REPORT

WATER QUALITY MANAGEMENT AND MONITORING PLAN
ONONDAGA LAKE

Prepared for

Honeywell

Prepared by

ANCHOR QEA

PARSONS

May 2012

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
A(A)	aquatic (acute)
Anchor QEA	Anchor QEA, LLC
BMP	best management practice
CM	compliance monitoring
CPOI	chemical parameters of interest
eDMS	electronic data management system
HSP^2	Honeywell Syracuse Portfolio Health and Safety Program
JSA	Job Safety Analysis
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
OCDWEP	Onondaga County Department of Water Environment Protection
PAH	polycyclic aromatic hydrocarbons
PDI	Pre-Design Investigation
PM	performance monitoring
PSP	Project Safety Plan
QAPP	Quality Assurance Project Plan
QA	quality assurance
QC	quality control
SMU	Sediment Management Unit
SOP	Standard Operating Procedure
SRP	soluble reactive phosphorus
SVOC	semivolatile organic compound
TDP	total dissolved phosphorus
TP	total phosphorus
TSS	Total Suspended Solids
VOC	volatile organic compound
WQMMP	Water Quality Management and Monitoring Plan

EXECUTIVE SUMMARY

The Onondaga Lake remediation plan, which was selected by the New York State Department of Environmental Conservation (NYSDEC) and the U.S. Environmental Protection Agency (USEPA), calls for a combination of dredging, capping, and monitored natural recovery, which are proven environmental remediation methods that address contamination in Lake sediment.

To prevent potential unacceptable water quality impacts as a result of sediment disturbances during these activities, a comprehensive water quality management and monitoring program will be implemented. This program will address suspension of contaminated sediments and potential release of contaminants. Suspension controls, both physical (i.e., silt or turbidity curtains) and operational (e.g., minimizing cutterhead rotation speed and implementing other best management practices [BMPs]) have proven effective at numerous capping and dredging sites, and will be used to mitigate any potential impacts during Onondaga Lake remedial activities.

The proposed methods and procedures for management of ambient water quality impacts are presented in this Water Quality Management and Monitoring Plan (WQMMP). The goals and objectives of this WQMMP are to: 1) describe water quality management and control measures; 2) provide procedures and protocols to monitor water quality during dredging and capping activities; and 3) establish response actions in the unlikely event that unacceptable conditions are detected. Water quality alert and action levels, management activities and controls such as silt curtains, water quality monitoring program elements, and potential response activities, are described in detail in the WQMMP.

Water quality alert and action levels have been developed such that an efficient and environmentally protective program can be implemented. A program based on real-time turbidity monitoring and supplemented periodically with samples analyzed for chemicals of interest will be used to monitor the impacts of dredging and capping and will provide for rapid implementation of response actions, if warranted, to ensure protection of water quality is achieved.

1 INTRODUCTION

The Onondaga Lake remediation is composed of a combination of dredging and capping in littoral areas as well as thin-layer capping and monitored natural recovery in the profundal zone, referred to as Sediment Management Unit (SMU) 8. Additional background information and an overview of the remedial action are provided in Section 1 of the Onondaga Lake Capping, Dredging, Habitat and Profundal Zone (SMU 8) Final Design (Final Design; Parsons and Anchor QEA, LLC [Anchor QEA], 2012).

This Water Quality Management and Monitoring Plan (WQMMP) describes the water quality monitoring and response activities to be performed during dredging and capping in the Lake.

1.1 WQMMP Goals and Objectives

The goals and objectives of the WQMMP are as follows:

- Identify water quality alert and action levels that would initiate investigation and/or implementation of additional engineering practices to control potential impacts of ongoing remedial work
- Describe water quality management and control measures (e.g., best management practices [BMPs]) that will mitigate unanticipated unacceptable water quality impacts
- Provide procedures and protocols to monitor water quality during dredging and capping activities to assess and manage potential impacts to water quality associated with the remedial construction activities on the Lake
- Establish response actions in the unlikely event that unacceptable conditions are detected

1.2 WQMMP Organization

This WQMMP includes the following sections:

- Section 1 presents a general overview of the WQMMP including the goals and objectives of the water quality monitoring program.
- Section 2 presents the water quality alert and action levels developed for this project.

- Section 3 discusses the management activities and controls that will be in place to protect water quality during dredging and capping activities.
- Section 4 describes the water quality monitoring program, including the monitoring parameters, locations, schedule, equipment, analyses, and reporting requirements.
- Section 5 discusses the response actions that will be followed based on monitoring results (i.e., in the unlikely event that construction-related impacts cause alert and action levels and/or criteria to be exceeded).
- Section 6 provides the references for this WQMMP.

2 WATER QUALITY ALERT AND ACTION LEVELS

Water quality alert and action levels for the dredging and capping work have been developed such that an efficient and environmentally protective program can be implemented. The primary means of monitoring impacts of dredging and capping on water quality will be based on real-time turbidity monitoring (as described in Section 4.4). Because turbidity is a measure of particulate matter that may contain sorbed phase chemicals (e.g., associated with dredging releases), real-time turbidity monitoring will allow for rapid response to adverse water quality conditions. The monitoring program will also include periodic sampling for analytical chemistry.

2.1 Turbidity

Based on the analysis of ambient turbidity measurements collected as part of the 2010 and 2011 Water Quality Monitoring for Construction Baseline programs (described in Sections 2 and 3 of Appendix B) and a review of relevant environmental dredging projects, a two-tiered approach will be used. The alert and action levels will be based on observed increases in turbidity relative to that measured at a designated "background" monitoring station. Turbidity alert levels of 25 Nephelometric Turbidity Units (NTU) above background at near-field, performance monitoring (PM) stations and turbidity action levels of 50 NTU above background at far-field, compliance monitoring (CM) stations have been deemed to be both protective and practical for this project.[1] This two-tiered turbidity program allows for early identification of elevated turbidity levels at the PM station (i.e., 25 NTU above background) with the initiation of specific investigative steps (described in Section 5) following a turbidity alert level exceedance at the PM station. As illustrated by the various graphics presented in Appendix B, the range of ambient turbidity in the Lake has been observed to be generally under 10 NTU, but can temporarily increase to several hundred NTU due to tributary runoff

[1] A relationship between Total Suspended Solids (TSS) and turbidity was observed using paired TSS/turbidity data from Onondaga Lake and its tributaries (discussed in Section 4 of Appendix B, and as noted on Figure B-13 of Appendix B). This relationship can be revised as additional data are collected during construction activities and, as necessary, could be used as a general guideline for estimating TSS levels for a given turbidity measurement.

and/or high winds.[2] Therefore, a turbidity alert level of 25 NTU above background at the PM station during dredging and capping operations is considered appropriate to provide a sufficient degree of indication to impacts on water quality from those activities, beyond levels expected under ambient conditions, and in the absence of substantial weather-related influence. These numerical trigger values (i.e., 25 and 50 NTU) may be modified based on observed field conditions (e.g., if frequent exceedances due to non-construction related factors occur); any such modifications would be made in consultation with the New York State Department of Environmental Conservation [NYSDEC]).

In summary, the real-time turbidity monitoring system will provide for rapid implementation of response actions, if warranted, to ensure that the water quality action level is met at the CM stations.

2.2 Chemistry Samples

During dredging and capping, discrete water column samples will also be collected at CM locations (as described in Section 4), and analyzed for chemical compounds with a corresponding NYSDEC aquatic (acute) (A[A]) water quality standard. The results from such sampling will be compared to these standards for documentation purposes. Those chemical compounds that have A(A) water quality criteria are listed in Table 2-1.

[2] Specifically, this point is demonstrated by: 1) Figures B-4 and B-5 of Appendix B, which present probability distributions of continuous turbidity monitoring data from 2010 and 2011, respectively; and 2) Figure B-8 of Appendix B, which compares turbidity measurements to flows in nearby tributaries, wind speed/direction, and precipitation.

Table 2-1
Water Quality Monitoring Parameters and Associated Aquatic (Acute) Criteria

Chemical Parameter	New York State Aquatic (Acute) Class B/C Surface Water Quality Standards (µg/L)
Benzene	760
Ethylbenzene	150
Toluene	480
Total Xylenes	590
Acenaphthene	48
Anthracene	35
Benzo(a)anthracene	0.23
Fluorene	4.8
Naphthalene	110
Phenanthrene	45
Pyrene	42
Mercury (Dissolved)	1.4

Note:
µg/L – micrograms per liter

These chemicals provide a good indicator set of the larger chemical parameters of interest (CPOI) list specified in the Record of Decision (ROD) for the Lake. For example, the chemicals listed in Table 2-1 are representative of the various classes of chemicals on the full CPOI list (i.e., they include volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs; including both low and high molecular weight polycyclic aromatic hydrocarbons (PAHs)], and mercury). Furthermore, areas within the Lake where the chemicals listed in Table 2-1 are present in sediments at elevated concentrations generally also contain elevated concentrations of CPOI chemicals that do not have A(A) criteria (e.g., chlorobenzenes, which do not have A(A) criteria are often co-located with benzene and/or naphthalene, both of which do have A(A) criteria).

Additionally, discrete water column samples collected at CM locations will also be analyzed for phosphorus (i.e., total phosphorus [TP], total dissolved phosphorus [TDP], soluble reactive phosphorus [SRP]) and total mercury. The phosphorus results will be used to supplement data collected by the Onondaga County Department of Water Environment Protection (OCDWEP).

3 WATER QUALITY MANAGEMENT AND ENGINEERED CONTROLS

Water quality protection during construction activities was built into the overall Lake remedy through several layers of protection within each stage of the project, including the choice of dredging equipment, implementation of turbidity controls and BMPs, and performance of monitoring activities to identify and help minimize any environmental impacts.

Hydraulic dredging will be utilized for removal of sediments within the project area. Hydraulic dredging inherently causes fewer water quality impacts than mechanical dredging because the sediments are removed at the sediment surface and pumped to a treatment area rather than lifting a bucket through the water column.

Turbidity controls, such as silt curtains and BMPs, will also be employed. Silt curtains promote deposition of suspended solids within the boundary of the curtain and mitigate transport of these solids to other regions of the Lake. Silt curtains will enclose the dredging areas throughout the dredging activities and will remain in place until the initial mixing layer of the cap has been placed over the completed dredge area. After dredging, adjacent dredge and cap areas will be separated using an interior silt curtain that can be moved as work progresses. The interior curtain will limit migration of turbidity from a dredge area to a cap area. Movable interior curtains will also be used to isolate areas not requiring remediation located within the primary silt curtain boundary to the extent practical. The location of the movable interior curtain will vary as the dredging and capping progress through a remediation area. Preliminary silt curtain alignments for each year of construction are provided on Figures 3-1 through 3-4. The final configurations and requirements for silt curtain placement may be modified during construction in consultation with NYSDEC, as the project advances and dredging and capping operations sequencing is finalized. As described in Section 5.3 of Appendix B, the capping activities in a cap-only area during the Capping Field Demonstration Program had minimal impact on turbidity outside of the demarcation curtain, and the turbidity plumes, when observed, quickly dissipated within the demarcation curtain. Therefore, demarcation curtains will be used in cap-only areas during capping activities.

In addition to silt curtains, the following BMPs will be implemented to minimize potential adverse impacts on water quality:

- The construction contractor will ensure that no fuel, garbage, or debris enters the Lake from the dredge, capping barge, or other vessels associated with the project.
- Capping materials will generally be placed uniformly over the sediment surface and in multiple lifts, minimizing potential disturbance to the sediment or previously placed cap material.
- Sequencing of dredging and capping will be optimized (upcurrent to downcurrent, offshore to onshore, or with respect to number of lifts) to minimize disturbance of non-impacted sediments.
- Dredging on slopes steeper than a set angle (e.g., steeper than 10 horizontal to 1 vertical) will begin, where feasible, at the highest elevation and work towards the lowest elevation to minimize sloughing. This will be modified as necessary to allow dredging from deeper water to shallower water where necessary to allow the dredge to approach the shallow shoreline areas.
- Operational controls will be implemented if adverse effects are noted.
- Capping materials will be placed from toe to the top of the slope on slopes steeper than a set angle (e.g., steeper than 10 horizontal to 1 vertical) to minimize sloughing.
- Location and material control equipment will be used to maximize controlled placement of cap material and, thus, minimize placement outside of the desired capping limits.
- Sheens, if observed, will be controlled through deployment of booms or other methods.

A comprehensive monitoring program, presented in Section 4 of this WQMMP, has been developed to identify and minimize any environmental impacts.

4 WATER QUALITY MONITORING PROGRAM

This section discusses the water quality monitoring program to be conducted during construction of the remedial action. Table 4-1 provides a summary of the proposed monitoring activities including monitoring location, schedule, analytes, and methods.

Monitoring activities described below may change in response to site conditions and results of previous monitoring. Any modifications to the monitoring activities described herein will be made in consultation with NYSDEC.

4.1 Monitoring Parameters

The monitoring parameters used as part of the water quality monitoring program include both parameters measured in the field and laboratory analyses. Turbidity, measured continuously in the field with a turbidity probe, will be the primary indication that water quality management is achieved. Visual monitoring of turbidity and sheens will also be employed. If visual observations indicate that revisions to the monitoring program such as adding monitoring locations, increasing the frequency of monitoring, or moving monitoring locations closer to the work area would provide more useful data, Honeywell will consult with NYSDEC on any such proposed modification(s).

Water column chemical analytes will be evaluated periodically during dredging and capping as well. Given the short-term nature of potential construction-related impacts, the water column monitoring parameters will be the site sediment CPOIs that have acute toxicity criteria (see Tables 2-1 and 4-1). As stated in Section 2, these compounds with acute toxicity standards are typically generally representative of the full suite of compounds containing the highest concentrations observed in sediment.

4.2 Monitoring Station Locations

Water quality monitoring will be performed near dredging and capping activities using a tiered location approach. The primary monitoring locations will be the PM stations, located outside of the turbidity controls (i.e., silt curtains) in the vicinity of ongoing dredging or capping operations. Secondary measurements will be taken at CM stations, which will be located some distance outside the remediation area boundaries, to ensure that water quality in the larger, Lake-wide system is maintained during construction. Each of these monitoring locations is discussed below.

4.2.1 Performance Monitoring Stations

The intent of the PM stations will be to monitor near-field turbidity in the vicinity of the construction area and provide an "early warning" of potential water quality impacts. PM stations will consist of real-time, continuous turbidity measurements using buoy systems that are easily transportable to various locations near dredging and capping activities. PM stations will be positioned approximately 200 feet from the edge of the turbidity control structure (i.e., silt curtain) during dredging, or approximately 200 feet from the demarcation system during capping activities. Three PM stations will be placed at each dredging/capping operation oriented around the turbidity control or demarcation system in an upcurrent, downcurrent, and cross-current configuration. For example, if both capping and dredging operations are occurring at separate locations within the Lake, two sets of three PM stations will be used, for a total of six PM stations. In the event that both capping and dredging operations are occurring near one another, some PM stations may be shared between the operations based on their proximity.

Figure 4-1 provides proposed PM stations that will be used during dredging in 2012. As shown, two silt curtain alignments (e.g., Remediation Area C and Remediation Area D) will be used in 2012. However, depending on the timing/sequencing of operations, both silt curtain alignments (and corresponding turbidity monitoring buoys) may not be used concurrently. PM stations will only be operated when dredging or capping activities are conducted within the respective turbidity or demarcation system. As demarcation curtains used during capping will surround smaller areas and may be moved frequently in the field, a conceptual configuration of PM stations in proximity to a proposed demarcation curtain alignment is shown on Figure 4-2. The locations of PM stations for subsequent years will follow the general pattern depicted on Figures 4-1 and 4-2.

During dredging and capping activities, one of the three PM stations will be used to define local background conditions for assessing compliance with water quality alert and action levels. The background turbidity monitor will be conservatively defined as the monitor at the PM station having the lowest turbidity reading. If observations in the field indicate that the PM station designated as "background" is not adequately capturing the local background conditions, an additional dedicated background turbidity station may be deployed based on consultation with the NYSDEC.

4.2.2 Compliance Monitoring Stations

CM stations will serve as the official compliance locations for water quality and will be used to assess and protect water quality associated with the remedial construction activities. Real-time, continuous turbidity readings and water quality grab samples will be collected from CM stations. These stations will be located approximately 500 feet from the edge of the turbidity control structures during dredging, or approximately 500 feet from the demarcation system during capping activities. One CM station will be placed at each dredging/capping operation; however, if both capping and dredging operations are occurring near one another, the CM station may be shared between the operations based on their proximity. Example locations for the CM stations during dredging and capping activities are presented on Figures 4-1 and 4-2, respectively. As with the PM stations, the CM stations will only be operated when dredging or capping activities are conducted within the respective turbidity or demarcation system.

4.3 Monitoring Schedules

Table 4-1 presents the monitoring activities and schedule for the water quality program. As discussed previously, turbidity is the primary indicator of water quality management and will be monitored continuously during dredging and capping operations at the PM and CM stations described in the previous sections. Turbidity measurements will be collected every 15 minutes and 2-hour running averages will be computed for assessment purposes.

Water column samples will also be collected at the CM station to evaluate chemical compounds. Separate tiered programs will be implemented during dredging and capping operations:

- For dredging operations, samples will be collected daily for an initial "verification period" that will span the first 2 weeks of dredging to gather site-specific data and confirm BMPs are protective. At the conclusion of this 2-week verification period, collection of grab samples at the CM station(s) will continue on a weekly basis (or biweekly, based on supporting compliance data and concurrence with NYSDEC).

- During capping operations (i.e., when only capping is being performed), visual turbidity is typically a result of clean material within the water column. Therefore, the water quality grab sampling will begin with weekly monitoring upon initiation of capping (to characterize construction-related general trends), graduating to a turbidity-only monitoring program after 3 to 4 weeks if water quality action level exceedance for chemicals is not observed.

4.4 Sampling and Analysis Methods

4.4.1 Water Quality Sampling

As discussed above, water quality data will be collected during dredging and capping activities to assess construction performance and resulting system-wide response of water quality in the Lake. Specific details pertaining to the collection of turbidity measurements and water column samples to be analyzed for chemical compounds are discussed below.

4.4.1.1 Turbidity Monitoring

Continuous turbidity measurements will be collected within the water column at buoyed PM and CM stations during dredging and capping activities, as discussed in Section 4.2. Turbidity sondes (i.e., probes) at each deployment will be set at a fixed depth of 10 feet or mid-depth in water depths shallower than 20 feet, consistent with the depth used to represent the upper mixed layer of the Lake in the discrete water quality sampling (see Section 4.4.1.2 below). Continuous turbidity monitoring will be conducted in accordance with Appendix A – Surface Water Sampling Standard Operating Procedure (SOP).

Each continuous (15-minute) turbidity monitoring station will consist of a manually deployed system comprised of a buoy with associated anchors and floats, a turbidity sonde, solar panel and battery, and data logging equipment (see Figure 4-3 for typical turbidity monitoring equipment configuration). This system will log and transmit data via cellular modem in real-time to an electronic data management system (eDMS).

The buoyed stations will be designed to withstand anticipated annual weather conditions and will meet regulatory requirements for buoys placed in a navigable waterbody. Manual inspection and maintenance, consisting of sonde cleaning and calibration (as necessary), will be conducted routinely (approximately weekly). Manual turbidity measurements will be made during these routine inspections with additional (hand-held) equipment, and deployed sonde units will also be exchanged with shop-calibrated units on a routine basis to ensure consistency and accuracy of the turbidity monitoring program (routine probe change-out will help avoid potential sonde malfunctioning associated with biofouling).

4.4.1.2 Discrete Water Column Sampling

As discussed in Section 4.3, discrete water column sampling is anticipated to occur approximately weekly during dredging activities (following daily sampling during the initial verification period). A tiered sampling program will also be employed during capping activities. Grab samples will be collected from the water column at the CM stations. Additionally, grab sample(s) will be collected at the CM station if the turbidity action level is exceeded (i.e., 50 NTU above background).

Consistent with the 2011 Water Quality Monitoring for Construction Baseline program (Parsons 2011), discrete water column samples will be collected from a fixed depth of 10 feet from the water surface. Based on a review of the typical depths of the thermocline observed in the Lake during approximately the last 10 years, a depth of 10 feet was selected to be representative of water quality within the upper mixed layer of the Lake during stratification. In cases where the water depth is less than 20 feet, sampling will be conducted from the midpoint of the water column, as was done in the Water Quality Monitoring for Construction Baseline program.

The discrete water column sampling will be conducted in accordance with standard operating procedures documented in Appendix A. Samples will be analyzed for the suite of parameters listed in Table 4-2 and the results will be compared to the A(A) water quality standards listed in Table 2-1. Measurements of Total Suspended Solids (TSS) will provide further information on particle concentrations and impacts on water clarity. Phosphorus results will be used to supplement data collected by the OCDWEP. Field measurements for temperature, pH, specific conductance, turbidity, oxidation-reduction potential, and dissolved oxygen will also be taken.

Table 4-2
Water Quality Parameters, Frequency of Sample Collection, and Analytical Methods

Parameter	Frequency[1]	Method
Mercury (total and filtered)	Weekly	1631E
VOCs (A[A])[2]	Weekly	8260B
SVOCs (A[A])[2]	Weekly	8270C
Total suspended solids	Weekly	SM 20 2540D
Total phosphorus	Weekly	SM 20 4500-P
Total dissolved phosphorus	Weekly	SM 20 4500-P
Soluble reactive phosphorus	Weekly	SM 20 4500-P
Temperature Turbidity pH Dissolved oxygen Specific conductance Oxidation-reduction potential	Weekly	Probe/Meter

Notes:
SVOC – semivolatile organic compound
VOC – volatile organic compound

1. During dredging operations, daily grab samples will be collected for the first 2 weeks of dredging and will continue afterwards on a weekly basis (or biweekly, based on supporting compliance data and concurrence with NYSDEC). During capping operations, weekly grab samples will be collected for 3 to 4 weeks, graduating to a turbidity-only program.
2. The A(A) list for VOCs consists of the following chemical compounds: benzene, ethylbenzene, toluene, total xylenes; the A(A) list for SVOCs includes: acenaphthene, anthracene, benzo(a)anthracene, fluorene, naphthalene, phenanthrene, and pyrene.

4.5 Health and Safety

The Honeywell team ranks health and safety as the highest priority. As part of the Honeywell Syracuse Portfolio Health and Safety Program (HSP²), Anchor QEA will develop a Project Safety Plan (PSP) that will be used for water quality monitoring activities. If any task identified falls outside the scope currently defined in the PSP, a new Job Safety Analysis (JSA) will be completed before the task begins. Copies of the JSAs and PSPs will be maintained at each work area.

4.6 Quality Assurance

Laboratory procedures will be conducted in accordance with the Quality Assurance Project Plan (QAPP; Parsons et al. 2012). Field quality assurance (QA) and quality control (QC) will consist of the collection and analysis of field duplicates, and matrix spike/matrix spike duplicate samples in accordance with the QAPP. One equipment rinse blank will be collected for each sampling event.

4.7 Sample and Data Management and Reporting

Sample names, QA/QC procedures, sample collection, data entry, and data validation for this water quality monitoring program will be conducted in accordance with the Phase I PDI Sampling and Analysis Plan (Parsons 2005). Any deviations from these procedures will be discussed with NYSDEC prior to execution of the work.

Analytical data generated during this investigation will be reviewed and validated for usability in accordance with pre-established data validation procedures summarized in the forthcoming QAPP. The results will be incorporated into the Honeywell Locus Focus database following validation.

As described in Section 4.3 and Table 4-1, water quality monitoring will occur continuously (e.g., turbidity) or daily/weekly (e.g., analytical chemistry) depending on the parameter of interest. Unvalidated, draft data will be informally shared with the NYSDEC representative at the on-site office, and a comprehensive water quality report will be submitted to NYSDEC annually.

In the event an exceedance of the water quality performance criteria occurs, protocols outlined in the response action flow chart (Figure 5-1; discussed in Section 5 below) will be followed and NYSDEC will be notified of the exceedance. A description of the exceedance and any response actions taken will be documented in the monthly report following the exceedance.

5 RESPONSE ACTIONS

Water quality monitoring will be performed to confirm that water quality protection measures (presented in Section 3) are effective. Turbidity measurements at the PM stations will serve as an early warning for possible unacceptable levels at the CM stations; therefore, response actions are discussed in this WQMMP with respect to the PM stations. However, if the water quality at a CM station does not meet the analytical chemistry (Table 2-1) or turbidity action levels (i.e., 50 NTU above background), additional sampling and further investigations will be performed to assess whether the water quality is being impacted by the remediation activities. If the turbidity alert level (i.e., 25 NTU above background, based on 2-hour rolling averages) at a PM station is exceeded, specific steps will be initiated to address the exceedances according to the flow chart presented on Figure 5-1. The first step will be to perform secondary evaluations or investigations, including the following:

- Confirm the turbidity values with additional measurements (i.e., manual probe measurements and visual observation from a sampling vessel)
- Evaluate potential causes of turbidity excursion

Turbidity values at PM stations will be confirmed by evaluating trends in turbidity for four consecutive 2-hour averaged turbidity values to remove potential anomalies. If 2-hour average turbidity values continue to exceed the turbidity alert level (i.e., 25 NTU above background), the cause of the elevated values will be investigated. Investigative activities will include, but not be limited to, the following:

- Inspection of the turbidity meter for damage, fouling, malfunction, or other localized conditions that may cause an elevated turbidity reading
- Visual inspection of the silt curtain, including a surface assessment of curtain condition, location, and anchoring, and, if necessary, an underwater assessment using a remote camera
- Visual inspection of the surrounding area for increased turbidity resulting from non-remedial activities (e.g., tributaries, wind-wave activity); turbidity readings may also be collected in this area using a hand-held turbidity meter to confirm elevated turbidity

If the turbidity exceedance can be reasonably attributed to a turbidity sonde or silt curtain malfunction or damage, the equipment will be repaired concurrent with dredging and/or capping activities, as appropriate.

If the turbidity exceedance is determined to be attributable to dredging or capping activities, dredging or capping operations will be evaluated and appropriate operational changes will be implemented as necessary, which may include the following:

- Optimizing specific dredging or capping operations (such as ladder swing speed, cutter rotation speed, depth of cut, speed of advance of dredge, cap material placement rate, and height/depth of release of cap material from bucket)
- Limiting dredging and placement operations to calmer environmental/weather conditions (e.g., modifying dredging or placement when wave heights or wind speeds exceed a certain value)
- Modifying single-cut depths to be more efficient
- Decreasing the cap lift thickness if turbidity exceedances are a result of resuspended sediment and not clean sand
- Modifying turbidity controls, as appropriate, to contain construction-related impacts

6 REFERENCES

Parsons, 2005. *Onondaga Lake Pre-Design Investigation: Phase I Work Plan.* Prepared for Honeywell. September 2005.

Parsons, 2011. *Onondaga Lake Pre-Design Investigation: Water Quality Monitoring for Construction Baseline Work Plan.* Prepared for Honeywell. May 2011.

Parsons and Anchor QEA, LLC [Anchor QEA], 2012. *Onondaga Lake Capping, Dredging, Habitat and Profundal Zone (Sediment Management Unit 8) Final Design.* Prepared for Honeywell. March 2012.

Parsons, Anchor QEA, and Upstate Freshwater Institute, 2012. *Draft Quality Assurance Project Plan for Onondaga Lake Construction and Post-Construction Media Monitoring (surface water, biota and sediment).* Prepared for Honeywell. May 2012.

