0	3.6
Larkin Creek	Lotic	1	8.40	12.0	9.0	9.0	3.0	9.0
Genesee River	***Lotic***	4	***5.40***	6.0	6.8	7.5	3.0	3.8
Braddock Bay Tribs	***Lotic***	7	***5.91***	4.7	6.9	6.4	5.6	6.0
Buck Pond	***Lentic***	10	***5.92***	4.7	7.3	6.8	6.0	4.8
Irondequoit Creek	**Lotic**	1	**6.00**	6.0	9.0	6.0	3.0	6.0
Irondequoit Bay	**Lentic**	3	**6.00**	5.0	7.0	6.0	4.0	8.0
Braddock Bay	**Lentic**	9	**6.13**	5.0	8.0	7.0	6.7	4.0
Long Pond	**Lentic**	5	**6.24**	6.0	8.4	8.4	4.2	4.2
Round Pond	Lentic	3	6.80	4.0	8.0	9.0	7.0	6.0
Cranberry Pond	Lentic	5	7.20	6.0	8.4	8.4	9.6	3.6

Table 3-6. Ranking water quality across waterbodies based on the total number of excursions of average parameter values from threshold screening levels, for water quality parameters for which a standard/criterion/guidance value relevant to aquatic life was located. Waterbodies with high numbers of excursions are shaded. Within the data columns, yellow shading indicates an excursion and brown shading identifies values that exceed the higher of two available threshold screening values.

Waterbody	Waterbody Class	Total Excursions	Water Grab Parameters (Fall 2012)				YSI Parameters				
							Fall 2012			Spring 2013	
			Ammonia (mg/L)	Nitrite (mg/L)	TP (mg/L)	TSS[1] (mg/L)	TDS (ug/L)	DO (mg/L)	pH	TDS (ug/L)	DO (mg/L)
Lake Ontario nearshore	A	3	0.04 (10)	0.01 (10)	0.046 (10)	33.32 (10)	221 (10)	13.7 (10)	7.88 (10)	na	na
LENTIC											
Braddock Bay	B	2	0.13 (6)	0.01 (6)	0.127 (6)	32.2 (6)	279 (6)	8.77 (6)	na	301 (5)	8.91 (5)
Bogus Pond	B	4	2.46 (1)	0.01 (1)	0.734 (1)	89 (1)	340 (1)	4.4 (1)	6.8 (1)	322 (2)	1.71 (2)
Rose Marsh	B	2	na	na	na	na	na	na	na	566 (2)	0.027 (2)
Cranberry Pond	B	2	0.04 (4)	0.01 (4)	0.083 (4)	22.78 (4)	406 (5)	5.22 (5)	8.11 (5)	389 (5)	2.23 (5)
Long Pond	B	5	0.17 (5)	0.01 (5)	0.169 (5)	153.7 (5)	321 (4)	4.73 (4)	8.43 (4)	559 (4)	3.88 (4)
Buck Pond	B	4	0.02 (5)	0.01 (5)	0.081 (5)	40.88 (5)	427 (5)	2.98 (5)	8.27 (5)	428 (10)	3.33 (10)
Round Pond	C	4	0.08 (2)	0.01 (2)	0.032 (2)	7.65 (2)	449 (3)	1.73 (3)	7.81 (3)	403 (1)	0.22 (1)
Irondequoit Bay	B	3	0.07 (10)	0.01 (10)	0.051 (10)	9.76 (10)	625 (9)	6.64 (9)	8.26 (4)	581 (3)	4.07 (3)
Total Lentic Excursions		26	3	0	7	4	1	2	0	3	6
LOTIC											
Genesee River	B	4	0.07 (8)	0.04 (8)	0.05 (8)	13.31 (8)	422 (8)	4.45 (8)	8.12 (8)	390 (2)	6.92 (2)
Salmon Creek	B	1	0.02 (4)	0.01 (4)	0.101 (4)	18.7 (4)	379 (4)	7.16 (4)	7.98 (2)	321 (4)	6.17 (4)
West Creek	B	4	0.11 (2)	0.01 (2)	1.18 (2)	631 (2)	288 (2)	4.85 (2)	7.9 (1)	302.3 (2)	6.66 (2)
Buttonwood Creek	B	3	0.04 (1)	0.01 (1)	0.341 (1)	179 (1)	416 (1)	8.02 (1)	na	897 (1)	8.79 (1)
Northrup Creek	B	3	0.1 (2)	0.01 (2)	0.068 (2)	7.05 (2)	345 (1)	3.86 (1)	7.51 (1)	na	na
Round Pond trib	C	2	na	na	na	na	845 (1)	4.85 (1)	7.93 (1)	na	na
Irondequoit Creek	B	5	0.04 (3)	0.01 (3)	0.04 (3)	12.7 (3)	841 (3)	2.43 (2)	8.15 (3)	533 (1)	5.31 (1)
Total Lotic Excursions		22	5	1	7	2	3	5	0	3	0
Range of Values[2] in Individual Samples			0.01 - 2.46	0.01 - 0.11	0.02 - 1.96	1 - 1200	201 - 852	1.51 - 15	6.8 - 9.14	86 - 1021	0.1 - 12
Lentic Screening Value			variable; based on pH and Temp.	>0.1	>0.03; 0.1	>30; 200	>500	<4	6.5-8.5	>500	<4
Lotic Screening Value			variable; based on pH and Temp.	>0.02	>0.024	>30; 200	>500	<5	6.5-8.5	>500	<5
Screening Value Source			NYSDEC 1998	NYSDEC 1998	Lentic: trophic state thresholds - Wetzel 2001; Lotic: EPA 2000	USEPA 2014	NYSDEC 1999	NYSDEC 1999	NYSDEC 1999	NYSDEC 1999	NYSDEC 1999

Footnotes:

1 - The "thresholds" used for TSS were not issued by a regulatory agency; they are reported as "of interest" to the RAC because they are values that appear in other BUI criteria

2 - For non-detects, the detection limit value was used.

Table 3-7. Ranges of individual station values and ranges of waterbody mean values for each wetland quality metric derived from 2013 animal community field data at the REAOC, tabulated by observation set.

Community Metric	BIRDS				AMPHIBIANS			
	LENTIC		LOTIC		LENTIC		LOTIC	
	Individual Stations (N=25)	Waterbody Means (N=8)	Individual Stations (N=11)	Waterbody Means (N=5)	Individual Stations (N=25)	Waterbody Means (N=8)	Individual Stations (N=5)	Waterbody Means (N=3)
Species Richness (All)	3 -14	5.3 - 10	6 - 14	7 - 10	0 - 4	1 - 3.7	0 - 4	0.3 - 4
Focal Species Richness	0 - 1	0 - 0.4	0 - 1	0 - 0.5	NA	NA	NA	NA
Species Diversity Index	2.6 - 12.6	4.7 - 9.2	5.3 - 12.5	6 - 9.1	0 - 6.3	0.3 - 4.1	0 - 5.7	1.2 - 4.1
IBI	24.9 - 81.2	31.6 - 58.9	17.1 - 65.8	31.6 - 53.4	0 - 86.7	32.1 - 74.8	0 - 51.2	2.5 - 51.2

Table 3-8. Ranking wetland quality across waterbodies based on animal community metrics. Individually ranked community metrics were averaged (averages range from 1 to 12), forming the basis for an overall rank for each waterbody. Lowest-scoring waterbodies in each of the four observation sets are identified by shading (Average Rank ≤ 6.0).

Birds

	Waterbody	Type	N	Mean Bird Species richness	Mean Bird Focal species richness	Mean Bird Spp Diversity	Mean Bird IBI score	Rank Bird Species richness	Rank Bird Focal species richness	Rank Bird Spp Diversity	Rank Bird IBI score	Average Rank - Bird Indices	Overall Bird Rank
Lentic	Irondequoit Bay	Lentic	3	5.3	0.0	4.7	31.6	1.0	4.5	1.0	1.5	2.0	1
	Rose Marsh	Lentic	1	8.0	0.0	7.1	46.6	6.5	4.5	5.0	6.0	5.5	2
	Bogus Pond	Lentic	1	8.0	0.0	7.1	48.7	6.5	4.5	5.0	7.0	5.8	3
	Braddock Bay	Lentic	5	6.8	0.2	6.2	53.3	2.0	9.0	3.0	10.0	6.0	4
	Long Pond	Lentic	3	9.7	0.0	8.6	38.4	10.0	4.5	10.5	3.0	7.0	5
	Buck Pond	Lentic	7	7.9	0.4	7.1	53.9	4.0	12.0	5.0	12.0	8.3	6
	Round Pond	Lentic	2	10.0	0.0	9.2	46.4	12.0	4.5	13.0	5.0	8.6	7
	Cranberry Pond	Lentic	3	8.0	0.3	7.2	58.9	6.5	10.5	7.0	13.0	9.3	8
Lotic	Irondequoit Creek	Lotic	1	7.0	0.0	6.0	51.5	3.0	4.5	2.0	9.0	4.6	1
	Buttonwood Creek	Lotic	1	8.0	0.0	7.6	45.0	6.5	4.5	8.0	4.0	5.8	2
	Genesee River	Lotic	3	10.0	0.0	8.6	31.6	12.0	4.5	10.5	1.5	7.1	3
	Salmon Creek	Lotic	4	9.3	0.3	8.3	50.8	9.0	10.5	9.0	8.0	9.1	4
	West Creek	Lotic	2	10.0	0.5	9.1	53.4	12.0	13.0	12.0	11.0	12.0	5

Amphibians

Waterbody	Type	N	Mean Amph Species Richness	Mean Amph Spp Diversity	Mean Amph IBI score	Rank Amph Species Richness	Rank Amph Spp Diversity	Rank Amph IBI score	Average Rank - Amph Indices	Overall Amph Rank
Braddock Bay	Lentic	5	1.0	1.2	32.1	2.0	2.0	2.0	2.0	1
Long Pond	Lentic	3	1.7	1.5	32.3	3.5	3.0	3.0	3.2	2
Irondequoit Bay	Lentic	3	1.7	1.7	44.2	3.5	4.0	4.0	3.8	3
Bogus Pond	Lentic	1	2.0	2.7	44.8	6.0	6.5	5.5	6.0	4
Rose Marsh	Lentic	1	2.0	1.9	74.8	6.0	5.0	11.0	7.3	5
Round Pond	Lentic	2	3.0	3.2	46.6	8.5	8.0	7.0	7.8	6
Buck Pond	Lentic	7	3.0	3.8	50.5	8.5	9.0	8.0	8.5	7
Cranberry Pond	Lentic	3	3.7	4.1	68.1	10.0	10.0	10.0	10.0	8
Genesee River	Lotic	3	0.3	0.3	2.5	1.0	1.0	1.0	1.0	1
Irondequoit Creek	Lotic	1	2.0	2.7	44.8	6.0	6.5	5.5	6.0	2
Buttonwood Creek	Lotic	1	4.0	5.7	51.2	11.0	11.0	9.0	10.3	3
Salmon Creek	Lotic									
West Creek	Lotic									

Table 3-9. Summary of lowest ranked waterbodies in each analysis category; the shading highlights consistency across assessment categories within watersheds.

	Structural Habitat EPA RAM	Water Quality YSI/grab	Animal Communities MMP	
			Birds	Herps
Lentic	Long Pond	Long Pond		Long Pond
	Buck Pond	Buck Pond	Braddock Bay	Braddock Bay
	Irondequoit Bay	Round Pond	Irondequoit Bay	Irondequoit Bay
Lotic	Genesee River	Genesee River		Genesee River
	Irondequoit Creek	Irondequoit Creek	Irondequoit Creek	Irondequoit Creek
	Braddock Bay Tributaries	West Creek	Buttonwood Creek	

Figure 3-1. Distribution of 112 points sampled for structural and vegetative habitat, water quality, and/or animal communities in order to rank wetland quality among waterbodies in the immediate vicinity of the REAOC. Points are differentiated by sampling season.

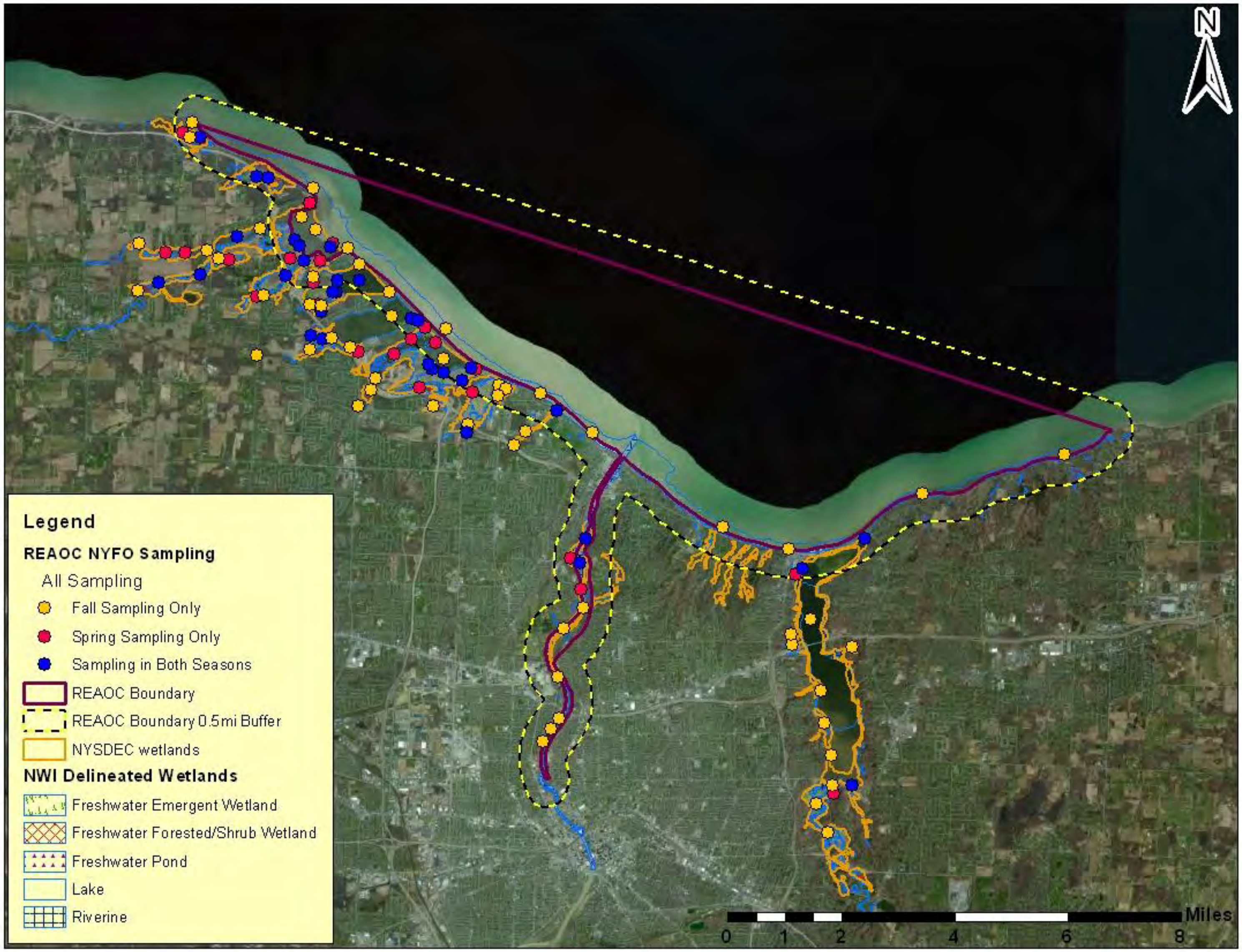


Figure 3-2. Ecosystem elements relevant to wetland habitat quality that were included in the USFWS Wetland Assessment Project at the Rochester Embayment Area of Concern were habitat structure (vegetation, substrate quality, hydrology, physical stressors, and physical structure), water quality, and animal communities.

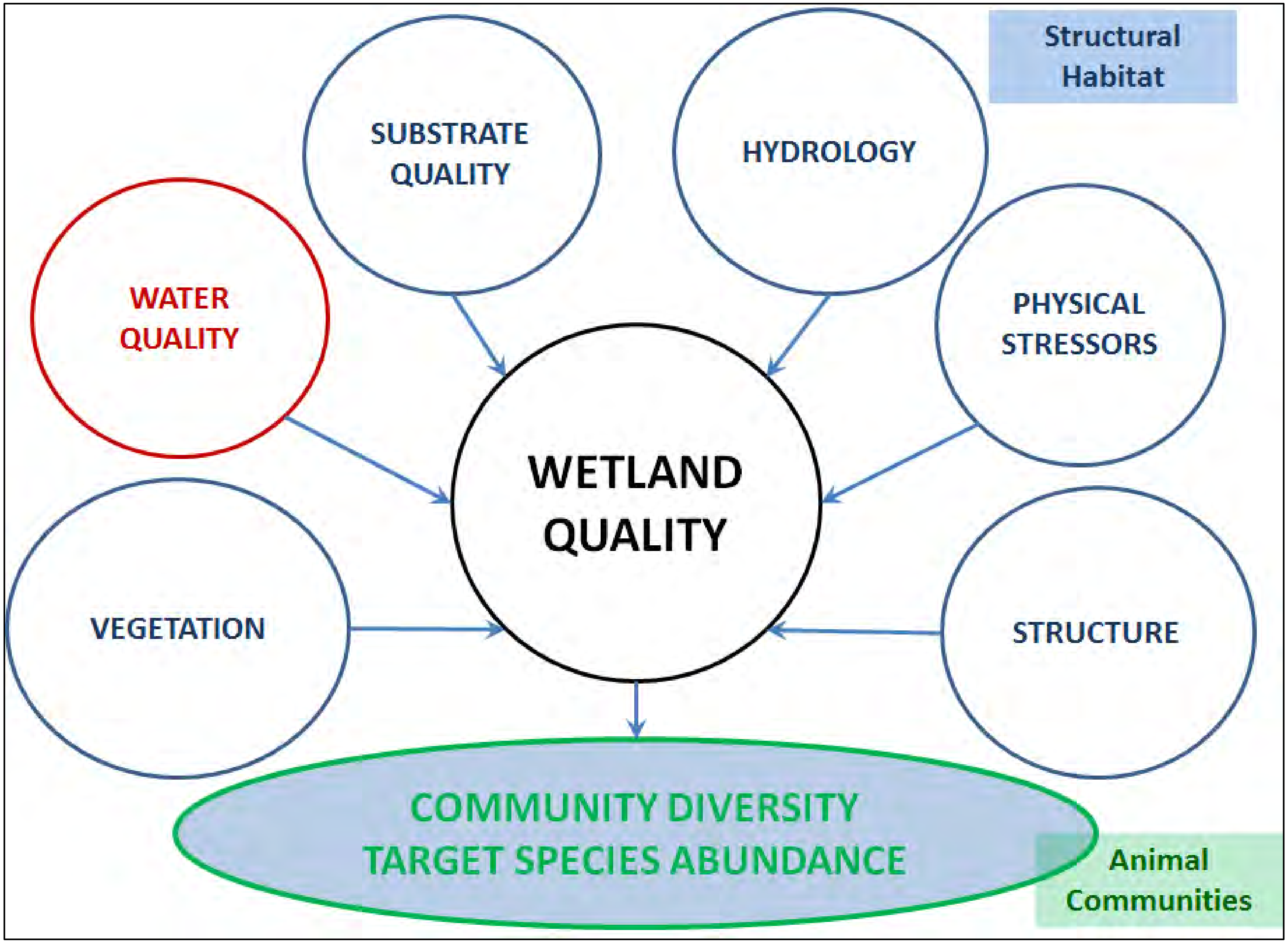


Figure 3-3. Distribution of 79 sampling stations for structural habitat assessment using the USEPA's multi-metric USA Rapid Assessment Method (RAM), distinguished by sampling period (Fall 2012 or Spring 2013).

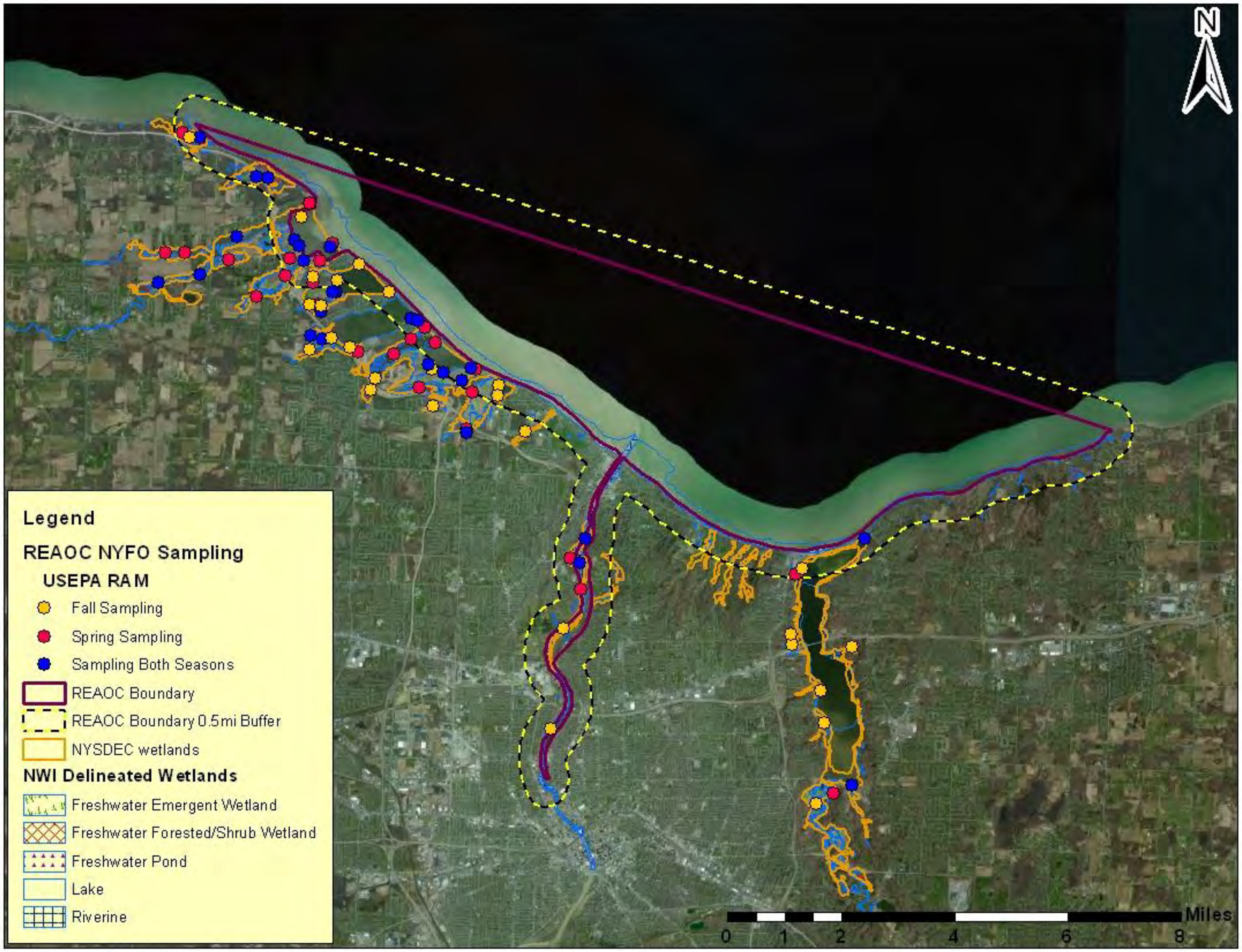


Figure 3-4. Distribution of 99 sampling stations for water quality assessment (68 grab and/or YSI samples in 2012 and 31 additional YSI only samples in 2013), distinguished by sampling method and sampling period.

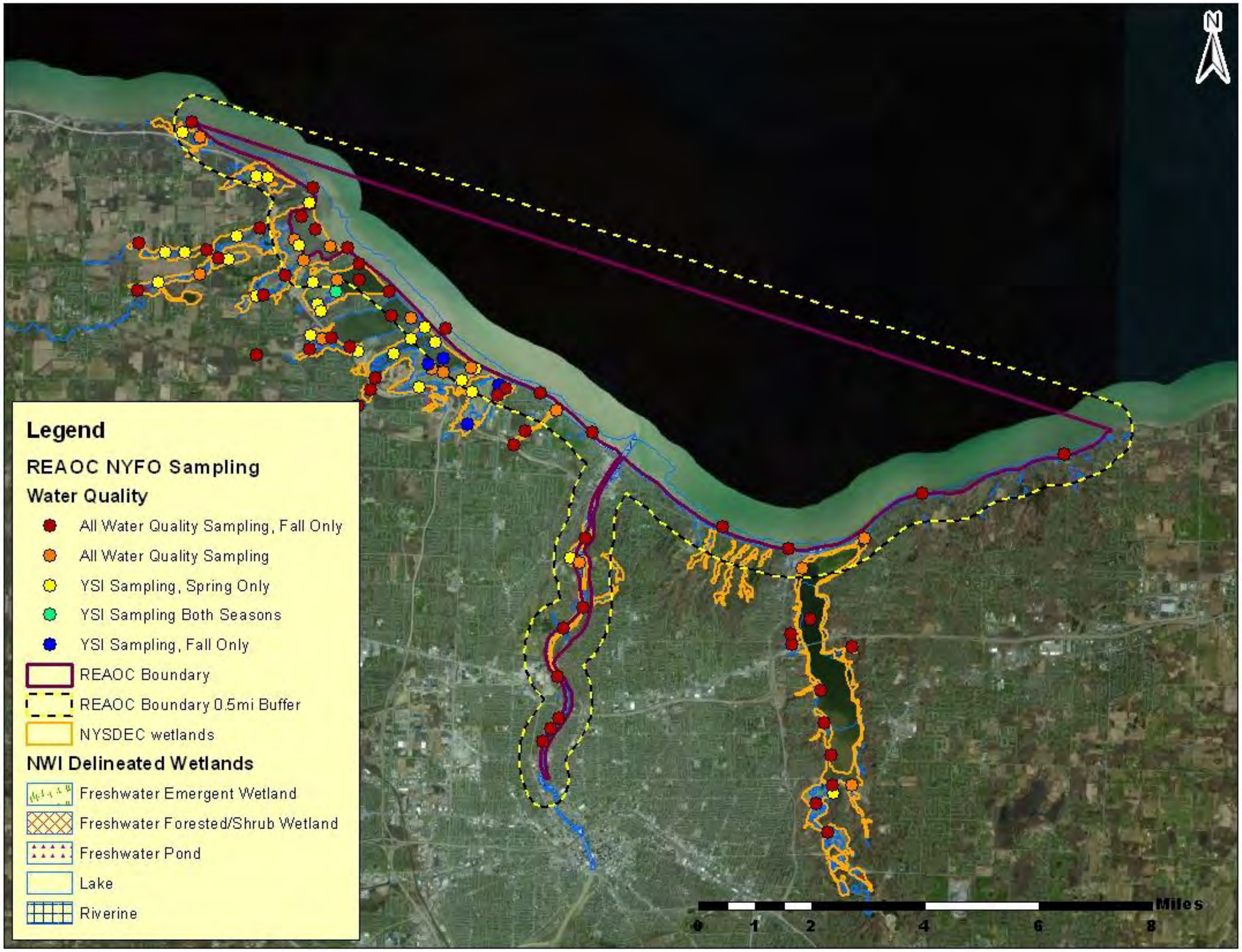


Figure 3-5. Distribution of 36 sampling stations for animal community assessment in the spring of 2013 using the Marsh Monitoring Program protocol, distinguished by taxa sampled.

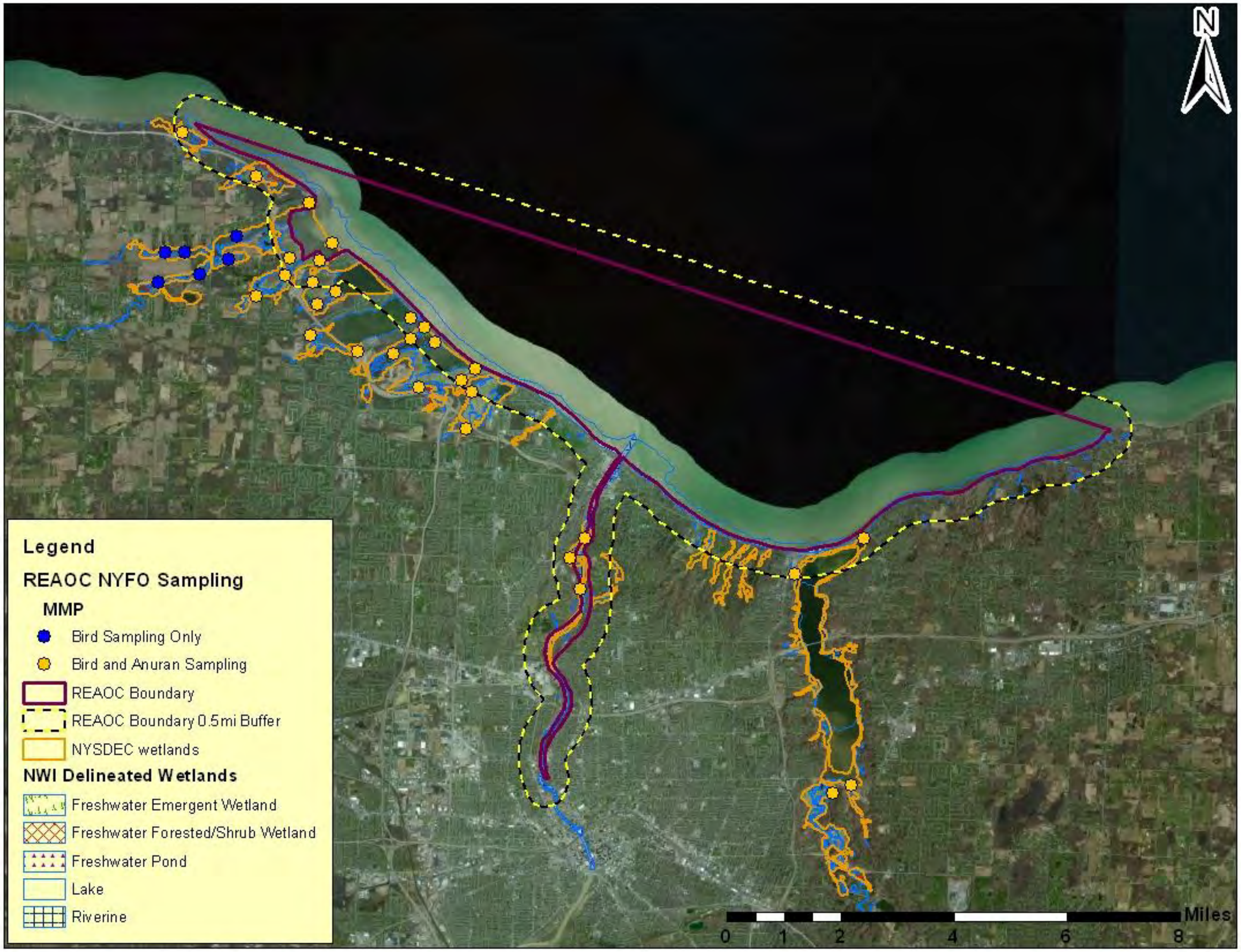


Figure 3-6. Schematic illustration of constructing a multi-metric index score from visual observations of a large number of relevant field indicators.

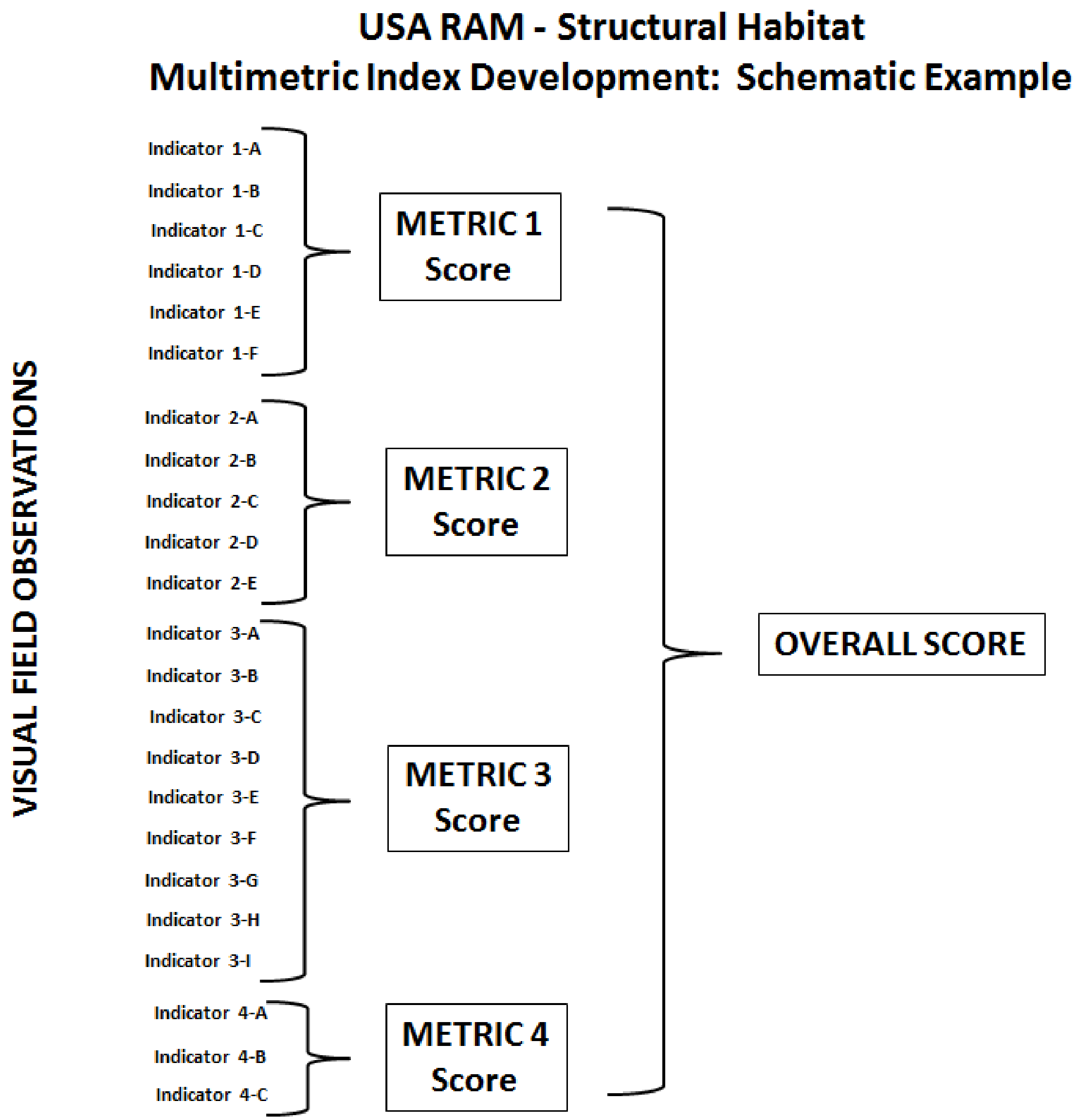
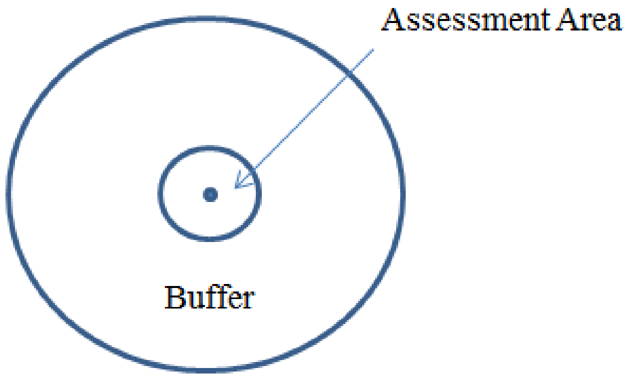
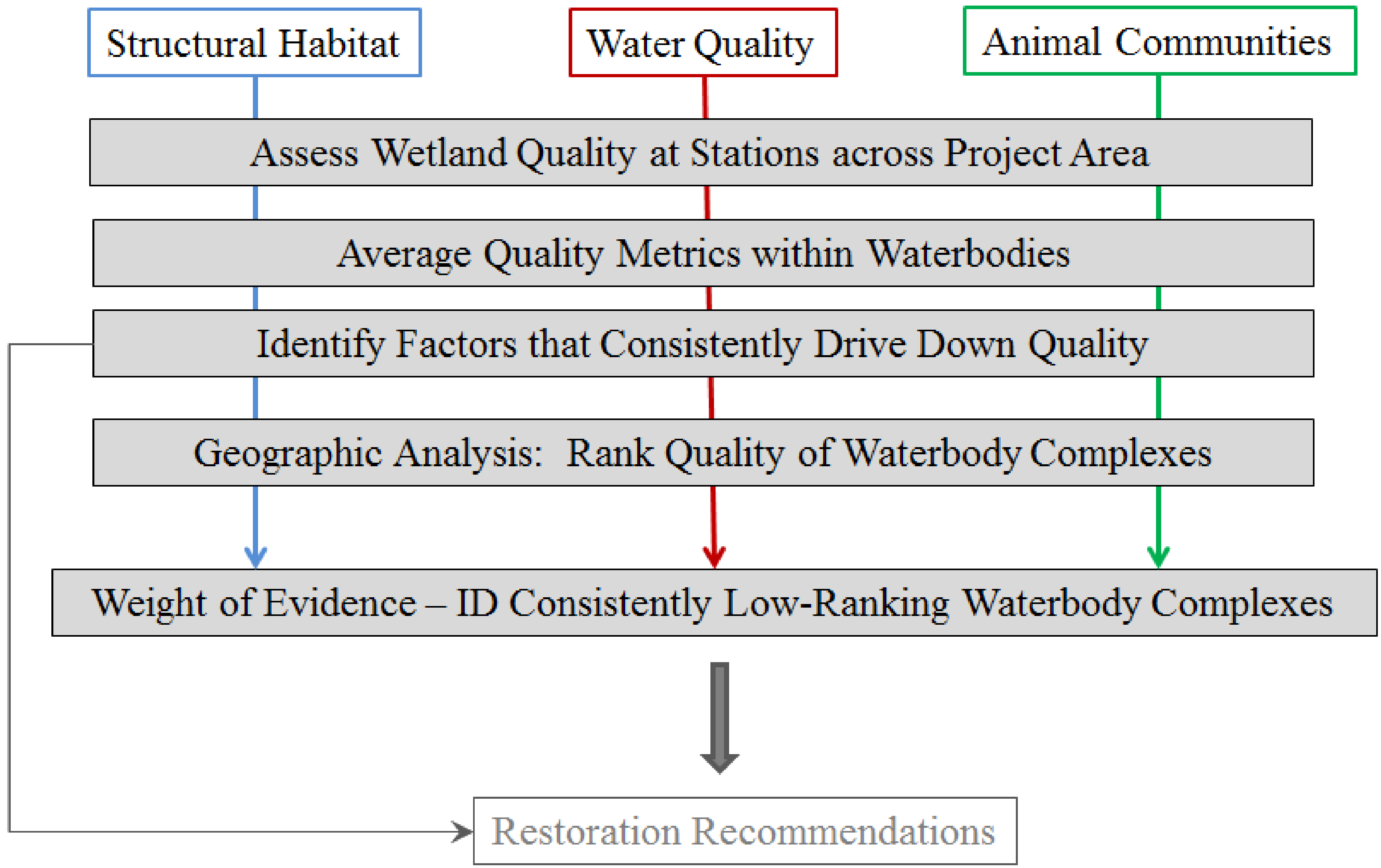


Figure 3-7. Schematic illustration of RAM sampling site and metric categories. Numbers of visual indicators associated with each metric are provided in parentheses, as applicable.



	Assessment Area (40m radius)	Buffer Area (100m radius)
Condition	• Topographic Complexity (20) • Patch Mosaic Complexity • Vertical Complexity • Plant Community Complexity	• % AA having a Buffer • Mean Buffer Width
Stressors	• Stress to Water Quality (13) • Alterations to Hydroperiod (11) • Habitat/Substrate Alterations (12) • % Cover Invasive Plant Species • Vegetation Disturbance (13)	• Stress to the Buffer Zone (57)

Figure 3-8. Summary of the parallel process used to rank current wetland habitat quality using three categories of wetland quality metrics, culminating in a weight-of-evidence analysis to identify candidate waterbodies for restoration.



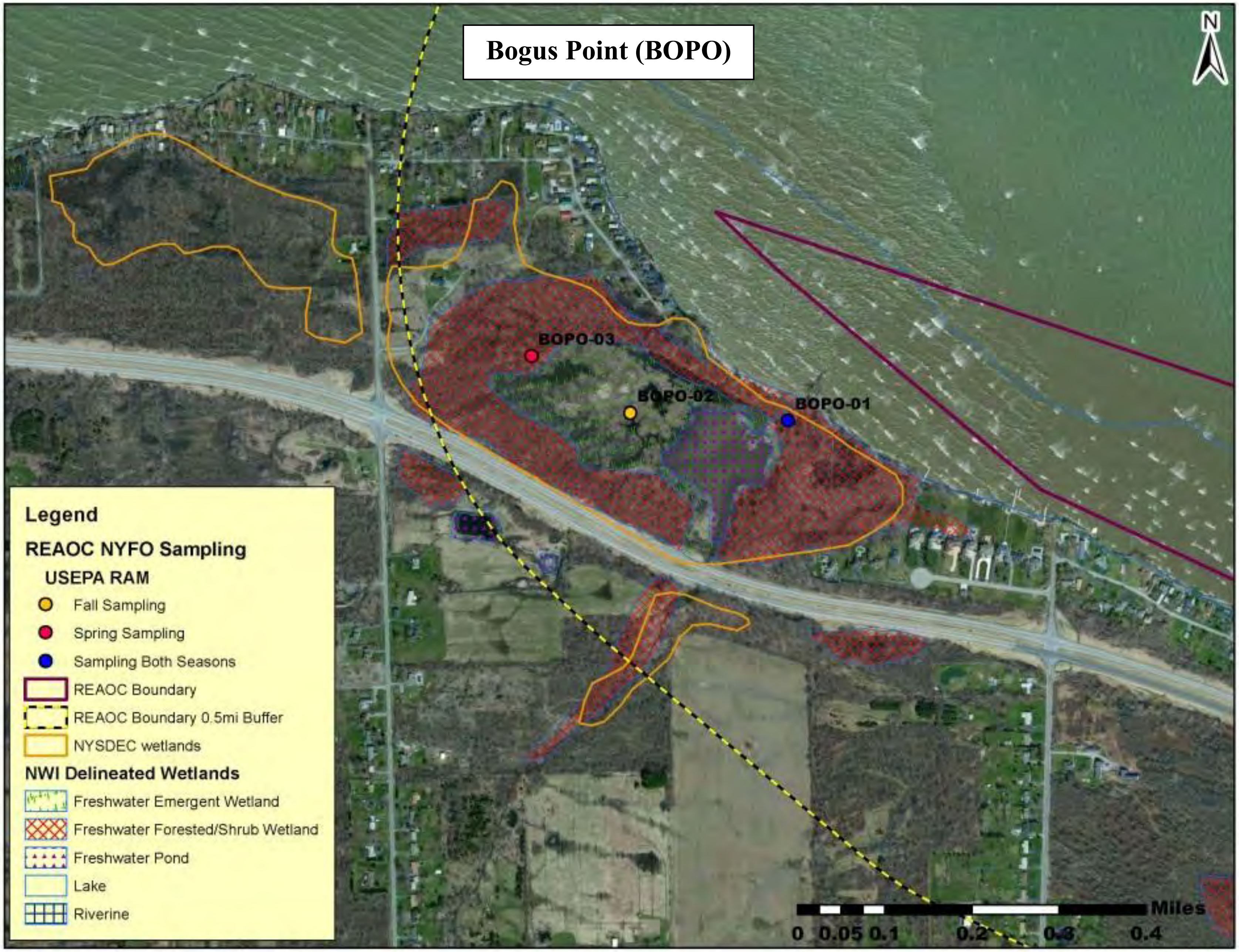
ATTACHMENT 3-1: NYFO Field Sampling Locations - RAM

Sampling Station IDs by Waterbody/Wetland Complex
(presented west to east in the project area)

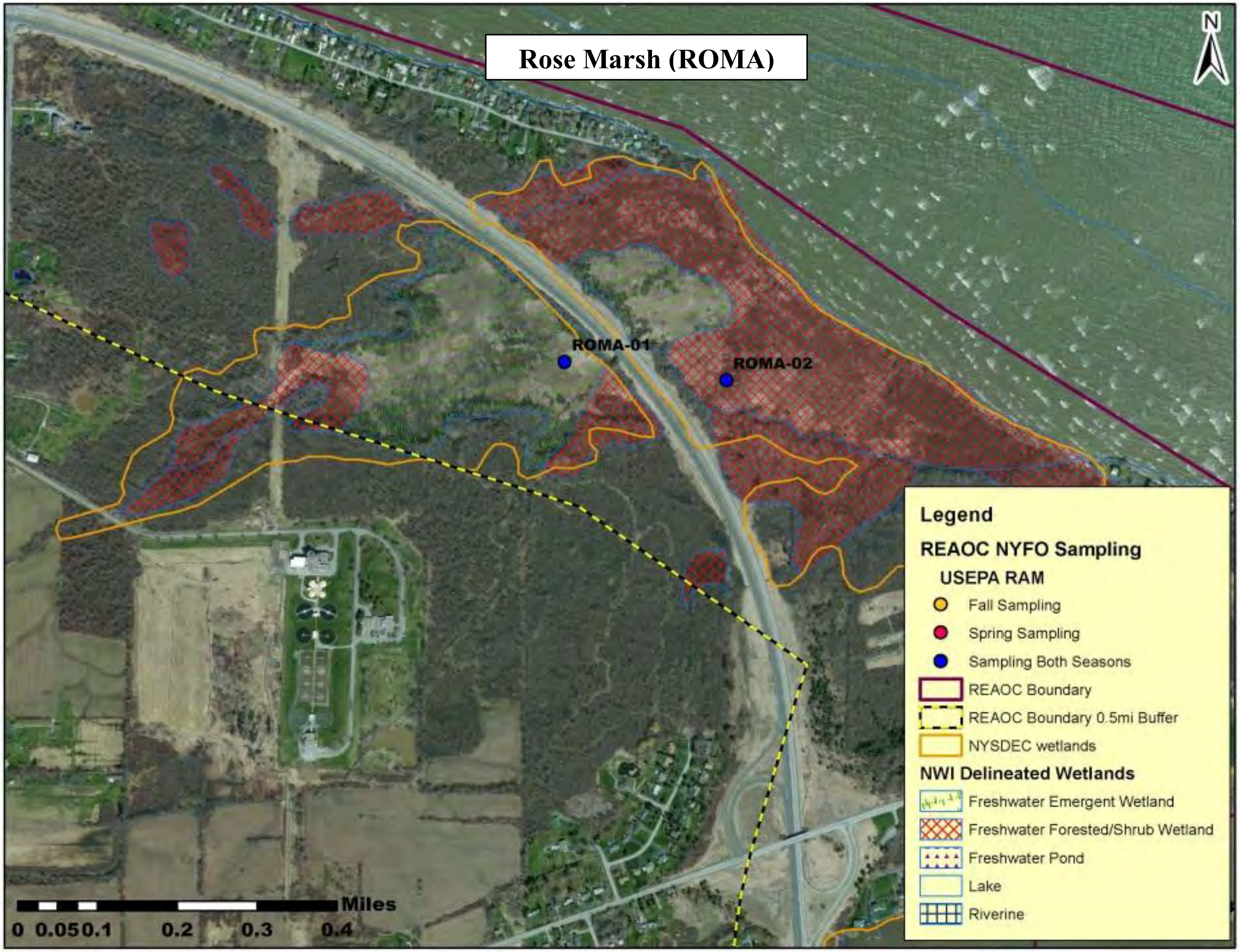
Structural Habitat – USEPA Rapid Assessment Method (RAM)

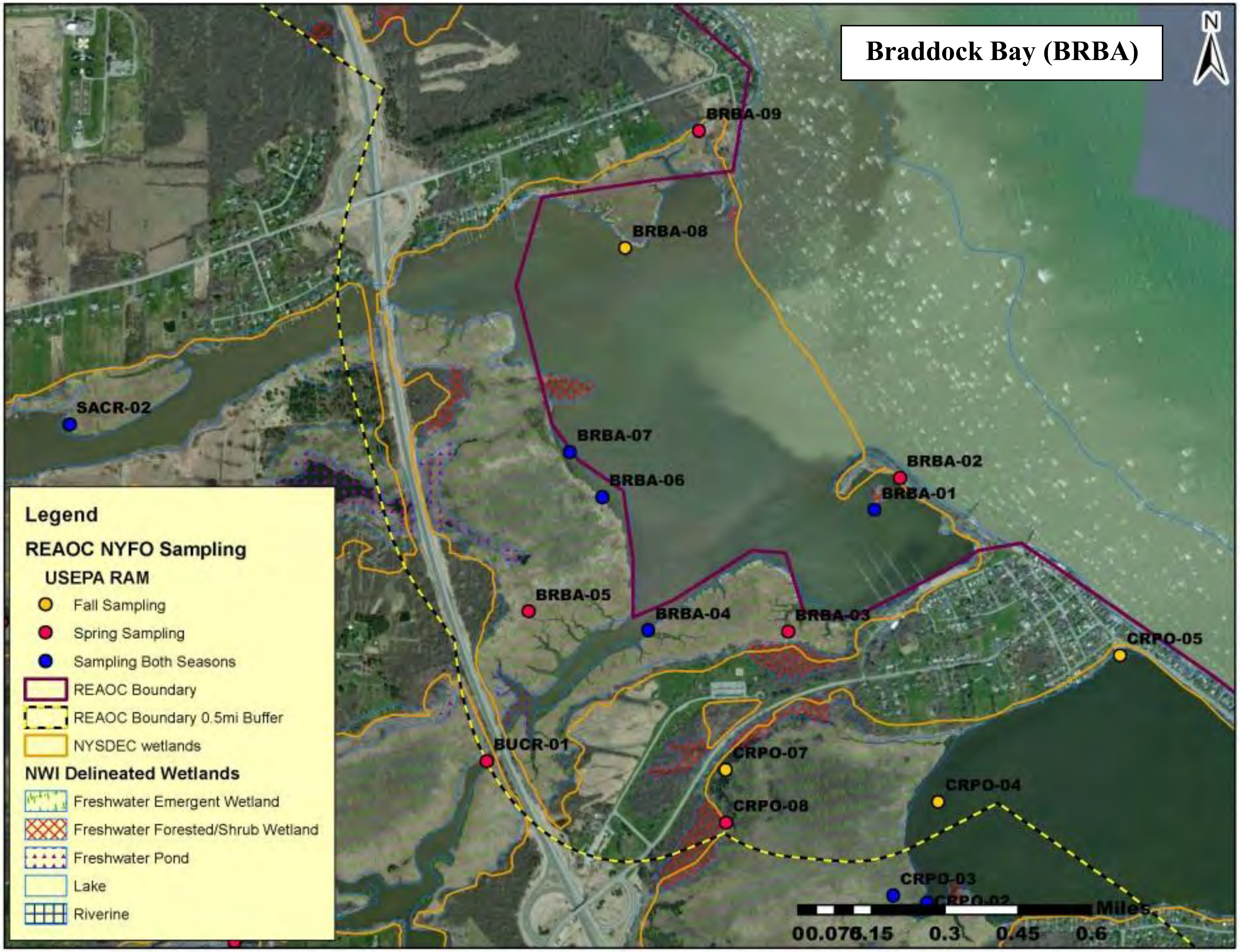
Bogus Point (BOPO)
Rose Marsh (ROMA)
Braddock Bay (BRBA)
Braddock Bay Tributaries:
- West Creek (WECR)
- Salmon Creek (SACR)
- Buttonwood Creek (BUCR)

Cranberry Pond (CRPO)
Long Pond (LOPO) and Northrup Creek (NOCR)
Buck Pond (BUPO) and Larkin Creek (LACR)
Round Pond (ROPO)
Slater Creek (SLCR)
Genesee River (GERI)
Irondequoit Bay (IRBA)
Irondequoit Creek (IRCR)

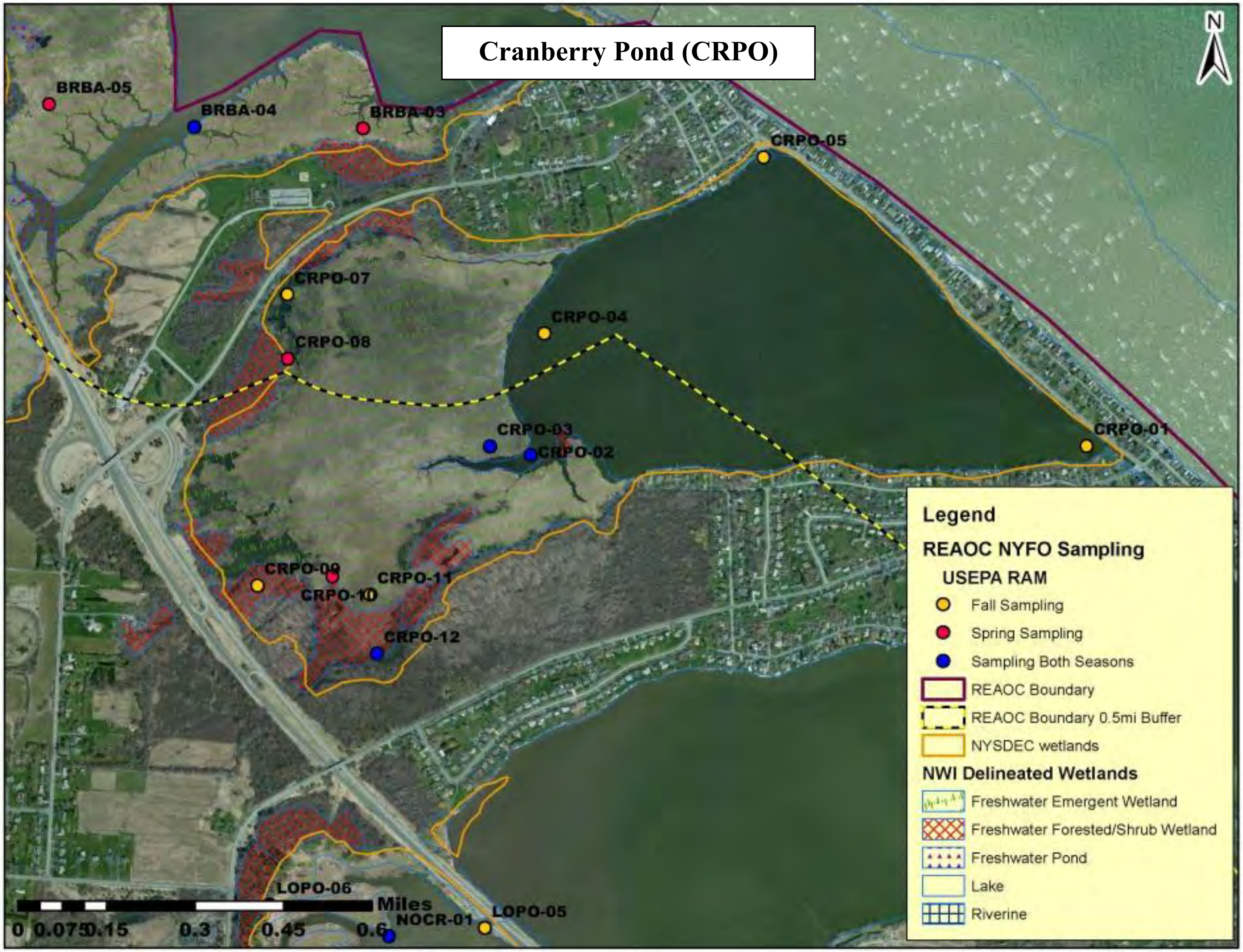


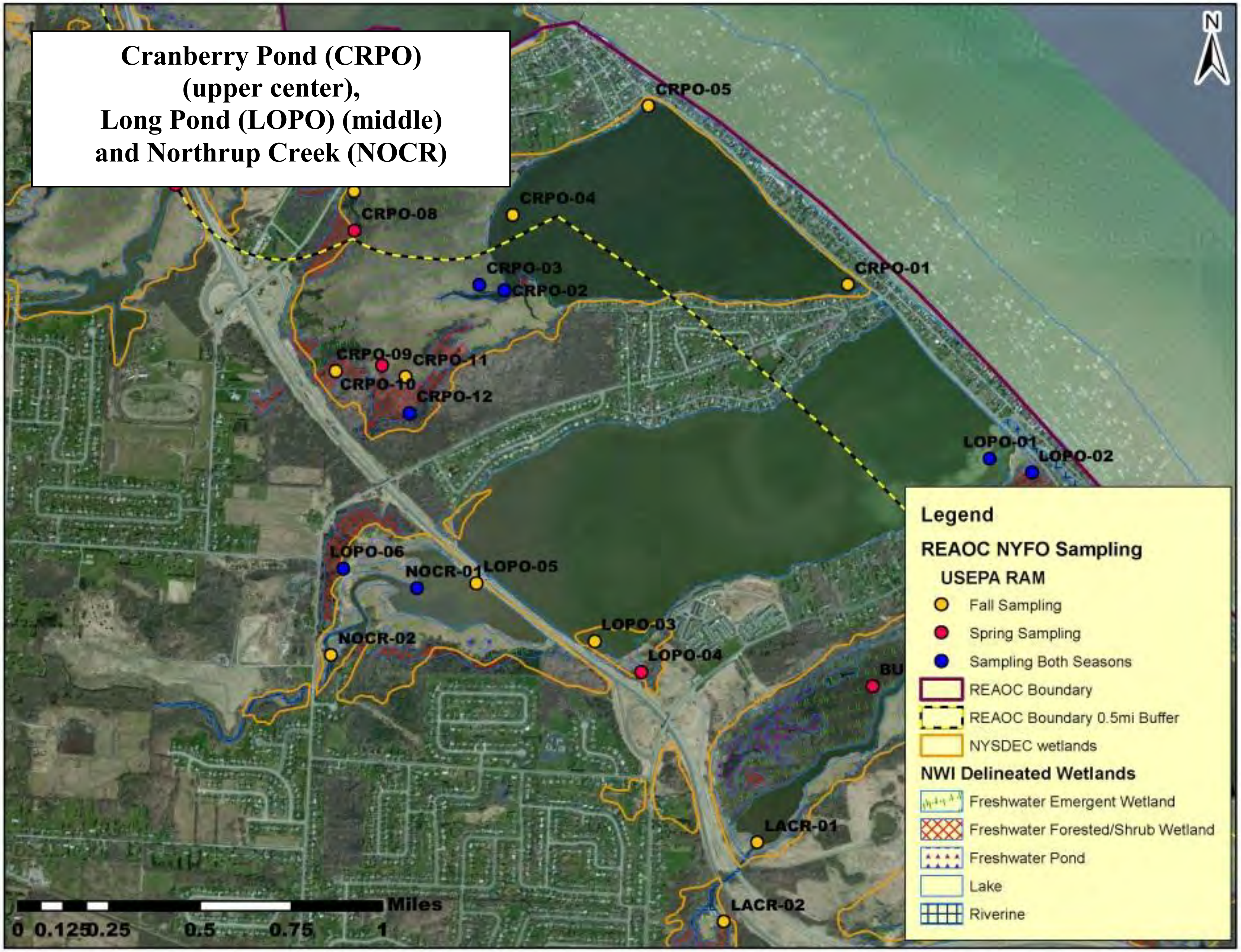
Bogus Point (BOPO)
N
BOPO-03
BOPO-02
BOPO-01
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
0 0.05 0.1 0.2 0.3 0.4
Miles