TABLE

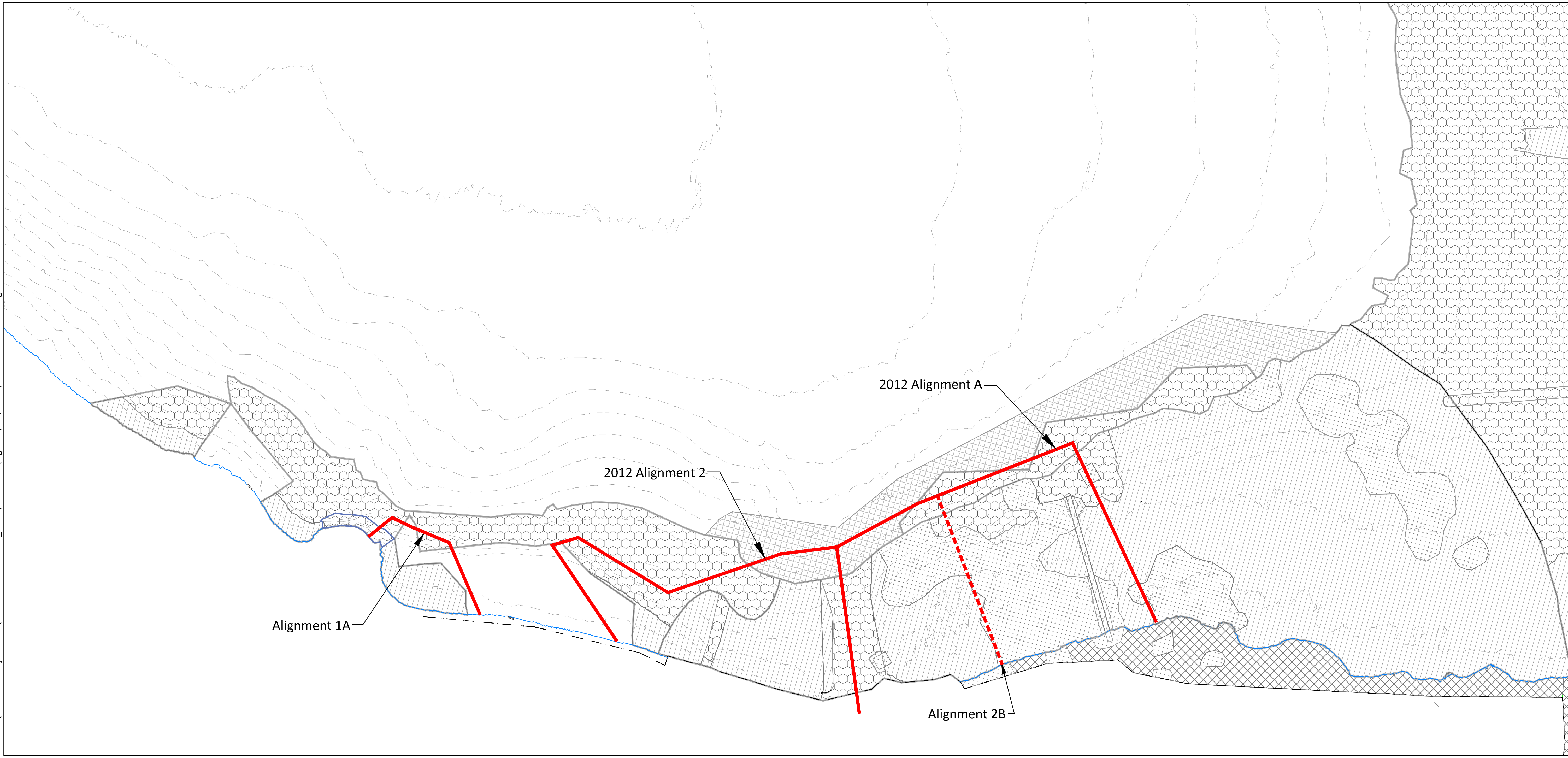
Table 4-1
Water Quality Monitoring Plan Summary

Summary Activity	Station	Location(s)	Monitoring Depth	Monitoring Method	Parameter(s)	Monitoring Schedule
Continuous Turbidity Measurement	Performance Monitoring	300 feet outside of turbidity control/demarcation system at three locations (see Figure 4-1): • 200 feet upcurrent • 200 feet downcurrent • 200 feet cross-current	10 feet or mid-depth in water depths less than 20 feet	Turbidity sonde attached to fixed buoy with telemetry system	Turbidity (NTU)	Collecting turbidity measurements every 15 minutes (with computed running 2-hour average)
	Compliance Monitoring	500 feet outside of turbidity control/demarcation system (see Figure 4-1)				
Discrete Water Column Sampling	Compliance Monitoring	500 feet outside of turbidity control/demarcation system	10 feet or mid-depth in water depths less than 20 feet	Grab sampling using Kemmerer or equivalent	• Mercury (total and filtered) • A(A) VOCs • A(A) SVOCs • TSS • TP • TDP • SRP • Field measurements	Dredging activities: • 1 sample/day/station for 2 weeks; 1 sample/ week/station thereafter Capping activities: • 1 sample/week/ station for 3 to 4 weeks; discontinue if no exceedances

Notes:
1. The A(A) list for VOCs and SVOCs consists of the following chemical compounds: benzene, ethylbenzene, toluene, total xylenes, acenaphthene, anthracene, benzo(a)anthracene, fluorene, naphthalene, phenanthrene, and pyrene.
2. Field measurements for temperature, pH, specific conductance, turbidity, oxidation-reduction potential, and dissolved oxygen will be collected at each sample station.

A(A) = aquatic (acute)
SVOCs = semivolatile organic compounds
TSS = total suspended solids
NTU = Nephelometric Turbidity Units
TDP = total dissolved phosphorus
VOCs = volatile organic compounds
SRP = soluble reactive phosphorus
TP = total phosphorus

FIGURES



HORIZONTAL DATUM: New York State Plane, Central Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet.
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88), U.S. Survey Feet.

NOTES: Turbidity curtain alignment presented herein is conceptual and will be updated in the field as necessary and placed with NYSDEC concurrence. Turbidity curtain alignment recived from Parsons on April 10, 2012.

LEGEND:

- Limits of Dredging and Capping
- Limits of Cap Only
- Limits of Removal and Capping in Adjacent Areas Included in Design
- Hot Spot Dredging
- Thin Layer Cap
- Barrier Wall
- Turbidity Curtain
- Interim Moveable Turbidity Curtain
- Existing Contour
- Shoreline (Elev. 362.5')

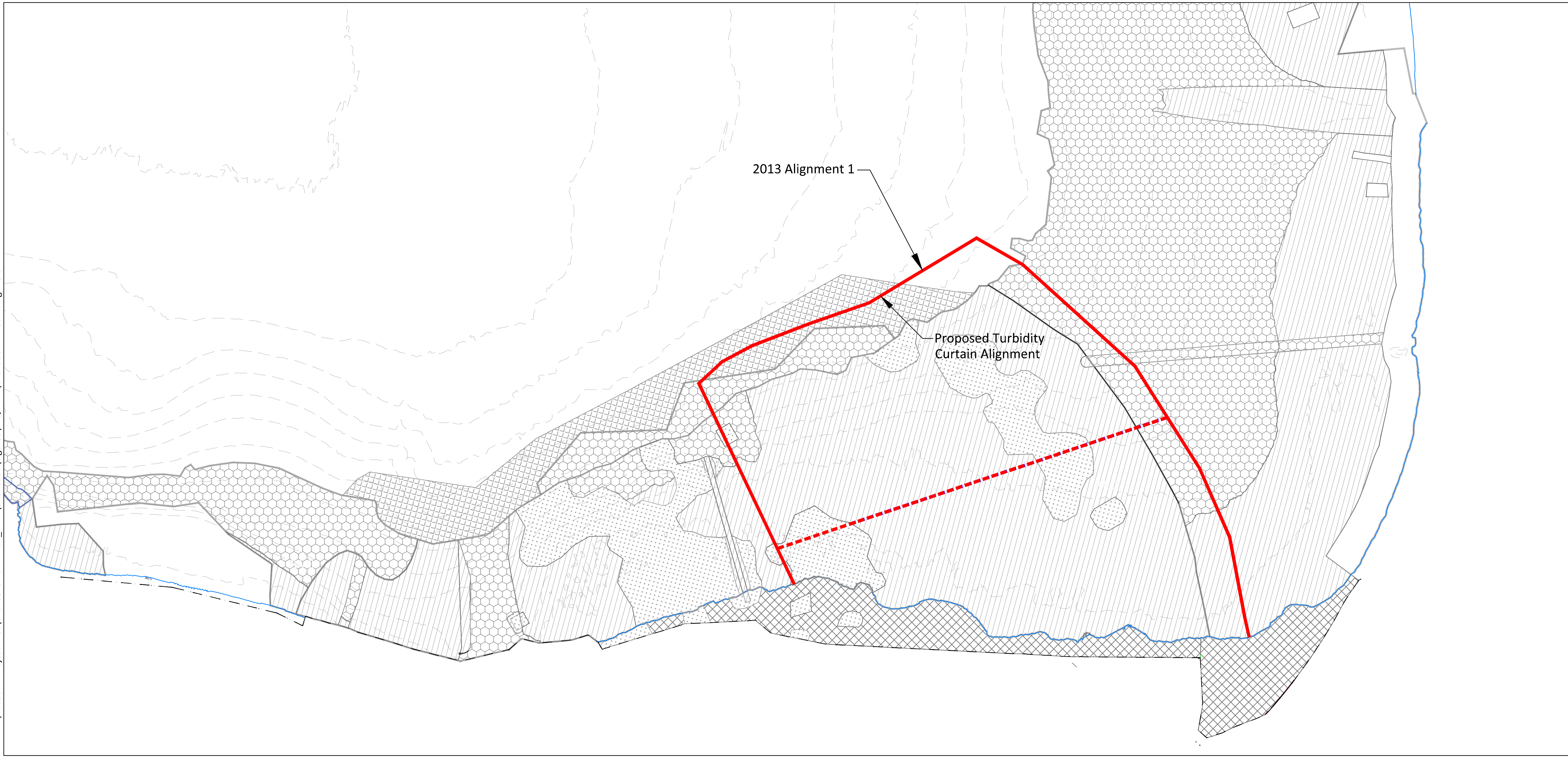
0 500
Scale in Feet

L:\AutoCAD Project Files\010139-ONONDAGA_LAKE\01013902\Figures\WQMMP\01013902-RP-001.dwg FIG 3-1

May 24, 2012 11:24am ghowell

Figure 3-1
Proposed Turbidity Curtain 2012 Alignment
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA
PARSONS COMMERCIAL TECHNOLOGY GROUP



L:\AutoCAD Project Files\010139-ONONDAGA_LAKE\01013902\Figures\WQMMP\01013902-RP-002.dwg FIG 3-2

May 24, 2012 11:30am ghowell

HORIZONTAL DATUM: New York State Plane, Central Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet.
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88), U.S. Survey Feet.

NOTES: Turbidity curtain alignment presented herein is conceptual and will be updated in the field as necessary and placed with NYSDEC concurrence. Turbidity curtain alignment recived from Parsons on July 25, 2011.

LEGEND:

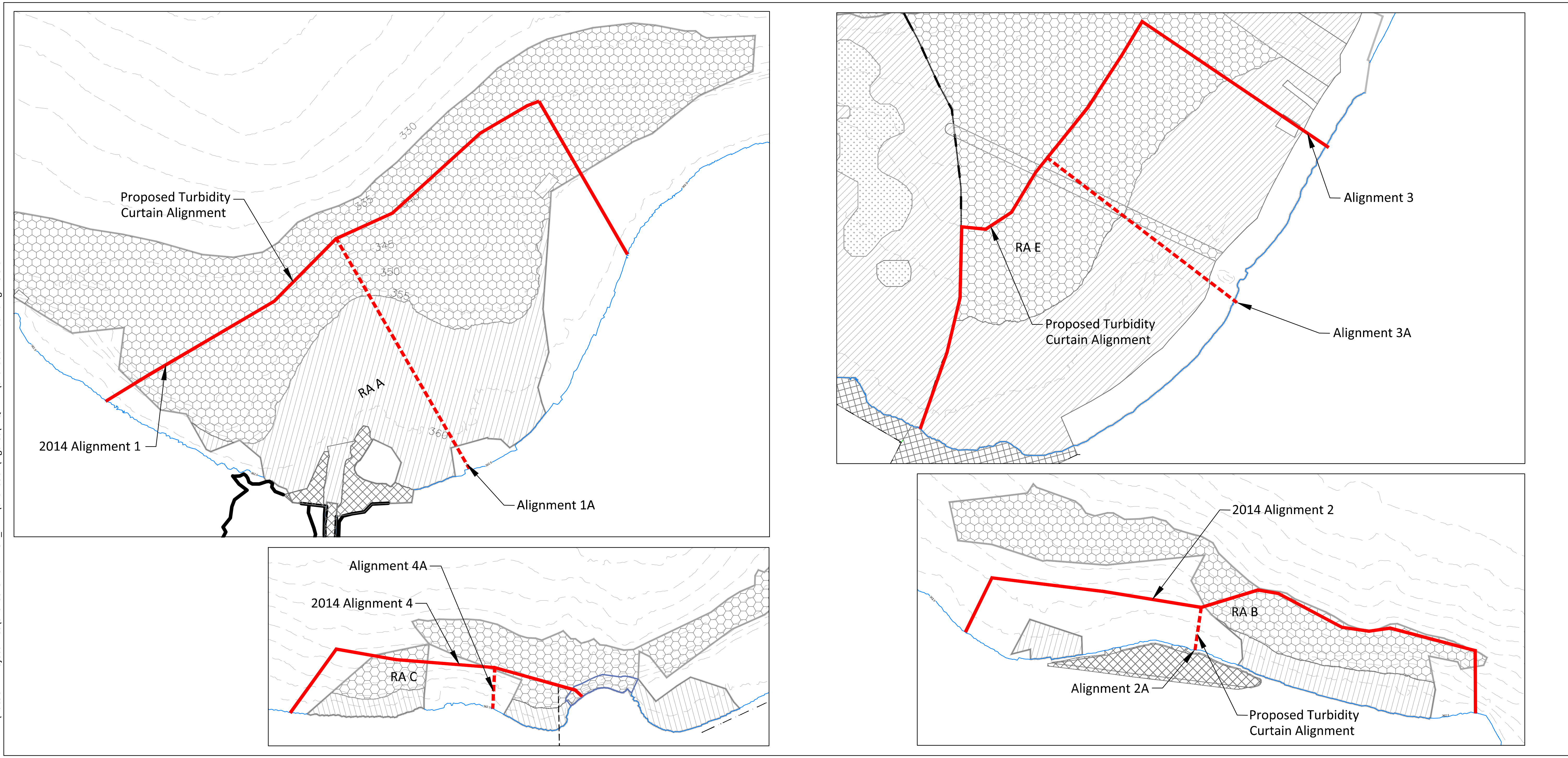
- Limits of Dredging and Capping
- Limits of Cap Only
- Limits of Removal and Capping in Adjacent Areas Included in Design
- Thin Layer Cap
- Existing Contour
- Shoreline (Elev. 362.5')
- Barrier Wall
- Turbidity Curtain
- Interim Moveable Turbidity Curtain
- Hot Spot Dredging

0 500
Scale in Feet

ANCHOR QEA

PARSONS
COMMERCIAL TECHNOLOGY GROUP

Figure 3-2
Proposed Turbidity Curtain 2013 Alignment
Water Quality Management and Monitoring Plan
Onondaga Lake



HORIZONTAL DATUM: New York State Plane, Central Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet.
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88), U.S. Survey Feet.

NOTES: Turbidity curtain alignment presented herein is conceptual and will be updated in the field as necessary and placed with NYSDEC concurrence. Turbidity curtain alignment recived from Parsons on July 25, 2011.

LEGEND:

- Limits of Dredging and Capping
- Limits of Cap Only
- Limits of Removal and Capping in Adjacent Areas Included in Design
- Existing Contour
- Shoreline (Elev. 362.5')
- Turbidity Curtain
- Interim Moveable Turbidity Curtain

0 500
Scale in Feet

L:\AutoCAD Project Files\010139-ONONDAGA_LAKE\01013902\Figures\WQMMP\01013902-RP-002.dwg FIG 3-3

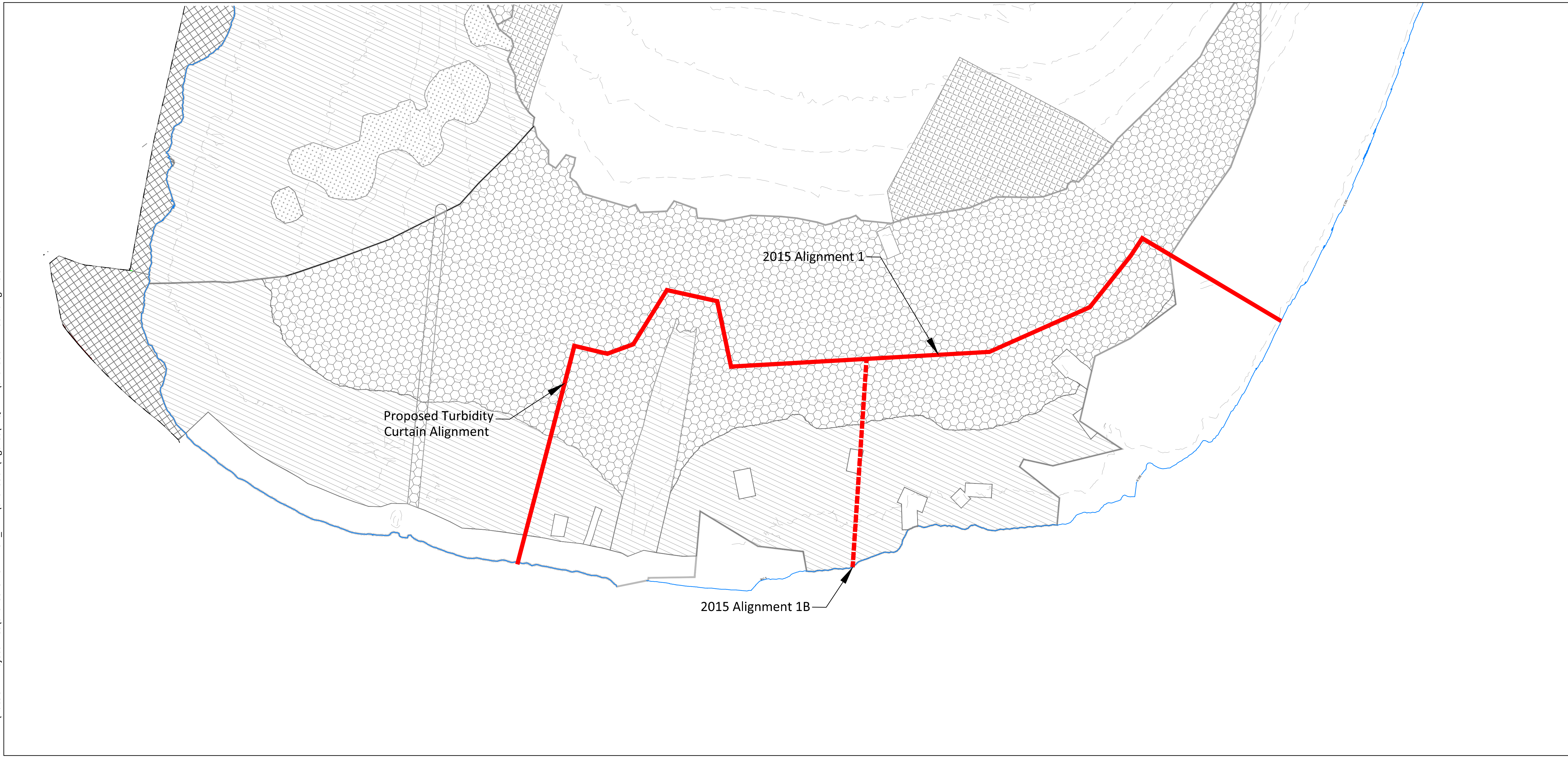
May 24, 2012 11:07am ghowell

ANCHOR QEA

PARSONS COMMERCIAL TECHNOLOGY GROUP

Figure 3-3
Proposed Turbidity Curtain 2014 Alignment
Water Quality Management and Monitoring Plan
Onondaga Lake

L:\AutoCAD Project Files\010139-ONONDAGA_LAKE\01013902\Figures\WQMMP\01013902-RP-002.dwg FIG 3-4



May 24, 2012 11:27am ghowell

HORIZONTAL DATUM: New York State Plane, Central Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet.
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88), U.S. Survey Feet.

NOTES: Turbidity curtain alignment presented herein is conceptual and will be updated in the field as necessary and placed with NYSDEC concurrence. Turbidity curtain alignment recived from Parsons on July 25, 2011.

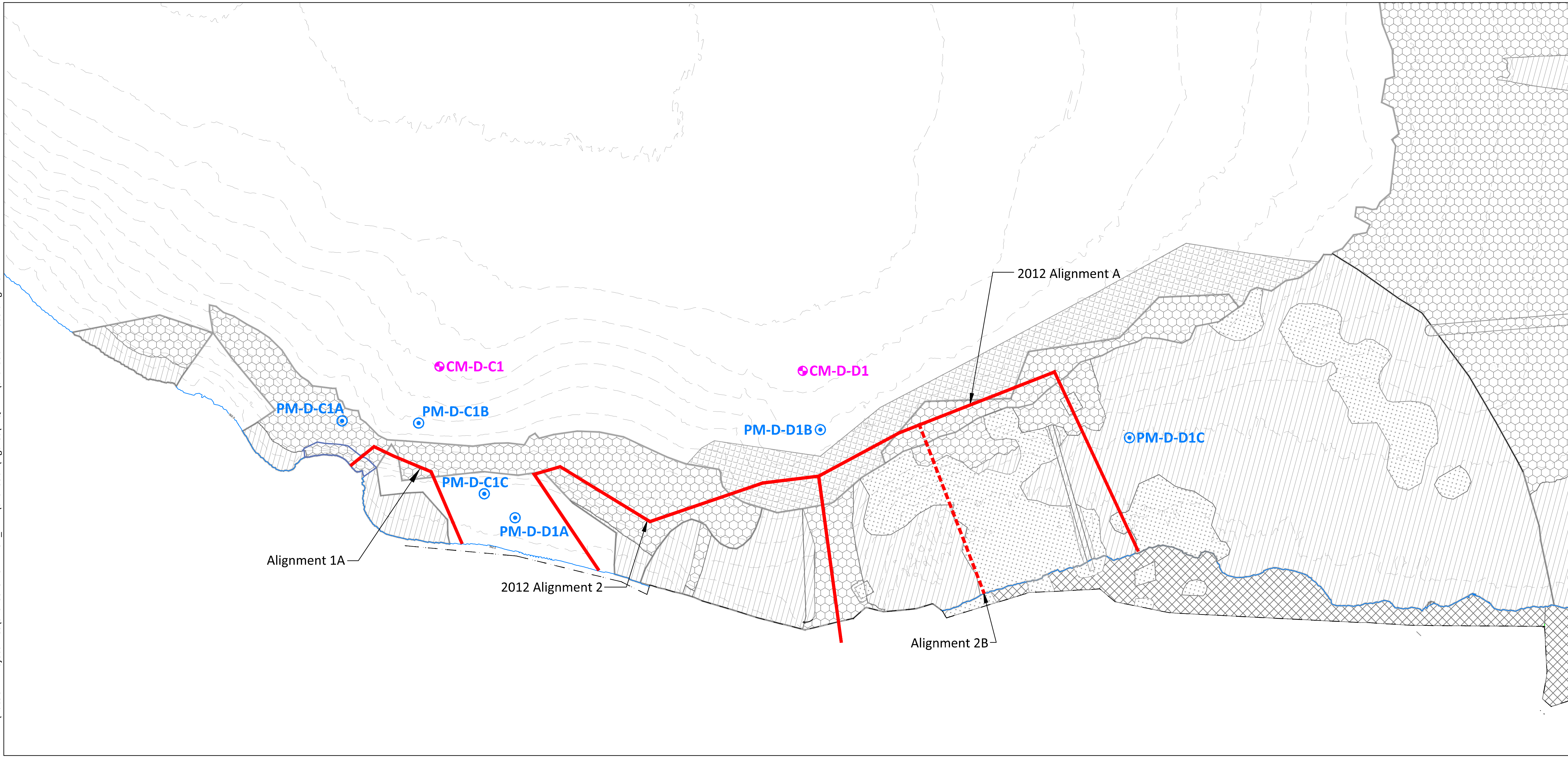
LEGEND:

- Limits of Dredging and Capping
- Limits of Cap Only
- Limits of Removal and Capping in Adjacent Areas Included in Design
- Existing Contour
- Shoreline (Elev. 362.5')
- Barrier Wall
- Turbidity Curtain
- Interim Moveable Turbidity Curtain
- Thin Layer Cap

0 500
Scale in Feet

ANCHOR QEA
PARSONS COMMERCIAL TECHNOLOGY GROUP

Figure 3-4
Proposed Turbidity Curtain 2015 Alignment
Water Quality Management and Monitoring Plan
Onondaga Lake



L:\AutoCAD Project Files\010139-ONONDAGA_LAKE\01013902\Figures\WQMMP\01013902-RP-003.dwg FIG 4-1

May 24, 2012 11:32am ghowell

HORIZONTAL DATUM: New York State Plane, Central Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet.
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88), U.S. Survey Feet.
NOTES:
1. Turbidity curtain alignment presented herein is conceptual and will be updated in the field as necessary and placed with DEC concurrence.
2. Labeling: CM-D-C1 (Type of monitoring station [CM = Compliance Monitoring; PM = Performance Monitoring; BG = Background]; Remediation activity [D = dredging; C = capping; DC = dredging and capping]; Remediation area/number of groups and/or buoys [C2C = Remediation Area C with two monitoring groups identifying the third buoy in the group]

LEGEND:
- Performance Monitoring Station
- Compliance Monitoring Station
- Turbidity Curtain
- Interim Moveable Turbidity Curtain
- Thin Layer Cap
- Limits of Dredging and Capping
- Limits of Cap Only
- Limits of Removal and Capping in Adjacent Areas Included in Design
- Hot Spot Dredging

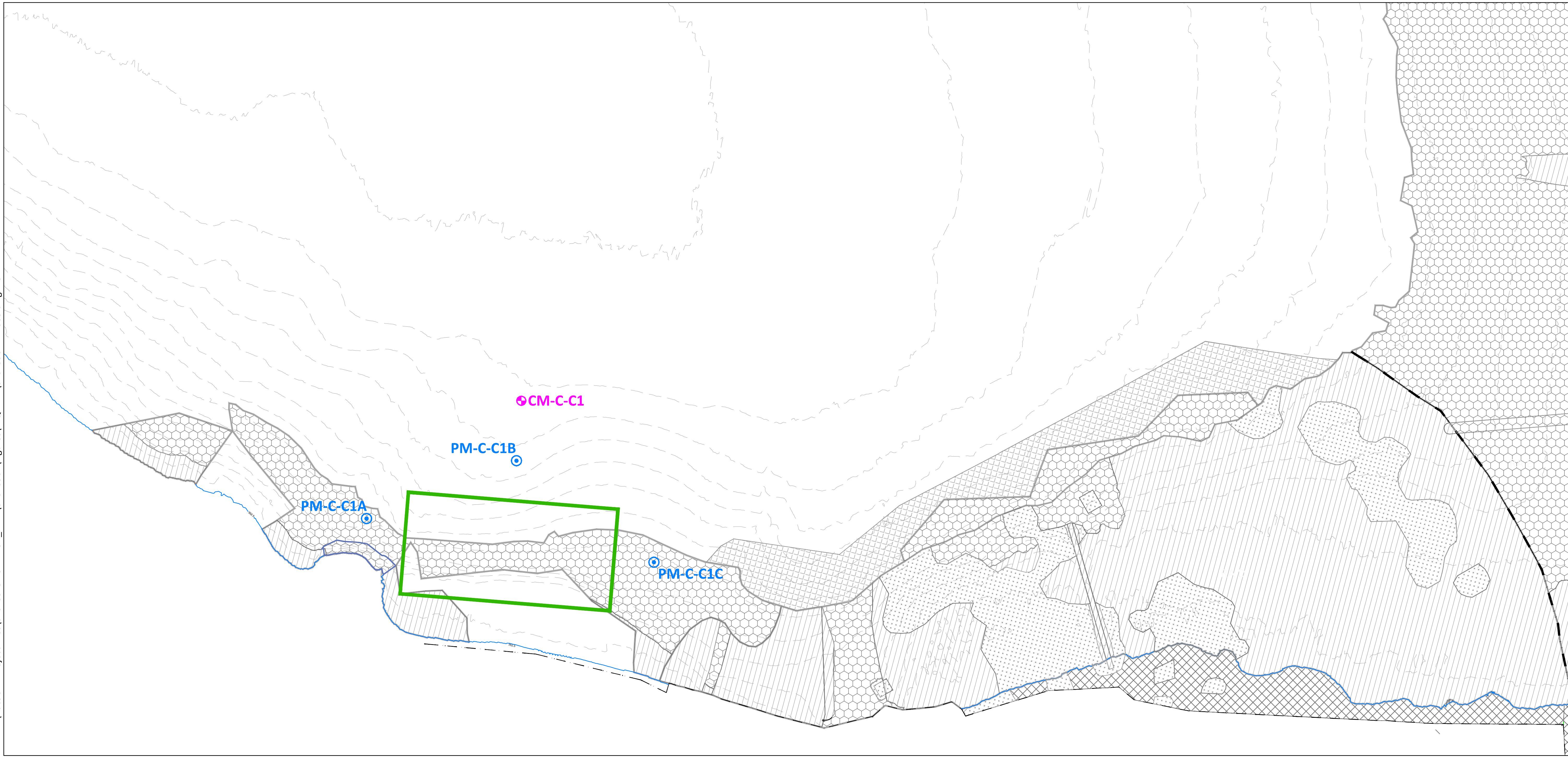
0 500
Scale in Feet

ANCHOR QEA

PARSONS
COMMERCIAL TECHNOLOGY GROUP

Figure 4-1
Typical Performance and Compliance Monitoring Stations During Dredging – Remediation Areas C and D
Water Quality Management and Monitoring Plan
Onondaga Lake