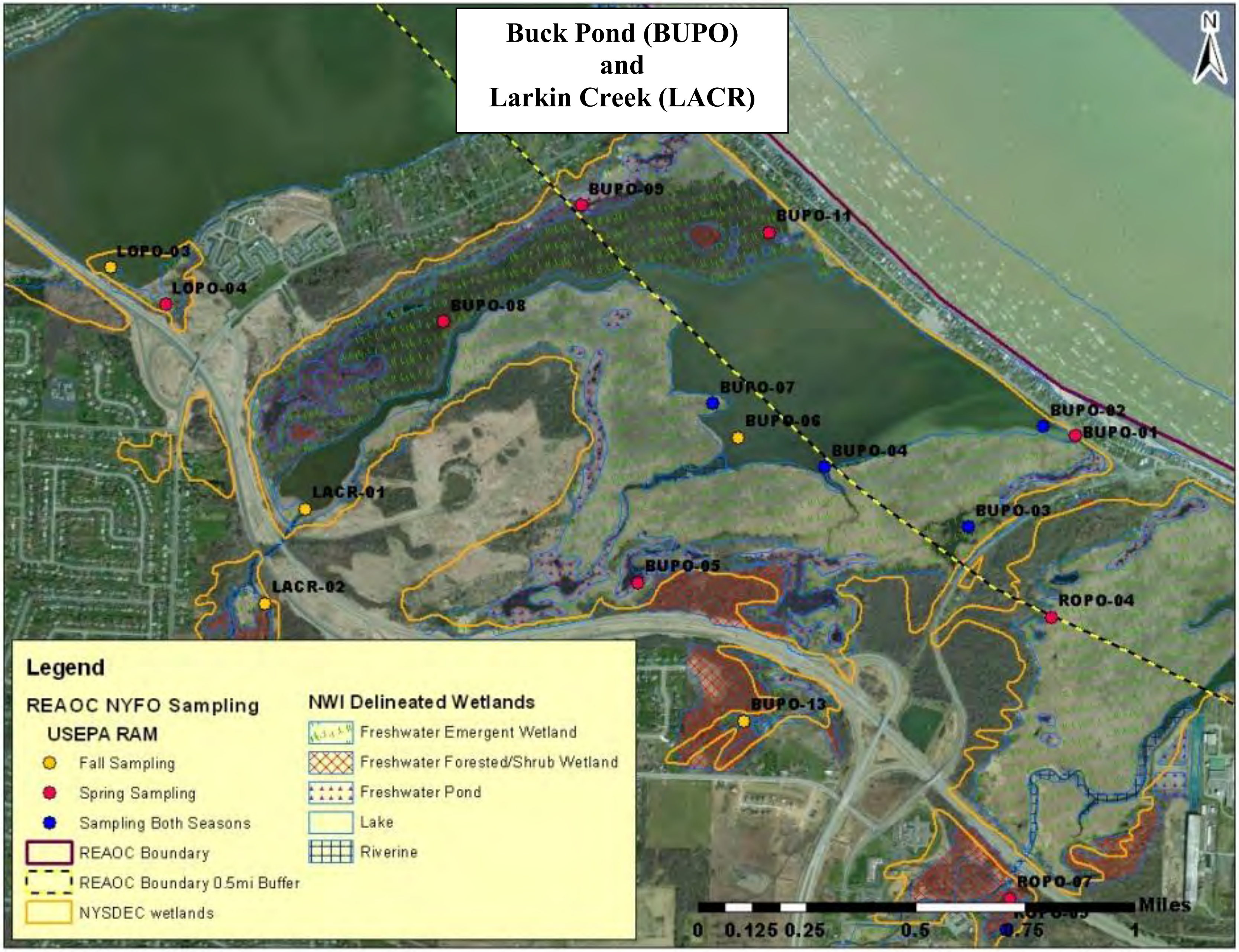

Rose Marsh (ROMA)
N
ROMA-01
ROMA-02
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.05 0.1 0.2 0.3 0.4

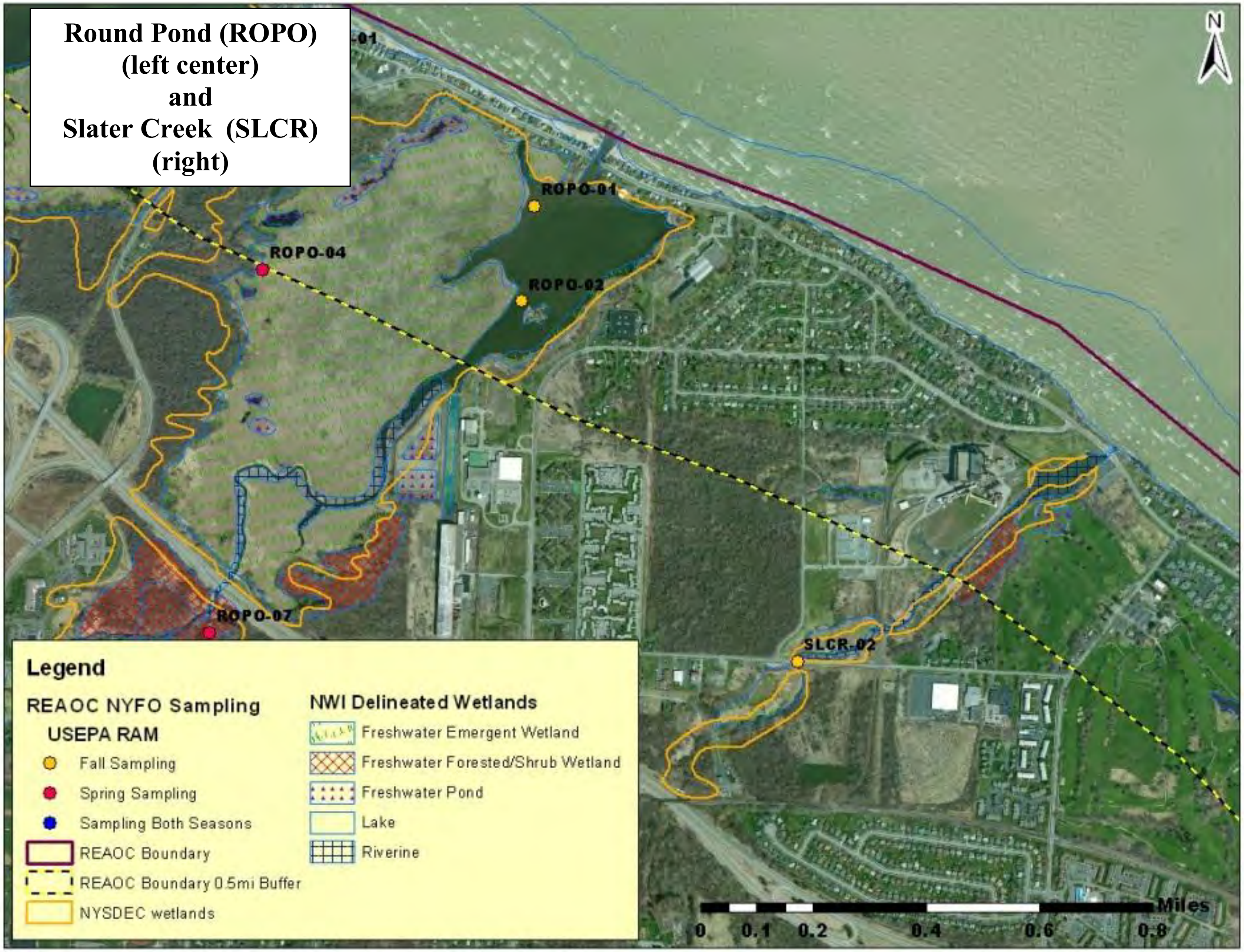

Braddock Bay (BRBA)
N
BRBA-09
BRBA-08
SACR-02
BRBA-07
BRBA-06
BRBA-02
BRBA-01
BRBA-05
BRBA-04
BRBA-03
CRPO-05
BUCR-01
CRPO-07
CRPO-04
CRPO-08
CRPO-03
CRPO-02
Miles
0 0.075 0.15 0.3 0.45 0.6
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

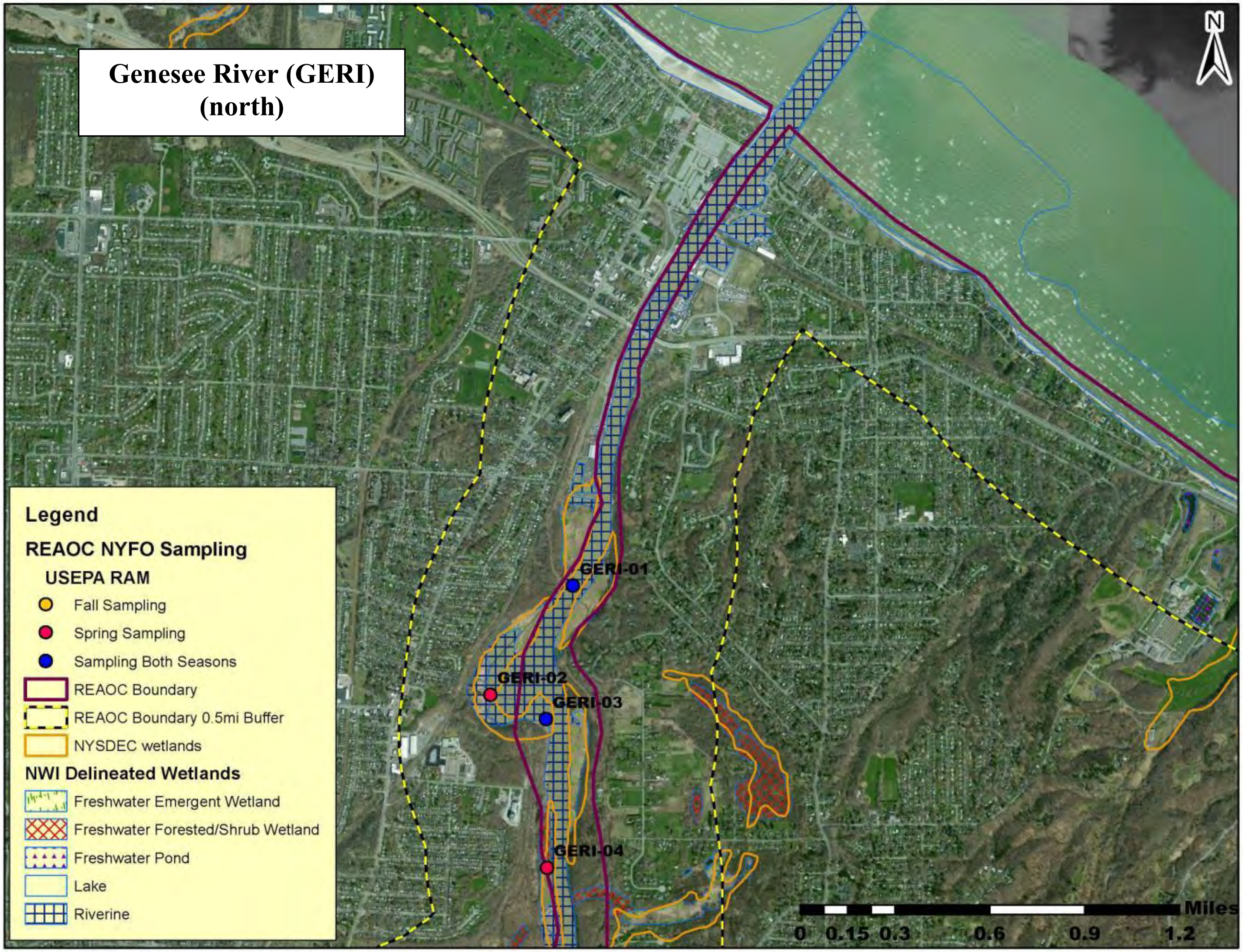

Braddock Bay Tribs: West (WECR), Salmon (SACR), Buttonwood (BUCR) Creeks
WECR-03
WECR-02
SACR-02
SACR-04
SACR-05
SACR-06
BUCR-01
BUCR-04
BRBA-08
BRBA-07
BRBA-06
BRBA-05
BRBA-04
BRBA-03
CRPO-07
CRPO-08
CRPO-11
CRPO-12
LOPO-06
NOCR-01
NOCR-02
N
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
0 0.175 0.35 0.7 1.05 1.4
Miles

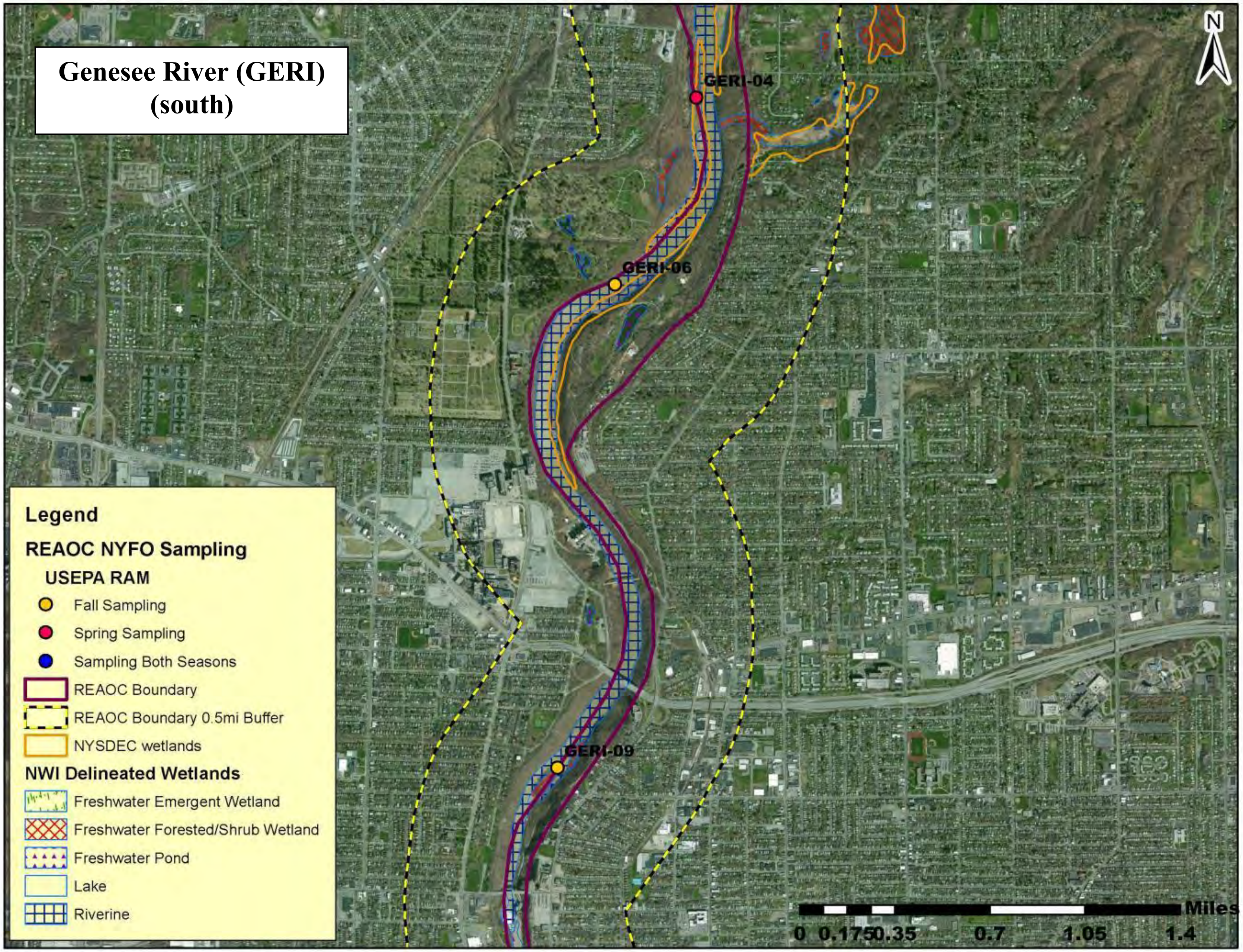

Cranberry Pond (CRPO)
N
BRBA-05
BRBA-04
BRBA-03
CRPO-05
CRPO-07
CRPO-04
CRPO-08
CRPO-03
CRPO-02
CRPO-01
CRPO-09
CRPO-11
CRPO-10
CRPO-12
LOPO-06
LOPO-05
NOCR-01
Miles
0 0.075 0.15 0.3 0.45 0.6
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

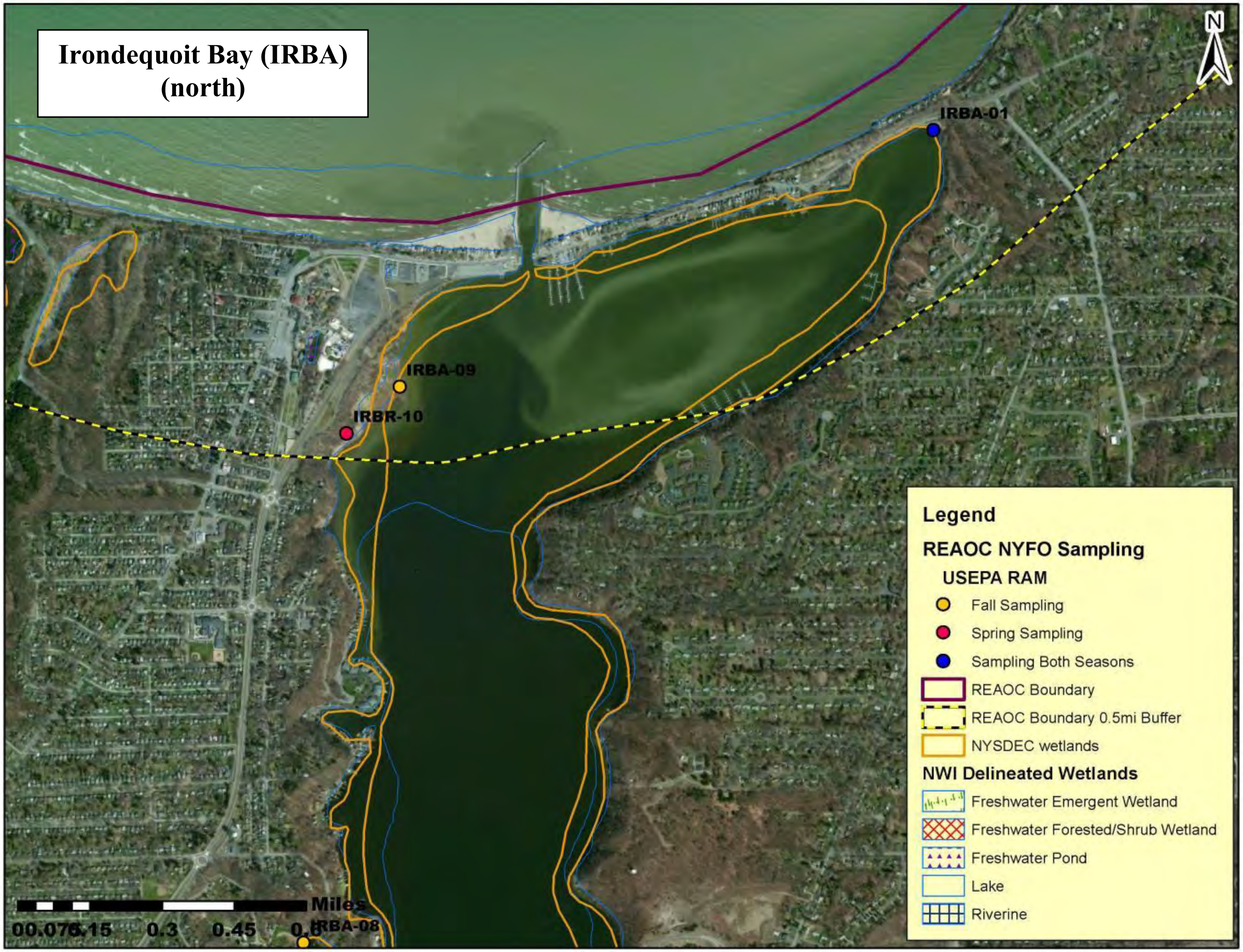

Cranberry Pond (CRPO)
(upper center),
Long Pond (LOPO) (middle)
and Northrup Creek (NOCR)
N
CRPO-05
CRPO-04
CRPO-08
CRPO-03
CRPO-02
CRPO-01
CRPO-09
CRPO-11
CRPO-10
CRPO-12
LOPO-01
LOPO-02
LOPO-06
NOCR-01
LOPO-05
LOPO-03
NOCR-02
LOPO-04
BU
LACR-01
LACR-02
Miles
0 0.125 0.25 0.5 0.75 1
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine


Buck Pond (BUPO)
and
Larkin Creek (LACR)
N
BUPO-09
BUPO-11
LOPO-03
LOPO-04
BUPO-08
BUPO-07
BUPO-06
BUPO-02
BUPO-01
BUPO-04
LACR-01
BUPO-03
BUPO-05
LACR-02
ROPO-04
BUPO-13
ROPO-07
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.125 0.25 0.5 0.75 1

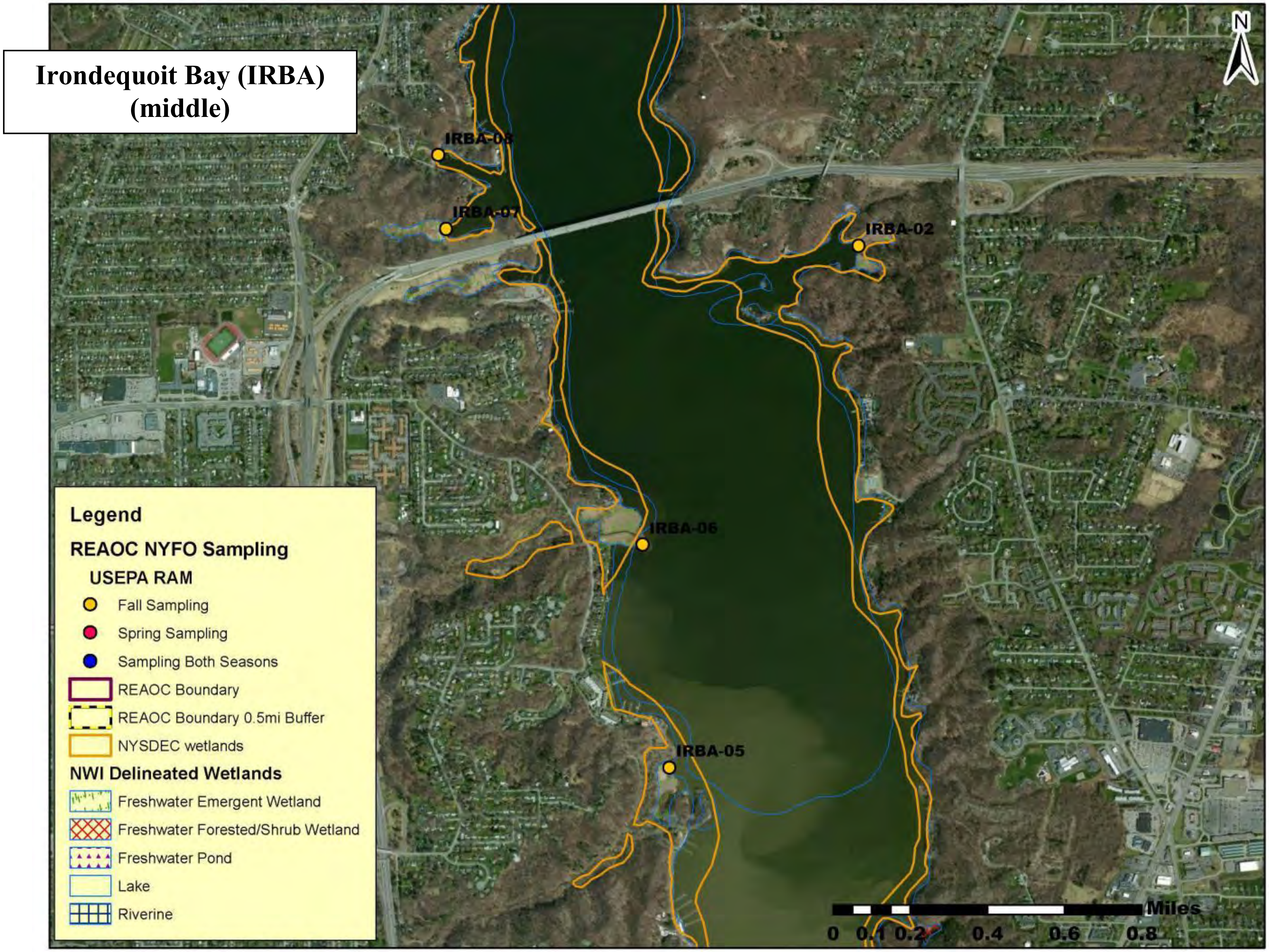

Round Pond (ROPO)
(left center)
and
Slater Creek (SLCR)
(right)
ROPO-01
ROPO-04
ROPO-02
ROPO-07
SLCR-02
N
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.1 0.2 0.4 0.6 0.8

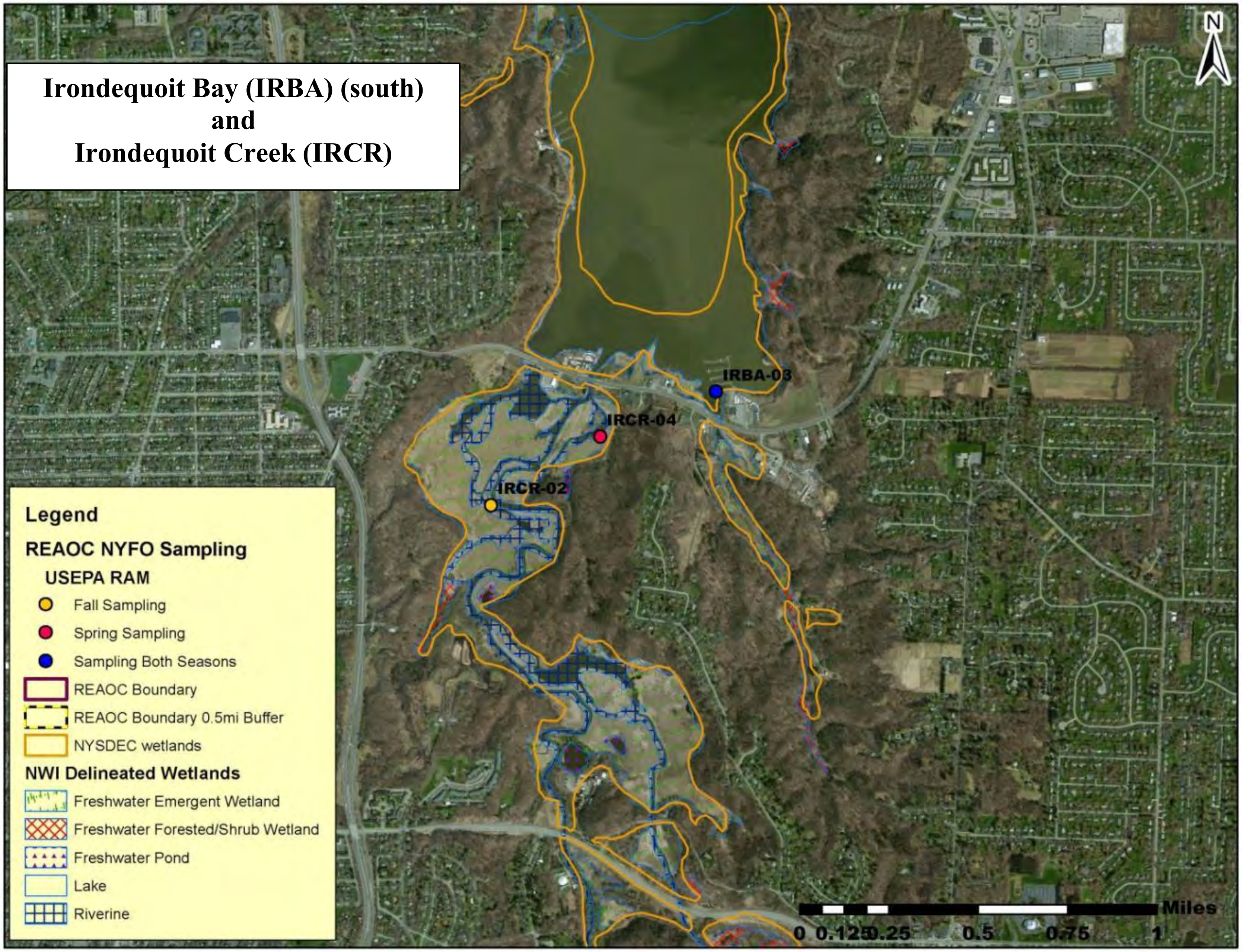

Genesee River (GERI)
(north)
N
GERI-01
GERI-02
GERI-03
GERI-04
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
0 0.15 0.3 0.6 0.9 1.2
Miles


Genesee River (GERI)
(south)
GERI-04
GERI-06
GERI-09
N
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.175 0.35 0.7 1.05 1.4



Irondequoit Bay (IRBA)
(north)
IRBA-01
IRBA-09
IRBR-10
IRBA-08
N
Miles
0 0.075 0.15 0.3 0.45 0.6
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine


Irondequoit Bay (IRBA)
(middle)
IRBA-08
IRBA-07
IRBA-02
IRBA-06
IRBA-05
N
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.1 0.2 0.4 0.6 0.8


Irondequoit Bay (IRBA) (south)
and
Irondequoit Creek (IRCR)
IRBA-03
IRCR-04
IRCR-02
N
Legend
REAOC NYFO Sampling
USEPA RAM
Fall Sampling
Spring Sampling
Sampling Both Seasons
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.125 0.25 0.5 0.75 1

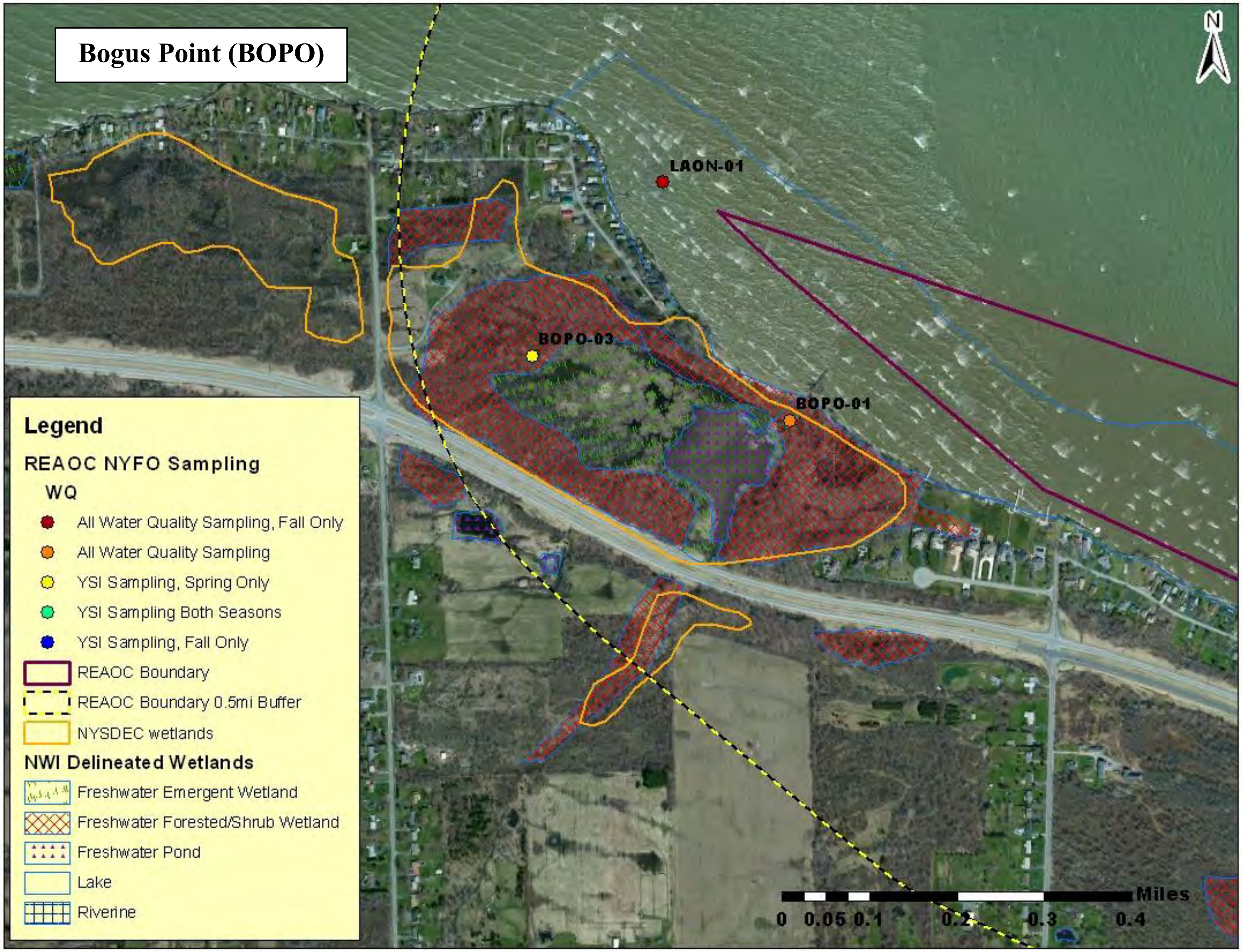
ATTACHMENT 3-2: NYFO Field Sampling Locations - WQ

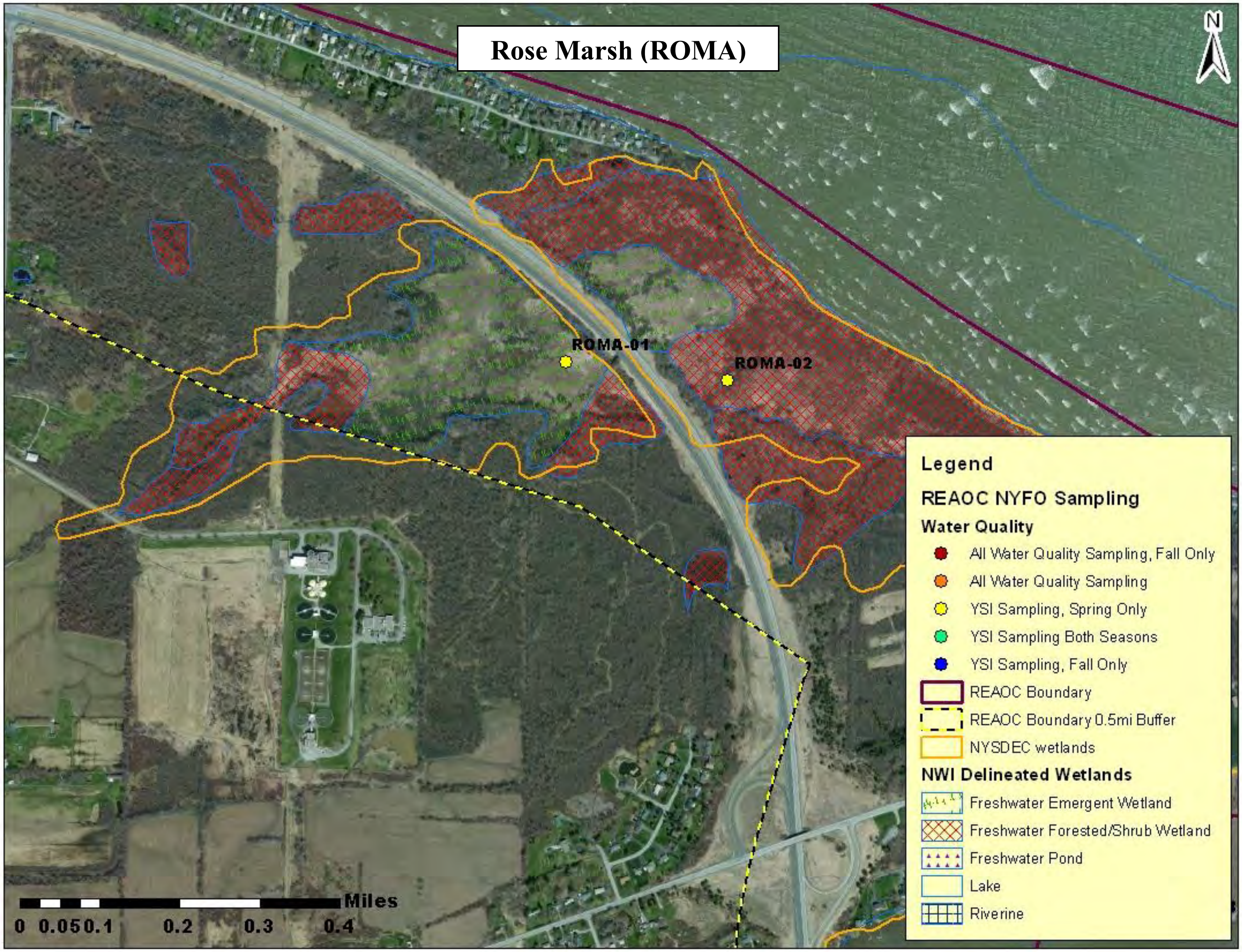
Sampling Station IDs by Waterbody/Wetland Complex
(presented west to east in the project area)

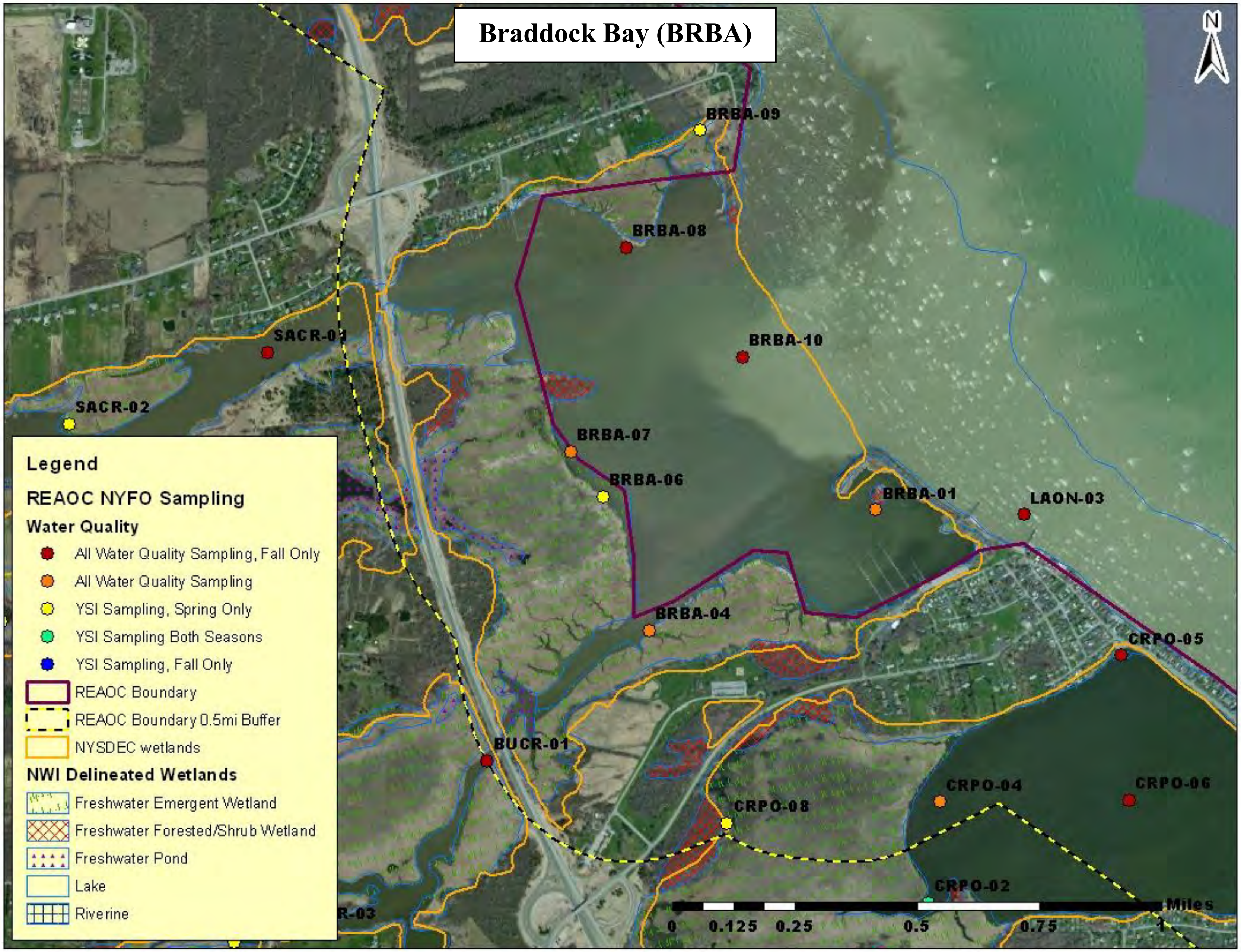
Water Quality

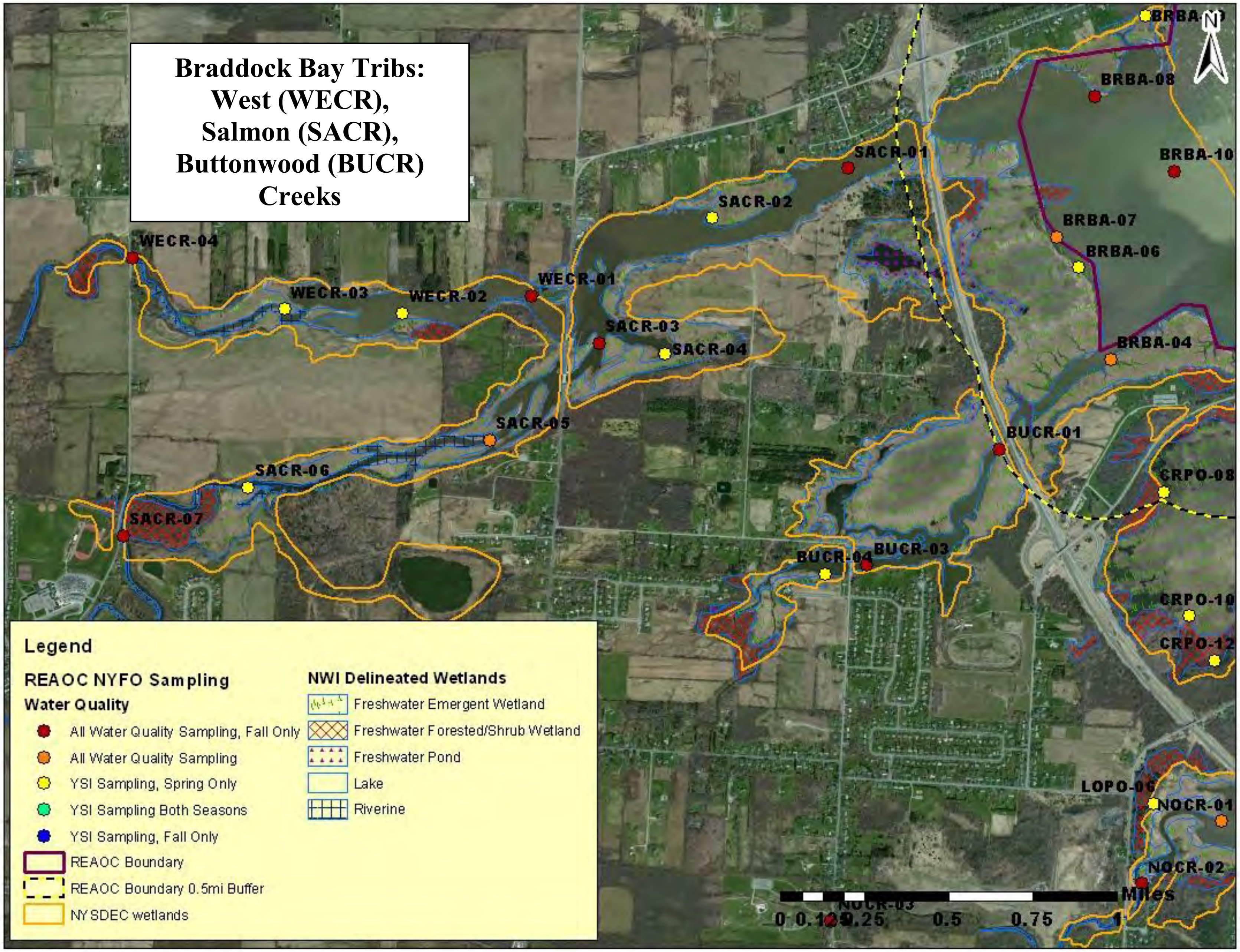
Bogus Point (BOPO)
Rose Marsh (ROMA)
Braddock Bay (BRBA)
Braddock Bay Tributaries:
- West Creek (WECR)
- Salmon Creek (SACR)
- Buttonwood Creek (BUCR)

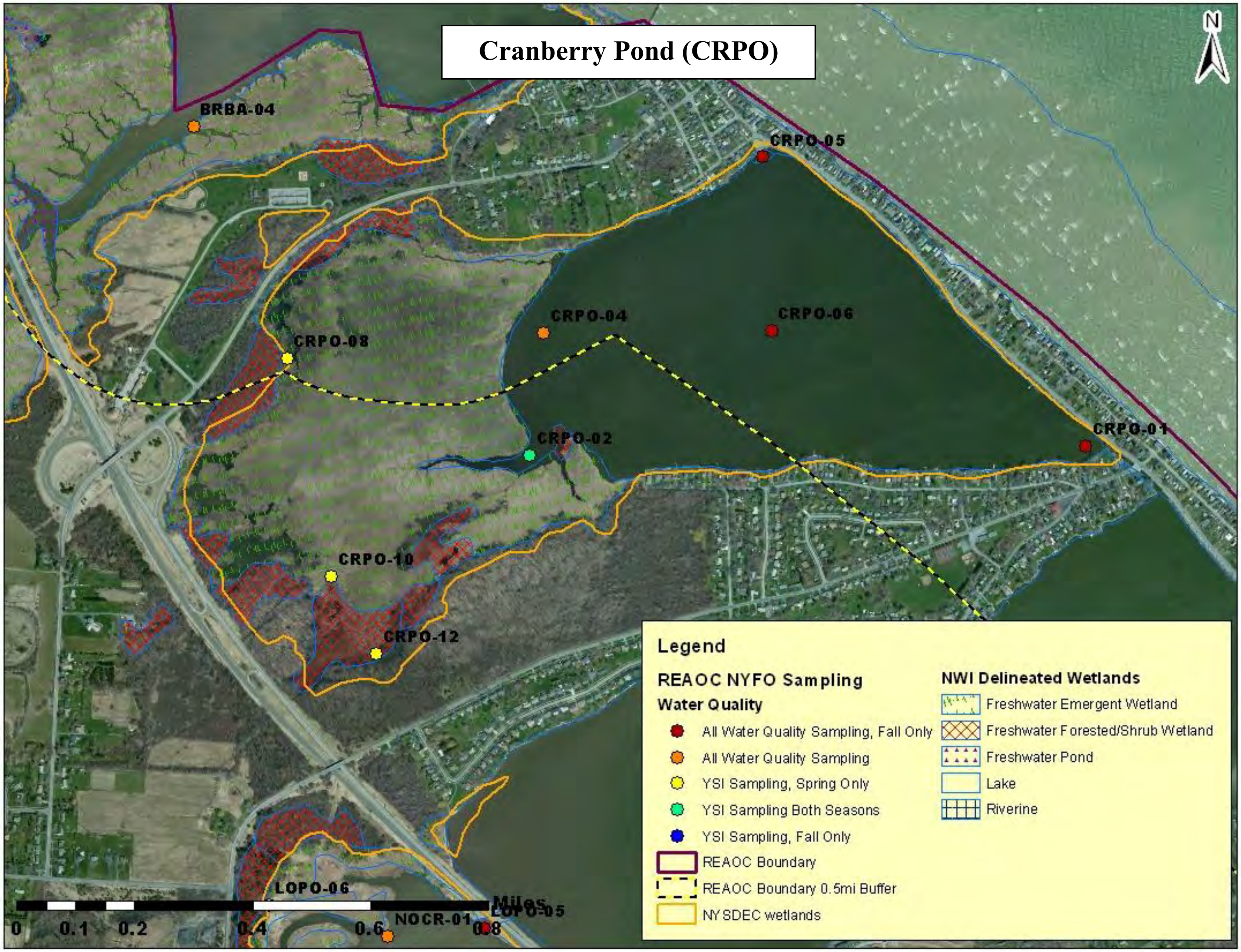
Cranberry Pond (CRPO)
Long Pond (LOPO) and Northrup Creek (NOCR)
Buck Pond (BUPO) and Larkin Creek (LACR)
Round Pond (ROPO)
Slater Creek (SLCR)
Genesee River (GERI)
Irondequoit Bay (IRBA)
Irondequoit Creek (IRCR)
Lake Ontario (LAON)

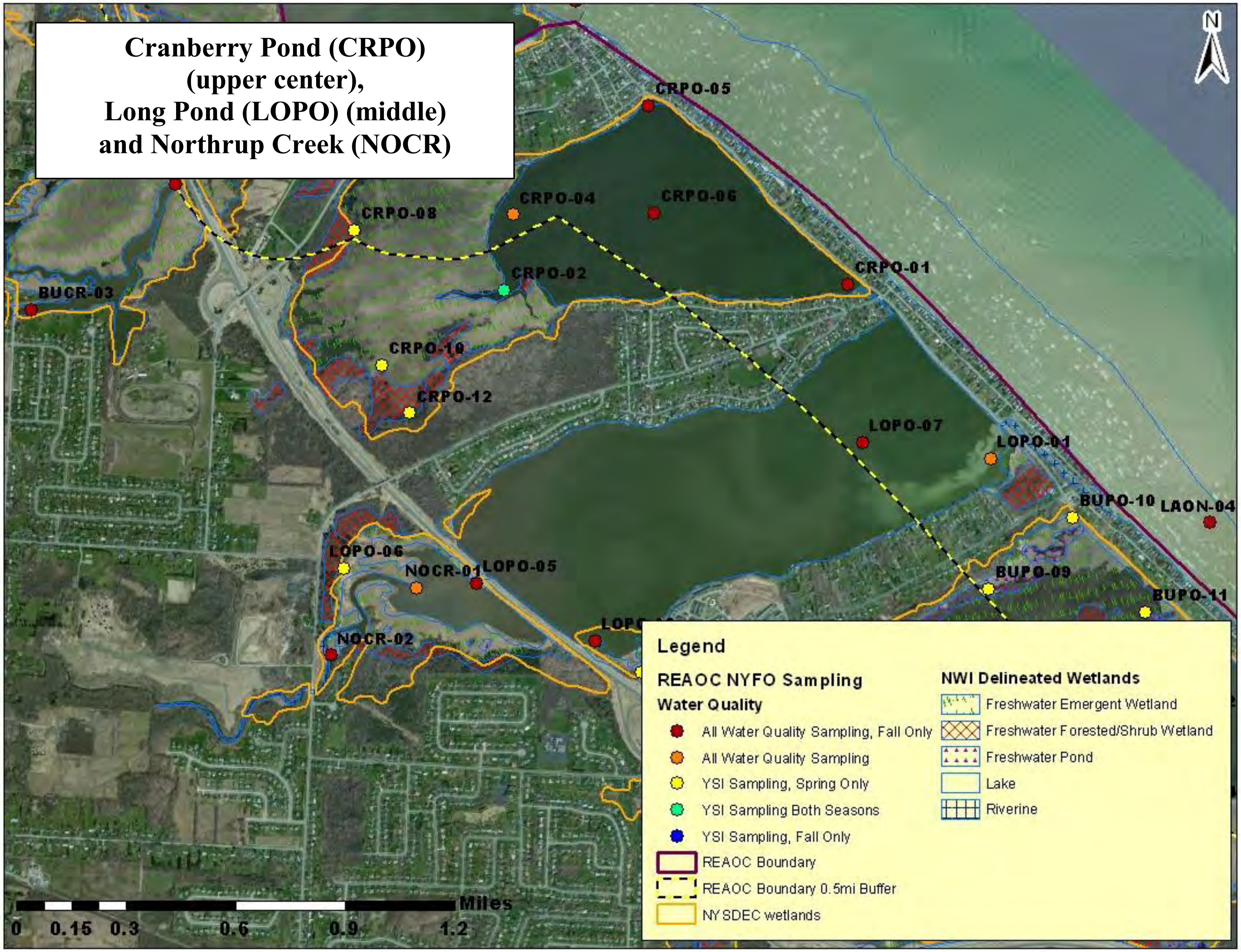

Bogus Point (BOPO)
N
LAON-01
BOPO-03
BOPO-01
Legend
REAOC NYFO Sampling
WQ
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.05 0.1 0.2 0.3 0.4

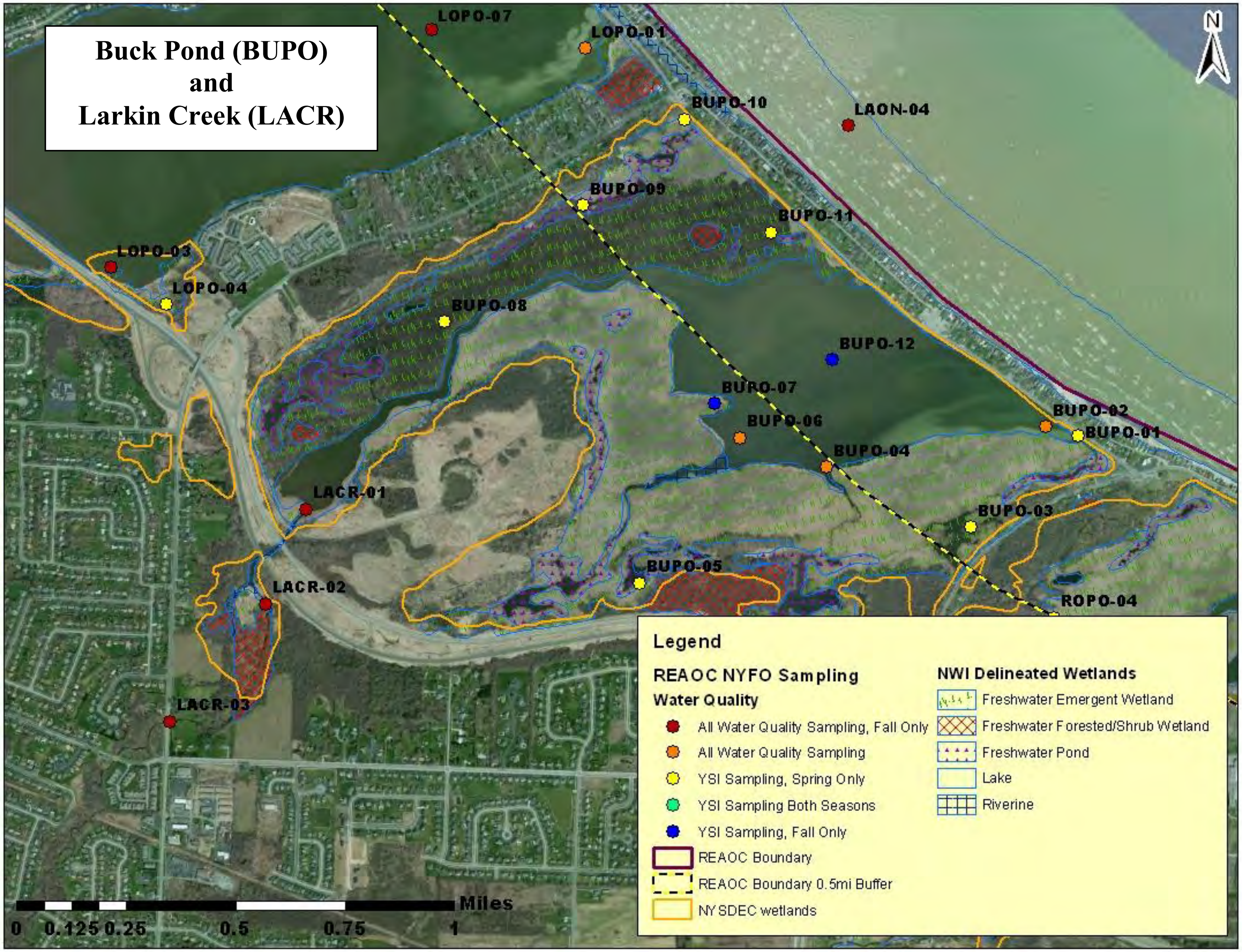

Rose Marsh (ROMA)
N
ROMA-01
ROMA-02
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.05 0.1 0.2 0.3 0.4