L:\AutoCAD Project Files\010139-ONONDAGA_LAKE\01013902\Figures\WQMMP\01013902-RP-003.dwg FIG 4-2



May 24, 2012 11:34am ghowell

HORIZONTAL DATUM: New York State Plane, Central Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet.
VERTICAL DATUM: North American Vertical Datum of 1988 (NAVD88), U.S. Survey Feet.
NOTES:

1. Demarcation curtain alignment presented herein is conceptual and will be updated in the field as necessary and placed with DEC concurrence.
2. Labeling: CM-D-C1 (Type of monitoring station [CM = Compliance Monitoring; PM = Performance Monitoring; BG = Background]; Remediation activity [D = dredging; C = capping; DC = dredging and capping]; Remediation area/number of groups and/or buoys [C2C = Remediation Area C with two monitoring groups identifying the third buoy in the group]

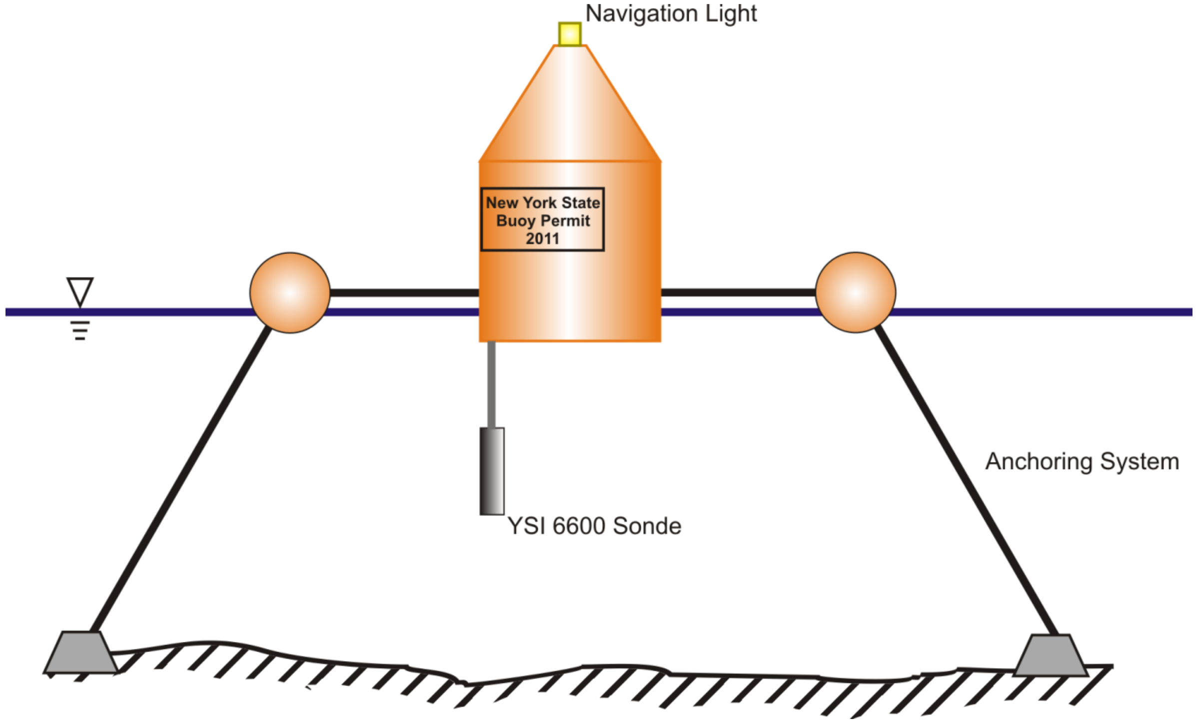
LEGEND:

- Performance Monitoring Station
- Compliance Monitoring Station
- Demarcation Curtain
- Thin Layer Cap
- Limits of Dredging and Capping
- Limits of Cap Only
- Limits of Removal and Capping in Adjacent Areas Included in Design
- Hot Spot Dredging

0 500
Scale in Feet

ANCHOR QEA
PARSONS COMMERCIAL TECHNOLOGY GROUP

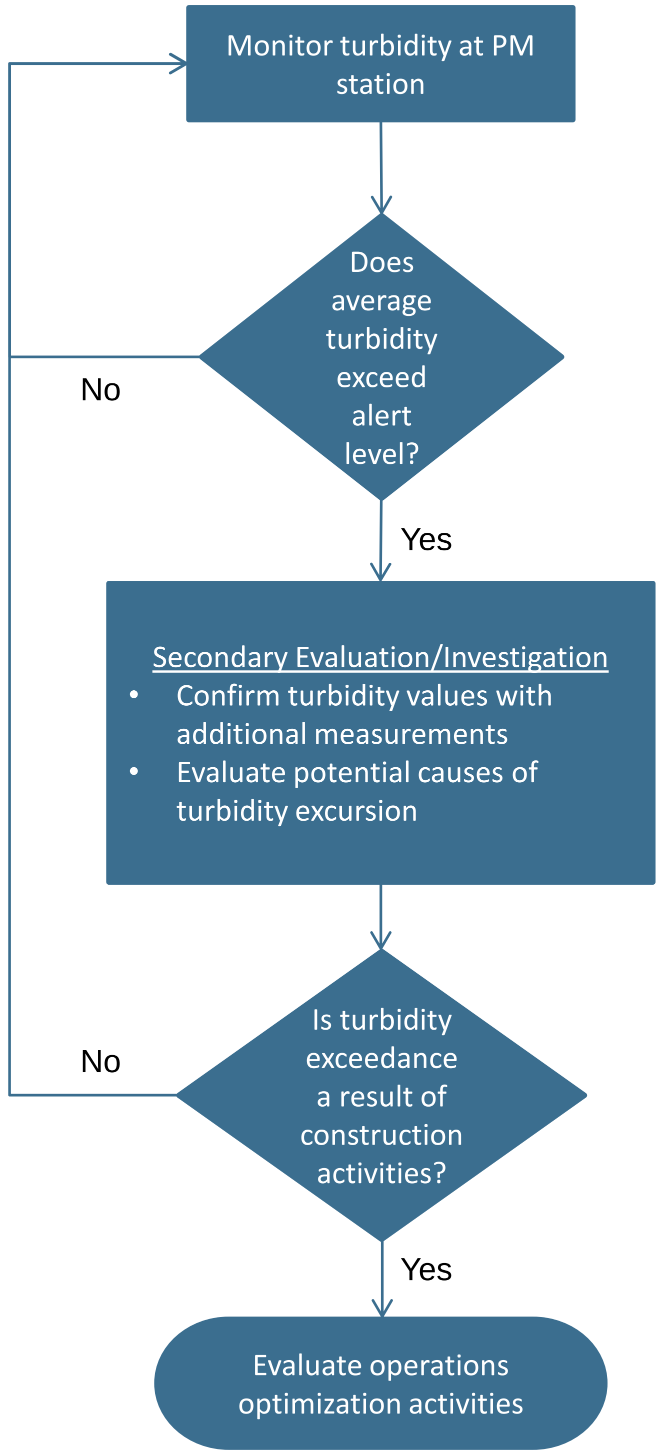
Figure 4-2
Typical Performance and Compliance Monitoring Stations During Capping – Remediation Areas C and D
Water Quality Management and Monitoring Plan
Onondaga Lake



Typical Monitoring Equipment Installation

Photograph of Monitoring Equipment

Figure 4-3
Typical Monitoring Equipment
Water Quality Management and Monitoring Plan
Onondaga Lake



Note:
PM = Performance Monitoring

Figure 5-1
Response Action Flow Chart at Performance Monitoring Station
Water Quality Management and Monitoring Plan
Onondaga Lake

APPENDIX A
STANDARD OPERATING PROCEDURE: SURFACE WATER QUALITY MONITORING AND SAMPLING

TABLE OF CONTENTS

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LIST OF ACRONYMS AND ABBREVIATIONS

A(A)	aquatic acute
GPS	global positioning system
ISO	International Organization for Standardization
MSDS	Material Safety Data Sheets
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
PPE	personal protective equipment
PSP	project safety plan
QA/QC	quality assurance and quality control
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedure
SSP	Subcontractor Safety Plan
SVOC	semivolatile organic carbon
TSS	Total Suspended Solids
VOC	volatile organic carbon

1 SCOPE

This Standard Operating Procedure (SOP) describes procedures used to monitor water quality in Onondaga Lake during dredging and capping activities. These activities will include deployment and servicing of continuous monitoring water quality sondes, conducting field measurements using a multi-parameter probe focusing on turbidity, and collecting water samples for subsequent laboratory analysis for selected chemical parameters.

2 HEALTH AND SAFETY CONSIDERATIONS

A safety briefing will be held at the beginning of each sampling event and at each change in personnel. The designated safety officer on the sampling vessel shall be responsible for ensuring the safety of personnel and will be contacted immediately in the event of an emergency. The standard safety considerations for marine sampling—caution deploying and retrieving heavy equipment, keeping hands and clothing out of winches and A-frame supports, and stepping in the bight of lines or cables—apply to the field crew during sampling. Winches, lifts, cables, and lines will be used within their designed limits to avoid injury from equipment failures. Appropriate personal protective equipment (PPE) will be donned prior to the start of work as described in the project safety plan (PSP). When using standard solutions for calibrations or decontamination of sampling equipment, care will be taken to avoid inhalation, skin contact, eye contact, and ingestion. Material Safety Data Sheets (MSDS) provided by the manufacturer should be reviewed by personnel prior to the use of a chemical. These considerations are discussed in more detail in the PSP (Anchor QEA, in preparation)

3 EQUIPMENT

The following equipment list contains materials that may be needed to carry out the procedures documented in this SOP. Because multiple procedures may be included in this SOP, not all of which are necessarily conducted when using this SOP, not all materials on the equipment list may be required for a specific activity.

- Sampling vessel
- Global positioning system (GPS)
- Multi-parameter sonde with data logger (YSI 6000 series or equivalent)
- Turbidity probes with the following minimum capabilities/features:
  - Turbidity measurement accuracy of 2% or 0.3 Nephelometric Turbidity Units (NTU; whichever is greater), using International Organization for Standardization (ISO) 7027 methodology
  - Turbidity measurement range of 0 to 1,000 NTU
- Buoys with data telemetry capabilities for sonde deployment
- Anchors for buoys
- Sampling equipment
  - A Kemmerer sampler will be used as the primary means of sample collection
  - A Teflon®-lined submersible pump with Teflon-lined tubing (or other Teflon-lined sampling equipment [e.g., peristaltic pump, Van Dorn sampler]) will be available if necessary in the event that the primary sampling equipment requires repair/replacement or field conditions warrant use of these alternate equipment
- Sample containers (supplied by laboratory)
- Coolers for sample storage
- Ice
- Log book
- Labels
- Chain-of-custody forms
- Disposable gloves
- Decontamination supplies (nitric acid, Alconox, deionized water, waste buckets, spray bottles)

3.1 Field Instrument Calibration

All probes for the multi-parameter water quality sonde will be calibrated prior to use per manufacturer recommendations. The procedures described in the sonde owner's manual will be adhered to when performing calibrations for temperature, pH, specific conductance, and dissolved oxygen. When calibrating for turbidity, the procedures listed below will be followed. These procedures have been modified from those prescribed in the owner's manual to account for fouling of the probe that can occur from long-term deployment, and will provide for increased accuracy of the turbidity sensor. Logs will be maintained on all calibrated equipment each time a calibration is performed.

3.1.1 Turbidity Probe Calibration Procedure

The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by standard reference solutions. Ensuring that the lens covering the detection unit is clean, both during the calibration and during field use, is critical to the instrument's operation. The turbidity probe used on the YSI 6000 Series sonde includes an automated optics wiper. This wiper can be activated using the display/logger. The manufacturer recommends use of a two-point calibration procedure and that the YSI 6136 turbidity probe be calibrated using the calibration cup provided with the sonde; however, one major drawback to this method is that the standard solutions must be discarded after calibration due to possible contamination. An alternative method is to place the standard solutions in secondary containers with openings large enough to allow the turbidity probe to be placed into the standard. These containers should have similar physical properties as the calibration cup (i.e., clear to opaque, plastic). The sides of the container should not have any material such as tape or writing on them. This alternative method will be used for the Onondaga Lake construction monitoring; furthermore, to provide for additional accuracy in turbidity measurements in the range of interest (i.e., <100 NTU) a three-point calibration procedure will be used. This turbidity calibration method is as follows:

1. Pour calibration solutions into the YSI calibration cups long enough before calibrating so bubbles have time to dissipate and do not interfere with optics. A separate calibration cup should be used for each solution.

2. Clean all of the probes on the sonde and rinse with deionized water. Shake off excess water. Dry with a lint-free cloth.
3. Remove wiper and clean. Replace wiper pad if needed. Reattach after calibration is complete.
4. Place the probes on the sonde into the 0.0 NTU standard (which can be deionized water).
5. From the “Calibrate” menu on the display/logger, select the “Turbidity” option and press enter.
6. Select the “2-point” option and press enter.
7. Enter “0.0” as the first calibration standard and press enter.
8. Wait for the turbidity measurement to equilibrate, and then press the enter key.
9. Dry probe with a lint-free cloth.
10. Place the probe in the YSI 6073G 126 NTU standard. Do not clean the probe before placing into the second standard.
11. Press enter to continue calibration.
12. Enter “126.0” as the second calibration standard and press enter.
13. Wait for the turbidity measurement to equilibrate and then press the enter key.
14. Rinse all of the probes on the sonde with deionized water. Shake off excess water and dry with a lint-free cloth.
15. Insert probes into the YSI 6072 12.7 NTU standard. The turbidity reading should be in the range of 12.5 to 12.9 NTU. If the buffer reading is not in this range, repeat the calibration procedure.
16. Fill in calibration forms each time a calibration is conducted.

4 PROCEDURES

4.1 Field Data Collection Procedures (Monitoring Buoys)

Data will be obtained using multi-parameter sondes suspended from buoys at each continuous turbidity monitoring station (as discussed in the main body of this report; [i.e., Water Quality Management and Monitoring Plan]). IDs and target coordinates for each station will be predetermined. Station IDs and coordinates will be downloaded to an on-board GPS. Below are the procedures for turbidity data collection.

1. Before collecting any data, calibrate the multi-parameter sonde in accordance with the specifications listed in Section 3 above.
2. Navigate the sampling vessel to the continuous turbidity monitoring station of interest. Anchor a buoy at the desired monitoring location.
3. Program the multi-parameter sondes to begin collecting data immediately after deployment and continue to collect and store data at 15-minute intervals.
4. Suspend the sonde from each buoy at a depth of 10 feet within the water column or at the midpoint of the water column if the water depth is less than 20 feet.
5. Sonde data will be routinely inspected to ensure data are being logged and that the equipment is functioning properly.
6. Routine sonde maintenance will be performed on a weekly basis and will include cleaning and comparing the measurements recorded by each sonde against those from a spare sonde on the sampling vessel.
7. Any sonde determined to have a malfunction or to be out of calibration will be replaced by a newly calibrated sonde. A percentage of sondes will also be exchanged on a routine basis to reduce deployment times and decrease the risk of fouling of the turbidity probes.
8. Retrieve the buoys, anchors, and sondes at the end of the data collection period. Download the data stored on each sonde to the appropriate database, if necessary.

4.2 Water Sample Collection Procedures

Samples will be collected in general accordance with SOP SB-9 (Parsons 2008; Littoral Zone Surface Water Sampling), with the following modifications:

- The USEPA “Clean Hands/Dirty Hands” protocols specified in SOP SB-9 (Parsons

2008) will be followed for mercury samples, but will not be followed for the other analytes (i.e., Total Suspended Solids [TSS], volatile organic carbons [VOCs], and semivolatile organic carbons [SVOCs]).

- Obtain water quality data at each station by lowering a YSI 6000 series (or equivalent) water quality sonde to a depth of 10 feet (or mid-depth if the total water depth is less than 20 feet) and record data in the field database and field notebook.
- Instead of collecting near-surface grab samples (as specified in SOP SB-9; Parsons 2008), a sample will be collected at a depth 10 feet from the water surface or from mid-depth if the total water depth is less than 20 feet. The sampling depth will be determined either by using the vessel's depth finder/sonar, hand-held electronic depth finder/sonar, or by manually deploying a telescoping stadia rod or weight attached to a calibrated rope/cable.
  - All samples will be collected by lowering a Kemmerer sampler or equivalent (e.g., Van Dorn sampler, submersible pump, peristaltic pump) appropriate for trace metal sampling at each location.
  - The Kemmerer sampler will be lowered to the desired sampling depth, deploying the messenger to trigger sample collection, and then filling the containers. When sampling for VOCs, water will be discharged from the sampling port on the bottom of the Kemmerer sampler slowly and allowed to flow in a laminar manner along the side of the designated VOC containers to minimize concerns over volatilization loss.

4.3 Decontamination Procedures

Sampling equipment that comes into contact with lake water will be decontaminated between each sampling location according to the following procedures:

1. Before commencing a sampling event, sampling equipment will be rinsed with a 10 percent nitric acid solution.
2. Rinse equipment with Alconox (or other low-phosphate detergent) along with deionized water, and if necessary scrub with a bristle brush or similar utensil to remove any solids.
3. This rinse shall utilize sufficient amounts of water to flush rather than just wet the surface.

4. Rinse with deionized water.
5. Rinse with dilute solution of nitric acid.
6. Rinse with deionized water.
7. Place equipment in a clean area and allow to air dry to the extent practicable.
8. Contain all wastes from decontamination in tubs or buckets to be properly disposed of after sampling is completed.

4.4 Sample Handling and Tracking

Samples will be handled, preserved, shipped, and tracked as described in SOP 1 (Parsons 2005).

4.4.1 Sample Handling and Preservation

Sample containers will be labeled during sample collection in accordance with labeling requirements specified in the Quality Assurance Project Plan (QAPP; Parsons et al. 2012). Each container will be placed in re-sealable food storage bags (double bagged, one inside the other for mercury samples) and placed in a clean dedicated cooler. The samples will be chilled with ice to approximately 4°C. Samples will be shipped by overnight delivery to the laboratory at the end of each day. Chain-of-custody procedures will be followed, as specified in the QAPP.

4.4.2 Data and Records Management

Data from water sample collection will be recorded in the field database using a laptop computer and field notebooks upon completion of sampling at one location. Blank field log sheets may also be used to record information manually in case difficulties with data entry using the computer are encountered. Manually recorded data will be transcribed into the field database at the end of each day, if necessary.

4.4.3 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) procedures are defined in the QAPP, and include collecting field QA/QC samples. Field QA/QC samples to be collected are blind duplicate samples, equipment blank samples, and matrix spike samples. One set of field

QA/QC samples will be collected for each sampling event. Blind duplicate samples and matrix spike samples will be prepared by filling additional appropriately marked containers at pre-selected sampling stations (both samples will not be collected at the same station). The station where these samples are collected will be rotated randomly for each sampling event. Equipment blank samples will be collected at the last location sampled for each event.

4.4.4 Sample Methods

Water samples will be analyzed using the methods shown below (which is based on Table 4-2 of the main body of this report [i.e., 2012 Water Quality Management and Monitoring Plan]).

Table A-1

Water Quality Parameters, Frequency of Sample Collection, and Analytical Methods

Parameter	Frequency[1]	Method
Mercury (total and filtered)	Weekly	1631E
VOCs (A[A])[2]	Weekly	8260B
SVOCs (A[A])[2]	Weekly	8270C
Total suspended solids	Weekly	SM 20 2540D
Total phosphorus	Weekly	SM 20 4500-P
Total dissolved phosphorus	Weekly	SM 20 4500-P
Soluble reactive phosphorus	Weekly	SM 20 4500-P
Temperature Turbidity pH Dissolved oxygen Specific conductance Oxidation-reduction potential	Weekly	Probe/Meter

Notes:
VOC – volatile organic compound
SVOC – semivolatile organic compound

1. During dredging operations, daily grab samples will be collected for the first 2 weeks of dredging and will continue afterwards on a weekly basis (or biweekly, based on supporting compliance data and concurrence with New York State Department of Environmental Conservation [NYSDEC]). During capping operations, weekly grab samples will be collected for 3 to 4 weeks, graduating to a turbidity-only program.
2. The aquatic (acute) (A[A]) list (i.e., those compounds for which NYSDEC has developed A[A] water quality standards) for VOCs consists of the following chemical compounds: benzene, ethylbenzene, toluene, total xylenes; the A(A) list for SVOCs includes: acenaphthene, anthracene, benzo(a)anthracene, fluorene, naphthalene, phenanthrene, and pyrene.

5 PERSONNEL

The captain and cruise leader shall be the primary persons responsible for ensuring the safety of personnel and following procedural guidelines. The field crew will be informed of boat rules and shall follow the captain's and cruise leader's guidelines. Documentation of training and certifications for the captain, cruise leader, and field crew will be maintained in the SSP.

6 REFERENCES

Parsons, 2005. *Onondaga Lake Pre-Design Investigation: Standard Operating Procedures*. Prepared for Honeywell, Morristown, New Jersey. Syracuse, New York.

Parsons, 2008. *Onondaga Lake Baseline Monitoring Book 2 Work Plan Fish, Invertebrate And Littoral Water Monitoring For 2008 Appendices*. Prepared for Honeywell, Morristown, New Jersey. Syracuse New York.

Parsons, 2010. *Onondaga Lake Pre-Design Investigation: Revised Quality Assurance Project Plan*. Prepared for Honeywell, Morristown, New Jersey. Syracuse, New York.

Parsons, Anchor QEA, LLC, and Upstate Freshwater Institute, 2012. *Draft Quality Assurance Project Plan for Onondaga Lake Construction and Post-Construction Media Monitoring (surface water, biota and sediment)*. Prepared for Honeywell. May 2012.

APPENDIX B
ONONDAGA LAKE WATER QUALITY DATA SUMMARY AND INTERPRETATION

TABLE OF CONTENTS

List of Figures

LIST OF ACRONYMS AND ABBREVIATIONS

A(A)	aquatic (acute)
A(C)	aquatic (chronic)
BMP	best management practice
cfs	cubic feet per second
CPOI	chemical parameters of interest
H(FC)	human consumption of fish
ILWD	in-lake waste deposit
ISUS	In-Situ Ultraviolet Spectrophotometer
Metro	Metropolitan Syracuse Wastewater Treatment Plant
mg/L	milligrams per liter
mph	miles per hour
Nm	Nanometer
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
OCDWEP	Onondaga County Department of Water Environment
PAH	polycyclic aromatic hydrocarbon
PAR	Photosynthetically Active Radiation
PCB	polychlorinated biphenyls
PDI	Pre-Design Investigation
RI	Remedial Investigation
SMU	Sediment Management Unit
SVOC	semivolatile organic compound
SU	Syracuse University
TSS	Total Suspended Solids
UFI	Upstate Freshwater Institute
VOC	volatile organic compound
WB	Wastebeds
WQMMP	Water Quality Management and Monitoring Plan

1 INTRODUCTION

There is a long history of water quality monitoring in Onondaga Lake. In general, water quality, and particularly turbidity, within Onondaga Lake can vary significantly due to natural events such as rain storms, high winds, and other weather events. For example, the southeast portion of the Lake represents its predominantly leeward end, and as a result becomes turbid on windy and stormy days due to particulate matter that enters from the tributaries and/or wind-driven resuspension of sediments (as well as Solvay Waste in the in-lake waste deposit [ILWD] area). On calm days, water clarity can be high in shallow areas. Additionally, tributaries to the Lake (e.g., Onondaga Creek, Harbor Brook, Ley Creek, and Ninemile Creek) and outfalls (i.e., Metropolitan Syracuse Wastewater Treatment Plant [Metro]) can contribute to increased turbidity within the littoral regions of the Lake, particularly after rain storm events. Furthermore, biological processes (i.e., algal production) have an effect on water clarity and turbidity levels in the Lake. The various water quality datasets available to assess the general water quality characteristics described above are summarized in the next section.

2 OVERVIEW OF WATER QUALITY DATASETS

2.1 2010 to 2011 Water Quality Monitoring for Construction Baseline

In order to understand potential impacts on water quality from the dredging and capping operations that will begin in 2012, baseline monitoring was conducted in fall 2010 and spring, summer, and fall 2011 as part of the Water Quality Monitoring for Construction Baseline sampling program (Parsons et al. 2010 and 2011, respectively). Section 1 of this appendix summarizes the results of that baseline survey, as well as other water quality data collected as part of more historical water quality monitoring programs, and discusses trends observed.

The primary objective of the 2010 to 2011 Water Quality Monitoring for Construction Baseline sampling program was to obtain an understanding of baseline chemical and optical (i.e., turbidity/water clarity) water quality characteristics near dredging and capping areas (and where water quality monitoring will occur during those remediation activities). As part of this program, continuous turbidity monitoring was performed and surface water samples were collected during a range of conditions that can affect various components of water quality. Sampling events occurred during relatively calm conditions as well as after periods of tributary runoff, wind-driven waves, and typical lake currents, as well as under varying degrees of thermal stratification, to understand how these natural forcing conditions affect water quality within the Lake.

The information collected during this sampling program was used to: 1) establish the typical range of ambient water quality conditions expected to occur during dredging and capping activities (i.e., spring to fall construction season), as presented in Section 1 of this appendix; 2) assess the repeatability of seasonal results from 2 consecutive years (i.e., compare results between fall 2010 and fall 2011), as presented in Section 1 of this appendix; and 3) establish action levels during dredging and capping operations and provide construction managers with information to implement best management practices (BMPs) towards minimizing impacts to water quality (see Section 3 of the main Water Quality Management and Monitoring Plan [WQMMP] text).

2.2 Other Datasets

In addition to the water quality data collected during the 2010 to 2011 Water Quality Monitoring for Construction Baseline program, several other datasets were also considered in evaluating baseline conditions in the Lake. These included the following:

- Sampling during the Remedial Investigation (RI) performed by Honeywell and New York State Department of Environmental Conservation (NYSDEC) in the 1990s and 2001 (TAMS Consultants, Inc. 2002):
  - The RI datasets consisted of primarily Lake water chemistry studies conducted in 1992 and 1999. The objective of these studies was to determine representative concentrations of substances in the epilimnion and hypolimnion of the Lake. In addition, water chemistry data were collected from nearshore sites where people could be in contact with Lake water during recreation activities.
  - Additional water column sampling was conducted in 2001 to evaluate resuspension of mercury from sediments in the littoral zone in the southwest corner of the Lake.
- The Baseline (Book 1 through Book 3) Monitoring Program conducted by Honeywell (Upstate Freshwater Institute [UFI] and Syracuse University [SU] 2008), which consisted of deep basin water monitoring from 2008 to 2011 at the South Deep station and littoral water monitoring during 2008 and 2010 at several nearshore stations:
  - Objectives of the deep basin monitoring were to: 1) provide a basis to measure achievement of surface water quality standards; 2) provide a basis to measure success in controlling key processes (e.g., mercury methylation in the hypolimnion, sediment resuspension from the ILWD, and mercury release from profundal sediment); and 3) provide information on the generation of methylmercury in the hypolimnion for use in the design of nitrate addition/oxygenation pilot tests and basis to measure results.
  - Objectives of the littoral sampling were to understand the movement of mercury/methylmercury generated from the hypolimnion during and following fall turnover into the surface waters of the Lake for assessing exposure to biota. Littoral water samples were collected at four locations in the south basin and two locations in the north basin.
- The Pre-Design Investigation (PDI; e.g., Parsons 2005, 2007), which included

primarily collection of surface water samples from Sediment Management Unit (SMU) 3 (between Remediation Areas B and C) in 2005 as part of the PDI Phase 1 to identify potential impacts from Wastebeds (WB) 1-8 to the Lake. These samples were analyzed for volatile organic compounds (VOCs), phenol, and mercury. The PDI also included collection of a limited number of samples during subsequent phases of the program.

- Onondaga County Department of Water Environment Protection's Ambient Monitoring Program (e.g., OCDWEP 2009). OCDWEP has been collecting and analyzing water quality samples from various areas of the lake on a periodic basis (bi-weekly, quarterly, etc.) and after select rain storm events each year. Although OCDWEP's lake sampling is mainly focused on the profundal zone, there is also some monitoring in the littoral area of the lake, including turbidity (e.g., see Appendices F and I of the Year 2009 Onondaga Lake AMP [OCDWEP 2009]). OCDWEP provides annual updates of its monitoring results for public consideration (e.g., OCDWEP 2007).

General trends in water quality associated with these data sets are discussed in Section 1 below. The sampling locations associated with NYSDEC/Honeywell datasets are presented on Figure B-1.