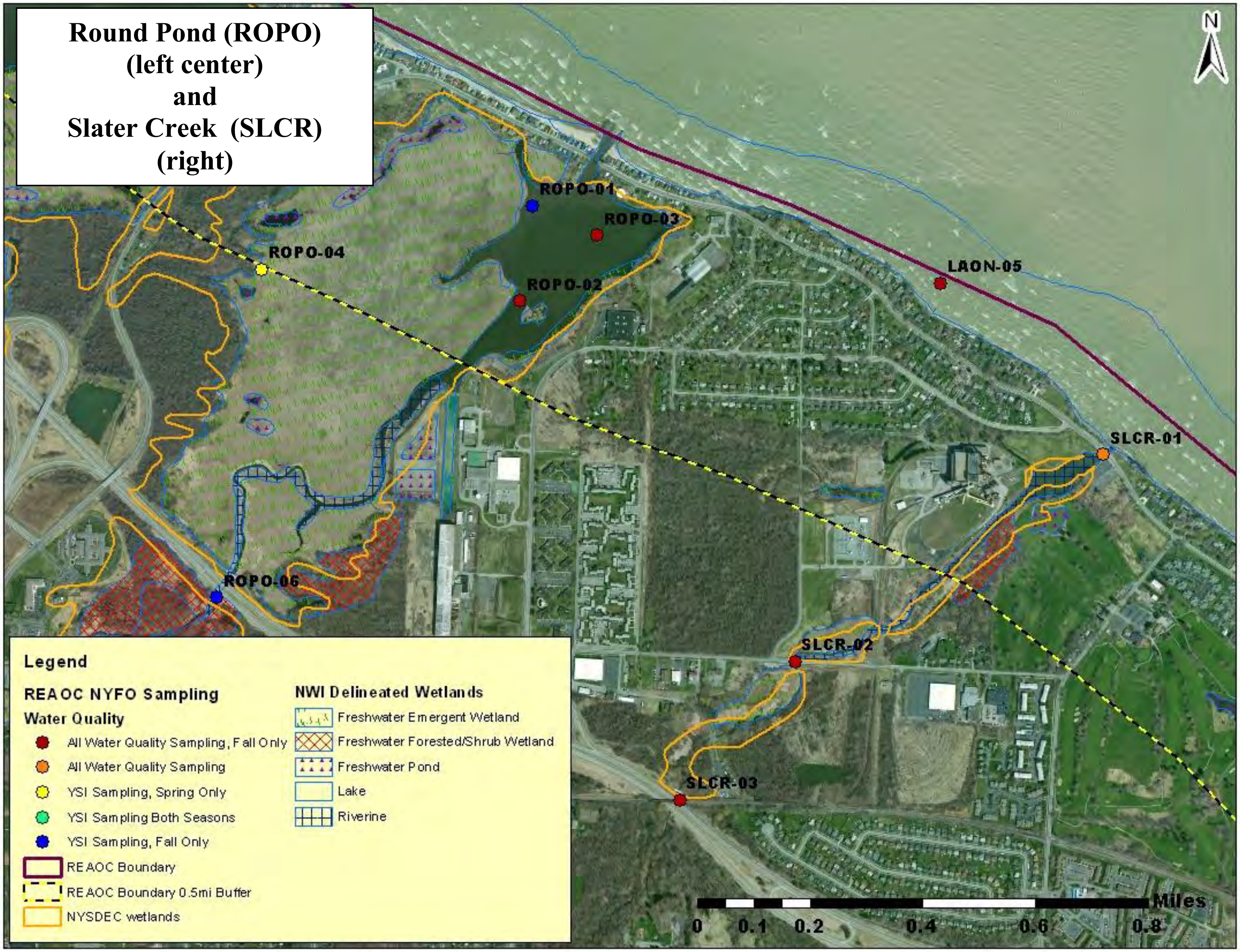

Braddock Bay (BRBA)
N
BRBA-09
BRBA-08
BRBA-10
SACR-01
SACR-02
BRBA-07
BRBA-06
BRBA-01
LAON-03
BRBA-04
CRPO-05
BUCR-01
CRPO-04
CRPO-06
CRPO-08
CRPO-02
R-03
0 0.125 0.25 0.5 0.75 1 Miles
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

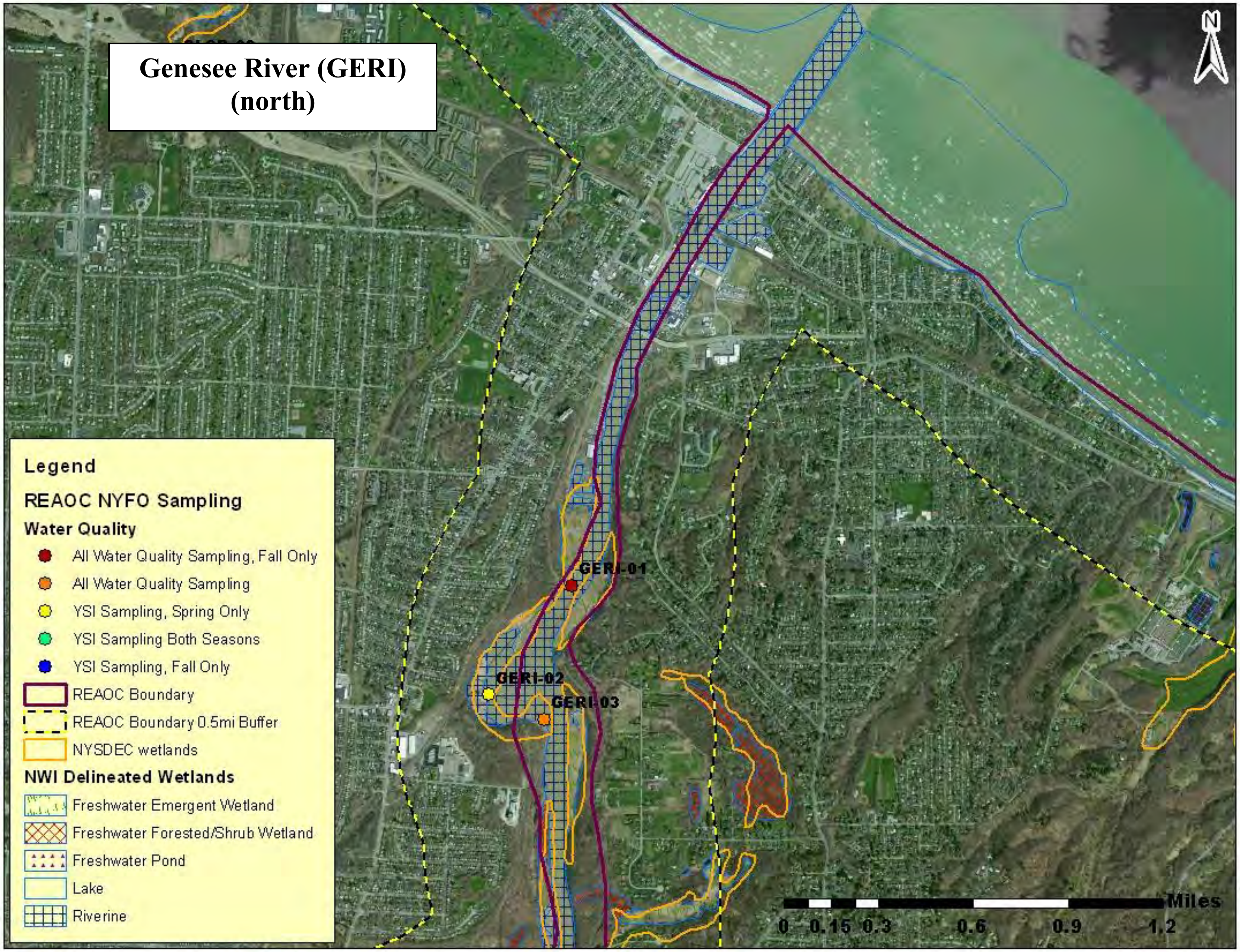

Braddock Bay Tribs:
West (WECR),
Salmon (SACR),
Buttonwood (BUCR)
Creeks
WECR-04
WECR-03
WECR-02
WECR-01
SACR-01
SACR-02
SACR-03
SACR-04
SACR-05
SACR-06
SACR-07
BUCR-01
BUCR-03
BUCR-04
BRBA-08
BRBA-10
BRBA-07
BRBA-06
BRBA-04
CRPO-08
CRPO-10
CRPO-12
LOPO-06
NOCR-01
NOCR-02
NOCR-03
N
Miles
0
0.25
0.5
0.75
1
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

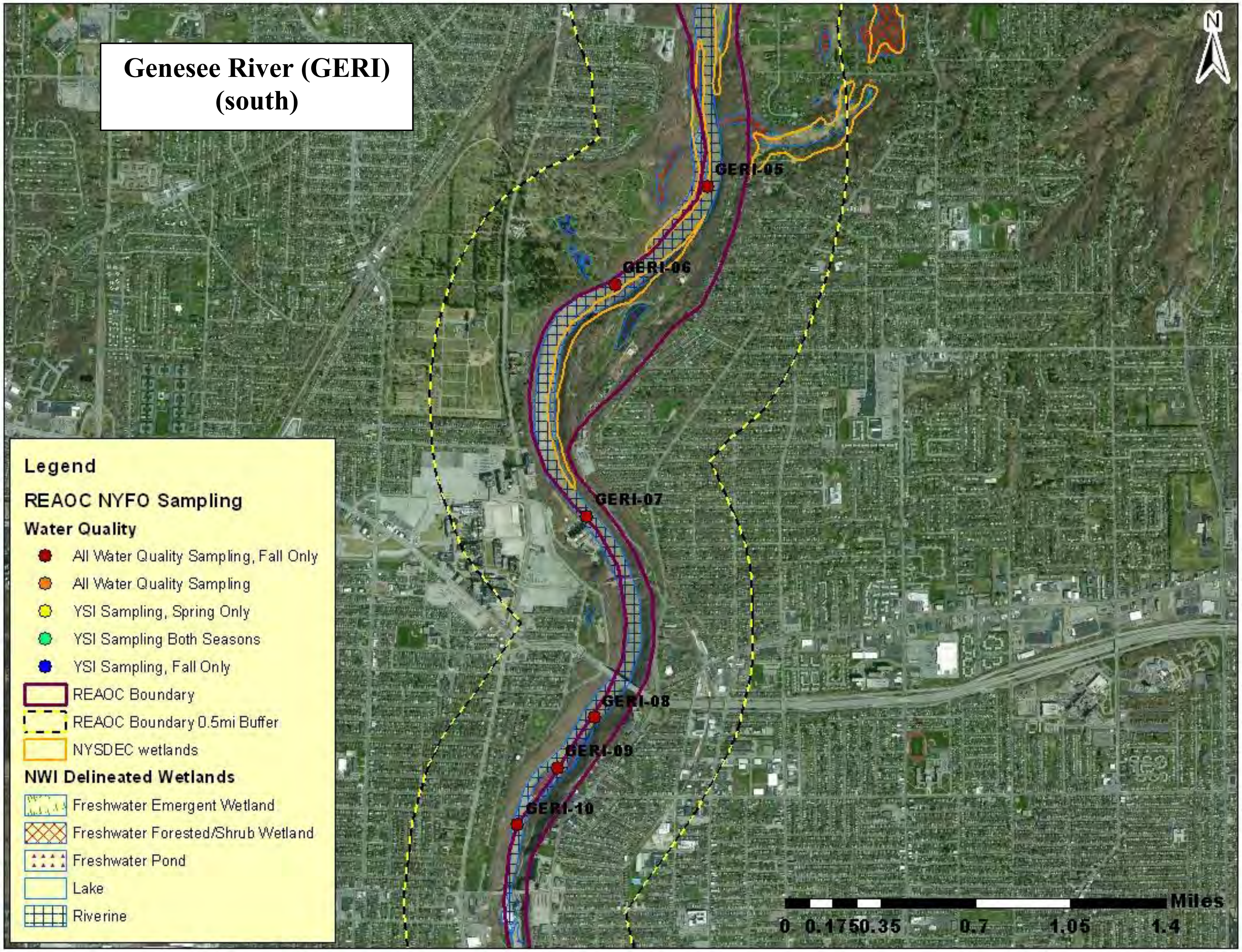

Cranberry Pond (CRPO)
N
BRBA-04
CRPO-05
CRPO-04
CRPO-06
CRPO-08
CRPO-02
CRPO-01
CRPO-10
CRPO-12
LOPO-06
NOCR-01
LOPO-05
Miles
0
0.1
0.2
0.4
0.6
0.8
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

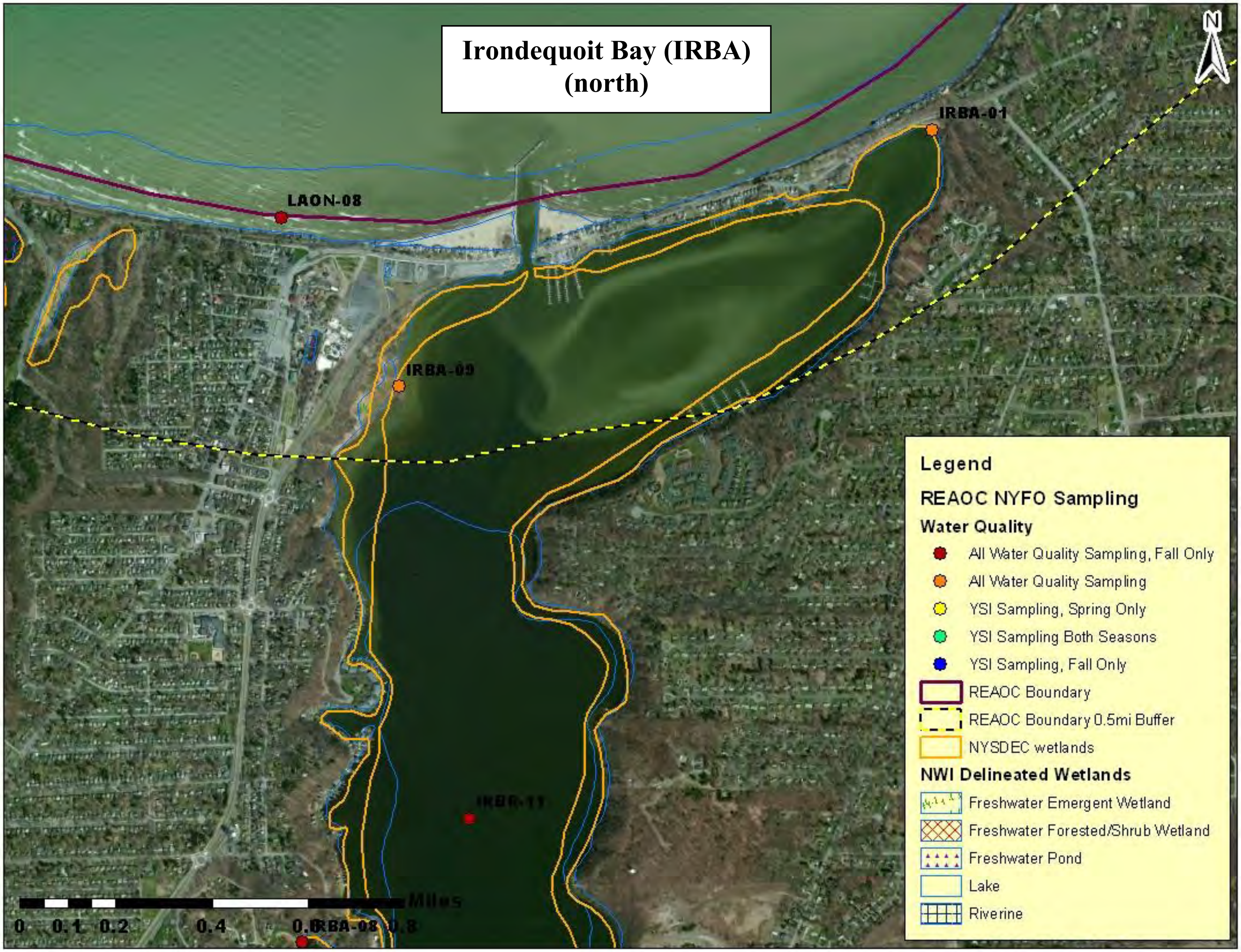

Cranberry Pond (CRPO)
(upper center),
Long Pond (LOPO) (middle)
and Northrup Creek (NOCR)
CRPO-05
CRPO-04
CRPO-06
CRPO-08
CRPO-02
CRPO-01
BUCR-03
CRPO-10
CRPO-12
LOPO-07
LOPO-01
BUPO-10
LAON-04
LOPO-06
NOCR-01
LOPO-05
BUPO-09
BUPO-11
NOCR-02
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.15 0.3 0.6 0.9 1.2
N

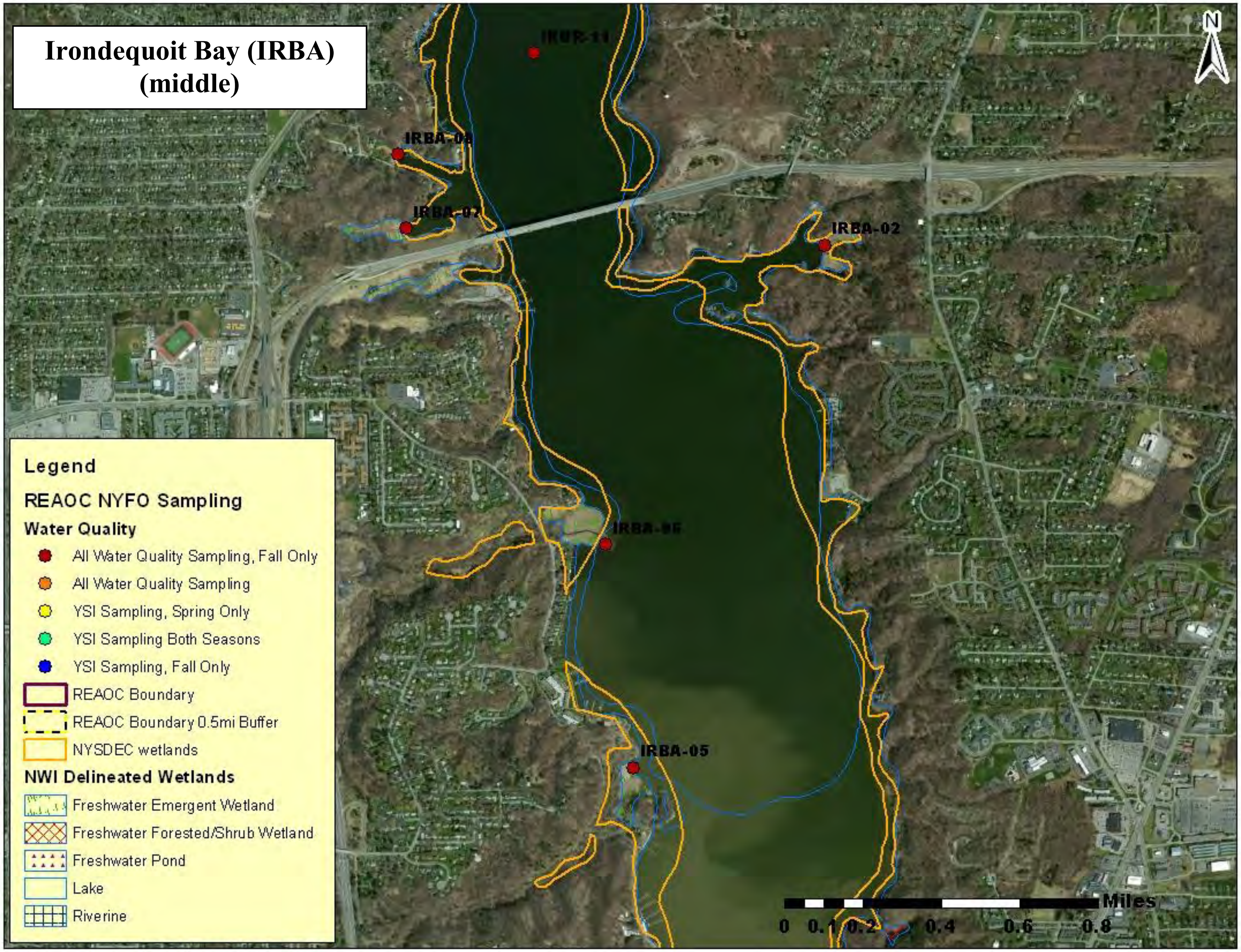

Buck Pond (BUPO)
and
Larkin Creek (LACR)
LOPO-07
LOPO-01
BUPO-10
LAON-04
BUPO-09
BUPO-11
LOPO-03
LOPO-04
BUPO-08
BUPO-12
BUPO-07
BUPO-06
BUPO-02
BUPO-01
BUPO-04
LACR-01
BUPO-03
BUPO-05
LACR-02
ROPO-04
LACR-03
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.125 0.25 0.5 0.75 1
N

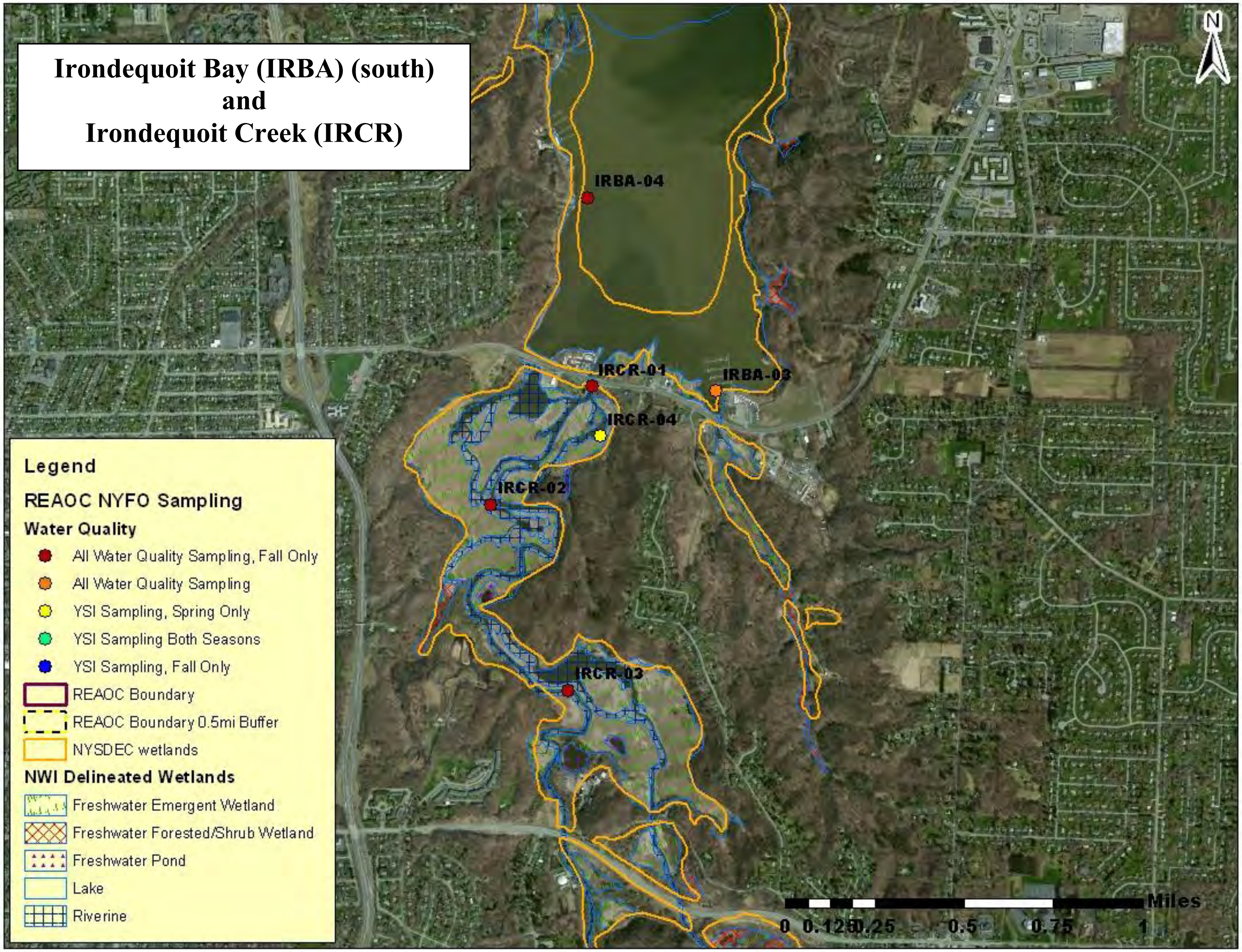

Round Pond (ROPO)
(left center)
and
Slater Creek (SLCR)
(right)
N
ROPO-01
ROPO-03
ROPO-04
ROPO-02
LAON-05
SLCR-01
ROPO-06
SLCR-02
SLCR-03
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.1 0.2 0.4 0.6 0.8


Genesee River (GERI)
(north)
N
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
GERI-01
GERI-02
GERI-03
0 0.15 0.3 0.6 0.9 1.2
Miles


Genesee River (GERI)
(south)
N
GERI-05
GERI-06
GERI-07
GERI-08
GERI-09
GERI-10
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.175 0.35 0.7 1.05 1.4


Irondequoit Bay (IRBA)
(north)
N
IRBA-01
LAON-08
IRBA-09
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.1 0.2 0.4 0.6 0.8


Irondequoit Bay (IRBA)
(middle)
IRBA-02
IRBA-05
N
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.1 0.2 0.4 0.6 0.8


Irondequoit Bay (IRBA) (south)
and
Irondequoit Creek (IRCR)
IRBA-04
IRCR-01
IRBA-03
IRCR-04
IRCR-02
IRCR-03
Legend
REAOC NYFO Sampling
Water Quality
All Water Quality Sampling, Fall Only
All Water Quality Sampling
YSI Sampling, Spring Only
YSI Sampling Both Seasons
YSI Sampling, Fall Only
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
N
Miles
0 0.125 0.25 0.5 0.75 1

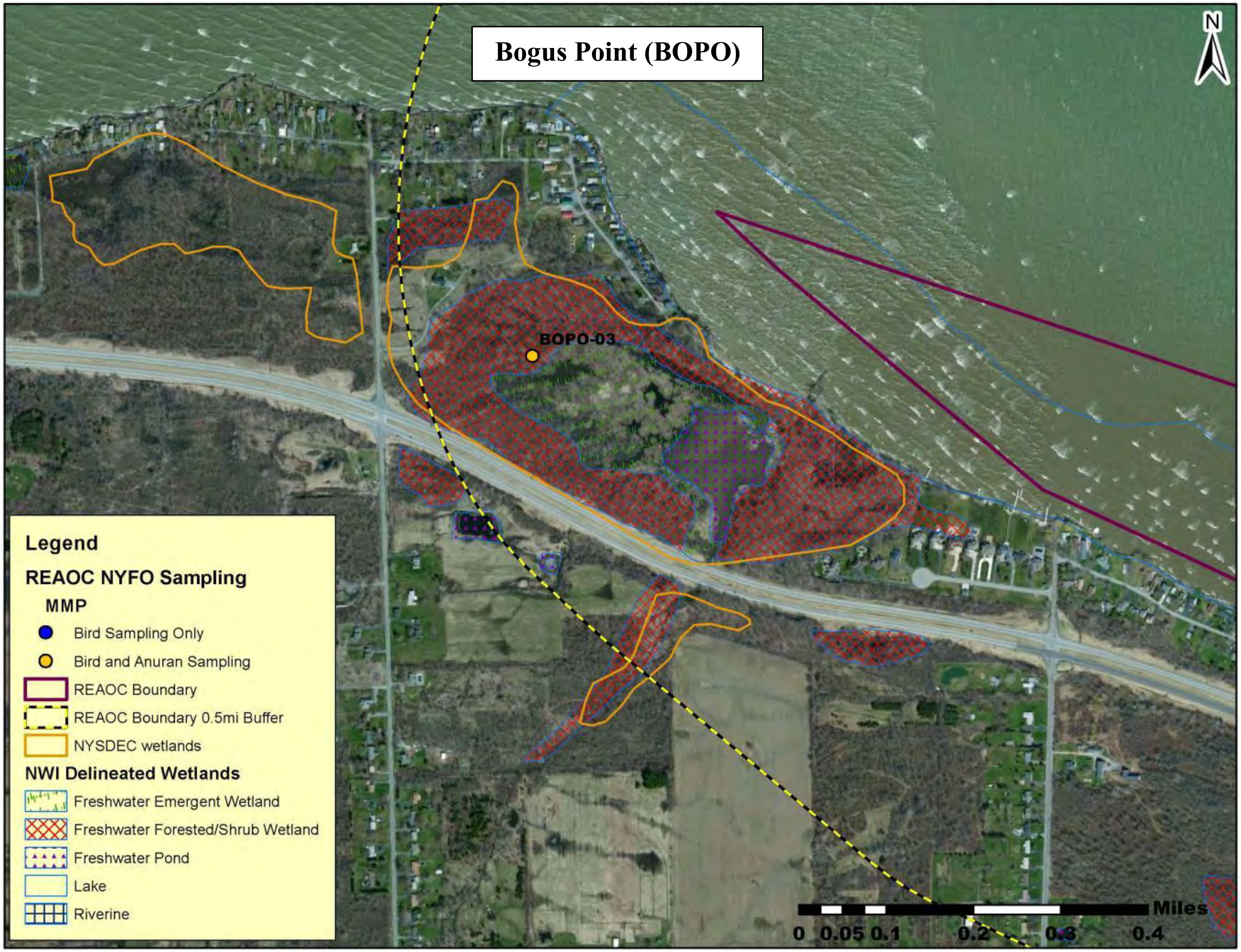
ATTACHMENT 3-3: NYFO Field Sampling Locations - MMP

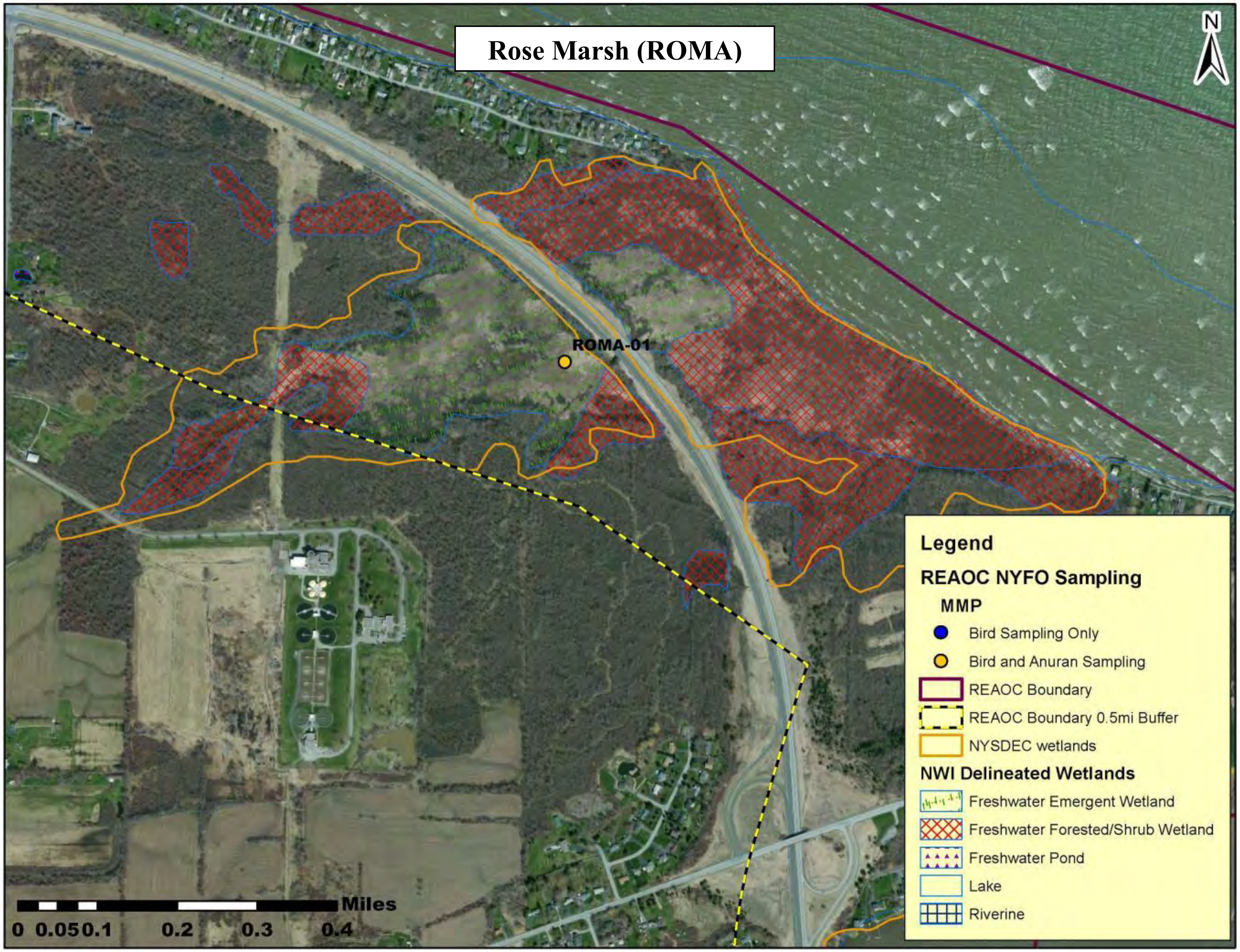
Sampling Station IDs by Waterbody/Wetland Complex
(presented west to east in the project area)

Animal Communities – Marsh Monitoring Program (MMP)

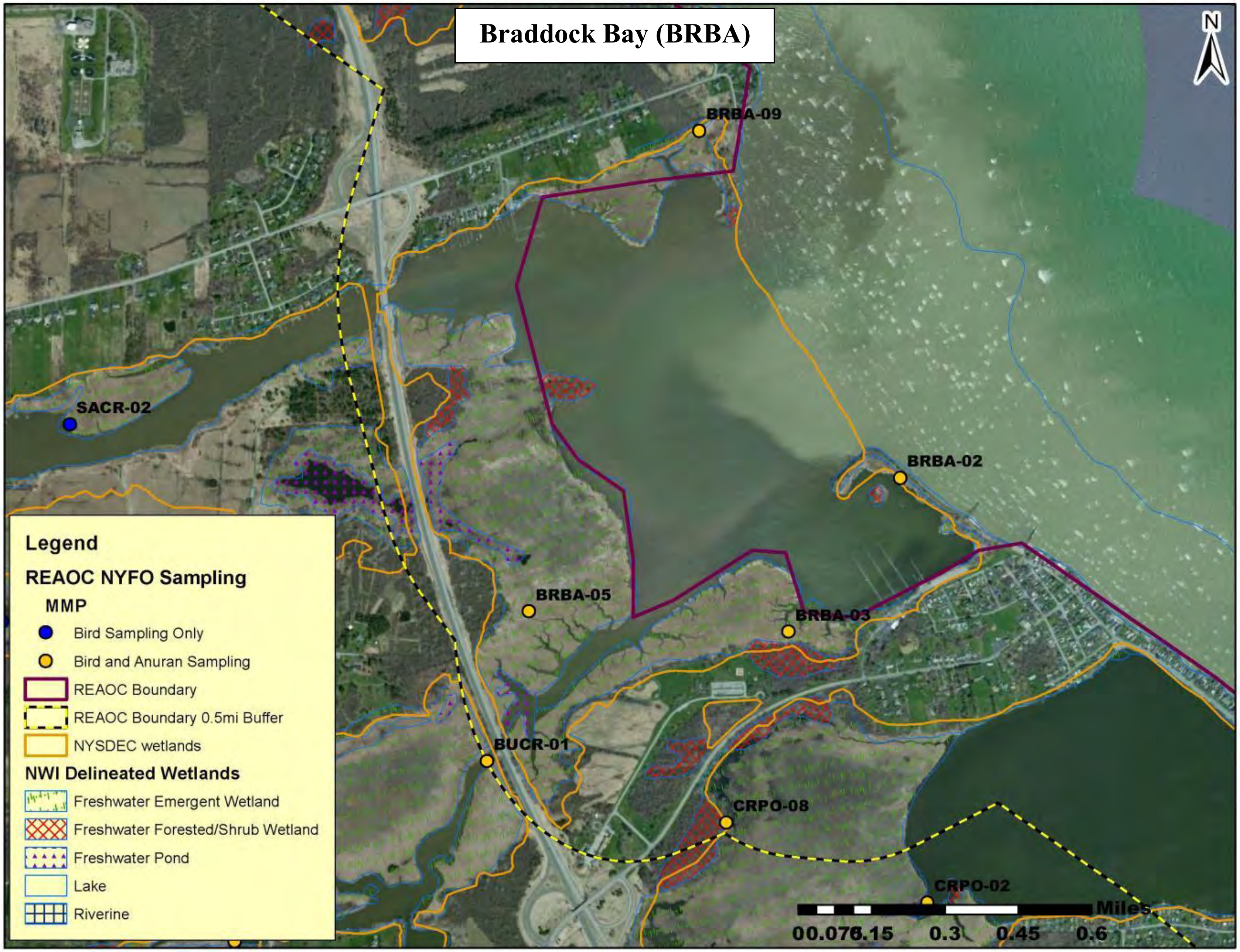
Bogus Point (BOPO)
Rose Marsh (ROMA)
Braddock Bay (BRBA)
Braddock Bay Tributaries:
- West Creek (WECR)
- Salmon Creek (SACR)
- Buttonwood Creek (BUCR)

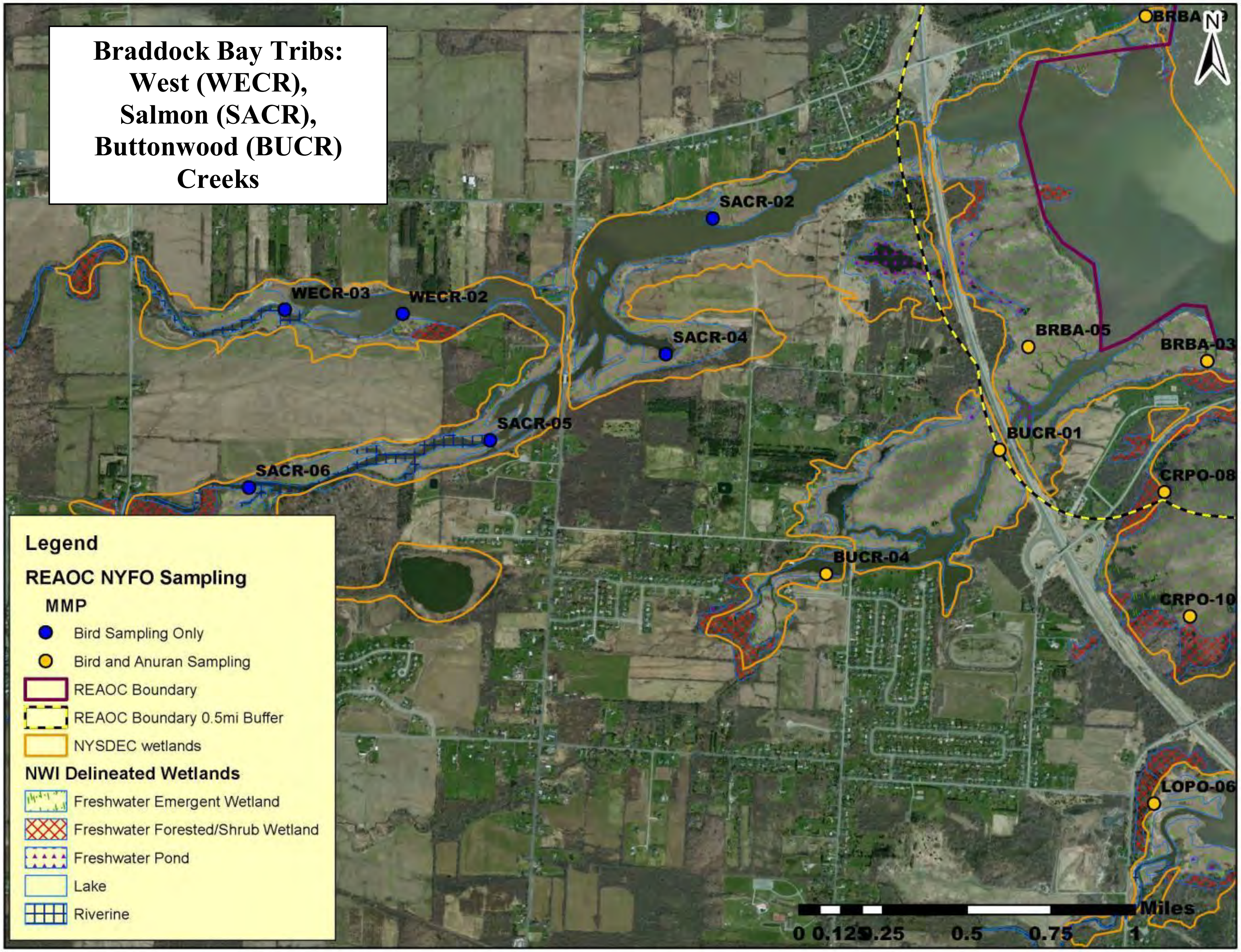
Cranberry Pond (CRPO)
Long Pond (LOPO) and Northrup Creek (NOCR)
Buck Pond (BUPO) and Larkin Creek (LACR)
Round Pond (ROPO)
Slater Creek (SLCR)
Genesee River (GERI)
Irondequoit Bay (IRBA)
Irondequoit Creek (IRCR)

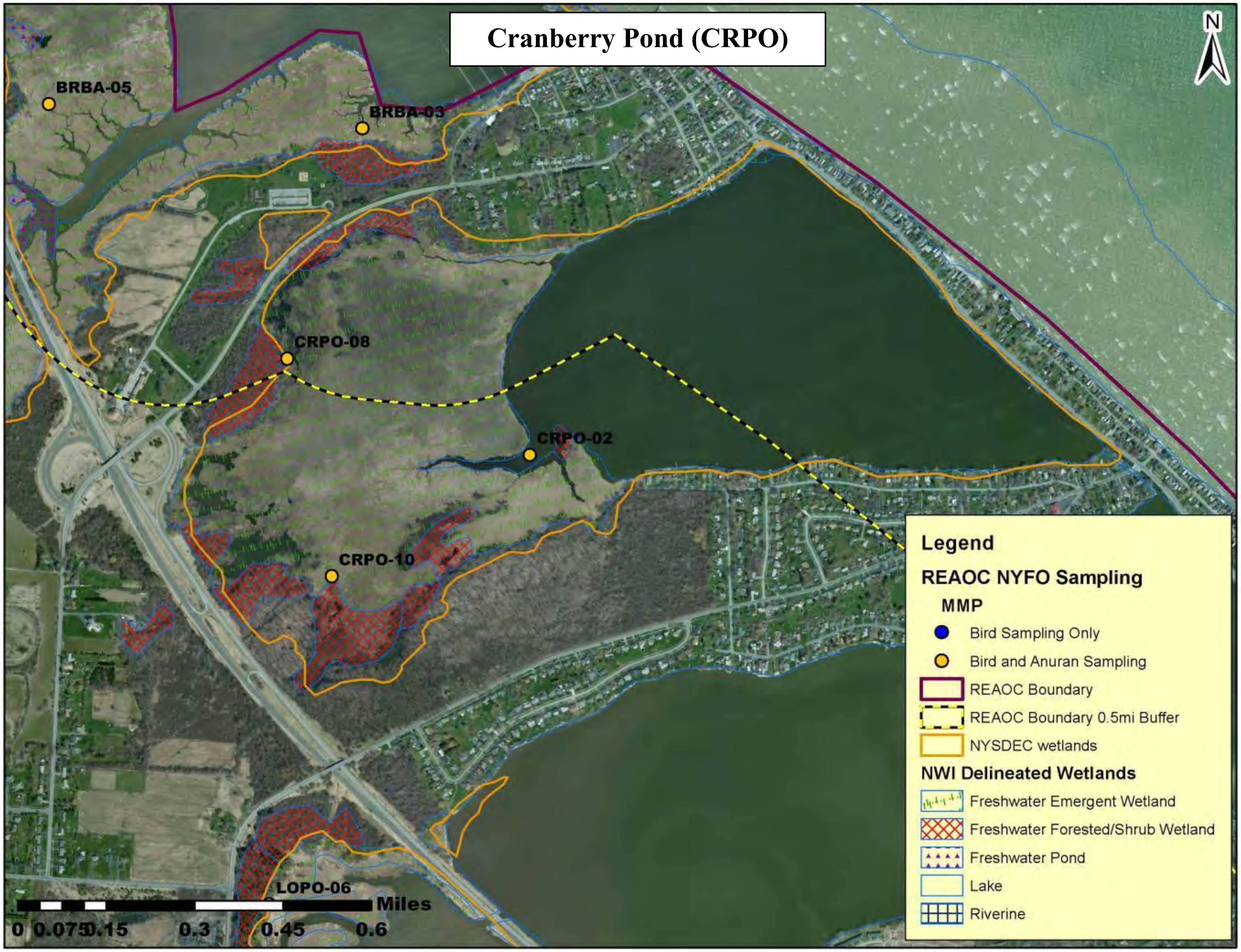

Bogus Point (BOPO)
N
BOPO-03
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.05 0.1 0.2 0.3 0.4

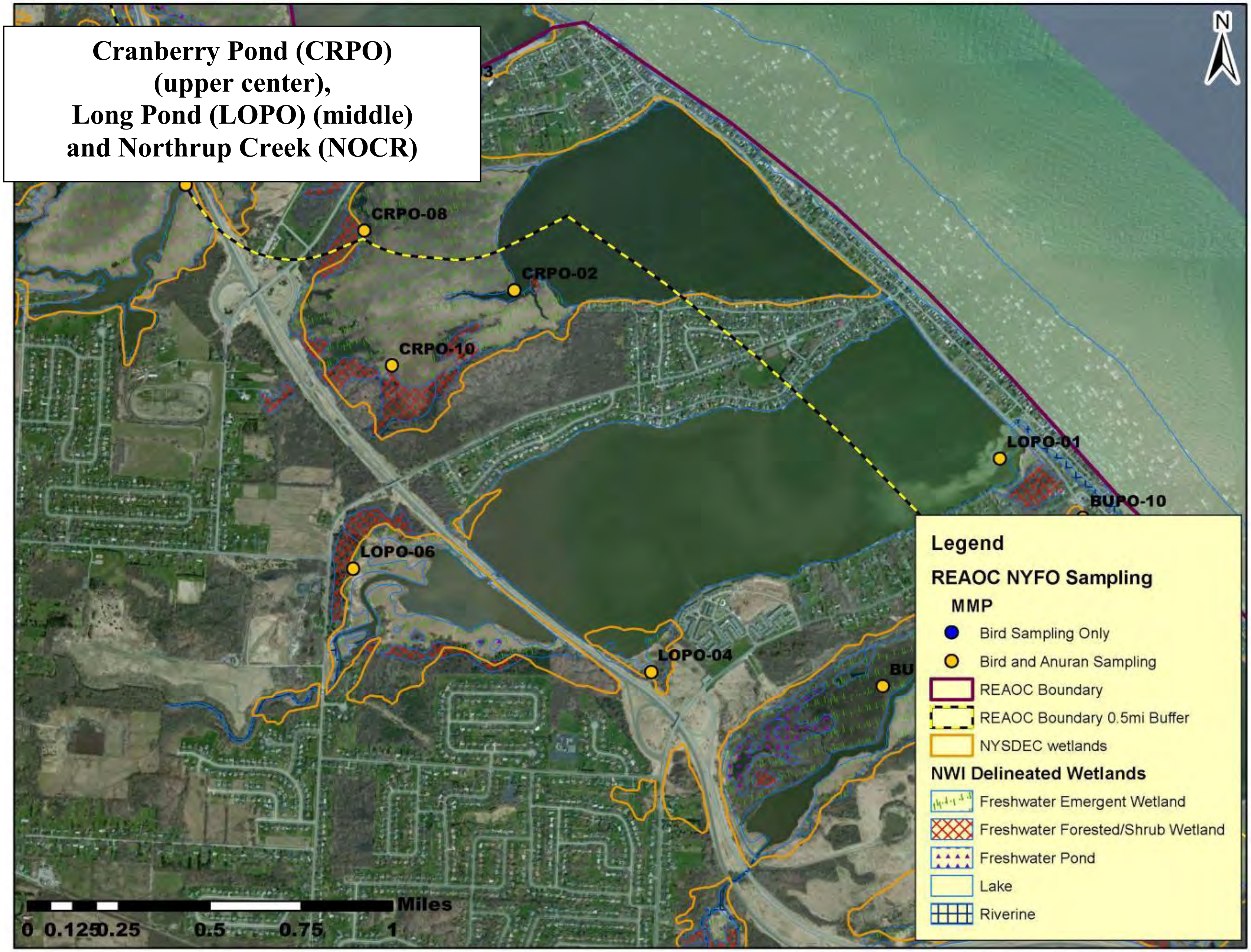


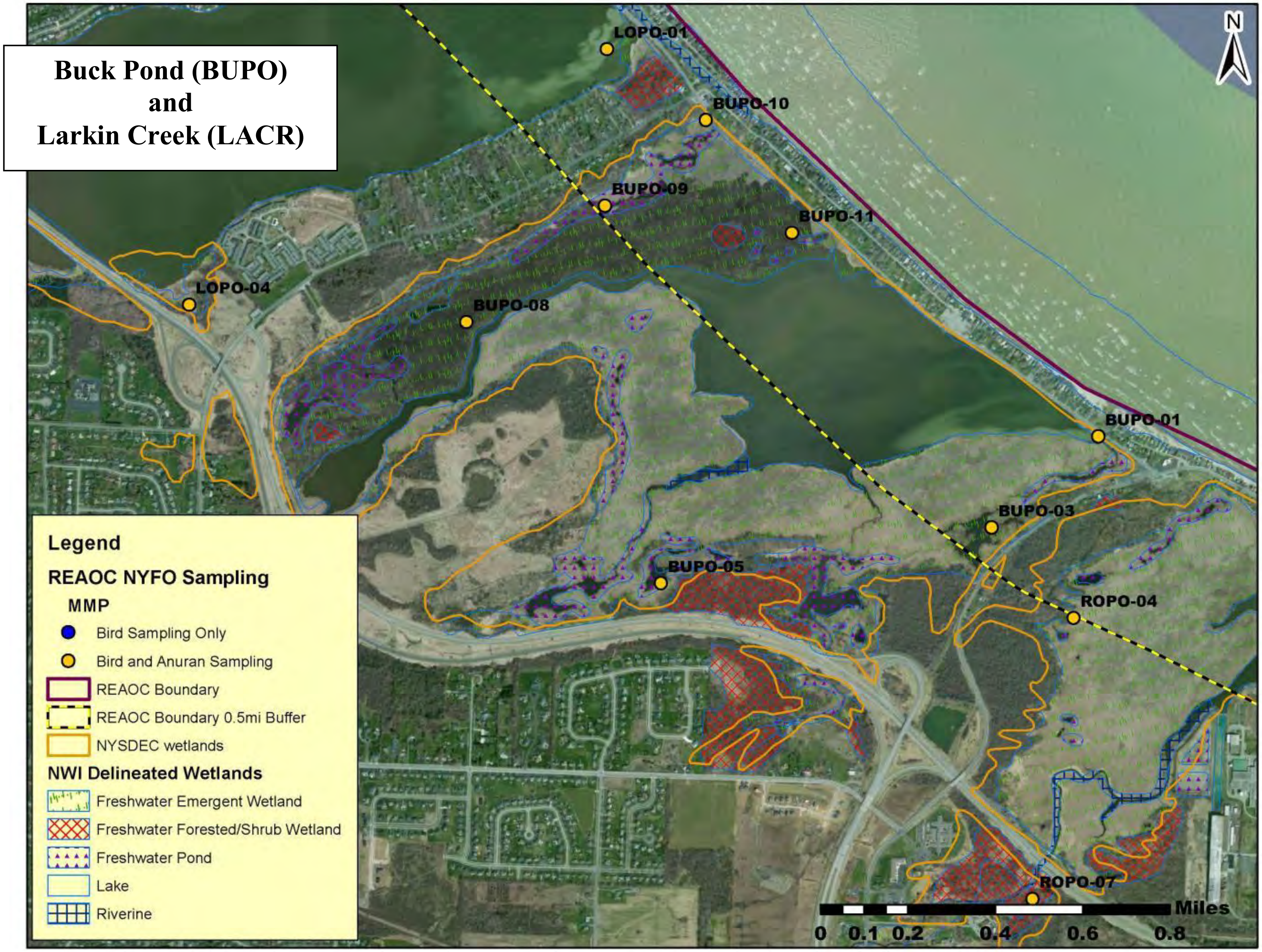
Rose Marsh (ROMA)
N
ROMA-01
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.05 0.1 0.2 0.3 0.4

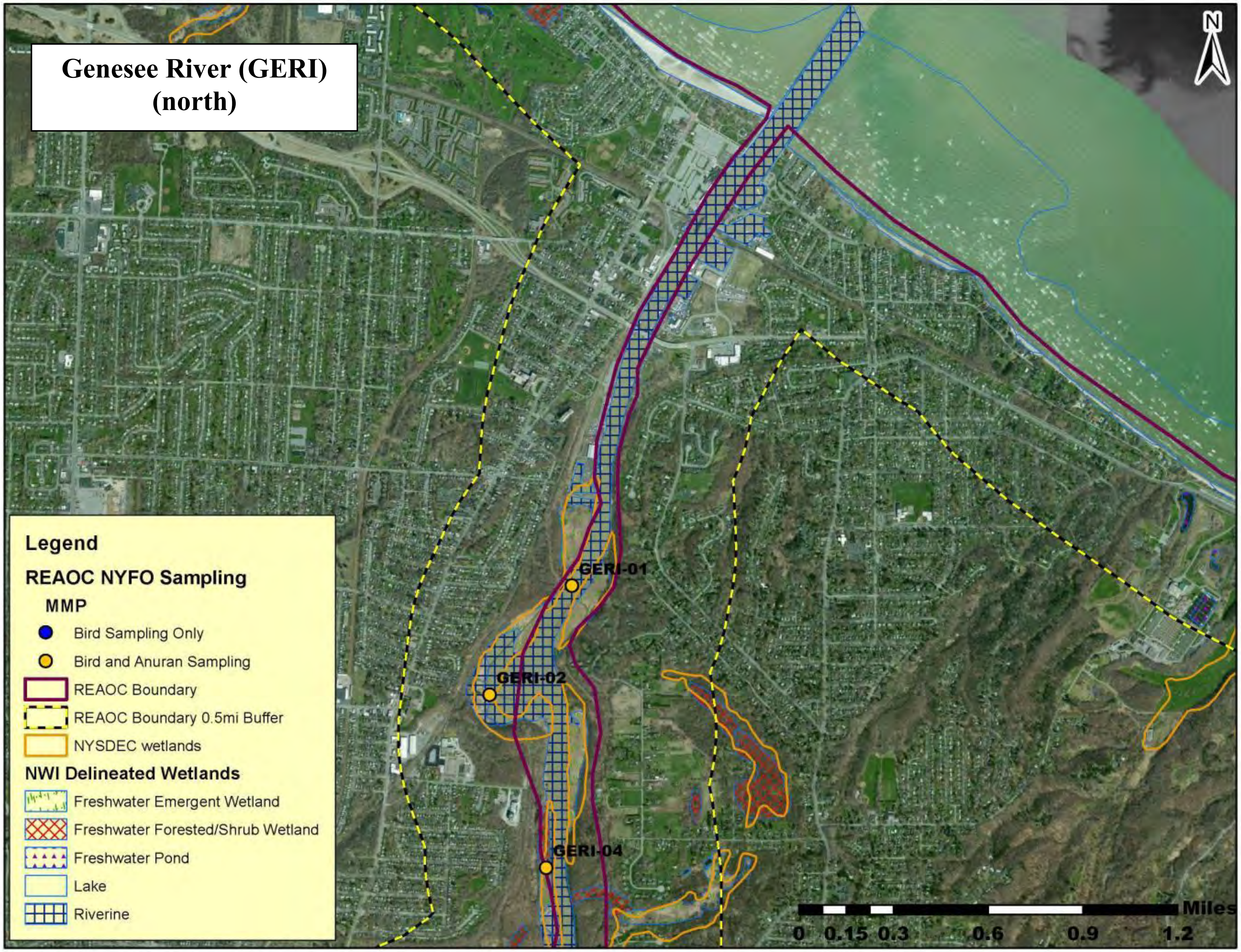

Braddock Bay (BRBA)
N
BRBA-09
SACR-02
BRBA-02
BRBA-05
BRBA-03
BUCR-01
CRPO-08
CRPO-02
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
00.0750.15 0.3 0.45 0.6

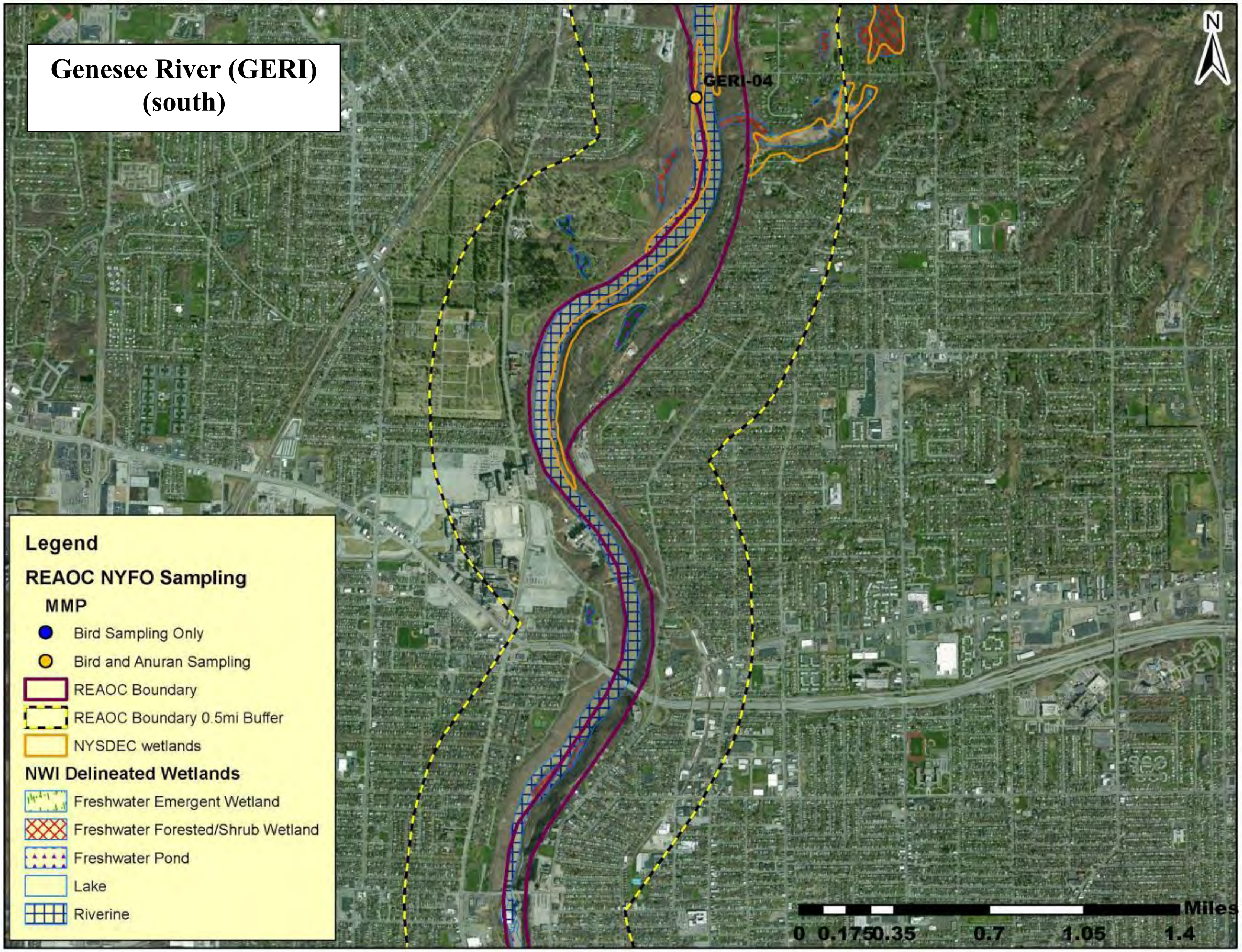

Braddock Bay Tribs:
West (WECR),
Salmon (SACR),
Buttonwood (BUCR)
Creeks
N
BRBA-09
SACR-02
WECR-03
WECR-02
SACR-04
BRBA-05
BRBA-03
SACR-05
BUCR-01
SACR-06
CRPO-08
BUCR-04
CRPO-10
LOPO-06
Miles
0 0.125 0.25 0.5 0.75 1
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