Water quality data were also collected during the following three activity-based sampling events, which are discussed in Section 1 of this appendix (because these are not necessarily representative of ambient/baseline conditions):

- Installation of the Willis-Semet wall
- Collection of bulk sediment for water treatment bench tests
- Capping field demonstration of activated carbon placement

3 SUMMARY OF BASELINE SURVEY AND EVALUATION OF WATER QUALITY TRENDS

An evaluation was conducted of spatial and temporal trends and patterns in the datasets noted above. Key results from this evaluation are summarized below.

Surface water data were evaluated with consideration of the following questions:

- What can be considered ambient conditions in the Lake with respect to turbidity and concentrations of chemical compounds?
- Do the following discernible trends exist across the turbidity and chemistry data collected to date?
  - Temporal (both long-term [e.g., RI to present] and seasonal)
  - Spatial (e.g., is turbidity higher near tributaries?)
  - In response to forcing conditions (e.g., wind, rainfall/runoff)
- How do chemical compound data compare to NYSDEC ambient water quality standards? Are water quality standards generally being met under current conditions?
- Can discernible trends between turbidity and Total Suspended Solids (TSS) measurements be drawn?

3.1 Turbidity Monitoring

As part of the Water Quality Monitoring for Construction Baseline program, four continuous turbidity monitoring buoys (15-minute measurements) were deployed for approximately 6 weeks during October and November 2010, and three buoys were deployed for approximately 6 months during 2011 (late May to late November). Each buoy included a data sonde (i.e., turbidity probe) and data logging equipment. A map displaying the locations of the buoys is provided as Figure B-2.[1]

[1] The 2011 locations were adjusted so that monitoring would be in areas located 300 to 600 feet outside of the silt curtain alignments anticipated during dredging and capping activities, whereas monitoring locations were closer to shore in 2010. Due to similarities in the statistical distribution of 2010 turbidity data, the two 2010 monitoring locations within Remediation Area E (locations T3 and T4) were combined into a single location near the perimeter of that area in 2011 (location E2). In 2011, the sonde (i.e., turbidity sensor) at each deployment was fixed at a depth of 10 feet, consistent with the depth used to represent the upper mixed layer of the Lake in the discrete water quality sampling (discussed below). In 2010, the sondes were fixed at mid-depth, as all three sampling events occurred post-turnover (i.e., in well-mixed waters).

During the discrete sampling events in 2010 and 2011 (as discussed below in Section 3.2), a second vessel collected spatially detailed water quality information with rapid profiling instrumentation. Vertical profiling[2] was conducted at three locations within each of four transects within the major remediation areas of the Lake (sample points designated as T1-*, T2-*, T3-*, and T4-*), and at North Deep and South Deep (see Figure B-3), for a total of 14 profiles per sampling event. Profiling was also conducted during approximately six additional occasions, such that optical/turbidity data were collected approximately bi-weekly during the program. The focus of the rapid profiling was to measure light scattering, including turbidity and the beam attenuation coefficient at 660 Nanometers (nm; cP660).

Finally, weekly profiles were also conducted using an In-Situ Ultraviolet Spectrophotometer (ISUS)[3] at ten sites (six along the longitudinal axis of the lake and four additional sites to form a lateral transect at South Deep), as part of Honeywell's Book 1 Baseline Monitoring Program (UFI and SU 2008). As part of the Water Quality Monitoring for Construction Baseline program, this Book 1 profile work was supplemented with two additional lateral transects in the south basin, one additional transect in the north basin, and one additional location outside of Remediation Area B in order to provide increased spatial resolution adjacent to the major remediation areas. The locations of the rapid turbidity profiling and ISUS monitoring are also provided on Figure B-3. A detailed interpretation of results from the rapid turbidity profiling and ISUS monitoring is presented in Attachment 1 to this Appendix.

The cumulative frequency distributions shown on Figures B-4 through B-6 illustrate the variability observed in 15-minute turbidity measurements at the continuous monitoring locations during fall 2010 (T1, T2, T3, and T4) and spring, summer, and fall 2011 (A2, D1, and E2). In general, turbidity measurements in the vicinity of Remediation Area A (Buoys T1 [2010]/A2 [2011]), Remediation Area D (Buoys T2 [2010]/D1 [2011]), and Remediation

[2] Profiling was conducted with a Sea-Bird Electronics, Inc. package of instruments, which contains: 1) Temperature, specific conductance, pressure - SBE 25 SEALOGGER CTD (Sea-Bird Electronics); 2) Chlorophyll - WETStar Fluorometer (WET Labs); 3) Beam attenuation coefficient - C-star transmissometer (WET Labs); 4) Photosynthetically Active Radiation (PAR) sensor (LI-COR Environmental); 5) Optical Backscattering (OBS) - OBS-3 (D&A Instruments; UFI calibrates for turbidity); and 6) Datalogger that stores and integrates all of the above components (Sea-Bird Electronics).

[3] The ISUS package of instruments contains: 1) Nitrate probe - Satlantic ISUS sensor (Satlantic Instruments); 2) Turbidity and chlorophyll - ECO FLNTU combination fluorometer and turbidity sensor (WET Labs); 3) Beam attenuation coefficient - C-star transmissometer (WET Labs); 4) Scalar PAR sensor (Biospherical Instruments); 5) Temperature, specific conductance, and pressure - CTD 37I sensor (Sea-Bird Electronics); and 6) Datalogger that stores and integrates all of the above components (WET Labs).

Area E (Buoy T3 [2010] and Buoys T4 [2010]/E2 [2011]) remained relatively low (e.g., less than 10 Nephelometric Turbidity Units [NTU]) throughout most of the monitoring activities, with a small percentage of measurements having higher turbidity. The sources of these variations are discussed in the sections below.

3.1.1 Temporal Variability

As illustrated on Figure B-4, during the 6-week period from mid-October to late November 2010, approximately 75% or greater of the turbidity measurements were less than 10 NTU at all stations (i.e., T1, T2, T3, and T4), with approximately 99% or greater of the measurements being less than 100 NTU.

As illustrated on Figure B-5, during the 6-month period from late May to late November 2011, approximately 90% or greater of the turbidity measurements were generally less than 10 NTU at all stations (i.e., A2, D1, and E2), with less than one tenth of one percent of measurements greater than 100 NTU at only one station (E2).

Figure B-6 presents these frequency distributions on a month-by-month basis.[4] Comparing October and November 2010 to the same period in 2011, the following variability is noted between these 2 years:

- October 2010:
  - Approximately 20% of measurements greater than 10 NTU at station T3
  - Approximately 40% of measurements greater than 10 NTU at station T4
  - At stations T1 and T2, fewer than 1% of measurements greater than 10 NTU
- November 2010:
  - Approximately 10% to 15% of measurements greater than 10 NTU at stations T2 and T4
  - Approximately 25% of measurements greater than 10 NTU at station T3

In October and November 2011, turbidity was generally only measured greater than 10 NTU at one station (E2 in November), with 5% of those measurements being greater than 10 NTU.

[4] May 2011 is not presented because less than 1 week's worth of measurements were collected.

These observed interannual differences can likely be attributed to differences in forcing conditions between these 2 years, with 2010 having somewhat higher winds and more rainfall events than 2011, as well as differences in sample locations with respect to distance from the tributaries, as discussed in Section 3.1.2.

3.1.2 Variability in Concentration Relative to Wind, Rain, Tributary Runoff

Observed short-term increases in turbidity during the 2010 and 2011 monitoring period were found to generally coincide with increases in wind, precipitation, and/or flow in nearby tributaries. Figure B-7 graphically presents turbidity measurements in conjunction with nearby tributary flow rates, wind speed/direction, and precipitation for each 2010/2011 continuous monitoring station pair (combined datasets as noted above), and for station T3 (2010). The periods of discrete water column sampling events (discussed below) are also noted on these plots. The higher turbidity measurements recorded in spring and fall generally correspond to more frequent storm/precipitation/flow events.

As illustrated in the cumulative frequency distribution plots discussed above (Figures B-4 and B-5), the vast majority of turbidity measurements were less than 10 NTU. Several periods where short-term spikes were observed above this general baseline can be seen on Figure B-7. Several noteworthy observations are as follows.

<u>Select 2010 Observations</u>

- Location T1: A noted increase up to approximately 15 NTU on October 25, 2010, was found to generally correlate with an accumulation of approximately 0.5 inches of rain on that day (Figure B-7a).
- Location T2: A period of increased and highly variable turbidity occurred between November 2 and 5, 2010, with turbidity as high as approximately 800 NTU (Figure B-7b). This period of short-term increase did not appear to correlate with any noteworthy increases in flow in Harbor Brook or Onondaga Creek, or in wind speed, although rainfall totaling approximately 0.4 inches was recorded during this period.
- Location T3:
  - A noted increase in turbidity on October 21, 2010, to approximately 60 NTU appears to coincide with a short-term increase in wind (measured wind speed up

to approximately 17 miles per hour [mph] from the west) and precipitation (approximately 0.3 inches of rainfall) on that day (Figure B-7d).

  - A noted increase in turbidity on November 8, 2010, up to approximately 140 NTU, seems to coincide with several hours of sustained winds out of the northwest (up to 14 mph) on that day, in the absence of any noted increases in precipitation or flow in Onondaga Creek (Figure B-7d).

- Location T4:
  - A noted increase in turbidity to approximately 180 NTU on October 28, 2010 (Figure B-7c) appeared following a rainfall event of approximately 0.5 inches from 3 days prior (and corresponding increases in Ley Creek flow), as well as a relative increase in wind speed on that day.
  - On November 17, 2010, a short-term increase in turbidity up to 200 NTU was recorded over a few hours following a period of approximately 8 hours of sustained winds from the west averaging 20 mph (Figure B-7c).

<u>Select 2011 Observations</u>

- Location A2:
  - A noted increase in turbidity to approximately 15 NTU on September 8, 2011, appeared following a rainfall event in which more than 2.5 inches of rain fell the day prior, and flows in Ninemile Creek increased to approximately 800 cubic feet per second (cfs) from a base flow close to 50 cfs (Figure B-7a).
  - A turbidity increase was noted again on September 29 and 30, 2011 (Figure B-7a), peaking just less than 40 NTU. This seems to coincide with increased flow of approximately 450 cfs in Ninemile Creek. Several hours of increased wind averaging approximately 12 mph from the southwest was also measured at that time.
- Location D1: Consistently low turbidity (less than 10 NTU) was measured at this station during the 6 months of 2011 monitoring (Figure B-7b). The highest measurement of approximately 25 NTU on May 28, 2011, does appear to correlate with a short-term increase in flow of approximately 680 cfs in Onondaga Creek the day prior (from a baseline flow previously of approximately 200 cfs).

- Location E2:
  - Consistently low turbidity (less than 10 NTU) was measured at this station during the 6 months of 2011 monitoring (Figure B-7c). Two noted increases (as seen on Figure B-7c) of approximately 240 NTU on July 28, 2011, and of approximately 180 NTU on September 6, 2011, were single elevated readings[5] and may be representative of a sonde error, as other readings on those days were out of range (< 0 NTU or > 1,000 NTU) and were not presented on that plot. Neither recent precipitation/elevated flow in nearby tributaries nor high winds were noted on these days.
  - Periods of variable turbidity in early to mid-June and in mid-November, where measurements generally ranged from 20 to 50 NTU, and from 10 to 30 NTU, respectively, were also noted (Figure B-7c), in absence of any specific increases in natural forcing conditions. These data may be indicative of the somewhat higher turbidity observed in this portion of the lake relative to others (see section below).

To further evaluate variations in turbidity with wind, precipitation, and flow conditions, turbidity data collected by OCDWEP from 9 littoral zone sampling locations from 2002 to 2007 were compared against yearly tributary flow and wind speed data, as shown on Figure B-8. Although sampled at a much lower frequency, the trends observed in the OCDWEP data are generally consistent with the variations in turbidity with forcing conditions observed in the 2010 to 2011 continuous monitoring data. For example, a review of 2006 turbidity results in the littoral regions of the lake indicated the turbidity levels near Ninemile Creek increased from approximately 5 NTU to over 50 NTU during a high flow event (500 to 1,000 cfs in Ninemile Creek). Similarly, 2002 turbidity results near the Metro outfall increased from approximately 10 NTU to over 40 NTU during a flow event in June (over 500 cfs in Onondaga Creek).

3.1.3 Spatial Variability

As compared to the other stations, the distribution of turbidity measurements observed in Remediation Area E (Buoys T3 and T4 [2010] and E2 [2011]) is somewhat higher than that from the other locations, as illustrated by Figures B-4 through B-7. These higher turbidity

[5] As opposed to several readings gradually increasing, reaching a maximum, and then decreasing.

measurements may be attributed to the proximity of those stations to the tributary outlets (Ley Creek and Onondaga Creek), as well as to influences from Metro and/or the increased prevalence of wind wave activity in this end of the Lake.

In addition, the data provide some evidence of variations in turbidity with proximity to shore and/or the mouths of tributaries. For instance, location E2 in 2011 was located approximately twice as far from the outlet of Ley Creek than was location T4 in 2010. Turbidity measurements were observed to be somewhat higher in October and November 2010 as compared to the same period in 2011 (Figure B-7c), under similar flows in the creek; therefore, this variability could be influenced by sediment loading in that tributary.

Despite these small differences in the turbidity distributions among the buoys, Figure B-9, which is based on the rapid profiling results from October and November 2010 and late May to October 2011, illustrates that, in general, the spatial distribution of turbidity in the Lake is relatively uniform, with average measurements over this time period varying by approximately only 1 NTU across the Lake. Figure B-9 also shows that the small spatial differences do indicate that turbidity is somewhat higher near Remediation Area E, which is consistent with the differences observed among the continuous monitoring buoys discussed above.

3.2 Discrete Water Column Sampling – Chemical Compounds

Discrete sampling of the water column and analysis for chemical compounds (mercury, methylmercury, VOCs/semivolatile organic compounds [SVOCs] chemical parameters of interest [CPOIs], and polychlorinated biphenyls [PCBs]) was conducted at 13 locations during three sampling events in 2010 and from 11 locations during six sampling events in 2011 (total of 105 samples plus one duplicate sample per event) as part of the Water Quality Monitoring for Construction Baseline program. A map displaying these locations is provided as Figure B-10. The results from these sampling events as well as from other programs (e.g., RI, PDI) have been evaluated, and a summary of general conclusions is presented below. A series of box and whisker plots (one page per chemical compound) are presented as Figure B-11 and a series of temporal plots as Figure B-12.[6]

3.2.1 Temporal and Spatial Variability

Mercury concentrations appear generally consistent spatially throughout the sampled areas of the Lake, and are generally decreasing over time, exhibiting a strong seasonal pattern, both of which are well documented. These trends are supported by data from the Book 2 baseline monitoring program (e.g., Parsons, Exponent, and Anchor QEA 2009, 2011a, 2011b). VOCs/SVOCs and PCBs are generally non-detect and, when detected, trends are difficult to discern from the available data.

3.2.2 Current Concentrations in Lake Compared to NYSDEC Water Quality Criteria

Of the New York State Class B/C Surface Water Quality Standards and Guidance Values[7], the aquatic (acute) criteria would be most relevant for consideration of short-term impacts from dredging and capping activities. As such, these standards have been indicated on the plots of chemical data results presented as Figures B-11 and B-12 (for those chemical compounds that have such standards). Based on the full set of available chemistry data, dating back to the first rounds of sampling from the RI in 1992, the only observed exceedances of NYSDEC's

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[6] The box plots presented on Figure B-11 were based on the "schematic" plot as presented in Tukey (1977):

- The height of the box is equal to the "upper hinge" minus the "lower hinge," each defined as follows:
  - Lower hinge (h_L) = median of all observations less than or equal to the overall sample median.
  - Upper hinge (h_U) = median of all observations greater than or equal to the overall sample median.
- Whiskers:
  - The upper whisker extends from the top of the box to the largest observation less than h_U + (1.5 x [h_U – median])
  - The lower whisker extends from the bottom of the box to the smallest observation greater than h_L – (1.5 x [median – h_L])
- Outliers:
  - Inner Outliers are as follows:
    - [greater than h_U + (1.5 x [h_U – median]) and less than h_U + (3 x [h_U – median])] OR
    - [less than h_L – (1.5 x [median – h_L]) and greater than h_L – (3 x [median – h_L])]
  - Outer Outliers are as follows:
    - [greater than h_U + (3 x [h_U – median])] OR
    - [less than h_L – (3 x [median – h_L])]

Further information can be found in Section 2.1.4.2 and Appendix A of Helsel and Hirsch (2010).

[7] Human consumption of fish [H(FC)], fish propagation in freshwater [aquatic chronic; A(C)], fish survival in freshwater [aquatic acute; A(A)], wildlife protection [W], and aesthetic [E]

A(A) criteria were a few limited samples for one polycyclic aromatic hydrocarbon (PAH) compound (benzo(a)anthracene) collected in 2010. Therefore, as this compound has been observed to exceed the criteria under ambient conditions, sporadic exceedances of the A(A) criteria for PAHs would not be unexpected during dredging and capping activities.

4 TURBIDITY AND TOTAL SUSPENDED SOLIDS RELATIONSHIP

As discussed in Section 3 of the WQMMP, an efficient and environmentally protective program based on real-time turbidity measurements will be implemented to monitor impacts of dredging and capping on water quality. However, there is often a desire to attempt to correlate TSS and turbidity. NYSDEC suggested that such an assessment be made in its comments on the January 2011 Draft Onondaga Lake Capping, Dredging and Habitat Intermediate Design:

> *"…the parameter of interest from the perspective of ecological resource protection is TSS and not turbidity. Thus, in order to use turbidity as a guide to water quality, it would appear necessary to establish a relationship between the two parameters…"* (Parsons and Anchor QEA 2011)

Therefore, a TSS and turbidity relationship was assessed to evaluate the ability to estimate TSS based on real-time turbidity monitoring. Turbidity and TSS data collected from the Lake during 2010 and 2011 as part of the Water Quality Monitoring for Construction Baseline program, and in certain tributaries from 2009 to 2011 as part of the Baseline Book 3 program (UFI and SU 2008)[8], have been evaluated to ascertain the relative degree of correlation between these parameters and to ensure that the turbidity action levels developed for this project will also be protective of relevant TSS standards that affect ecological resources.As illustrated on Figure B-13, a relationship between these parameters appears to exist. As expected, the range of values observed in the tributaries, monitored as part of the Baseline Book 3 program, is significantly higher than those observed in the Lake as part of the Water Quality Monitoring for Construction Baseline program.

Tributary data:

- TSS ranges from approximately 1 to 700 mg/L
- Turbidity ranges from approximately 2 to 700 NTU

Lake data:

- TSS ranges from approximately 2 to 40 mg/L

[8] While other sources of historical data exist, these datasets were used as representative to evaluate the general relationship.

- Turbidity ranges from approximately 1 to 60 NTU

When considered across the full range of both datasets (Lake-focused 2010/2011 Water Quality Monitoring for Construction Baseline and tributary-focused 2009 to 2011 Baseline Book 3 program), a near direct correlation is observed. This relationship can be revised as additional data are collected during construction activities and, as necessary, could be used as a general guideline for estimating TSS levels for a given turbidity measurement.

5 ACTIVITY-BASED WATER QUALITY MONITORING

In addition to the baseline water quality monitoring activities discussed above, three activity-based sampling programs were conducted in recent years. Although the results of the activity-based sampling are not necessarily directly representative of the water quality impacts associated with hydraulic dredging or capping activities, these results provide insight into the sensitivity of the system during a physical disturbance. Water quality monitoring was conducted during two events in 2008 and during the capping demonstration project in 2011. These programs include:

- Installation of the Willis-Semet barrier wall in 2008
- Collection of bulk sediment for water treatment bench tests using a clamshell excavator in 2008
- Field demonstration of placement of sand/activated carbon capping material in 2011

5.1 Willis-Semet Barrier Wall Installation

During installation of the Willis-Semet barrier wall from August to December 2008, monitoring of TSS was conducted at three fixed stations in the Lake approximately 50 feet outboard of a silt curtain that was placed around the work area and at one background station approximately 500 feet from the work area. As the direction of the current varied over time, there were two background stations established—one station located approximately 500 feet northwest and one station located 500 feet southeast of the site. However, generally only the background station located at the upstream end of the Lake current was sampled. In general, the TSS samples remained below 5 mg/L, except for a few occasions when the background stations resulted in TSS samples of approximately 30 mg/L during easterly winds, which highlights the potential fluctuations in background levels in the Lake.

5.2 Bulk Sediment Sampling

Bulk sediment samples were collected for use in the water treatment bench tests in November 2008 using a barge-mounted excavator located within a silt-curtain-enclosed area within Remediation Area D (Parsons 2008). Continuous turbidity (readings at approximate 10-minute intervals) and water column grab samples were collected both inside and outside of the silt curtain during the collection of the bulk sediment samples. Samples were analyzed for TSS, mercury (total and filtered), VOCs (total and filtered), SVOCs (total and filtered), methylmercury (total and filtered), and ammonia (total and filtered).

Figure B-14 presents a time-series plot of the turbidity measurements before, during, and after the bulk sediment sample collection as well as both inside and outside of the silt curtain. Continuous turbidity results showed the turbidity outside of the silt curtain remained below 5 NTU for the duration of the bulk sediment collection, while turbidity measurements within the silt curtain increased during excavation to 270 NTU, and remained variable for a short time after excavation. Similarly, TSS sample results outside of the silt curtain remained low throughout the sampling event (i.e., all below 5 mg/L) and exhibited higher levels inside of the silt curtain during and following excavation, ranging from approximately 12 to 30 mg/L. These data demonstrate a silt curtain's ability to successfully contain suspended sediments.

In comparing the chemistry results outside of the silt curtain with New York Class C Surface Water Quality Standards (6 NYCRR Part 703.5), three out of five samples met the New York Class C Surface Water Quality A(A) standards for all parameters where standards are provided. Of the remaining two samples, New York Class C Surface Water Quality A(A) standards were met for all parameters except benzo(a)anthracene (which is the same compound for which criteria exceedances were observed during 2010 to 2011 baseline sampling). These measurements yield a truly conservative estimate of sediment resuspension, as the proposed hydraulic dredging method is expected to induce much lesser sediment disturbance than the mechanical dredge/excavator.

5.3 Capping Field Demonstration

Turbidity was monitored at four locations during the fall 2011 capping field demonstration to assess water quality conditions during capping at locations similar to the full-scale program (Parsons 2011). These four turbidity monitoring locations consisted of three performance monitoring stations, or near-field stations, and one compliance monitoring station, or far-field station. The performance monitoring stations were located approximately 300 feet outside of the demarcation curtain in a radial pattern (e.g., west, northwest, and east), while the compliance monitoring station (monitoring buoy D1 used in the 2011 Water Quality

Monitoring for Construction Baseline program) was positioned approximately 500 feet northwest of the demarcation curtain. Figure B-15 presents the locations of the turbidity monitoring stations at the capping field demonstration site.

Turbidity measurements were collected from October 24 to November 18, 2011, at 15-minute intervals and averaged every 2 hours (in a running mode; Figure B-16). In general, the turbidity measurements at all four locations ranged from 2 to 5 NTU, consistent with ambient water quality measurements within the Lake, as discussed above. On four occasions (November 1, 8, 14, and 17), there were noticeable short-term increases in turbidity (10 to 30 NTU) greater than the typical background concentrations (Figure B-16). On November 1, turbidity results of approximately 5 to 15 NTU were measured at Locations 1 and 2 within 1 hour of the completion of the capping lane. The three remaining short-term increases in turbidity (e.g., November 8, 14, and 17) occurred during periods of high winds (i.e., greater than 10 mph).

In addition to the continuous turbidity monitoring described above, discrete turbidity measurements were collected within 100 to 200 feet of the capping activities, within observed turbidity plumes associated with the cap material. Turbidity measurements ranging from approximately 30 to 100 NTU were observed within these plumes, but were dissipated (i.e., turbidity returning to background conditions) within approximately 1 hour of capping.

Overall, the capping activities during the demonstration project had minimal impact on turbidity outside of the demarcation curtain, and the turbidity plumes, when observed, quickly dissipated within the demarcation curtain.

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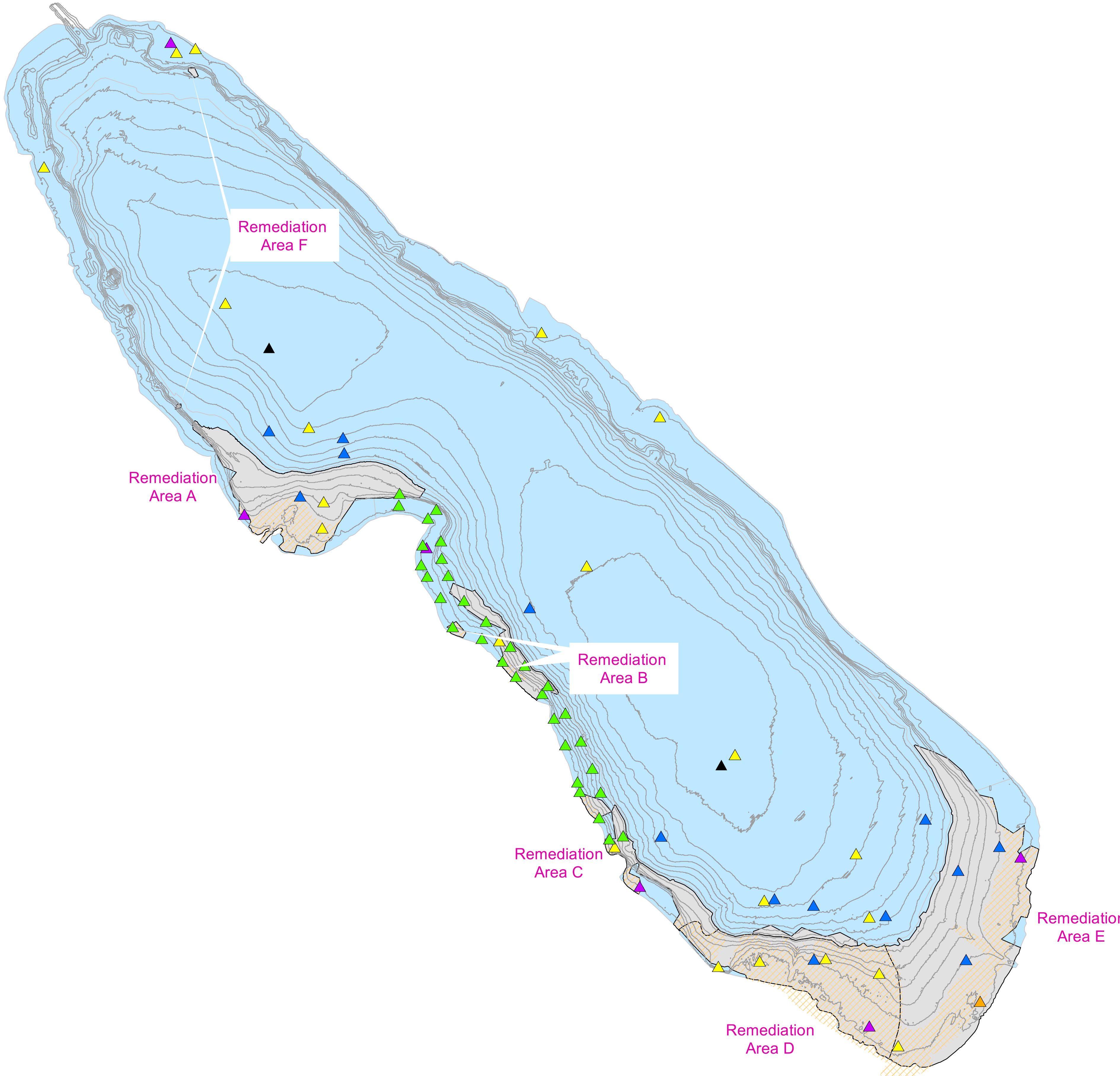
FIGURES



Scale

0 1,000 2,000 4,000 Feet

Legend

Onondaga Lake Monitoring Programs

- Various*
- 2005 - PDI PHASE 1
- 2007 - PDI PHASE 3
- 2008 & 2010 Baseline Book 2
- 2010/2011 Construction Baseline
- Remedial Investigation (1990's)
- 2005 Bathymetry (displayed every 5 ft)**
- Dredge Areas
- Remediation Areas

* 2008 - 2011 Baseline Book 1; 2010 - 2011 Construction Baseline; 2011 Baseline Book 3; and 2011 Nitrate Addition Program.