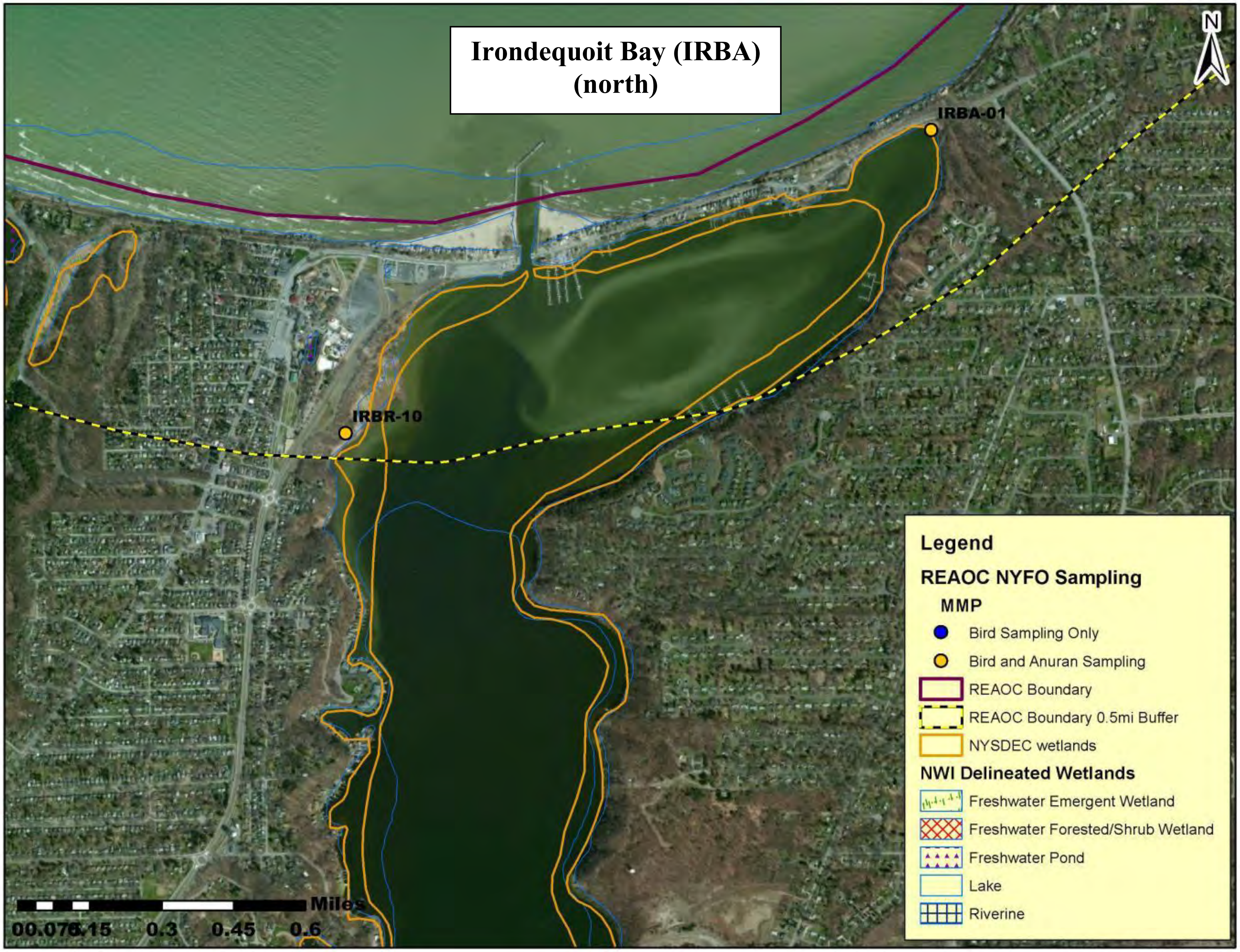

Cranberry Pond (CRPO)
N
BRBA-05
BRBA-03
CRPO-08
CRPO-02
CRPO-10
LOPO-06
Miles
0 0.075 0.15 0.3 0.45 0.6
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine

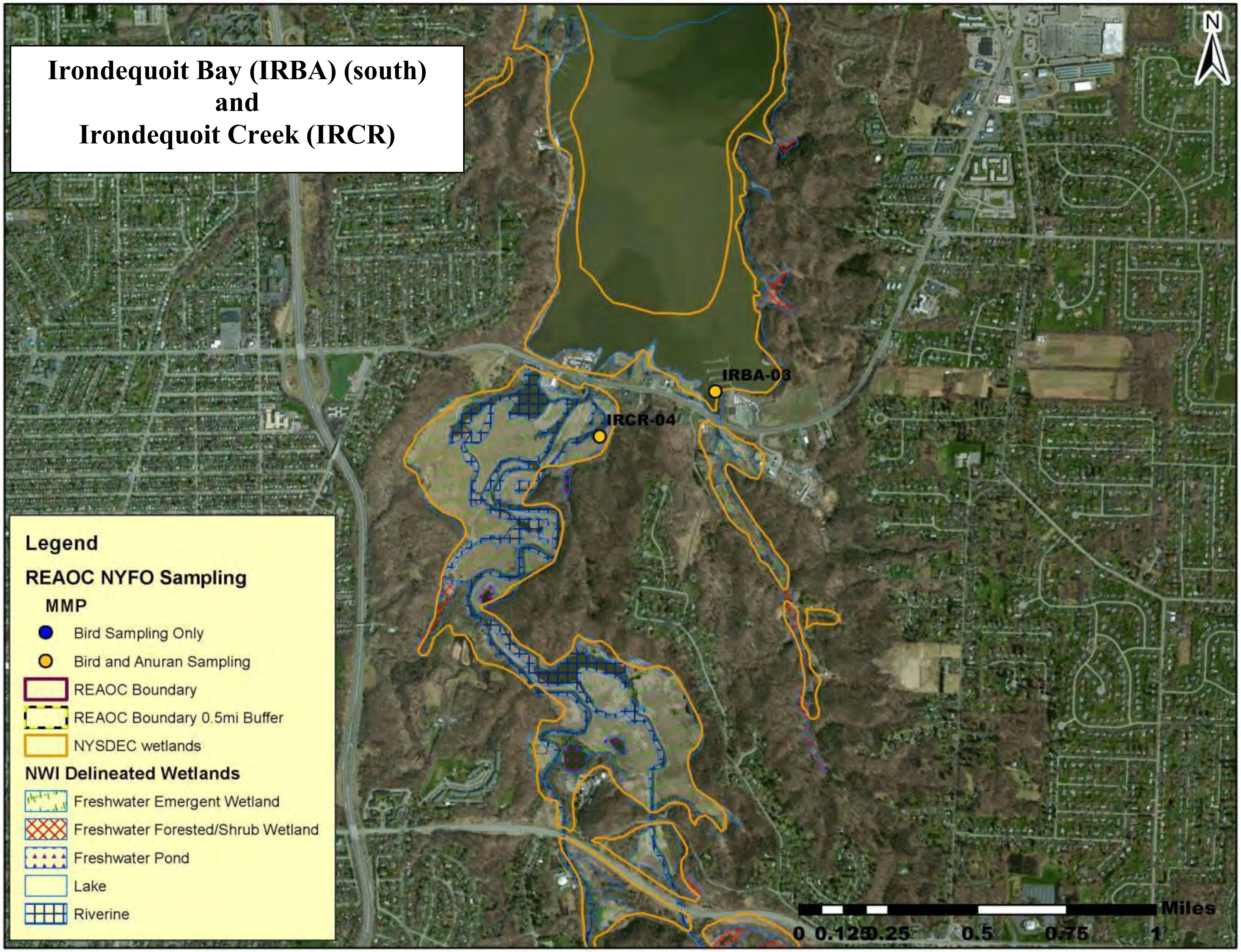

Cranberry Pond (CRPO)
(upper center),
Long Pond (LOPO) (middle)
and Northrup Creek (NOCR)
CRPO-08
CRPO-02
CRPO-10
LOPO-01
BUPO-10
LOPO-06
LOPO-04
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.125 0.25 0.5 0.75 1
N


Buck Pond (BUPO)
and
Larkin Creek (LACR)
LOPO-01
BUPO-10
BUPO-09
BUPO-11
LOPO-04
BUPO-08
BUPO-01
BUPO-03
BUPO-05
ROPO-04
ROPO-07
N
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
0 0.1 0.2 0.4 0.6 0.8
Miles


Genesee River (GERI)
(north)
N
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
GERI-01
GERI-02
GERI-04
Miles
0 0.15 0.3 0.6 0.9 1.2


Genesee River (GERI)
(south)
GERI-04
N
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
0 0.175 0.35 0.7 1.05 1.4
Miles


Irondequoit Bay (IRBA)
(north)
N
IRBA-01
IRBR-10
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.075 0.15 0.3 0.45 0.6


Irondequoit Bay (IRBA) (south)
and
Irondequoit Creek (IRCR)
IRBA-03
IRCR-04
Legend
REAOC NYFO Sampling
MMP
Bird Sampling Only
Bird and Anuran Sampling
REAOC Boundary
REAOC Boundary 0.5mi Buffer
NYSDEC wetlands
NWI Delineated Wetlands
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Miles
0 0.125 0.25 0.5 0.75 1
N

ATTACHMENT 3-4: Metric Scores - RAM

By Sampling Station ID
(presented west to east in the project area)

Structural Habitat – USEPA's USA Rapid Assessment Method (RAM)

Bogus Point (BOPO)
Rose Marsh (ROMA)
Braddock Bay (BRBA)
Braddock Bay Tributaries:
- West Creek (WECR)
- Salmon Creek (SACR)
- Buttonwood Creek (BUCR)

Cranberry Pond (CRPO)
Long Pond (LOPO) and Northrup Creek (NOCR)
Buck Pond (BUPO) and Larkin Creek (LACR)
Round Pond (ROPO)
Slater Creek (SLCR)
Genesee River (GERI)
Irondequoit Bay (IRBA)
Irondequoit Creek (IRCR)

			Structural Habitat RAM Data - Fall 2012													Structural Habitat RAM Data - Spring 2013												
Station ID	Latitude	Longitude	Overall Score	Topographic Complexity	Altered Hydroperiod	Altered Substrate	Water Quality Stress	Vegetation Disturbance	Invasive Species Cover	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	Percent AA With Buffer	Buffer Width	Patch Mosaic Complexity	Overall Score	Topographic Complexity	Altered Hydroperiod	Altered Substrate	Water Quality Stress	Vegetation Disturbance	Invasive Species Cover	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	Percent AA With Buffer	Buffer Width	Patch Mosaic Complexity
BOPO-01	276701	4801840	102	12	3	3	12	12	9	9	3	6	12	12	9	117	9	9	12	6	12	6	12	12	6	12	12	9
BOPO-02	276410	4801854	120	6	12	12	12	12	9	6	9	9	12	12	9													
BOPO-03	276227	4801959														114	3	12	12	12	12	6	9	9	12	12	12	3
ROMA-01	278302	4800717	102	3	12	12	12	12	12	3	3	3	12	12	6	102	6	9	12	9	12	9	6	6	3	12	12	6
ROMA-02	278628	4800680	111	6	12	12	12	12	9	9	6	3	12	12	6	108	6	9	12	12	12	6	9	9	3	12	12	6
BRBA-01	280408	4798724	120	6	12	12	9	12	12	12	9	6	12	12	6	117	6	12	12	9	12	12	12	6	6	12	12	6
BRBA-02	280492	4798829														102	6	9	12	9	12	6	9	9	3	12	12	3
BRBA-03	280124	4798323														111	6	12	12	9	12	6	9	9	9	12	12	3
BRBA-04	279664	4798328	105	3	12	12	12	12	12	6	6	3	12	12	3	99	6	12	9	9	12	6	6	9	3	12	12	3
BRBA-05	279269	4798390														102	3	9	12	12	12	9	6	3	9	12	12	3
BRBA-06	279512	4798766	117	6	12	12	12	12	12	6	6	12	12	12	3	105	6	12	9	6	12	9	6	6	12	12	12	3
BRBA-07	279406	4798914	120	9	12	12	12	12	9	9	6	12	12	12	3	111	6	12	9	9	12	9	9	6	12	12	12	3
BRBA-08	279588	4799585	114	3	12	12	12	12	9	9	6	12	12	12	3													
BRBA-09	279830	4799971														117	3	12	12	12	12	12	9	9	3	12	12	9
BRBA-10	279971	4799226																										
WECR-01	276892	4798633																										
WECR-02	276271	4798655														105	3	12	12	9	12	9	6	6	6	12	12	6
WECR-03	275710	4798568														105	6	12	12	6	12	9	6	6	6	12	12	6

			Structural Habitat RAM Data - Fall 2012													Structural Habitat RAM Data - Spring 2013												
Station ID	**Latitude**	**Longitude**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**
WECR-04	274984	4798815																										
SACR-01	278409	4799240																										
SACR-02	277758	4799005	105	3	12	12	9	12	9	9	9	3	12	12	3	93	3	12	12	6	9	6	6	6	6	12	12	3
SACR-03	277218	4798407																										
SACR-04	277534	4798355														111	3	12	12	9	12	9	6	6	12	12	12	6
SACR-05	276694	4797944	96	9	9	12	9	12	6	6	3	3	12	12	3	102	6	12	12	9	12	6	6	6	3	12	12	6
SACR-06	275538	4797717	111	6	12	12	12	12	12	6	6	3	12	12	6	90	6	12	9	3	6	6	9	6	3	12	12	6
SACR-07	274942	4797484																										
BUCR-01	279131	4797898														99	3	9	12	9	12	12	6	6	3	12	12	3
BUCR-03	278495	4797344																										
BUCR-04	278301	4797304														111	6	12	12	6	12	12	9	9	3	12	9	9
CRPO-01	282096	4797457	90	6	12	12	12	9	9	6	3	3	9	6	3													
CRPO-02	280581	4797432	111	3	12	12	9	12	12	9	6	9	12	12	3	108	6	12	12	9	12	9	6	6	9	12	12	3
CRPO-03	280470	4797456	111	3	12	12	12	12	12	6	3	12	12	12	3	114	6	12	12	12	12	9	6	6	12	12	12	3
CRPO-04	280618	4797764	108	3	12	12	12	12	9	6	3	12	12	12	3													
CRPO-05	281216	4798245	81	3	9	9	9	9	12	6	3	3	9	6	3													
CRPO-06	281240	4797771																										
CRPO-07	279918	4797870	117	9	12	12	12	12	9	9	9	3	12	9	9													

			Structural Habitat RAM Data - Fall 2012													Structural Habitat RAM Data - Spring 2013												
Station ID	Latitude	Longitude	Overall Score	Topographic Complexity	Altered Hydroperiod	Altered Substrate	Water Quality Stress	Vegetation Disturbance	Invasive Species Cover	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	Percent AA With Buffer	Buffer Width	Patch Mosaic Complexity	Overall Score	Topographic Complexity	Altered Hydroperiod	Altered Substrate	Water Quality Stress	Vegetation Disturbance	Invasive Species Cover	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	Percent AA With Buffer	Buffer Width	Patch Mosaic Complexity
CRPO-08	279919	4797695														117	6	12	12	9	12	6	12	12	9	12	12	3
CRPO-09	279836	4797076	117	6	9	12	12	12	12	9	12	3	12	12	6													
CRPO-10	280041	4797101														111	6	12	12	9	12	6	9	9	9	12	12	3
CRPO-11	280144	4797051	114	3	12	12	12	12	12	3	6	12	12	12	6													
CRPO-12	280162	4796890	129	9	12	12	12	12	12	9	12	9	12	12	6	114	6	12	12	12	12	3	9	9	9	12	12	6
LOPO-01	282722	4796690	105	12	12	9	9	12	9	9	6	3	12	9	3	90	6	6	9	9	12	9	6	6	3	12	9	3
LOPO-02	282907	4796628	105	3	12	9	12	9	12	9	9	3	12	9	6	108	6	6	12	12	12	6	12	12	3	12	9	6
LOPO-03	280978	4795885	90	9	9	3	9	9	9	9	6	3	12	9	3													
LOPO-04	281183	4795749														108	6	9	12	12	12	6	9	12	3	12	12	3
LOPO-05	280457	4796141	90	6	9	9	6	9	9	9	6	3	12	9	3													
LOPO-06	279870	4796205	117	9	9	9	12	12	12	9	12	3	12	12	6	96	6	6	9	9	12	6	9	6	3	12	12	6
LOPO-07	282157	4796759																										
NOCR-01	280195	4796119	108	9	12	9	9	12	9	6	6	9	12	12	3	102	6	12	12	6	12	6	6	6	9	12	12	3
NOCR-02	279815	4795823	99	3	12	12	12	9	9	9	6	3	12	6	6													
NOCR-03	278327	4795643																										
BUPO-01	284532	4795265														84	6	6	9	6	12	6	6	6	3	9	9	6
BUPO-02	284415	4795300	96	3	12	12	12	12	9	6	3	3	12	9	3	90	3	6	12	9	12	9	6	6	3	12	9	3
BUPO-03	284139	4794930	108	6	12	12	12	12	9	6	6	3	12	12	6	105	9	9	12	9	12	6	6	6	3	12	12	9

			Structural Habitat RAM Data - Fall 2012													Structural Habitat RAM Data - Spring 2013												
Station ID	**Latitude**	**Longitude**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**
BUPO-04	283608	4795152	108	6	12	12	9	12	12	6	6	6	12	12	3	108	6	12	12	9	12	6	9	9	6	12	12	3
BUPO-05	282922	4794725														102	3	9	12	9	12	6	9	9	3	12	12	6
BUPO-06	283292	4795259	102	3	12	12	12	12	9	6	6	3	12	12	3													
BUPO-07	283198	4795385	114	9	12	6	12	12	12	6	6	12	12	12	3	108	6	12	6	9	12	6	9	9	12	12	12	3
BUPO-08	282205	4795686														102	3	12	12	12	12	9	3	3	9	12	12	3
BUPO-09	282715	4796114														111	3	12	12	12	12	9	6	3	12	12	12	6
BUPO-10	283087	4796429														93	3	9	12	12	9	6	9	9	3	9	9	3
BUPO-11	283404	4796014														96	3	6	12	12	12	6	6	9	3	12	12	3
BUPO-12	283629	4795546																										
BUPO-13	283313	4794217	102	3	9	9	12	12	9	9	9	3	12	12	3													
LACR-01	281696	4794997	102	12	6	9	9	12	12	6	6	3	12	9	6													
LACR-02	281548	4794648	114	12	9	9	12	9	9	9	9	3	12	12	9													
LACR-03	281196	4794217																										
ROPO-01	285212	4794779	111	6	12	12	12	12	12	6	6	6	12	12	3													
ROPO-02	285178	4794508	114	6	12	12	12	12	9	6	6	12	12	12	3													
ROPO-03	285399	4794694																										
ROPO-04	284442	4794597														111	3	12	12	12	12	9	6	6	12	12	12	3
ROPO-05	284280	4793449	123	6	12	9	12	12	12	9	12	6	12	12	9	117	3	12	12	12	12	9	9	9	6	12	12	9

			Structural Habitat RAM Data - Fall 2012													Structural Habitat RAM Data - Spring 2013												
Station ID	**Latitude**	**Longitude**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**
ROPO-06	284312	4793663																										
ROPO-07	284290	4793563														114	6	9	12	12	12	9	9	12	3	12	12	6
SLCR-01	286841	4794070																										
SLCR-02	285962	4793480	84	9	3	3	9	3	9	9	9	3	12	9	6													
SLCR-03	285634	4793085																										
GERI-01	287641	4790423	87	6	12	3	3	12	9	6	6	3	12	12	3	96	6	12	9	9	12	6	6	6	3	12	12	3
GERI-02	287503	4789743														90	6	9	9	6	12	9	6	6	3	12	9	3
GERI-03	287572	4789765	78	6	9	3	9	3	12	6	3	3	12	9	3	90	6	6	3	9	12	9	9	9	3	12	9	3
GERI-04	287509	4788986														99	6	9	9	9	12	6	6	9	3	12	12	6
GERI-05	287574	4788459																										
GERI-06	287027	4787878	111	12	12	6	12	12	9	9	6	6	12	12	3													
GERI-07	286862	4786504																										
GERI-08	286909	4785311																										
GERI-09	286685	4785014	96	12	3	3	3	12	9	9	12	3	12	12	6													
GERI-10	286452	4784676																										
IRBA-01	295596	4790432	108	12	9	12	9	12	6	9	9	3	12	9	6	99	6	9	9	9	12	6	9	6	3	12	9	9
IRBA-02	295242	4787338	123	9	12	12	9	12	12	9	6	9	12	12	9													
IRBA-03	295213	4783410	78	12	3	6	3	6	12	6	6	3	12	6	3	93	3	9	12	9	12	6	6	6	3	12	9	6

			Structural Habitat RAM Data - Fall 2012													Structural Habitat RAM Data - Spring 2013												
Station ID	**Latitude**	**Longitude**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**	**Overall Score**	**Topographic Complexity**	**Altered Hydroperiod**	**Altered Substrate**	**Water Quality Stress**	**Vegetation Disturbance**	**Invasive Species Cover**	**Vertical Complexity**	**Plant Community Complexity**	**Buffer Zone Stress**	**Percent AA With Buffer**	**Buffer Width**	**Patch Mosaic Complexity**
IRBA-04	294635	4784282																										
IRBA-05	294453	4785191	114	6	12	12	12	12	9	9	6	6	12	12	6													
IRBA-06	294342	4786117	102	12	12	9	12	12	9	3	3	3	12	12	3													
IRBA-07	293521	4787407	93	6	12	12	9	12	9	6	6	3	3	12	3													
IRBA-08	293489	4787710	96	3	12	12	9	9	9	9	6	3	12	6	6													
IRBA-09	293811	4789572	105	3	12	12	12	12	6	6	6	9	12	12	3													
IRBA-10	293633	4789416														111	6	12	12	9	12	9	6	6	6	12	12	9
IRBA-11	294048	4788126																										
IRCR-01	294655	4783432																										
IRCR-02	294201	4782898	114	6	12	12	12	12	12	6	6	9	12	12	3													
IRCR-03	294550	4782064																										
IRCR-04	294693	4783207														96	6	6	9	9	12	6	6	6	6	12	12	6
LAON-01	276467	4802278																										
LAON-02	279905	4800413																										
LAON-03	280896	4798708																										
LAON-04	283688	4796406																										
LAON-05	286377	4794559																										
LAON-06	287861	4793462																										

Station ID	Latitude	Longitude	Structural Habitat RAM Data - Fall 2012: Overall Score	Topographic Complexity	Altered Hydroperiod	Altered Substrate	Water Quality Stress	Vegetation Disturbance	Invasive Species Cover	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	Percent AA With Buffer	Buffer Width	Patch Mosaic Complexity	Structural Habitat RAM Data - Spring 2013: Overall Score	Topographic Complexity	Altered Hydroperiod	Altered Substrate	Water Quality Stress	Vegetation Disturbance	Invasive Species Cover	Vertical Complexity	Plant Community Complexity	Buffer Zone Stress	Percent AA With Buffer	Buffer Width	Patch Mosaic Complexity
LAON-07	291542	4790767																										
LAON-08	293417	4790138																										
LAON-09	297209	4791699																										
LAON-10	301253	4792829																										

ATTACHMENT 3-5: Parameter Values - WQ

By Sampling Station ID
(presented west to east in the project area)

Water Quality

Bogus Point (BOPO)
Rose Marsh (ROMA)
Braddock Bay (BRBA)
Braddock Bay Tributaries:
- West Creek (WECR)
- Salmon Creek (SACR)
- Buttonwood Creek (BUCR)

Cranberry Pond (CRPO)
Long Pond (LOPO) and Northrup Creek (NOCR)
Buck Pond (BUPO) and Larkin Creek (LACR)
Round Pond (ROPO)
Slater Creek (SLCR)
Genesee River (GERI)
Irondequoit Bay (IRBA)
Irondequoit Creek (IRCR)
Lake Ontario (LAON)

			YSI Data - Fall 2012									YSI Data - Spring 2013										Water Grab Sample Data - Fall 2012							
Station ID	Latitude	Longitude	TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Water Temperature (C)	pH	TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Oxidation-Reduction Potential (mV)	Water Temperature (C)	pH	Total P (mg/L)	Orthophosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Nitrate+Nitrite (mg/L)	TSS (mg/L)
BOPO-01	276701	4801840	340	4.4	39.7	524.0	380.4	0.25	2629	10.7	6.8	221	2.96	34	339.8	322.0	0.16	3106	22.9	22.3	NA	0.734	0.108	6.840	2.46	0.050	0.01	0.018	89
BOPO-02	276410	4801854																											
BOPO-03	276227	4801959										423	0.46	5.5	648.0	641.0	0.31	1559	-158.3	24.5	NA								
ROMA-01	278302	4800717										566	0.4	4.5	872.0	808.0	0.43	1237	-159.1	21.1	NA								
ROMA-02	278628	4800680										566	0.14	1.5	868.0	809.0	0.43	1236	-124.9	21.5	NA								
BRBA-01	280408	4798724	232	10.5	116	356.6	324.8	0.17	3079	20.3	NA	205	10	70.8	385.8	365.6	0.18	2735	116.3	22.3	NA	0.205	0.006	2.060	0.269	0.050	0.01	0.027	104
BRBA-02	280492	4798829										219	5.44	60.4	337.2	307.3	0.16	3254	43.4	20.4	NA								
BRBA-03	280124	4798323										251	6.3	72.5	385.9	365.9	0.18	2733	111.6	22.3	NA								
BRBA-04	279664	4798328	343	9.85	107	528.0	470.1	0.26	2127	19.3	NA	210	9.79	113	323.4	307.2	0.15	3255	79.1	22.4	NA	0.113	0.052	0.880	0.017	0.050	0.01	0.003	3.5
BRBA-05	279269	4798390										384	0.09	1.1	586.0	577.0	0.28	1733	-211.7	24.2	NA								
BRBA-06	279512	4798766										207	12.4	141	318.6	297.4	0.15	3363	33.7	21.5	NA								
BRBA-07	279406	4798914	236	7.37	82.6	363.5	335.2	0.17	2984	20.9	NA	293	12.2	141	450.0	426.1	0.22	2347	71.3	22.2	NA	0.114	0.027	1.020	0.337	0.050	0.01	0.028	25.5
BRBA-08	279588	4799585	269	8.32	89.3	414.3	364.6	0.2	2743	18.7	NA											0.119	0.072	0.740	0.026	0.050	0.01	0.009	8.8
BRBA-09	279830	4799971										592	0.09	1.1	913.0	883.0	0.45	1132	-180.3	23.3	NA								
BRBA-10	279971	4799226	221	9.88	107	340.5	303.3	0.16	3297	19.3	NA											0.077	0.006	1.000	0.071	0.050	0.01	0.045	48
WECR-01	276892	4798633	270	2.6	27.2	415.0	355.2	0.2	2816	17.4	NA											1.960	0.057	13.200	0.212	0.050	0.01	0.028	1200
WECR-02	276271	4798655										287	5.14	57.4	441.6	405.7	0.21	2465	79.4	20.7	NA								