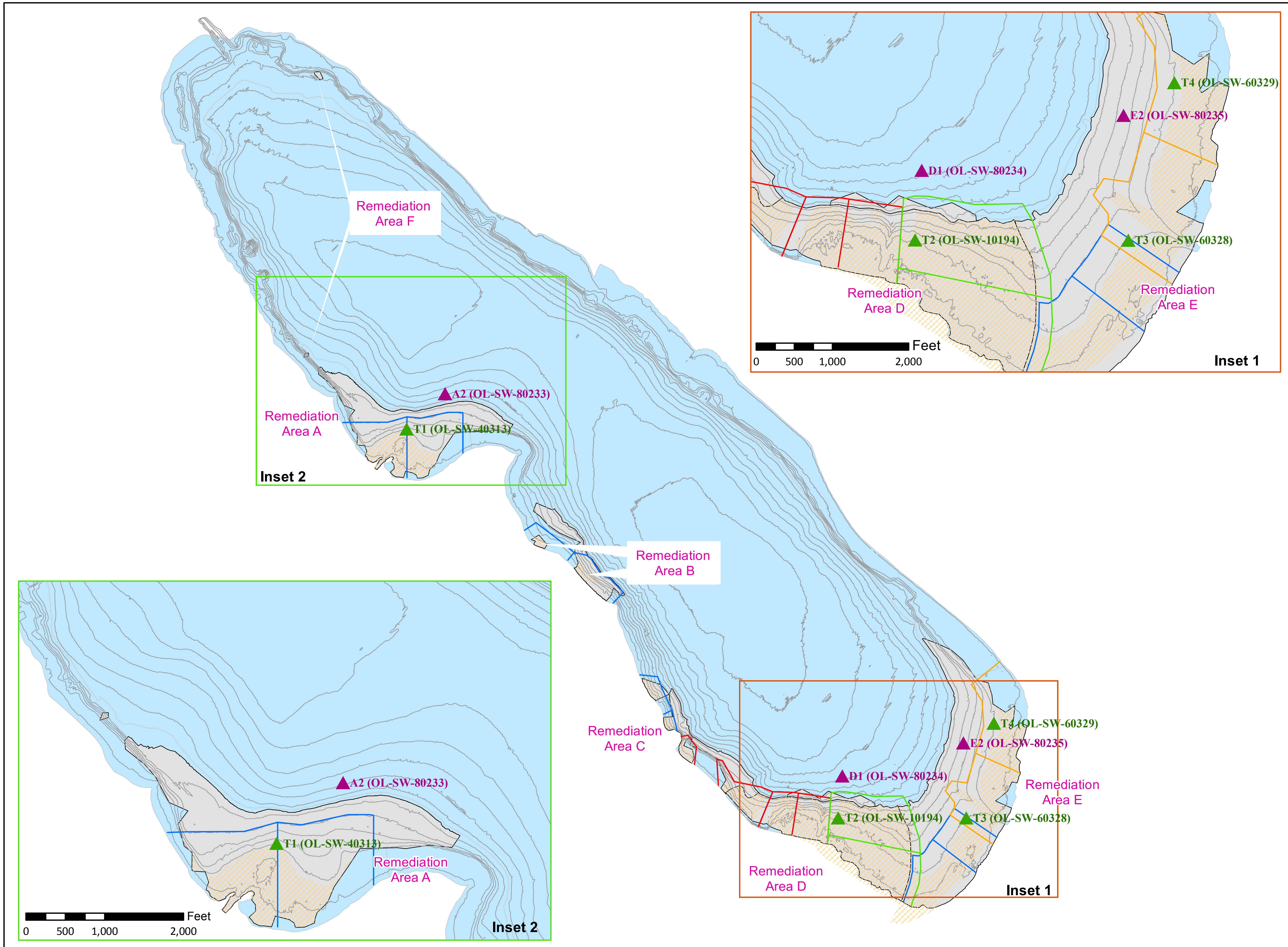
**Bathymetric survey performed by CR Environmental, Inc. for Honeywell in 2005.

Figure B-1
Sample Locations of Data Evaluated as Part of Baseline Survey
Onondaga Lake

Honeywell
PARSONS
ANCHOR QEA

120139-01.01 MAY 2012

H:\Honeywell\Onondaga_Lake_Remediation(090139-01)\WQMMP\GIS - Figure B-1 - spatial extent of historic datasets.mxd; B.Solomon; 11JAN2011



* Turbidity curtain alignments presented herein are conceptual and will be updated in the field as necessary and placed with DEC concurrence.

** Bathymetric survey performed by CR Environmental, Inc. for Honeywell in 2005.

Figure B-2
2010/2011 Water Quality Monitoring for Construction Baseline Turbidity Monitoring Locations Onondaga Lake

Honeywell PARSONS ANCHOR QEA

120139-01.01 MAY 2012

H:\Honeywell\Onondaga_Lake_Remediation(090139-01)\WQMMP\GIS\Figure B-2 - 2010&2011 Turbidity Monitoring.mxd - B.Solomon - 16APR2012

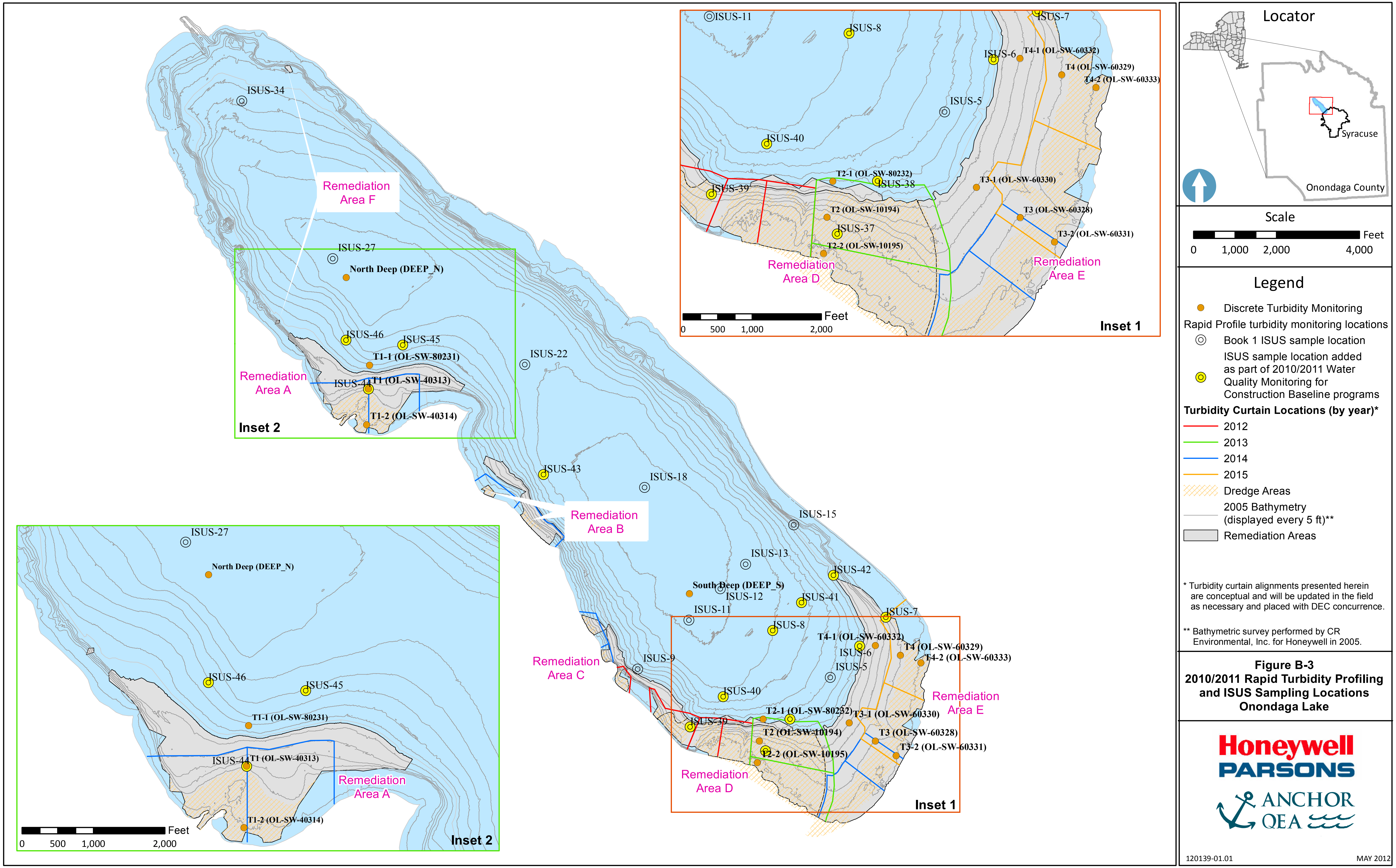


Figure B-3
2010/2011 Rapid Turbidity Profiling and ISUS Sampling Locations Onondaga Lake

H:\Honeywell\Onondaga_Lake_Remediation(090139-01)\WQMMP\GIS\Figure B-3 - 2010&2011 discrete turbidity & ISUS.mxd - B.Solomon - 16APR2012

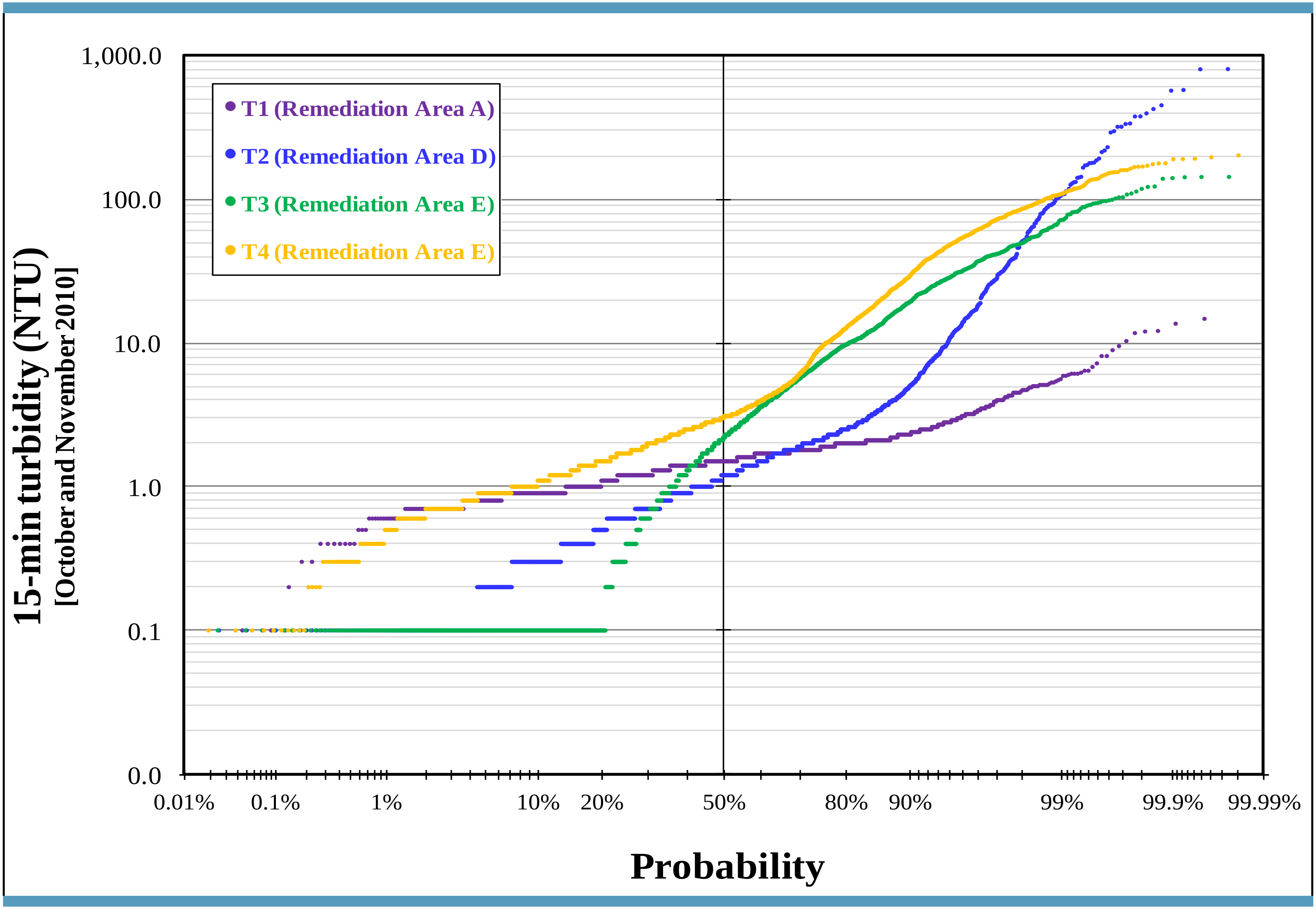
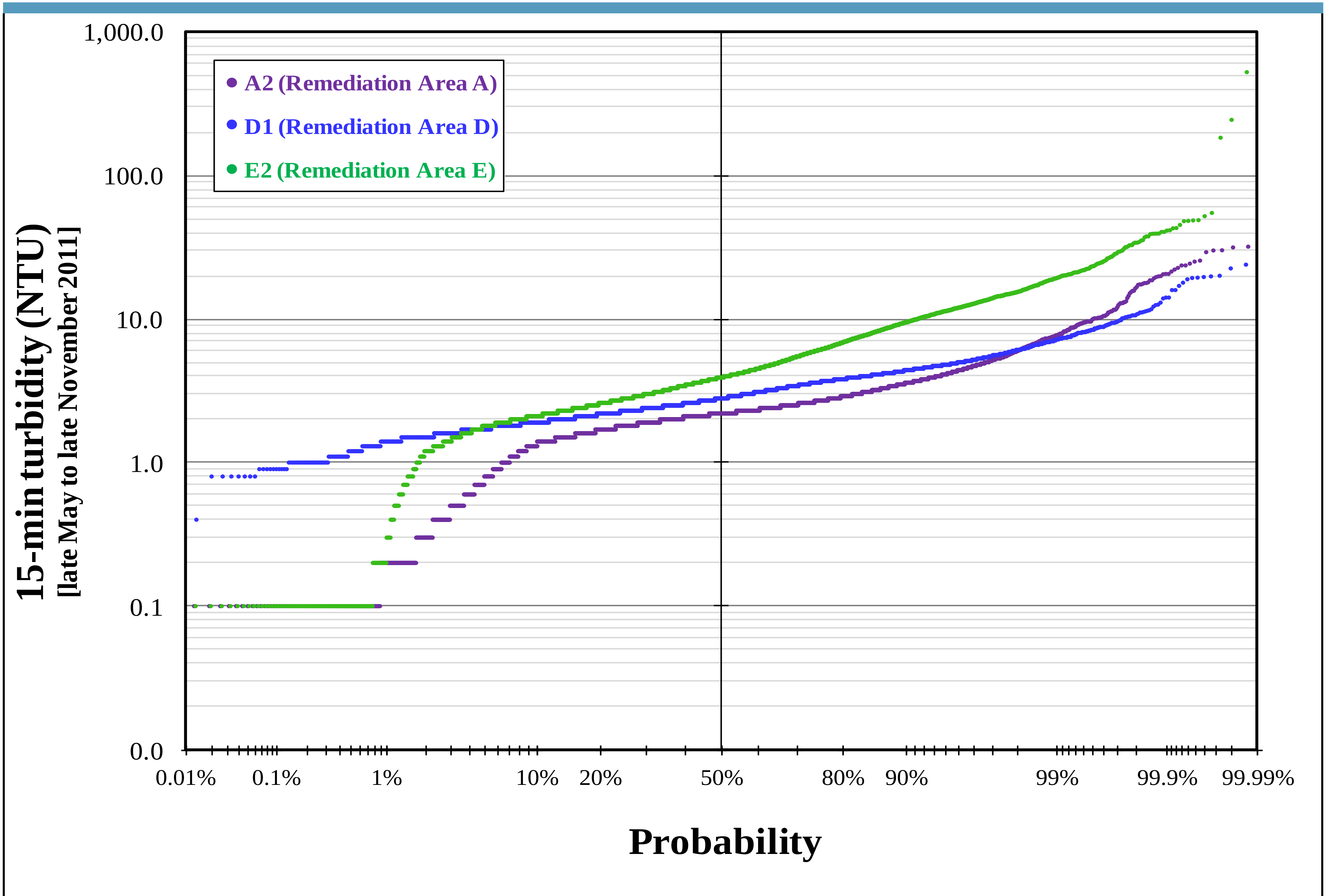
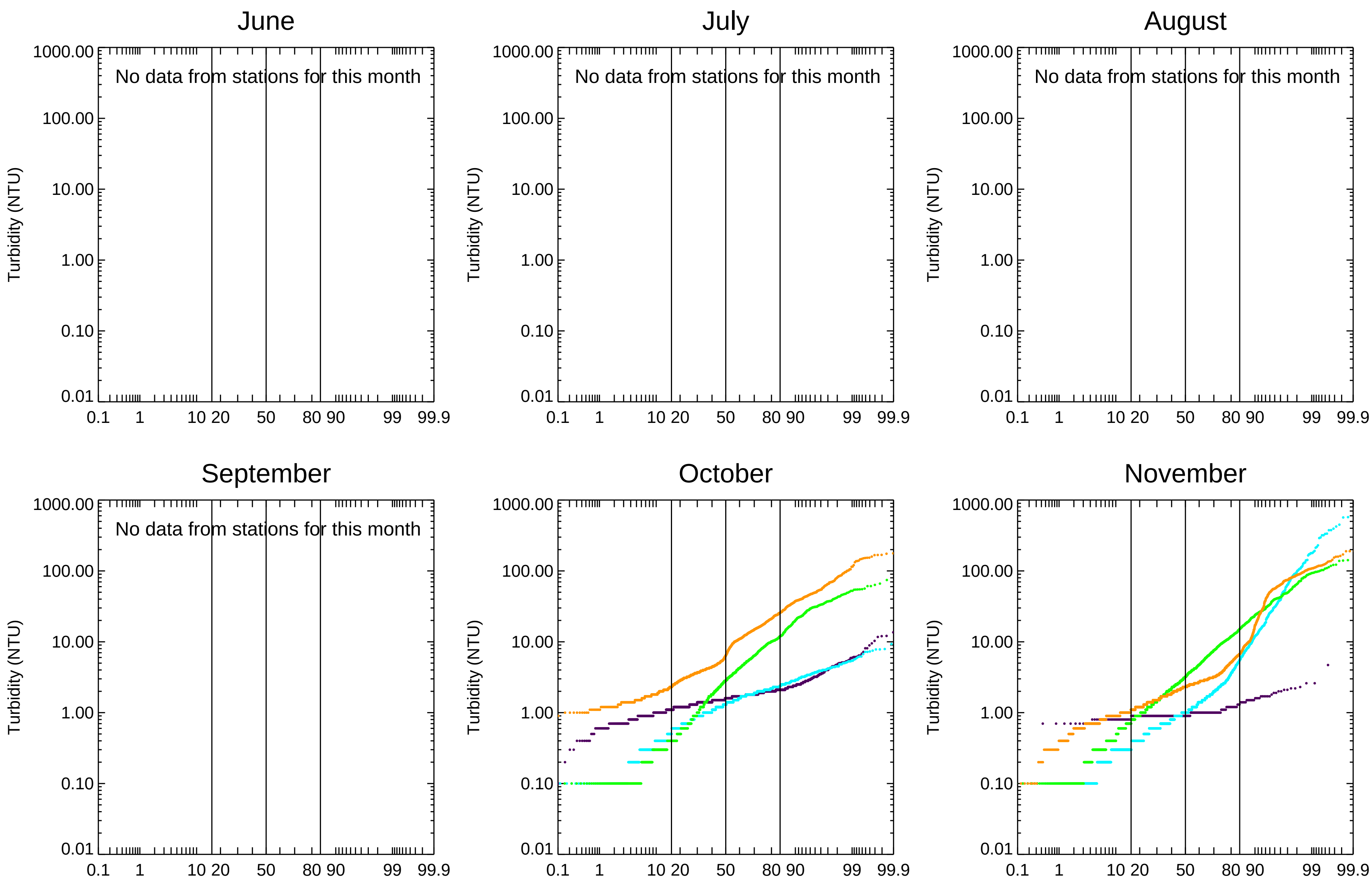


Figure B-4
2010 Continuous Turbidity Monitoring Data – Probability Distribution
Water Quality Management and Monitoring Plan
Onondaga Lake



ANCHOR QEA

Figure B-5
2011 Continuous Turbidity Monitoring Data – Probability Distribution
Water Quality Management and Monitoring Plan
Onondaga Lake

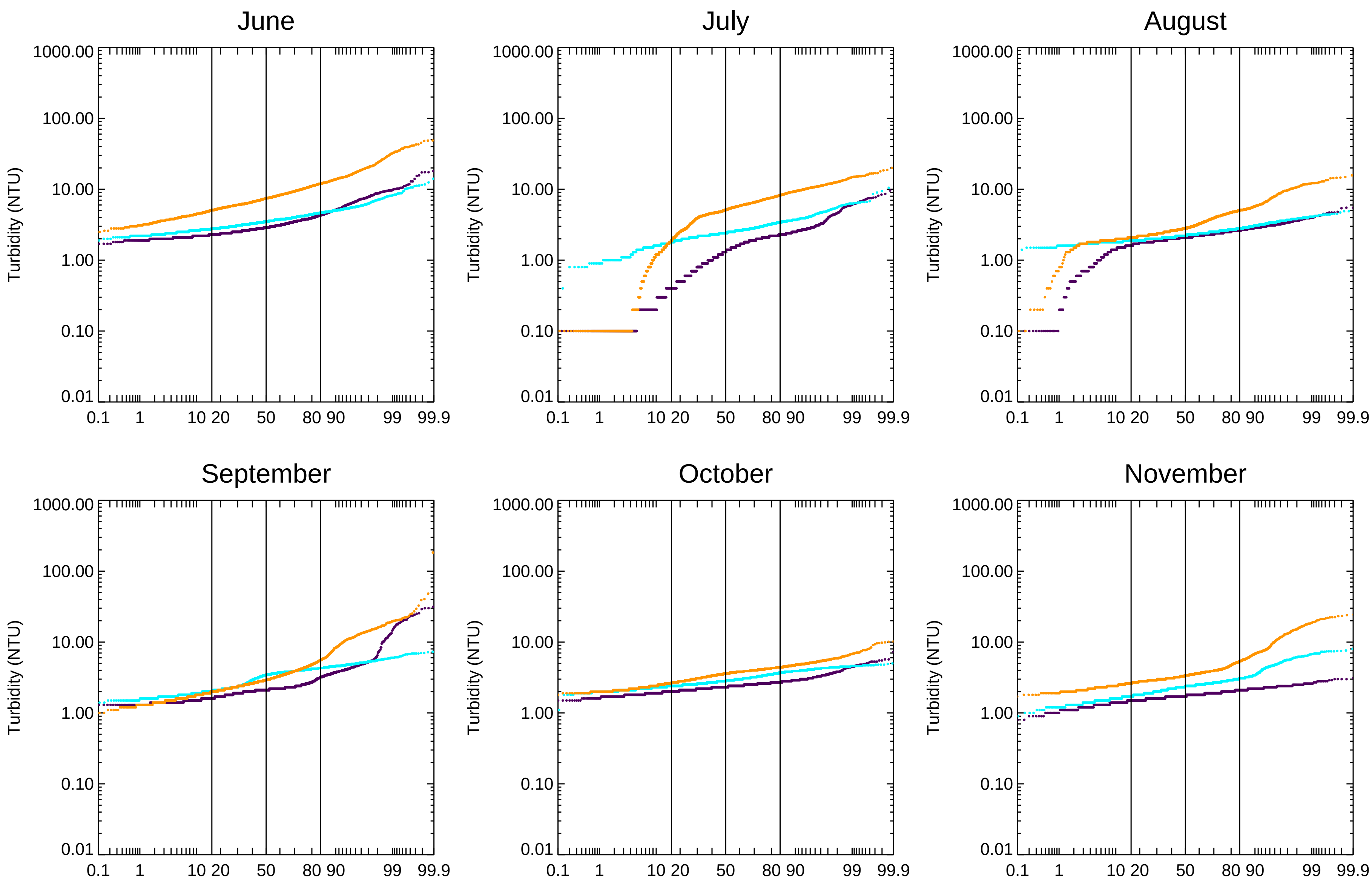


- T1 (Remediation Area A)
- T2 (Remediation Area D)
- T3 (Remediation Area E)
- T4 (Remediation Area E)

Figure B-6a

2010 Continuous Turbidity Monitoring Data - Month-by-Month Probability Distributions
Water Quality Management and Monitoring Plan
Onondaga Lake

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\OL_wq_prob_plot_Turbidity.pro Tue Jan 17 12:13:27 2012



● A2 (Remediation Area A)
● D1 (Remediation Area D)
● E2 (Remediation Area E)

Figure B-6b

2011 Continuous Turbidity Monitoring Data - Month-by-Month Probability Distributions
Water Quality Management and Monitoring Plan
Onondaga Lake

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\OL_wq_prob_plot_Turbidity.pro Tue Jan 17 12:13:32 2012

Remediation Area A

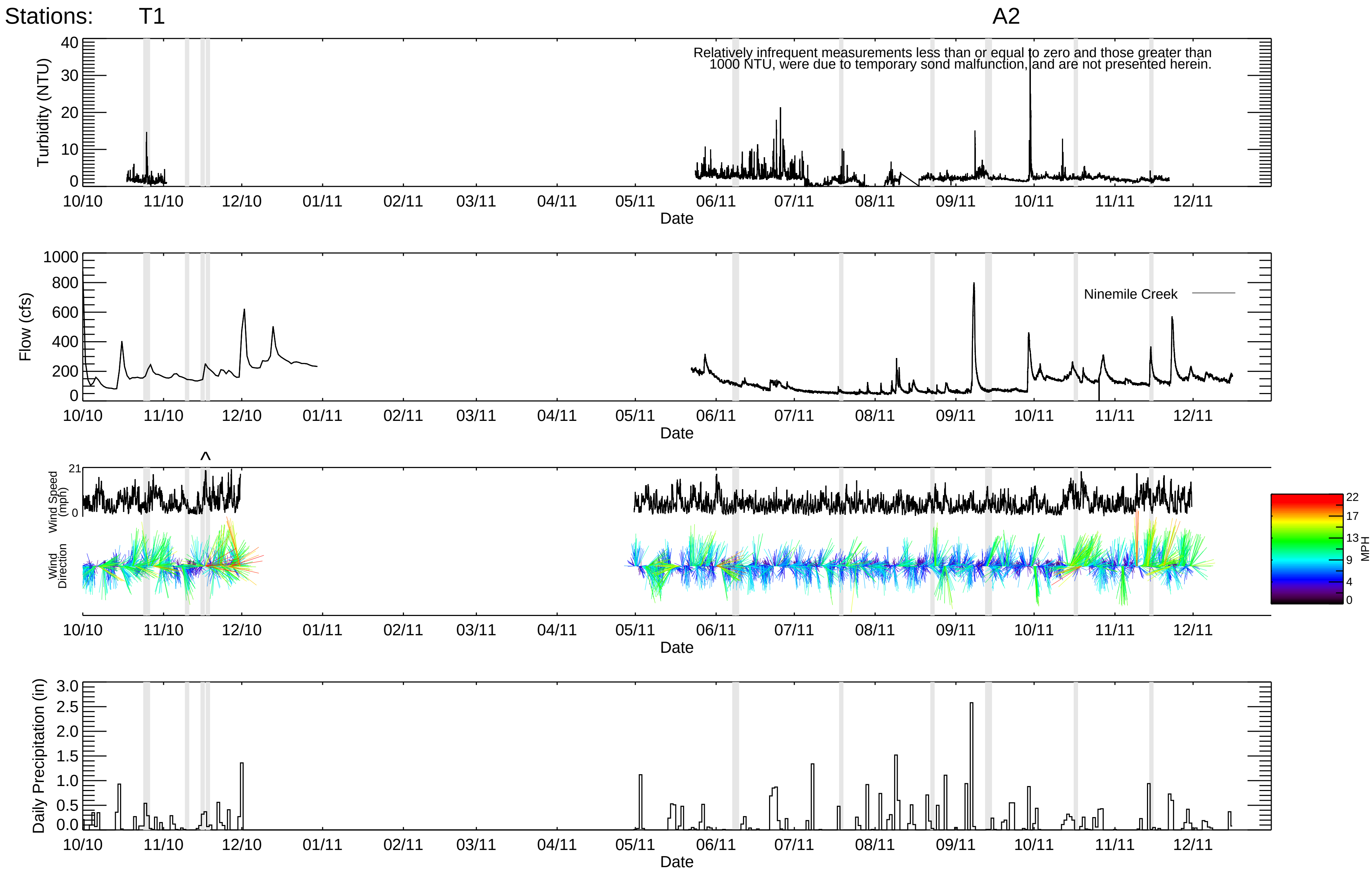


Figure B-7a

2010/2011 Continuous Turbidity Data Temproal Plot Compared to Tributary Flow, Wind and Precipitation
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Precipitation data from Syracuse Hancock International Airport, NY NOAA weather station. Wind data recorded hourly at Lakshore/Willis Ave. meteorlogical site (provided by Parsons). Orientation of wind direction line indicates direction wind is blowing towards, where up is north. Line color indicates wind speed. Wind data from 8/21/11 to 9/20/11 collected from Waste Bed 13 monitoring station. Vertical grey lines indicate days in which discrete water column sampling occurred.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\OL_wq_const_monitoring_2011_combine_stations.pro Mon Apr 30 16:53:01 2012