			YSI Data - Fall 2012									YSI Data - Spring 2013										Water Grab Sample Data - Fall 2012							
Station ID	**Latitude**	**Longitude**	**TDS (mg/L)**	**DO (mg/L)**	**DO (%)**	**Specific Conductance (uS/cm)**	**Conductivity (uS/cm)**	**Salinity (ppt)**	**Resistivity (Ohms)**	**Water Temperature (C)**	**pH**	**TDS (mg/L)**	**DO (mg/L)**	**DO (%)**	**Specific Conductance (uS/cm)**	**Conductivity (uS/cm)**	**Salinity (ppt)**	**Resistivity (Ohms)**	**Oxidation-Reduction Potential (mV)**	**Water Temperature (C)**	**pH**	**Total P (mg/L)**	**Orthophosphate (mg/L)**	**Total Kjeldahl Nitrogen (mg/L)**	**Ammonia (mg/L)**	**Nitrate (mg/L)**	**Nitrite (mg/L)**	**Nitrate+Nitrite (mg/L)**	**TSS (mg/L)**
WECR-03	275710	4798568										317	8.18	91.2	488.4	447.7	0.24	2234	59.7	20.6	NA								
WECR-04	274984	4798815	306	7.09	62.2	470.3	331.0	0.23	3021	9.5	7.9											0.394	0.150	1.680	0.013	0.050	0.01	0.022	61.8
SACR-01	278409	4799240	379	8.75	90.3	583.0	492.1	0.28	2032	16.8	NA											0.090	0.014	0.910	0.025	0.050	0.01	0.014	25.6
SACR-02	277758	4799005										301	6.58	74.6	462.8	432.1	0.22	2314	75.1	21.5	NA								
SACR-03	277218	4798407	321	8.07	83.6	493.7	418.2	0.24	2391	17	NA											0.059	0.026	0.480	0.034	0.050	0.01	0.028	6.1
SACR-04	277534	4798355										85.8	0.09	1	131.7	114.9	0.06	8702	-256.7	18.3	NA								
SACR-05	276694	4797944	407	3.46	32.1	626.0	469.6	0.31	2130	11.9	7.52	442	8.61	97.6	684.0	637.0	0.33	1569	28.6	21.4	NA	0.123	0.072	0.710	0.01	0.050	0.01	0.009	11.8
SACR-06	275538	4797717										455	10.2	114	702.0	644.0	0.34	1552	51.0	20.7	NA								
SACR-07	274942	4797484	408	8.37	75.6	627.0	456.2	0.31	2192	10.8	8.44											0.132	0.069	0.580	0.01	0.050	0.01	0.006	31.3
BUCR-01	279131	4797898	375	6.7	55.5	540.0	481.5	0.26	2077	19.3	NA											0.134	0.065	1.060	0.035	0.050	0.01	0.017	3.4
BUCR-03	278495	4797344	416	8.02	87.7	637.0	572.0	0.31	1749	19.7	NA											0.341	0.077	1.680	0.042	0.050	0.01	0.006	179
BUCR-04	278301	4797304										397	8.79	95.7	611.0	546.0	0.3	1832	-36.7	19.4	NA								
CRPO-01	282096	4797457	378	5.08	51	581.0	475.0	0.28	2105	15.5	8.66											0.090	0.018	1.830	0.01	0.050	0.01	0.002	39
CRPO-02	280581	4797432	475	4.53	43.8	734.0	576.0	0.36	1736	13.7	7.91	442	2.47	31.2	676.0	707.0	0.33	1414	-142.5	27.4	NA								
CRPO-03	280470	4797456																											
CRPO-04	280618	4797764	390	7.05	69.4	600.0	480.6	0.29	2081	14.6	8.35	416	7.18	83.3	643.0	614.0	0.31	1630	5.6	22.6	NA	0.086	0.010	1.470	0.12	0.050	0.01	0.003	13
CRPO-05	281216	4798245	380	5.72	55.9	584.0	464.1	0.29	2155	14.2	7.24											0.086	0.016	1.840	0.01	0.050	0.01	0.002	21.1

			YSI Data - Fall 2012									YSI Data - Spring 2013										Water Grab Sample Data - Fall 2012							
Station ID	Latitude	Longitude	TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Water Temperature (C)	pH	TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Oxidation-Reduction Potential (mV)	Water Temperature (C)	pH	Total P (mg/L)	Orthophosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Nitrate+Nitrite (mg/L)	TSS (mg/L)
CRPO-06	281240	4797771	410	3.74	37.2	630.0	510.0	0.31	1960	15	8.4											0.069	0.012	1.520	0.01	0.050	0.01	0.002	18
CRPO-07	279918	4797870																											
CRPO-08	279919	4797695										462	0.63	7.5	713.0	703.0	0.35	1423	-124.0	24.2	NA								
CRPO-09	279836	4797076																											
CRPO-10	280041	4797101										358	0.26	3.1	551.0	534.0	0.27	1873	-95.8	23.4	NA								
CRPO-11	280144	4797051																											
CRPO-12	280162	4796890										269	0.62	7.3	414.2	406.3	0.2	2461	-107.8	24	NA								
LOPO-01	282722	4796690	294	7.63	69.9	452.5	335.0	0.22	2986	11.4	8.96	351	7.5	94.6	544.0	567.0	0.26	1765	-23.6	27.2	NA	0.212	0.026	2.580	0.176	0.081	0.01	0.081	78.8
LOPO-02	282907	4796628																											
LOPO-03	280978	4795885	291	3.97	38.5	447.8	352.7	0.22	2836	13.9	9.14											0.341	0.033	4.780	0.117	0.062	0.023	0.085	647
LOPO-04	281183	4795749										1021	0.44	5.2	1566.0	1532.0	0.79	653	-132.0	23.9	NA								
LOPO-05	280457	4796141	349	3.24	31.1	537.0	419.1	0.26	2386	13.5	8.08											0.062	0.030	0.600	0.119	0.103	0.013	0.116	8
LOPO-06	279870	4796205										442	0.1	1.2	678.0	667.0	0.33	1499	-207.9	24.2	NA								
LOPO-07	282157	4796759																				0.154	0.015	1.920	0.295	0.050	0.01	0.021	23.6
NOCR-01	280195	4796119	350	4.09	37.6	538.0	399.2	0.26	2505	11.5	7.52	423	7.46	83.6	651.0	600.0	0.32	1668	51.7	20.8	NA	0.078	0.030	0.740	0.13	0.109	0.012	0.121	11.3
NOCR-02	279815	4795823	345	3.86	34.7	530.0	384.1	0.26	2604	10.6	7.51											0.079	0.027	0.880	0.19	0.146	0.011	0.157	9.5
NOCR-03	278327	4795643																				0.057	0.041	0.490	0.018	0.329	0.01	0.329	4.6

			YSI Data - Fall 2012									YSI Data - Spring 2013										Water Grab Sample Data - Fall 2012							
Station ID	Latitude	Longitude	TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Water Temperature (C)	pH	TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Oxidation-Reduction Potential (mV)	Water Temperature (C)	pH	Total P (mg/L)	Orthophosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Nitrate+Nitrite (mg/L)	TSS (mg/L)
BUPO-01	284532	4795265										311	2.75	33.2	478.7	478.2	0.23	2091	-97.3	24.9	NA								
BUPO-02	284415	4795300	410	3.67	36.5	629.0	509.0	0.31	1963	15.1	8.4	312	11.8	122	479.7	408.8	0.23	2446	114.7	17.3	NA	0.036	0.005	0.900	0.015	0.050	0.01	0.005	59
BUPO-03	284139	4794930										475	0.78	9.2	725.0	709.0	0.35	1411	-122.4	23.8	NA								
BUPO-04	283608	4795152	481	3.13	33.2	741.0	644.0	0.36	1554	18.1	8.01	455	7.62	82.6	703.0	625.0	0.34	1601	117.0	19.2	NA	0.116	0.026	1.240	0.02	0.050	0.01	0.002	52
BUPO-05	282922	4794725										416	0.23	2.8	642.0	635.0	0.31	1576	-125.1	24.4	NA								
BUPO-06	283292	4795259	481	3.34	33.1	736.0	593.0	0.36	1687	14.8	8.19	397	7.54	81.9	610.0	544.0	0.3	1838	126.0	19.3	NA	0.090	0.005	1.370	0.02	0.050	0.01	0.003	45.2
BUPO-07	283198	4795385	374	2.33	24.6	575.0	497.6	0.28	2010	17.9	8.34	410	8.16	95.2	633.0	609.0	0.31	1643	26.0	23	NA								
BUPO-08	282205	4795686										481	0.36	4.2	741.0	713.0	0.36	1403	-122.3	23	NA								
BUPO-09	282715	4796114										540	0.57	6.7	825.0	804.0	0.4	1244	-125.7	23.6	NA								
BUPO-10	283087	4796429										494	0.29	3.4	762.0	724.0	0.37	1380	-108.3	22.4	NA								
BUPO-11	283404	4796014										397	1.41	16.8	607.0	594.0	0.29	1683	-121.7	23.9	NA								
BUPO-12	283629	4795546	389	2.41	24.5	599.0	495.6	0.29	2018	15.9	8.43											0.090	0.108	6.840	0.02	0.050	0.01	0.018	25.5
BUPO-13	283313	4794217																											
LACR-01	281696	4794997																				0.070	0.012	0.600	0.01	0.061	0.01	0.062	22.7
LACR-02	281548	4794648																				0.040	0.012	0.500	0.01	0.050	0.01	0.047	10.5
LACR-03	281196	4794217																				0.028	0.013	0.340	0.01	0.050	0.01	0.045	4.5
ROPO-01	285212	4794779	442	1.73	16.6	682.0	529.0	0.33	1889	13.3	7.61																		

			YSI Data - Fall 2012									YSI Data - Spring 2013										Water Grab Sample Data - Fall 2012							
Station ID	**Latitude**	**Longitude**	**TDS (mg/L)**	**DO (mg/L)**	**DO (%)**	**Specific Conductance (uS/cm)**	**Conductivity (uS/cm)**	**Salinity (ppt)**	**Resistivity (Ohms)**	**Water Temperature (C)**	**pH**	**TDS (mg/L)**	**DO (mg/L)**	**DO (%)**	**Specific Conductance (uS/cm)**	**Conductivity (uS/cm)**	**Salinity (ppt)**	**Resistivity (Ohms)**	**Oxidation-Reduction Potential (mV)**	**Water Temperature (C)**	**pH**	**Total P (mg/L)**	**Orthophosphate (mg/L)**	**Total Kjeldahl Nitrogen (mg/L)**	**Ammonia (mg/L)**	**Nitrate (mg/L)**	**Nitrite (mg/L)**	**Nitrate+Nitrite (mg/L)**	**TSS (mg/L)**
ROPO-02	285178	4794508	488	1.51	14.7	748.0	591.0	0.37	1691	14	7.78											0.043	0.012	0.570	0.087	0.124	0.01	0.124	9.8
ROPO-03	285399	4794694	416	1.95	19.7	642.0	530.0	0.31	1888	15.8	8.05											0.021	0.006	0.440	0.082	0.159	0.01	0.159	5.5
ROPO-04	284442	4794597										403	0.22	2.5	620.0	583.0	0.3	1716	-102.3	21.9	NA								
ROPO-05	284280	4793449																											
ROPO-06	284312	4793663	845	4.85	45.7	1296	987.0	0.65	1014	12.5	7.93																		
ROPO-07	284290	4793563																											
SLCR-01	286841	4794070	696	7.82	71.3	1073	788.0	0.53	1269	11.1	8.71	832	8.55	88	1283.0	1076.0	0.64	929	63.6	16.6	NA	0.076	0.033	0.950	0.161	1.120	0.033	1.160	14.2
SLCR-02	285962	4793480	800	4.19	37.2	1229	876.0	0.62	1141	10	8.17											0.086	0.052	0.860	0.044	1.790	0.011	1.800	22
SLCR-03	285634	4793085	793	3.49	31.1	1224	876.0	0.61	1142	10.1	8.35											0.064	0.054	0.450	0.014	1.880	0.01	1.880	1
GERI-01	287641	4790423	429	5.55	54.1	662.0	525.0	0.32	1907	14.2	8.11											0.050	0.026	0.430	0.066	0.652	0.025	0.677	11.9
GERI-02	287503	4789743										384	7.03	87.5	594.0	610.0	0.29	1640	9.3	26.4	NA								
GERI-03	287572	4789765	429	5.46	53.1	662.0	524.0	0.32	1909	14	8.07	397	6.8	83.9	612.0	624.0	0.3	1604	0.0	26	NA	0.053	0.026	0.440	0.092	0.675	0.031	0.706	16.6
GERI-04	287509	4788986																											
GERI-05	287574	4788459	429	5.25	51.2	655.0	520.0	0.32	1922	14.2	8.14											0.047	0.027	0.410	0.096	0.699	0.038	0.737	11.6
GERI-06	287027	4787878	423	6.06	59.4	653.0	519.0	0.32	1925	14.3	8.12											0.053	0.029	0.400	0.103	0.724	0.049	0.773	13.2
GERI-07	286862	4786504	442	4.73	46.5	677.0	541.0	0.33	1847	14.5	8.13											0.065	0.040	0.430	0.101	0.938	0.113	1.050	11.7
GERI-08	286909	4785311	410	3	29.4	628.0	500.0	0.31	1998	14.3	8.06											0.043	0.019	0.350	0.046	0.608	0.01	0.608	13.8

			YSI Data - Fall 2012									YSI Data - Spring 2013										Water Grab Sample Data - Fall 2012							
Station ID	**Latitude**	**Longitude**	**TDS (mg/L)**	**DO (mg/L)**	**DO (%)**	**Specific Conductance (uS/cm)**	**Conductivity (uS/cm)**	**Salinity (ppt)**	**Resistivity (Ohms)**	**Water Temperature (C)**	**pH**	**TDS (mg/L)**	**DO (mg/L)**	**DO (%)**	**Specific Conductance (uS/cm)**	**Conductivity (uS/cm)**	**Salinity (ppt)**	**Resistivity (Ohms)**	**Oxidation-Reduction Potential (mV)**	**Water Temperature (C)**	**pH**	**Total P (mg/L)**	**Orthophosphate (mg/L)**	**Total Kjeldahl Nitrogen (mg/L)**	**Ammonia (mg/L)**	**Nitrate (mg/L)**	**Nitrite (mg/L)**	**Nitrate+Nitrite (mg/L)**	**TSS (mg/L)**
GERI-09	286685	4785014	410	2.77	27.1	628.0	500.0	0.31	1998	14.3	8.15											0.043	0.018	0.270	0.047	0.598	0.01	0.608	14.2
GERI-10	286452	4784676	408	2.78	27.2	628.0	500.0	0.31	2000	14.3	8.19											0.042	0.019	0.370	0.047	0.597	0.011	0.608	13.5
IRBA-01	295596	4790432										605	0.13	1.5	932.0	903.0	0.46	1107	-224.1	23.4	NA	0.042	0.005	1.060	0.05	0.096	0.01	0.096	10.7
IRBA-02	295242	4787338	637	4.75	49.7	983.0	840.0	0.49	1191	17.4												0.052	0.011	1.140	0.38	0.050	0.01	0.017	4.6
IRBA-03	295213	4783410	540	6.56	60.9	827.0	621.0	0.41	1611	12	7.16	507	4.1	49.5	778.0	775.0	0.38	1291	-3.9	24.8	NA	0.126	0.017	1.030	0.105	0.251	0.01	0.251	40.6
IRBA-04	294635	4784282	650	5.72	56.7	1000	807.0	0.5	1240	14.9	8.74											0.044	0.016	0.380	0.014	0.342	0.01	0.342	8.4
IRBA-05	294453	4785191	618	3.55	37.5	950.0	820.0	0.47	1219	17.9	8.59											0.028	0.006	0.390	0.016	0.050	0.01	0.008	5.2
IRBA-06	294342	4786117	611	2.58	27.3	939.0	813.0	0.46	1229	18	8.54											0.031	0.008	0.360	0.035	0.050	0.01	0.015	13.6
IRBA-07	293521	4787407	644	5.41	56.7	995.0	851.0	0.49	1175	17.5	NA											0.025	0.006	0.540	0.076	0.050	0.01	0.019	1.8
IRBA-08	293489	4787710	696	13.3	139	1069	914.0	0.53	1095	17.4	NA											0.100	0.005	1.010	0.01	0.050	0.01	0.024	8.8
IRBA-09	293811	4789572	618	9.74	102	955.0	817.0	0.47	1224	17.4	NA	631	7.97	86.2	975.0	863.0	0.48	1159	121.0	19	NA	0.021	0.005	0.560	0.011	0.050	0.01	0.003	1.9
IRBA-10	293633	4789416																											
IRBA-11	294048	4788126	618	8.12	85.1	954.0	816.0	0.47	1226	17.4	NA											0.039	0.013	0.550	0.038	0.050	0.01	0.008	2
IRCR-01	294655	4783432	832	3.27	31.2	1282	989.0	0.64	1012	13	8.15											0.054	0.011	0.590	0.05	0.423	0.01	0.423	34
IRCR-02	294201	4782898	839	2.27	21.6	1290	990.0	0.65	1010	12.8	8.14											0.036	0.012	0.530	0.045	0.453	0.01	0.453	2.6
IRCR-03	294550	4782064	852	1.76	16.4	1305	984.0	0.66	1017	12.1	8.16											0.031	0.016	0.400	0.01	0.494	0.01	0.494	1.5
IRCR-04	294693	4783207										533	5.31	62.3	815.0	788.0	0.4	1269	-50.6	23.3	NA								

Station ID	Latitude	Longitude	YSI Data - Fall 2012									YSI Data - Spring 2013										Water Grab Sample Data - Fall 2012							
			TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Water Temperature (C)	pH	TDS (mg/L)	DO (mg/L)	DO (%)	Specific Conductance (uS/cm)	Conductivity (uS/cm)	Salinity (ppt)	Resistivity (Ohms)	Oxidation-Reduction Potential (mV)	Water Temperature (C)	pH	Total P (mg/L)	Orthophosphate (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Nitrate+Nitrite (mg/L)	TSS (mg/L)
LAON-01	276467	4802278	205	15	118	315.7	195.6	0.15	5112	5.1	7.1											0.065	0.012	0.290	0.041	0.397	0.01	0.397	53.9
LAON-02	279905	4800413	201	14	110	309.3	191.6	0.15	5218	5.1	7.67											0.053	0.007	0.240	0.042	0.367	0.01	0.367	34.6
LAON-03	280896	4798708	216	13.6	108	331.5	207.5	0.16	4820	5.4	7.82											0.027	0.008	0.360	0.053	0.369	0.01	0.369	12.9
LAON-04	283688	4796406	215	13.8	107	331.3	202.7	0.16	4932	4.7	7.94											0.044	0.015	0.340	0.053	0.422	0.01	0.422	38.3
LAON-05	286377	4794559	234	13.4	105	360.0	223.0	0.17	4483	5.1	7.92											0.044	0.010	0.370	0.064	0.471	0.01	0.471	31.6
LAON-06	287861	4793462	221	13.2	104	340.5	213.7	0.16	4679	5.5	7.96											0.048	0.027	0.270	0.051	0.503	0.01	0.503	42
LAON-07	291542	4790767	211	13.1	106	324.0	208.2	0.16	4804	6.3	8.06											0.058	0.028	0.300	0.028	0.431	0.01	0.431	45.1
LAON-08	293417	4790138	217	13.2	107	333.6	216.2	0.16	4626	6.6	8.09											0.057	0.021	0.250	0.022	0.411	0.01	0.411	42.1
LAON-09	297209	4791699	268	13.9	114	411.7	267.9	0.2	3732	6.7	8.19											0.027	0.014	0.170	0.055	0.360	0.01	0.360	11.2
LAON-10	301253	4792829	218	14.1	113	334.9	212.9	0.16	4696	5.9	8.08											0.035	0.016	0.190	0.01	0.395	0.01	0.395	21.5

ATTACHMENT 3-6: Metric Values - MMP

By Waterbody and Sampling Station ID
(presented west to east in the project area)

Animal Communities – Marsh Monitoring Program (MMP)

Bogus Point (BOPO)
Rose Marsh (ROMA)
Braddock Bay (BRBA)
Braddock Bay Tributaries:
- West Creek (WECR)
- Salmon Creek (SACR)
- Buttonwood Creek (BUCR)

Cranberry Pond (CRPO)
Long Pond (LOPO) and Northrup Creek (NOCR)
Buck Pond (BUPO) and Larkin Creek (LACR)
Round Pond (ROPO)
Slater Creek (SLCR)
Genesee River (GERI)
Irondequoit Bay (IRBA)
Irondequoit Creek (IRCR)

				Bird Community Metric Values (from MMP Data) - Spring 2013				Amphibian Community Metric Values (from MMP Data) Spring 2013		
Station ID	Waterbody	Latitude	Longitude	Total species richness	Focal species richness	Diversity index	Bird IBI score	Total species richness	Diversity index	Amphibian IBI score
BOPO-01	Bogus Pond	276701	4801840							
BOPO-02	Bogus Pond	276410	4801854							
BOPO-03	Bogus Pond	276227	4801959	8	0	7.1	48.7	2	2.7	44.787
ROMA-01	Rose Marsh	278302	4800717	8	0	7.1	46.6	2	1.9	74.787
ROMA-02	Rose Marsh	278628	4800680							
BRBA-01	Braddock Bay	280408	4798724							
BRBA-02	Braddock Bay	280492	4798829	6	0	5.6	40.2	1	1.0	7.3939
BRBA-03	Braddock Bay	280124	4798323	8	0	7.1	41.2	0	NONE	0
BRBA-04	Braddock Bay	279664	4798328							
BRBA-05	Braddock Bay	279269	4798390	4	1	3.6	81.2	1	1.0	54.06
BRBA-06	Braddock Bay	279512	4798766							
BRBA-07	Braddock Bay	279406	4798914							
BRBA-08	Braddock Bay	279588	4799585							
BRBA-09	Braddock Bay	279830	4799971	9	0	8.3	41.3	2	3.0	44.787
BRBA-10	Braddock Bay	279971	4799226							
WECR-01	West Creek	276892	4798633							
WECR-02	West Creek	276271	4798655	12	0	10.7	41			
WECR-03	West Creek	275710	4798568	8	1	7.4	65.8			
WECR-04	West Creek	274984	4798815							

				Bird Community Metric Values (from MMP Data) - Spring 2013				Amphibian Community Metric Values (from MMP Data) Spring 2013		
Station ID	Waterbody	Latitude	Longitude	Total species richness	Focal species richness	Diversity index	Bird IBI score	Total species richness	Diversity index	Amphibian IBI score
SACR-01	Salmon Creek	278409	4799240							
SACR-02	Salmon Creek	277758	4799005	8	0	7.2	62.6			
SACR-03	Salmon Creek	277218	4798407							
SACR-04	Salmon Creek	277534	4798355	6	0	5.3	53.5			
SACR-05	Salmon Creek	276694	4797944	10	1	8.9	51.6			
SACR-06	Salmon Creek	275538	4797717	13	0	11.8	35.5			
SACR-07	Salmon Creek	274942	4797484							
BUCR-01	Buttonwood Creek	279131	4797898	7	0	6.4	62.4	1	1.0	54.06
BUCR-03	Buttonwood Creek	278495	4797344							
BUCR-04	Buttonwood Creek	278301	4797304	8	0	7.6	45	4	5.7	51.242
CRPO-01	Cranberry Pond	282096	4797457							
CRPO-02	Cranberry Pond	280581	4797432	8	0	7.2	54.1	3	2.6	46.626
CRPO-03	Cranberry Pond	280470	4797456							
CRPO-04	Cranberry Pond	280618	4797764							
CRPO-05	Cranberry Pond	281216	4798245							
CRPO-06	Cranberry Pond	281240	4797771							
CRPO-07	Cranberry Pond	279918	4797870							
CRPO-08	Cranberry Pond	279919	4797695	10	1	9	66.6	3	3.6	71.07
CRPO-09	Cranberry Pond	279836	4797076							

				Bird Community Metric Values (from MMP Data) - Spring 2013				Amphibian Community Metric Values (from MMP Data) Spring 2013		
Station ID	**Waterbody**	**Latitude**	**Longitude**	**Total species richness**	**Focal species richness**	**Diversity index**	**Bird IBI score**	**Total species richness**	**Diversity index**	**Amphibian IBI score**
CRPO-10	Cranberry Pond	280041	4797101	6	0	5.5	56	5	6.3	86.666
CRPO-11	Cranberry Pond	280144	4797051							
CRPO-12	Cranberry Pond	280162	4796890							
LOPO-01	Long Pond	282722	4796690	9	0	8.1	24.9	2	1.9	44.787
LOPO-02	Long Pond	282907	4796628							
LOPO-03	Long Pond	280978	4795885							
LOPO-04	Long Pond	281183	4795749	12	0	10.4	33.3	1	1.0	7.3939
LOPO-05	Long Pond	280457	4796141							
LOPO-06	Long Pond	279870	4796205	8	0	7.3	57	2	1.8	44.787
LOPO-07	Long Pond	282157	4796759							
NOCR-01	Northrup Creek	280195	4796119							
NOCR-02	Northrup Creek	279815	4795823							
NOCR-03	Northrup Creek	278327	4795643							
BUPO-01	Buck Pond	284532	4795265	8	0	7	27.9	3	3.8	46.626
BUPO-02	Buck Pond	284415	4795300							
BUPO-03	Buck Pond	284139	4794930	9	2	8.4	70.6	3	4.9	46.626
BUPO-04	Buck Pond	283608	4795152							
BUPO-05	Buck Pond	282922	4794725	9	0	8	45.3	4	4.6	51.242
BUPO-06	Buck Pond	283292	4795259							

Station ID	Waterbody	Latitude	Longitude	Bird Community Metric Values (from MMP Data) - Spring 2013				Amphibian Community Metric Values (from MMP Data) Spring 2013		
				Total species richness	Focal species richness	Diversity index	Bird IBI score	Total species richness	Diversity index	Amphibian IBI score
BUPO-07	Buck Pond	283198	4795385							
BUPO-08	Buck Pond	282205	4795686	7	0	6.3	66.6	2	1.9	44.787
BUPO-09	Buck Pond	282715	4796114	7	1	6.4	66.6	2	1.9	44.787
BUPO-10	Buck Pond	283087	4796429	11	0	9.7	33.6	4	4.5	72.908
BUPO-11	Buck Pond	283404	4796014	4	0	4	66.6	3	4.8	46.626
BUPO-12	Buck Pond	283629	4795546							
BUPO-13	Buck Pond	283313	4794217							
LACR-01	Larkin Creek	281696	4794997							
LACR-02	Larkin Creek	281548	4794648							
LACR-03	Larkin Creek	281196	4794217							
ROPO-01	Round Pond	285212	4794779							
ROPO-02	Round Pond	285178	4794508							
ROPO-03	Round Pond	285399	4794694							
ROPO-04	Round Pond	284442	4794597	6	0	5.7	59.4	3	3.5	46.626
ROPO-05	Round Pond	284280	4793449							
ROPO-06	Round Pond	284312	4793663							
ROPO-07	Round Pond	284290	4793563	14	0	12.6	33.3	3	2.8	46.626
SLCR-01	Slater Creek	286841	4794070							
SLCR-02	Slater Creek	285962	4793480							

				Bird Community Metric Values (from MMP Data) - Spring 2013				Amphibian Community Metric Values (from MMP Data) Spring 2013		
Station ID	Waterbody	Latitude	Longitude	Total species richness	Focal species richness	Diversity index	Bird IBI score	Total species richness	Diversity index	Amphibian IBI score
SLCR-03	Slater Creek	285634	4793085							
GERI-01	Genesee River	287641	4790423	9	0	7.5	29.7	0	NONE	0
GERI-02	Genesee River	287503	4789743	7	0	5.9	17.1	1	1.0	7.3939
GERI-03	Genesee River	287572	4789765							
GERI-04	Genesee River	287509	4788986	14	0	12.5	48.1	0	NONE	0
GERI-05	Genesee River	287574	4788459							
GERI-06	Genesee River	287027	4787878							
GERI-07	Genesee River	286862	4786504							
GERI-08	Genesee River	286909	4785311							
GERI-09	Genesee River	286685	4785014							
GERI-10	Genesee River	286452	4784676							
IRBA-01	Irondequoit Bay	295596	4790432	5	0	4.7	33.3	3	3.0	71.07
IRBA-02	Irondequoit Bay	295242	4787338							
IRBA-03	Irondequoit Bay	295213	4783410	8	0	6.9	28.1	1	1.0	54.06
IRBA-04	Irondequoit Bay	294635	4784282							
IRBA-05	Irondequoit Bay	294453	4785191							
IRBA-06	Irondequoit Bay	294342	4786117							
IRBA-07	Irondequoit Bay	293521	4787407							
IRBA-08	Irondequoit Bay	293489	4787710							

Station ID	Waterbody	Latitude	Longitude	Bird Community Metric Values (from MMP Data) - Spring 2013				Amphibian Community Metric Values (from MMP Data) Spring 2013		
				Total species richness	Focal species richness	Diversity index	Bird IBI score	Total species richness	Diversity index	Amphibian IBI score
IRBA-09	Irondequoit Bay	293811	4789572							
IRBA-10	Irondequoit Bay	293633	4789416	3	0	2.6	33.3	1	1.0	7.3939
IRBA-11	Irondequoit Bay	294048	4788126							
IRCR-01	Irondequoit Creek	294655	4783432							
IRCR-02	Irondequoit Creek	294201	4782898							
IRCR-03	Irondequoit Creek	294550	4782064							
IRCR-04	Irondequoit Creek	294693	4783207	7	0	6	51.5	2	2.7	44.787
LAON-01	Lake Ontario	276467	4802278							
LAON-02	Lake Ontario	279905	4800413							
LAON-03	Lake Ontario	280896	4798708							
LAON-04	Lake Ontario	283688	4796406							
LAON-05	Lake Ontario	286377	4794559							
LAON-06	Lake Ontario	287861	4793462							
LAON-07	Lake Ontario	291542	4790767							
LAON-08	Lake Ontario	293417	4790138							
LAON-09	Lake Ontario	297209	4791699							
LAON-10	Lake Ontario	301253	4792829							

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