Remediation Area D

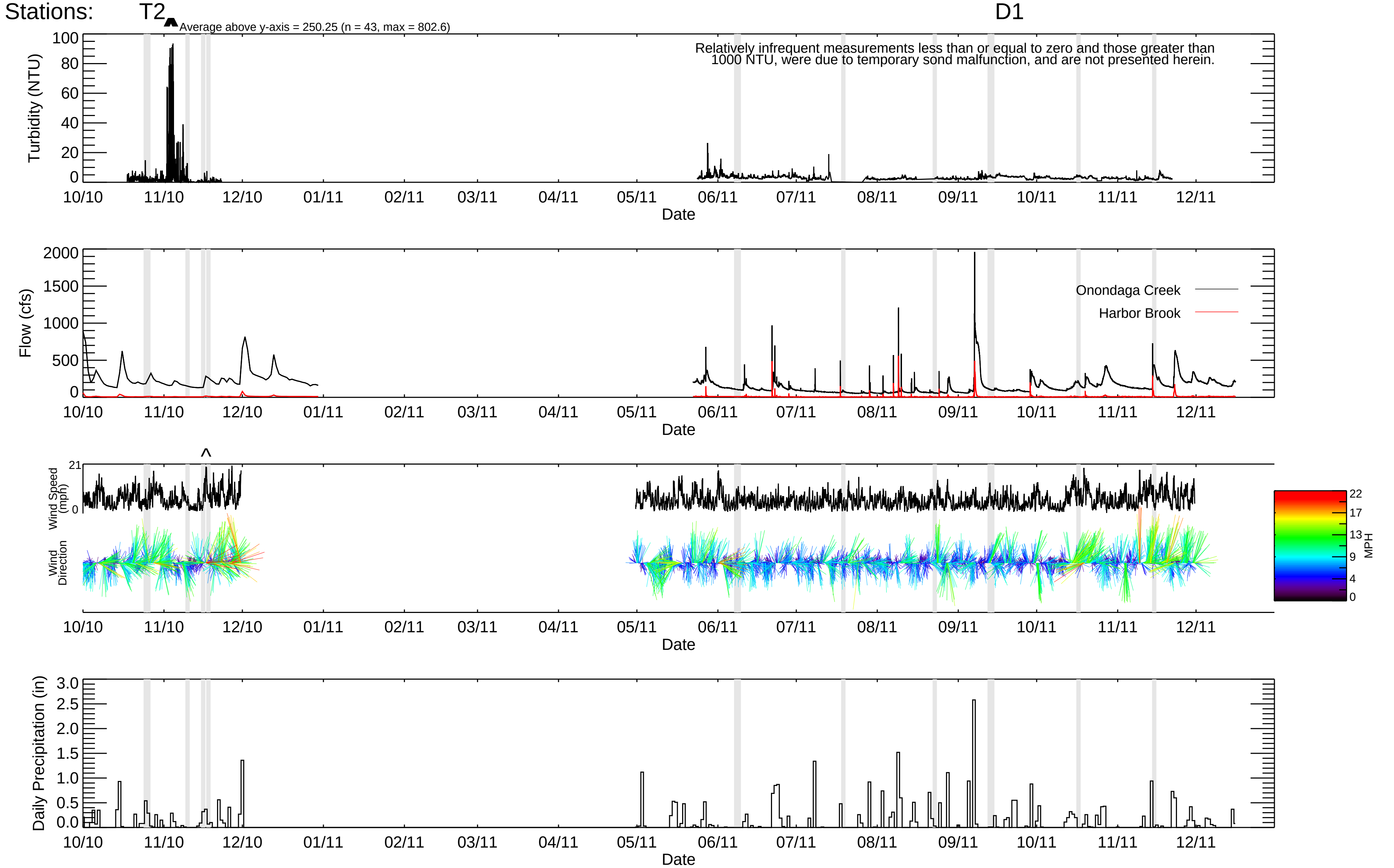


Figure B-7b

2010/2011 Continuous Turbidity Data Temproal Plot Compared to Tributary Flow, Wind and Precipitation
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Precipitation data from Syracuse Hancock International Airport, NY NOAA weather station. Wind data recorded hourly at Lakshore/Willis Ave. meteorlogical site (provided by Parsons). Orientation of wind direction line indicates direction wind is blowing towards, where up is north. Line color indicates wind speed. Wind data from 8/21/11 to 9/20/11 collected from Waste Bed 13 monitoring station. Vertical grey lines indicate days in which discrete water column sampling occurred.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\OL_wq_const_monitoring_2011_combine_stations.pro Mon Apr 30 16:53:06 2012

Remediation Area E

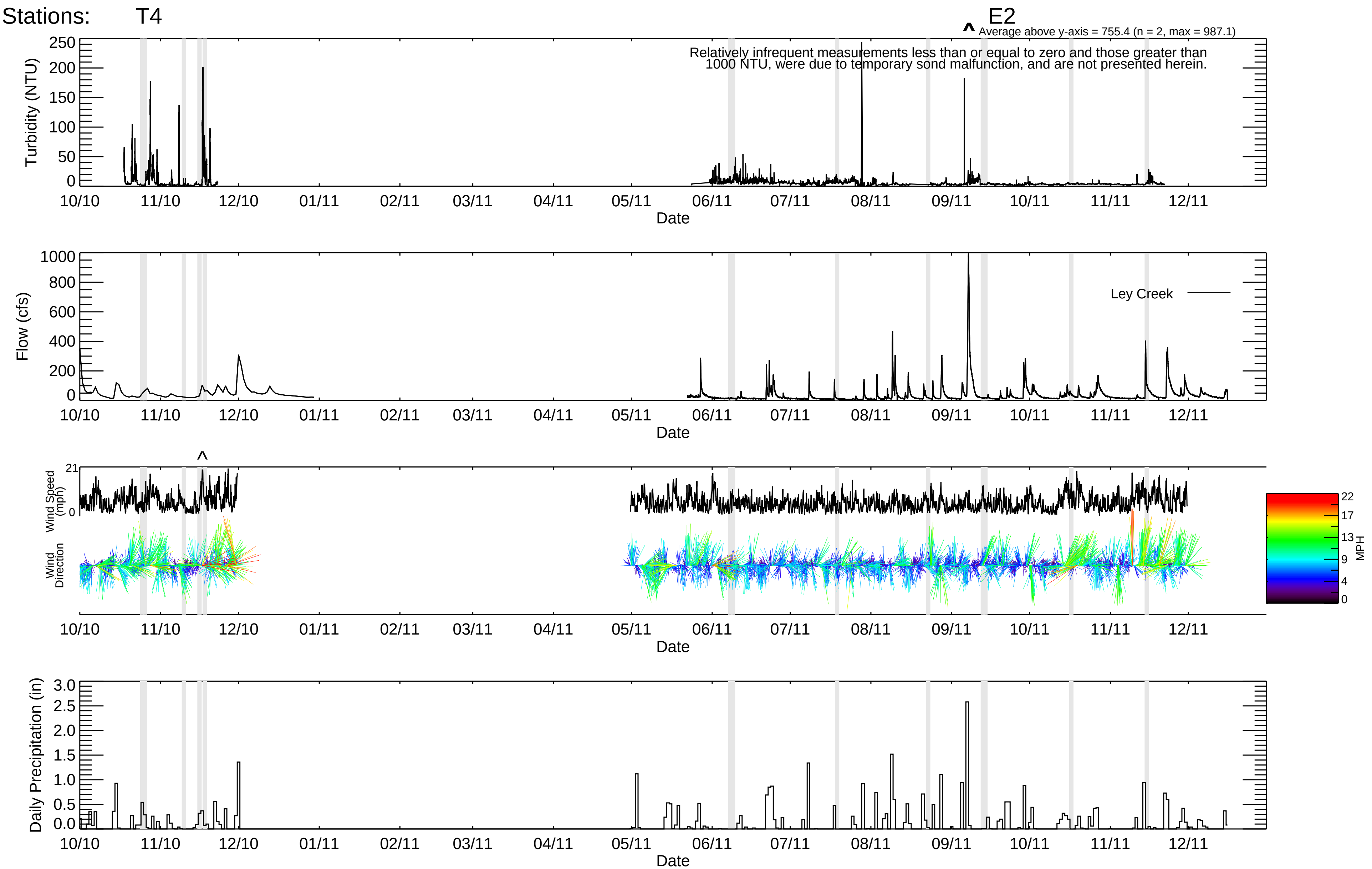


Figure B-7c

2010/2011 Continuous Turbidity Data Temproal Plot Compared to Tributary Flow, Wind and Precipitation
Water Quality Management and Monitoring Plan
Onondaga Lake

Precipitation data from Syracuse Hancock International Airport, NY NOAA weather station. Wind data recorded hourly at Lakshore/Willis Ave. meteorlogical site (provided by Parsons). Orientation of wind direction line indicates direction wind is blowing towards, where up is north. Line color indicates wind speed. Wind data from 8/21/11 to 9/20/11 collected from Waste Bed 13 monitoring station. Vertical grey lines indicate days in which discrete water column sampling occurred.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\OL_wq_const_monitoring_2011_combine_stations.pro Mon Apr 30 16:53:12 2012

Remediation Area E

Stations: T3

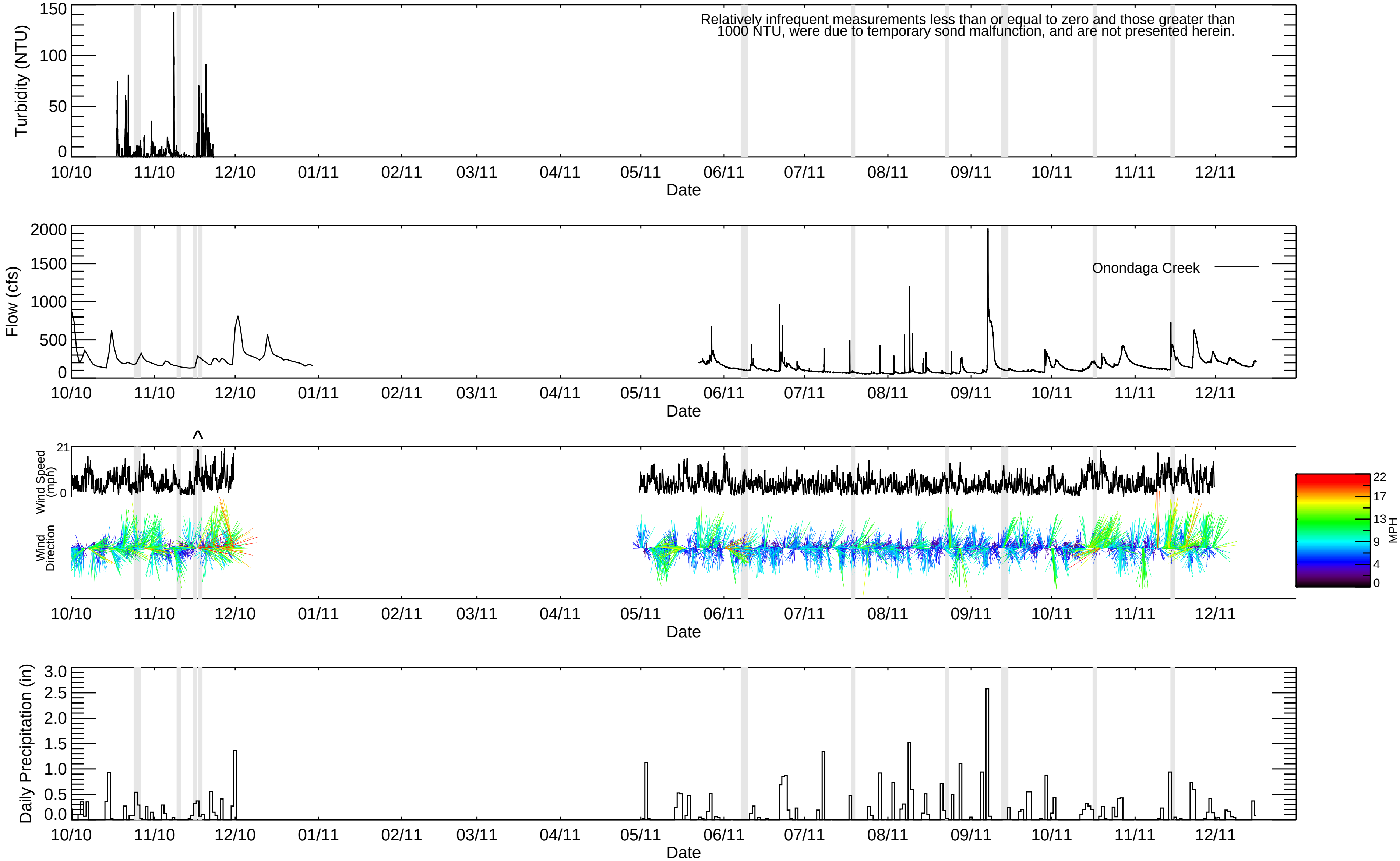


Figure B-7d

2010/2011 Continuous Turbidity Data Temproal Plot Compared to Tributary Flow, Wind and Precipitation
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Precipitation data from Syracuse Hancock International Airport, NY NOAA weather station. Wind data recorded hourly at Lakshore/Willis Ave. meteorlogical site (provided by Parsons). Orientation of wind direction line indicates direction wind is blowing towards, where up is north. Line color indicates wind speed. Wind data from 8/21/11 to 9/20/11 collected from Waste Bed 13 monitoring station. Vertical grey lines indicate days in which discrete water column sampling occurred.

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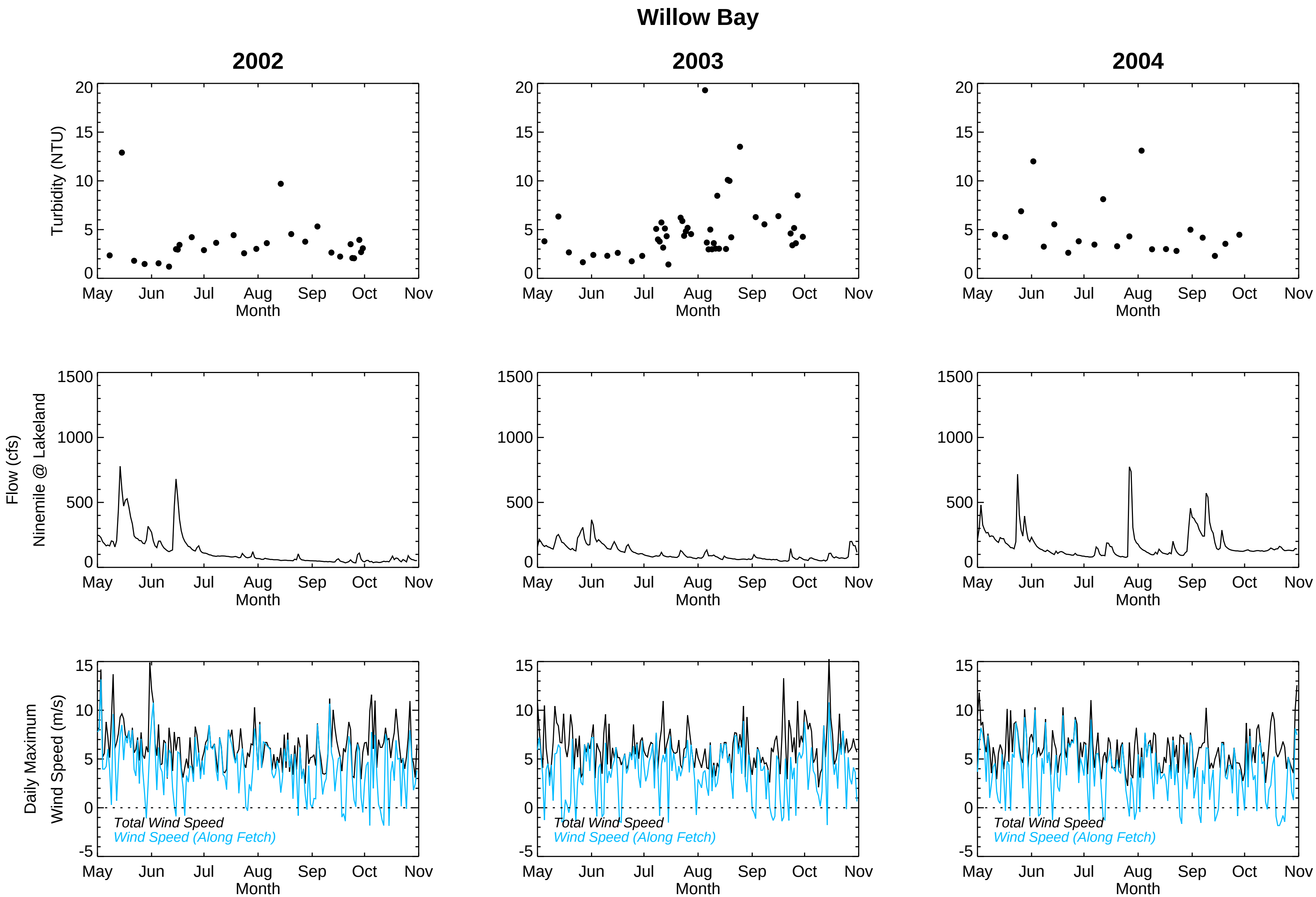


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

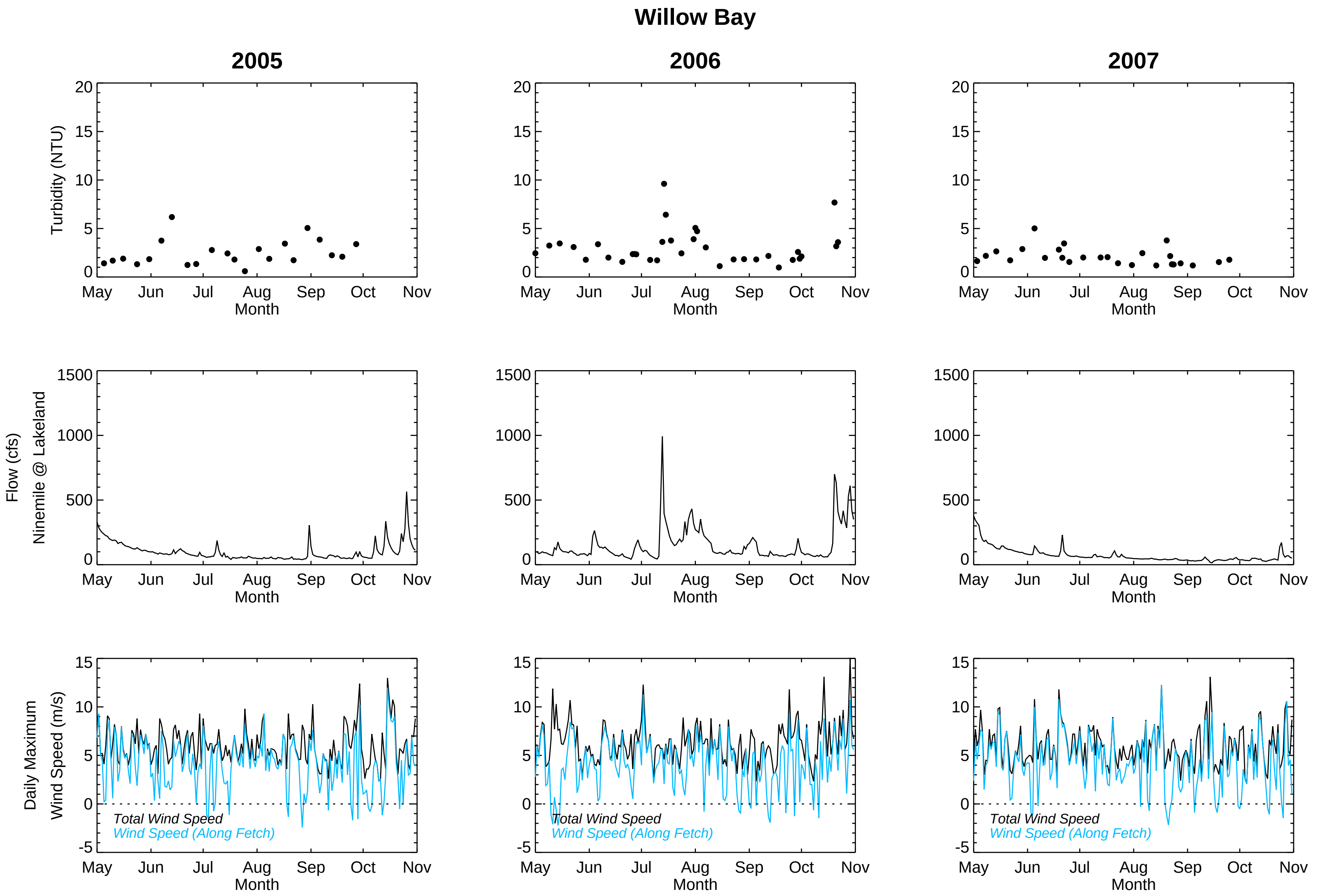


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

Onondaga Lake Park

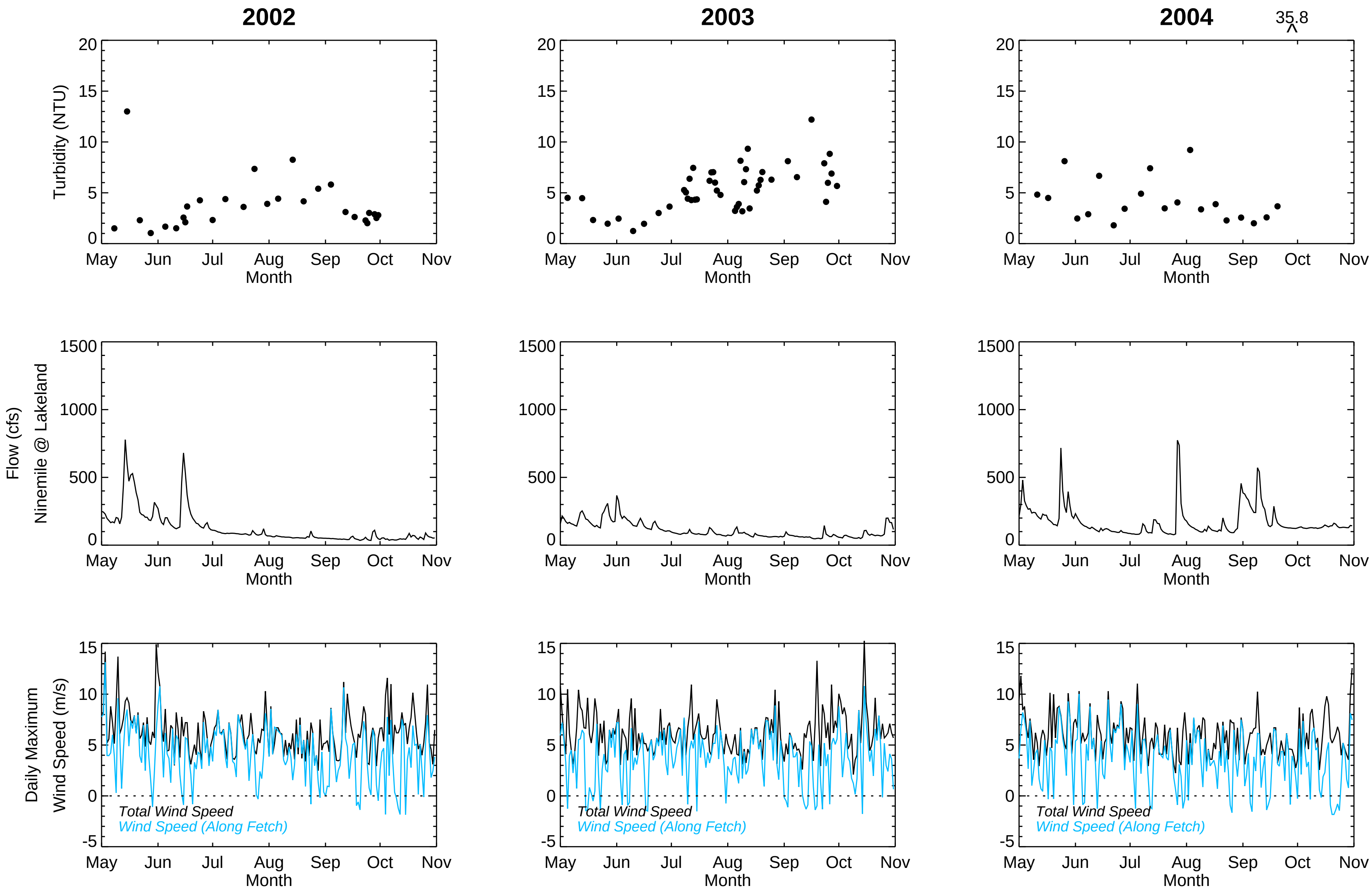


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

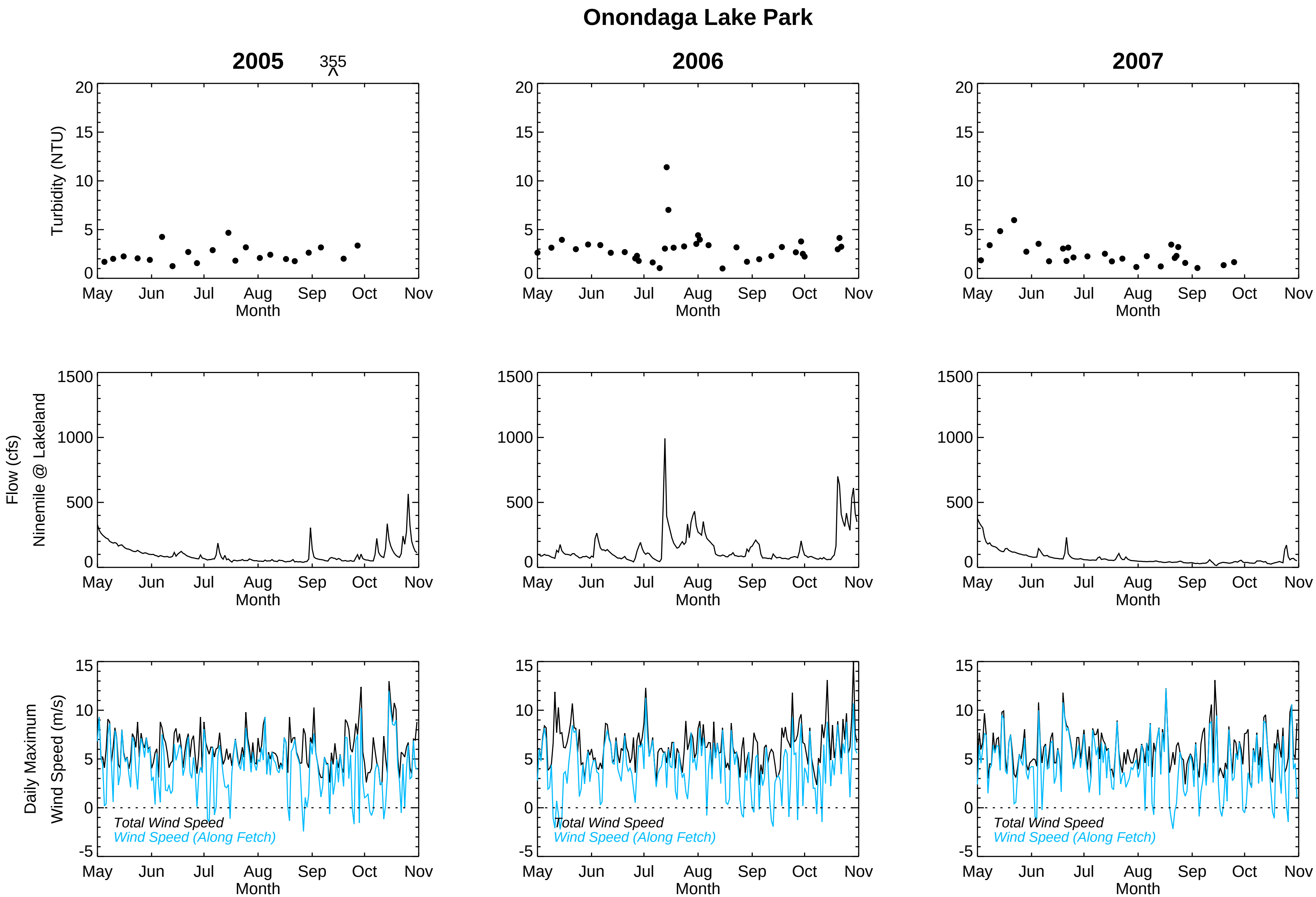


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

Bloody Brook

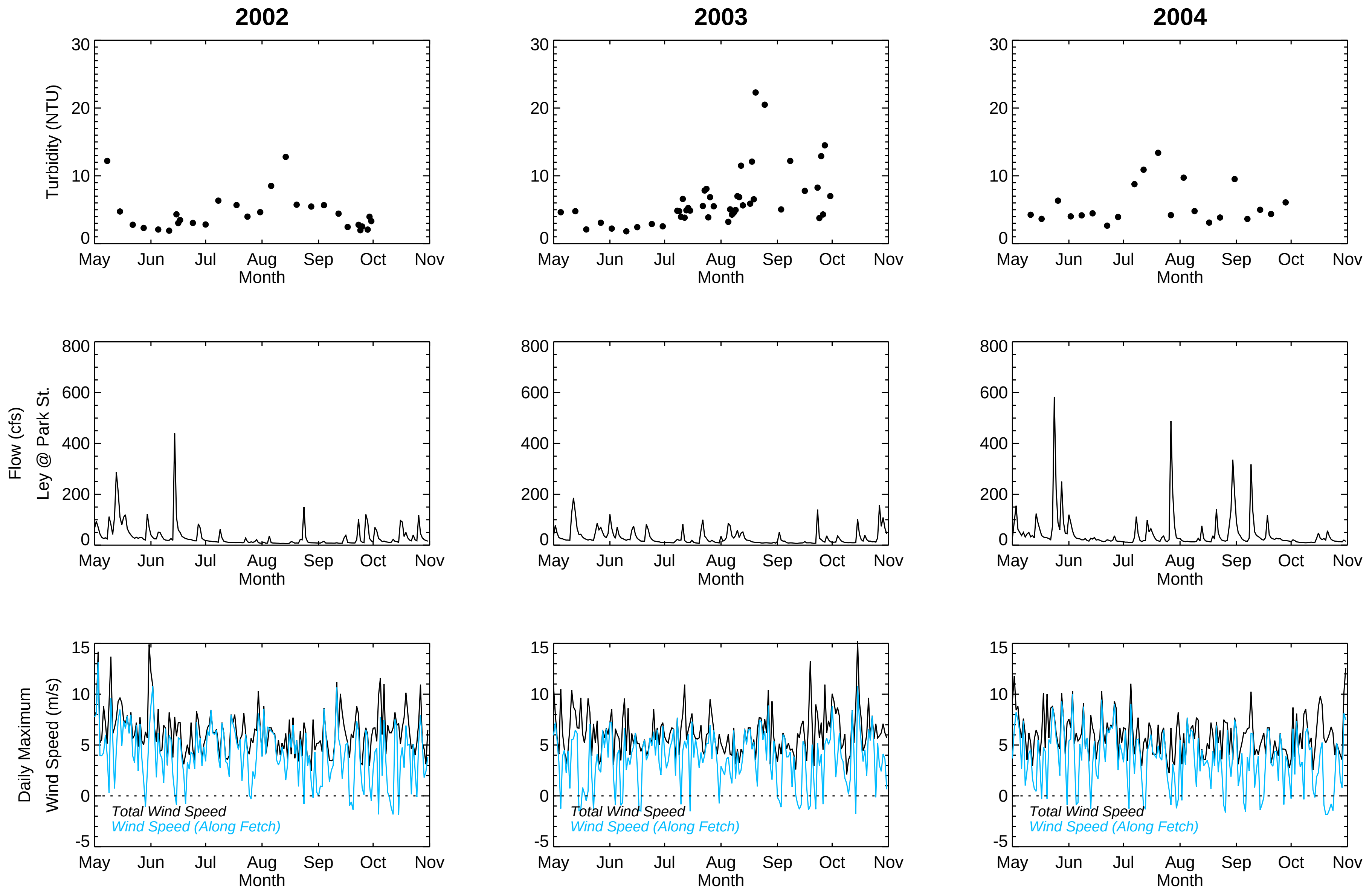


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

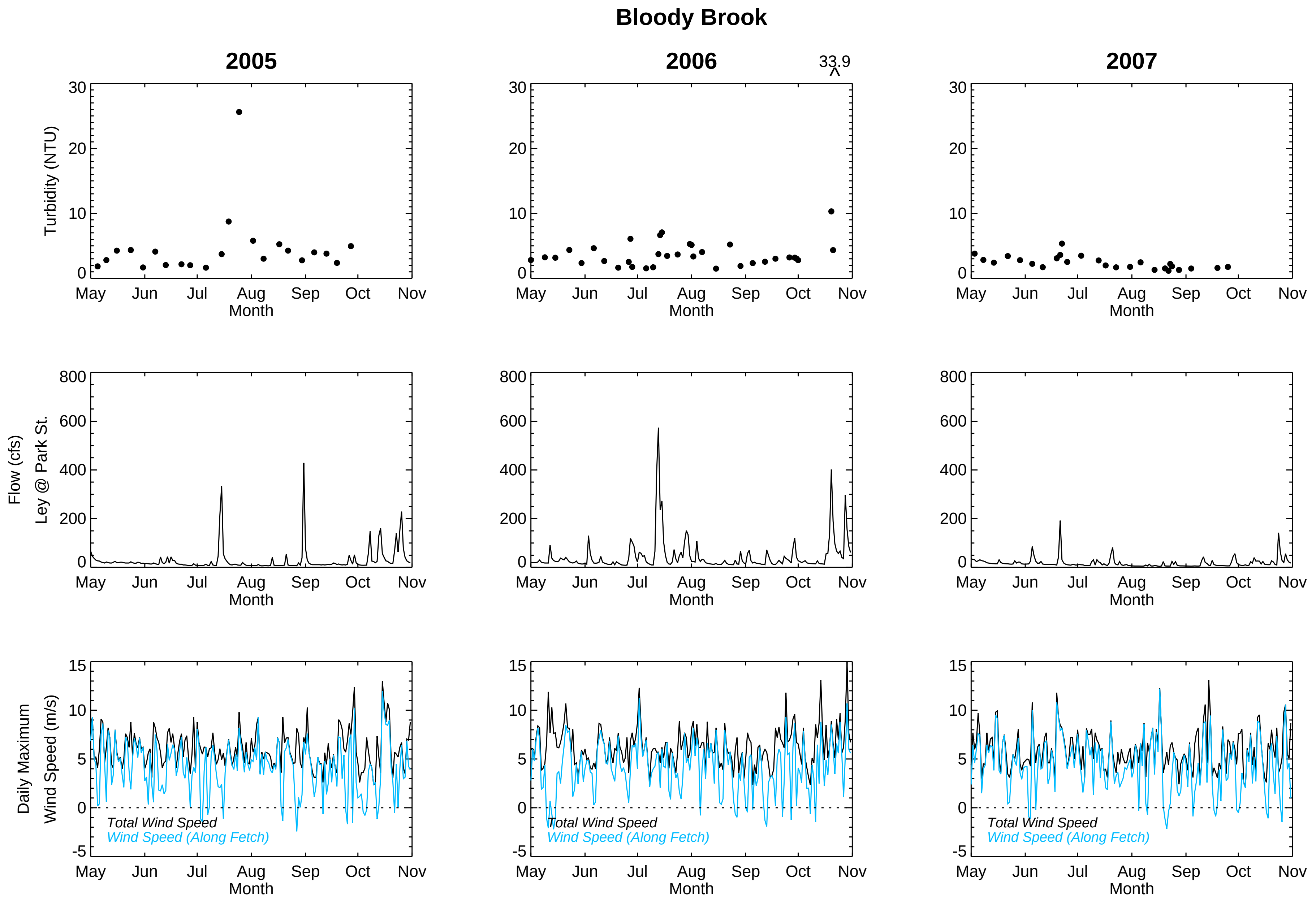


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

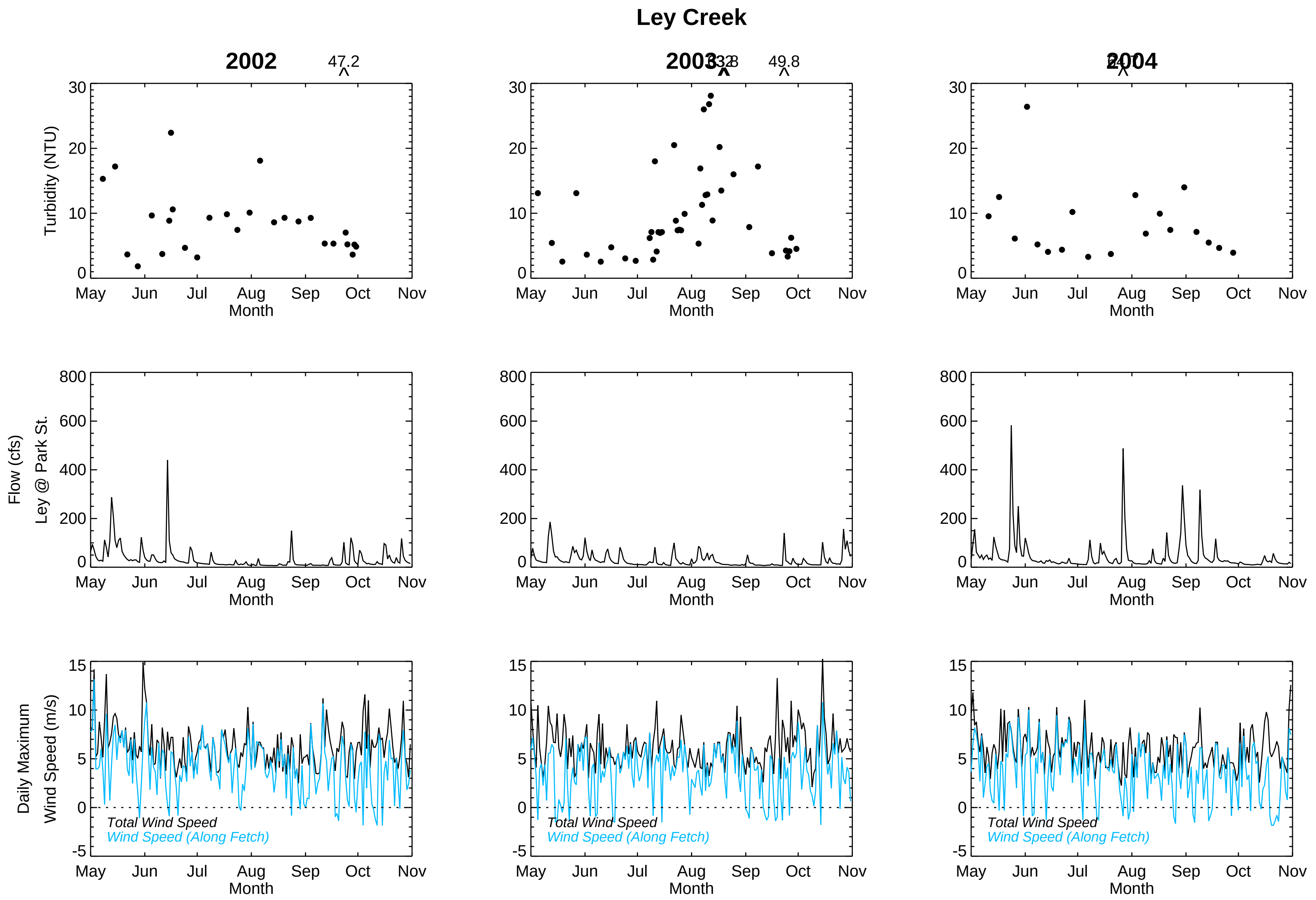


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

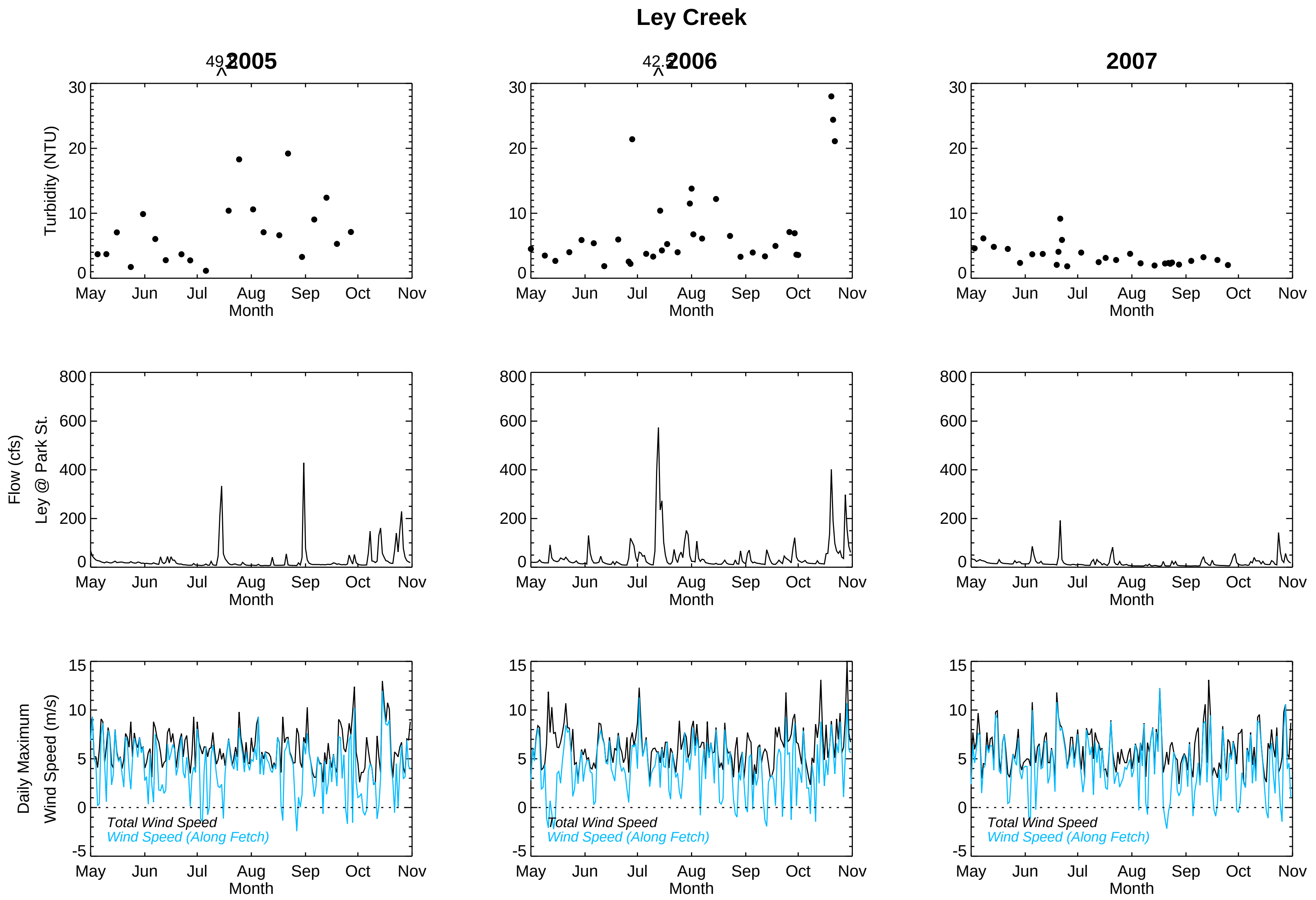


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

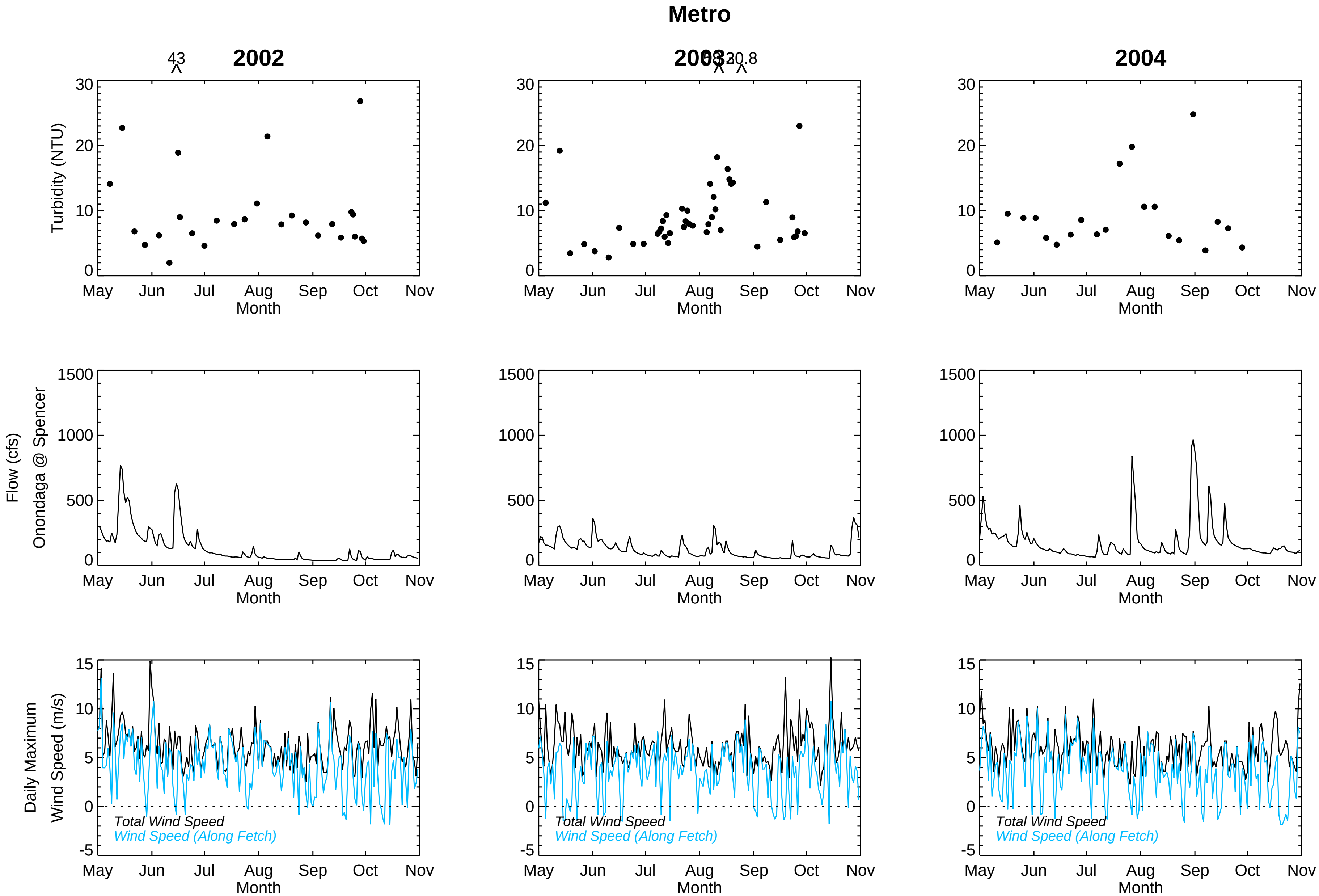


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

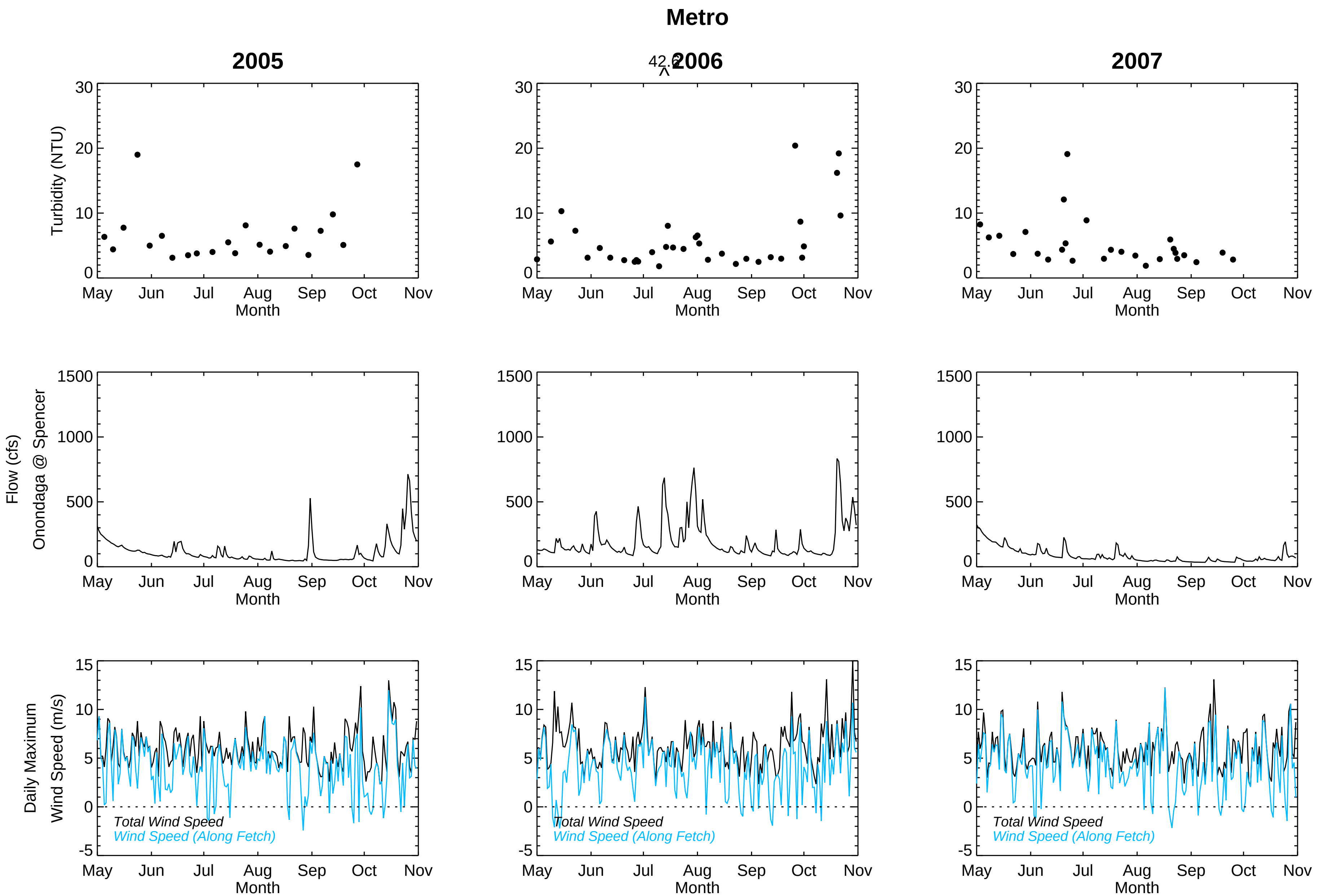


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

Harbor Brook

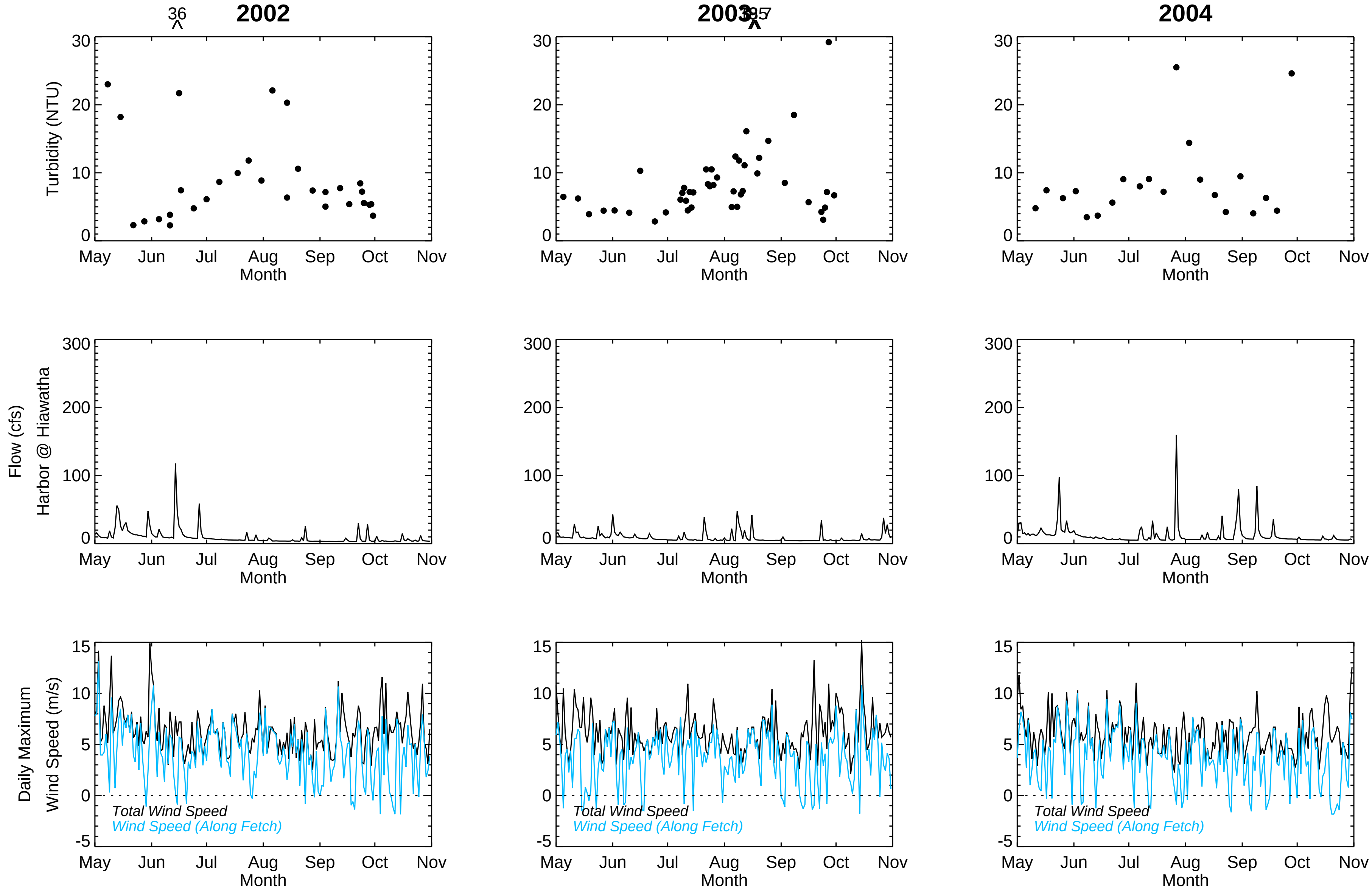


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

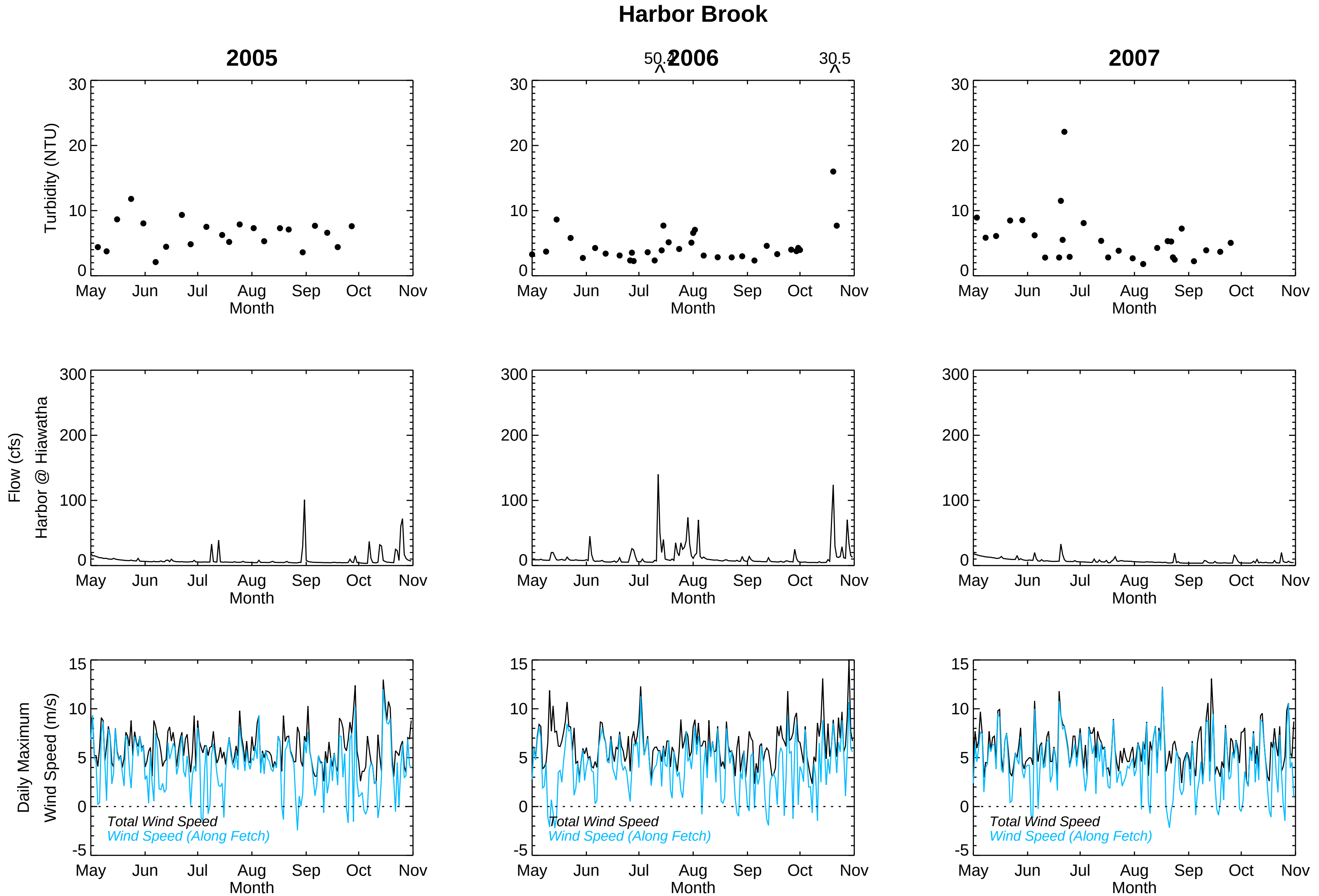


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)

Water Quality Management and Monitoring Plan

Onondaga Lake

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

Ninemile

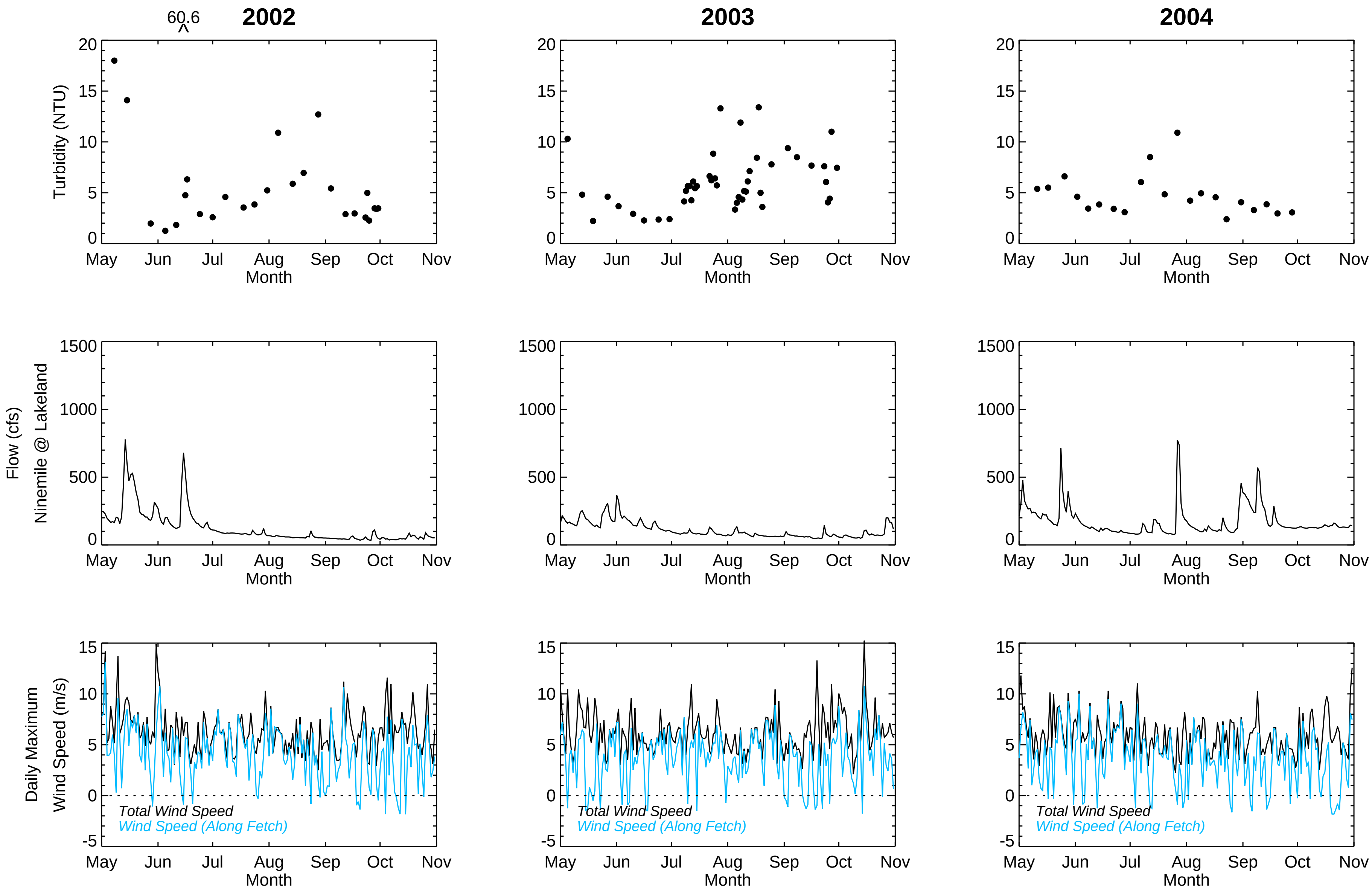


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

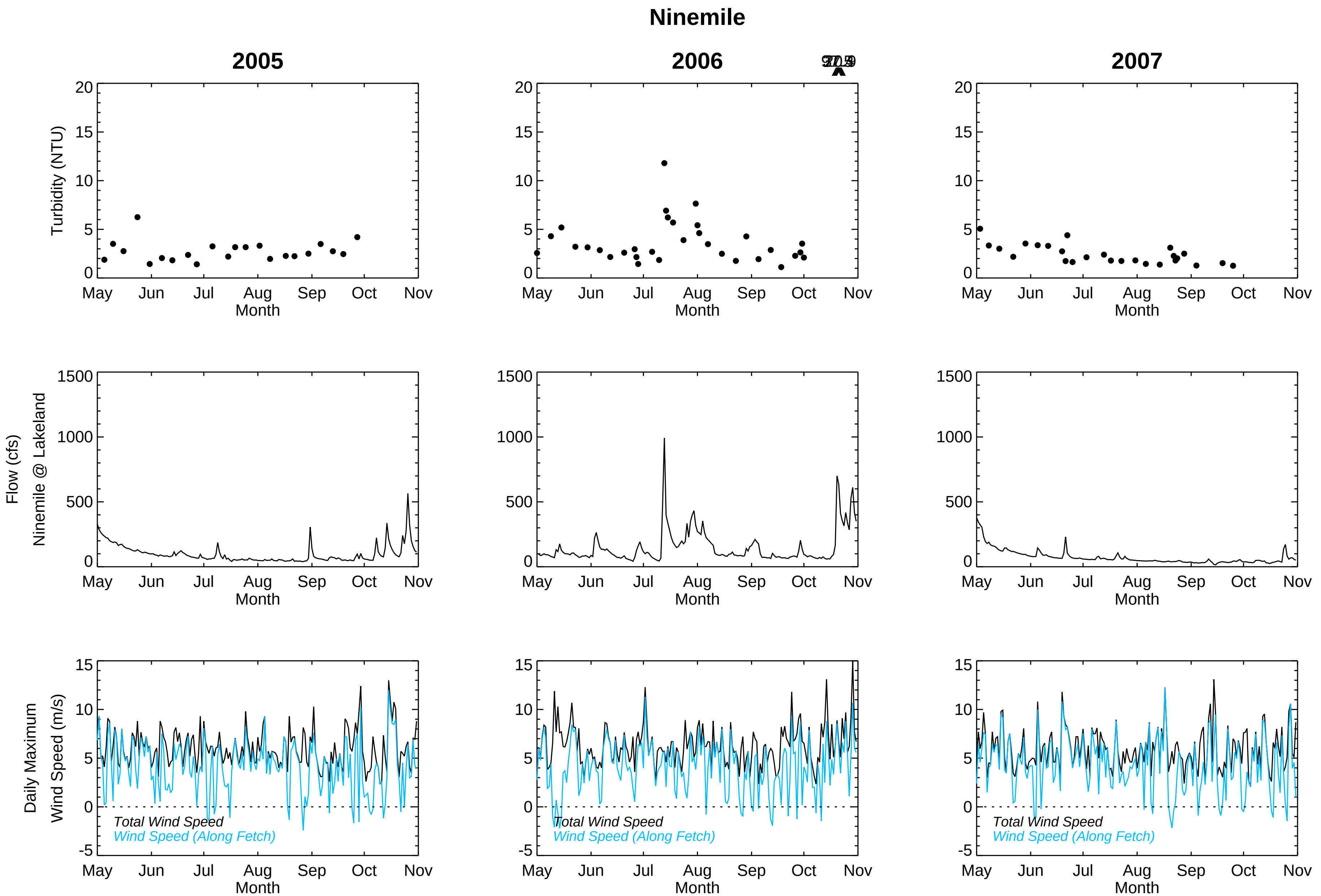


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

Maple Bay

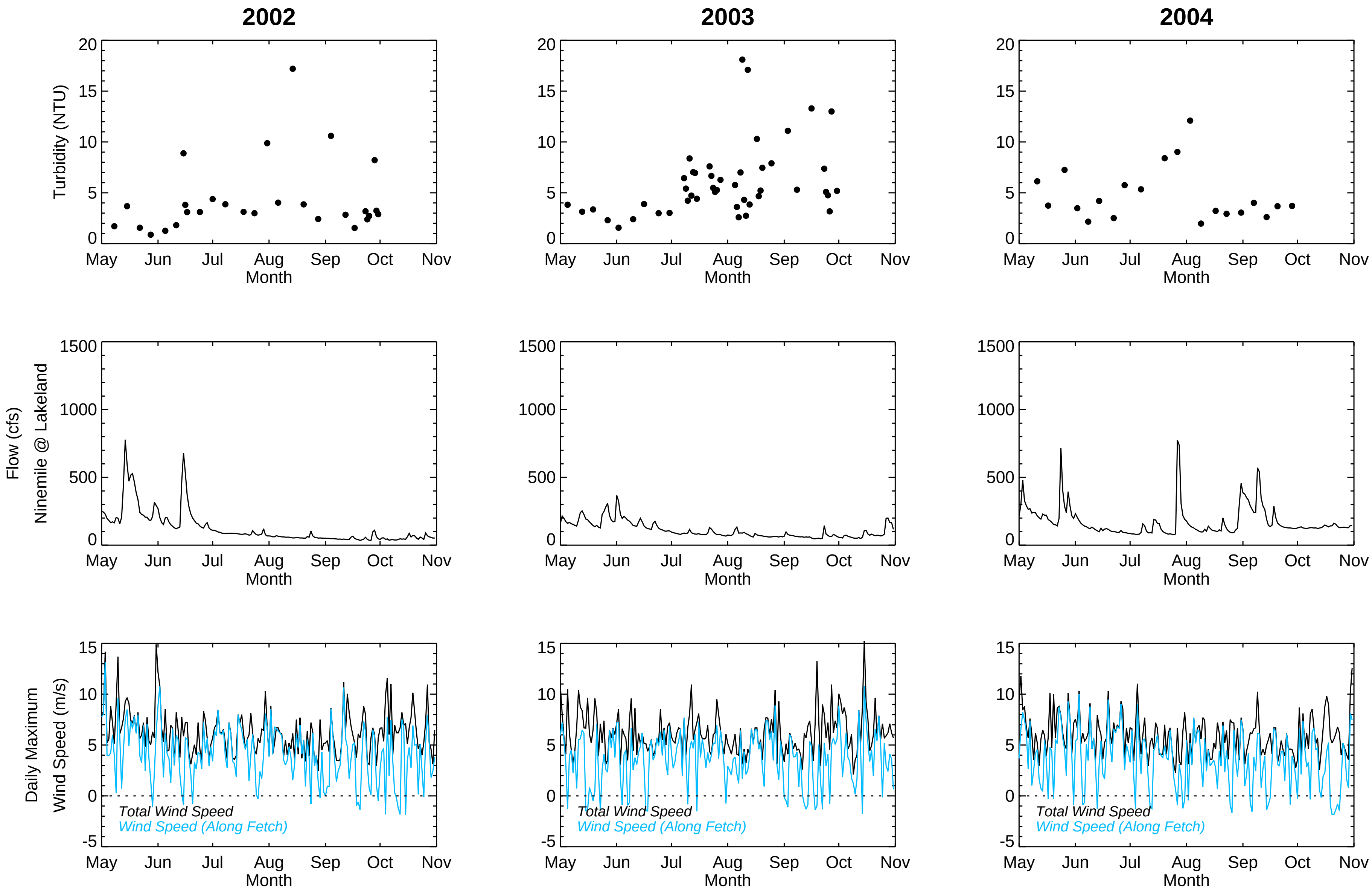


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

LD - H:\Honeywell\Onondaga_Lake_Remediation(090139-01)\DredgeOps_IDS\ANALYSIS\Nearshore_Turb\Nearshore_turb_flow_wind_temporals_MAYOCT.pro
Fri Jan 20 14:30:11 2012

Maple Bay

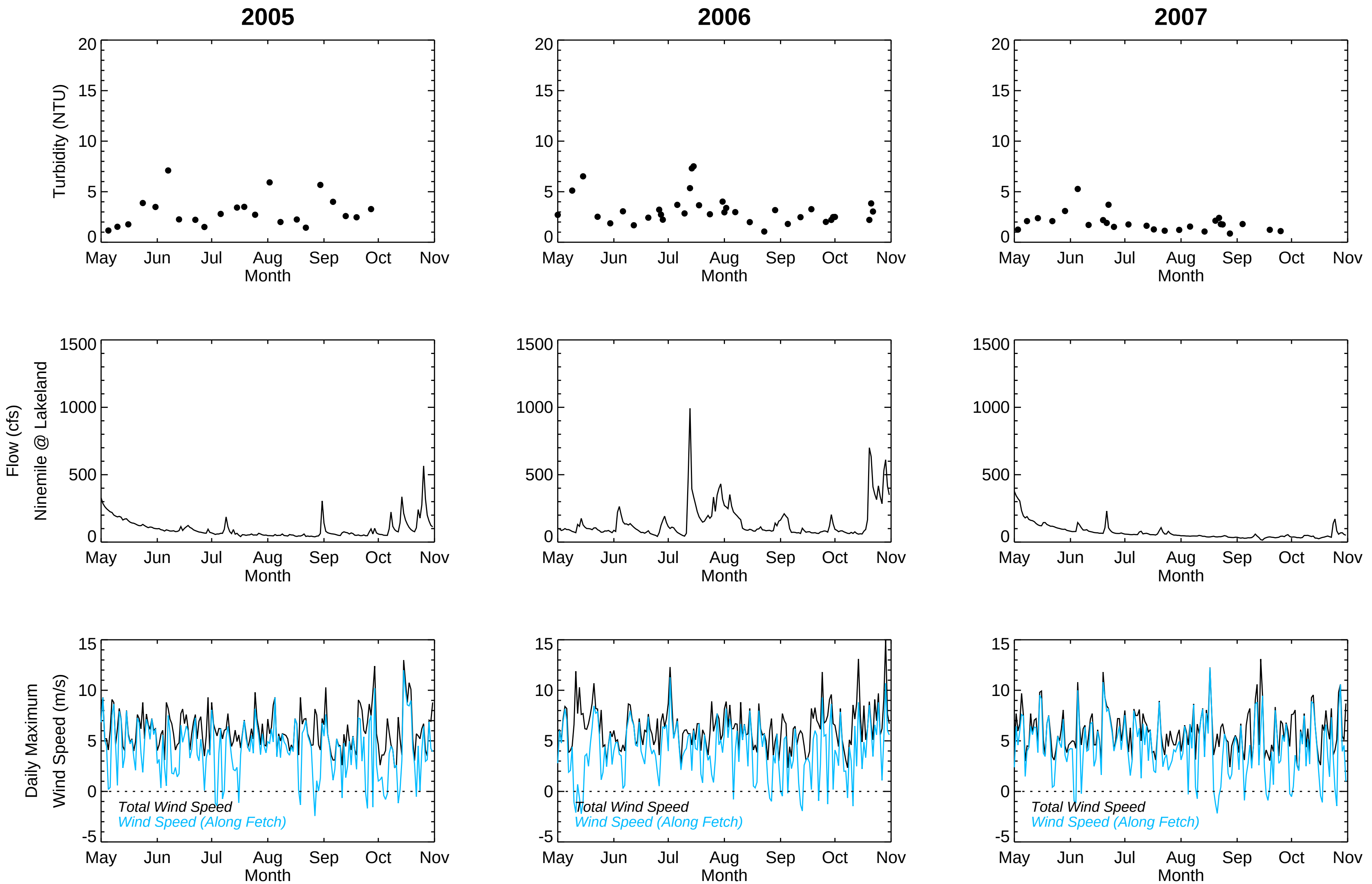


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

Wastebeds

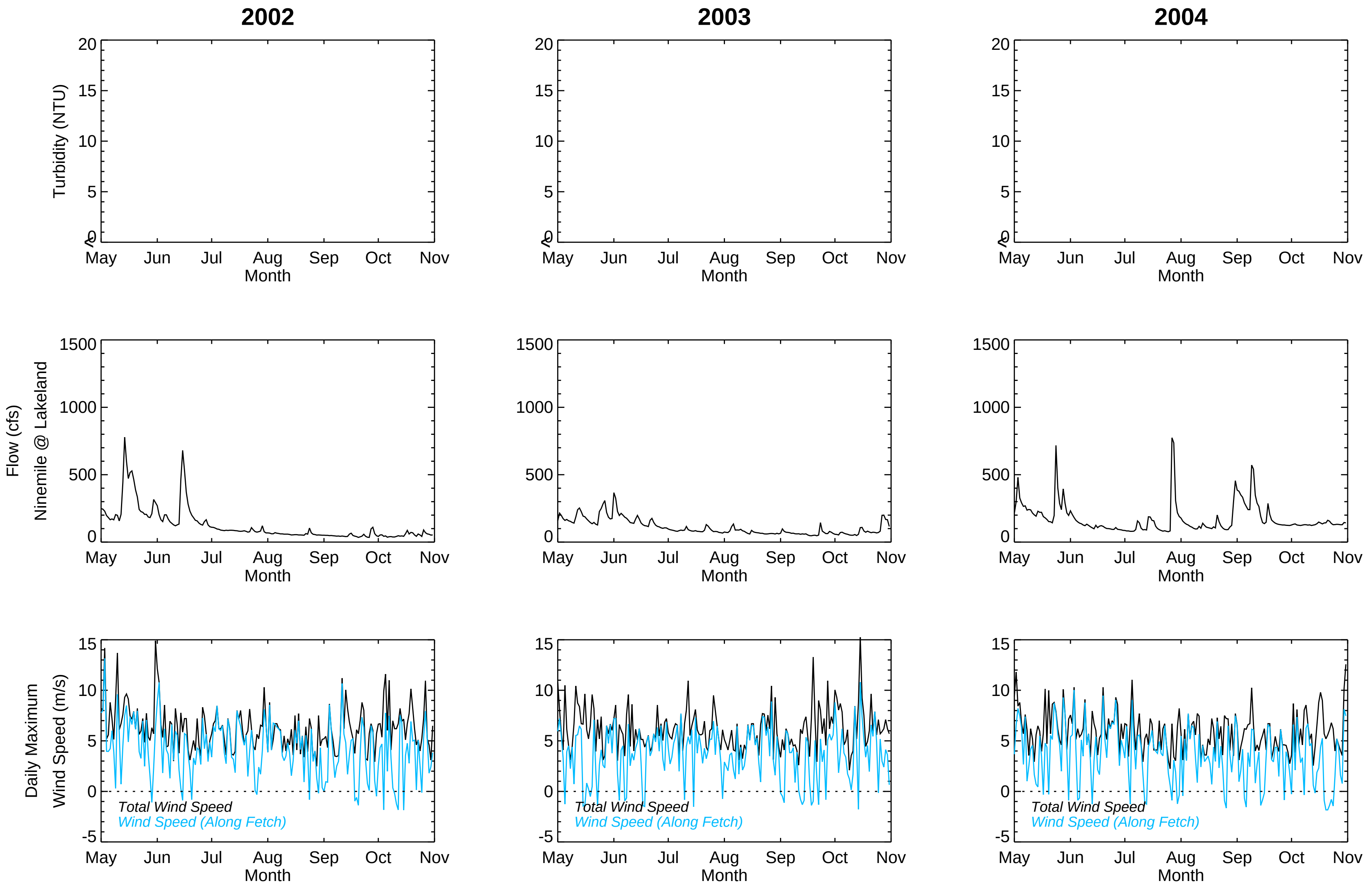


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.

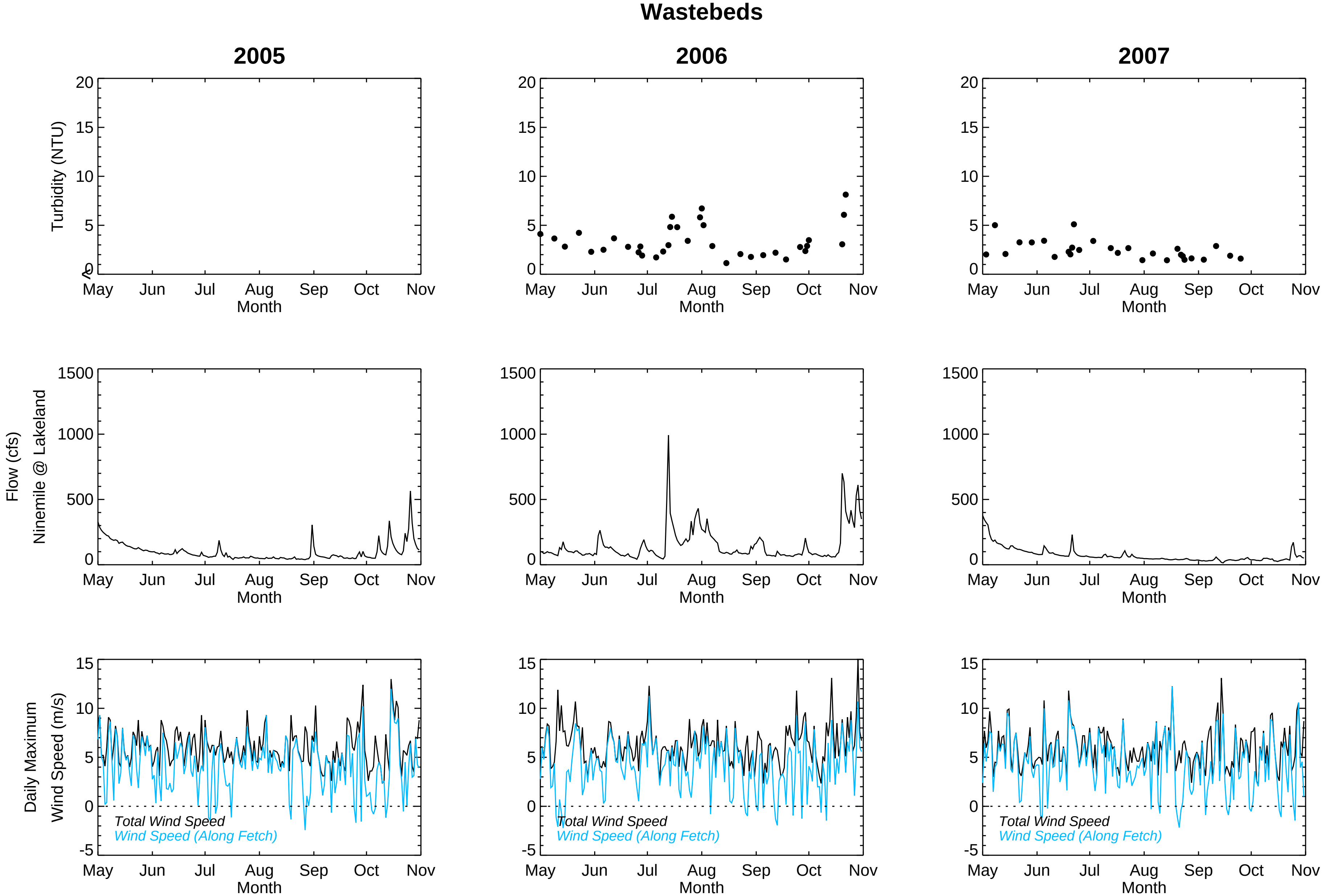
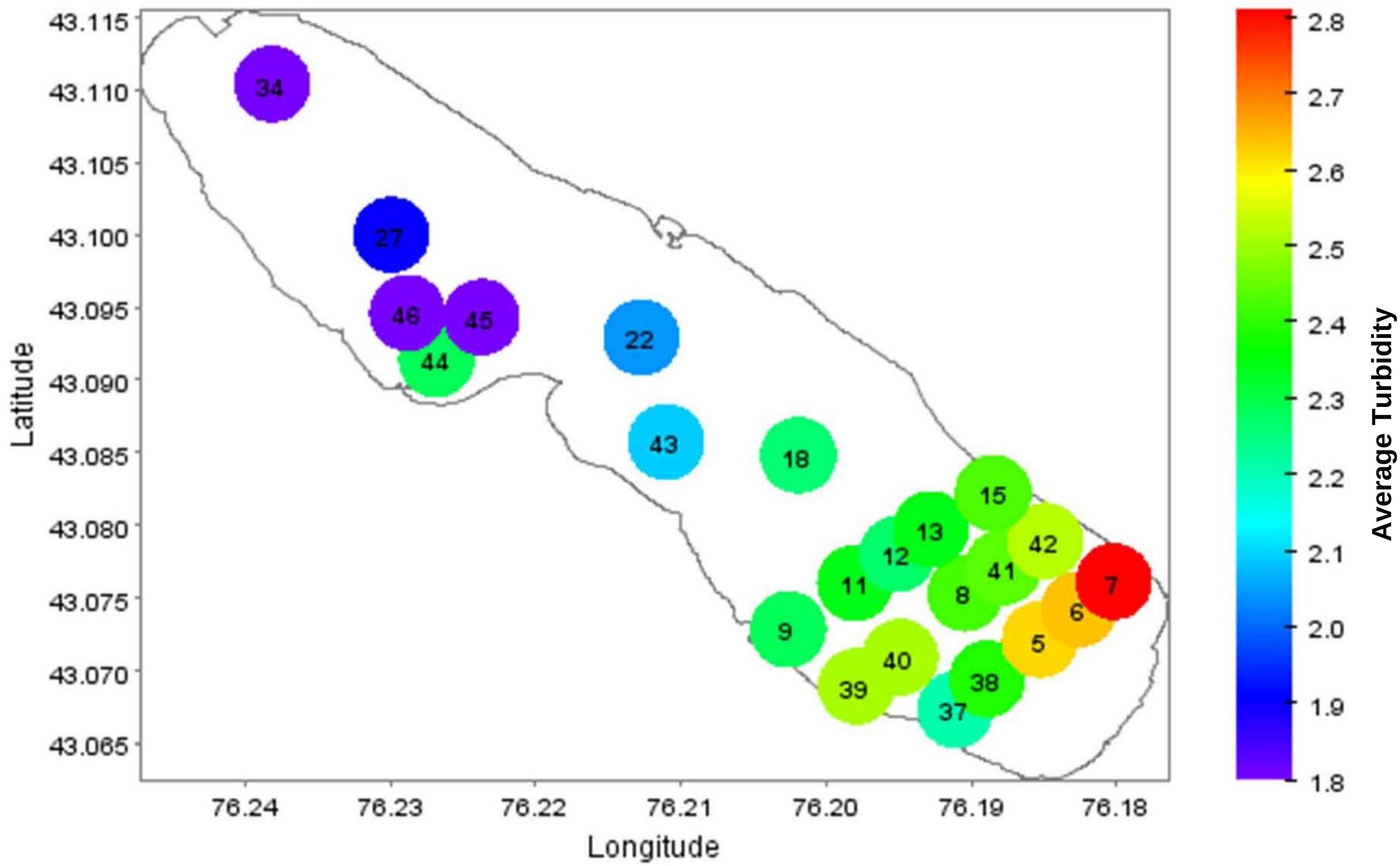


Figure B-8

Temporal Profile of Turbidity, Flow, and Wind Speed at Nearshore Sampling Locations (Onondaga Lake Ambient Montioring Program)
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Wind data are a daily average from NOAA station at Hancock Airport; Flow data are a daily average.



Note:
1. Numbered locations indicate monitoring location station IDs. Average surface (0-4 m) turbidity values based on data collected between October 2010 and October 2011.

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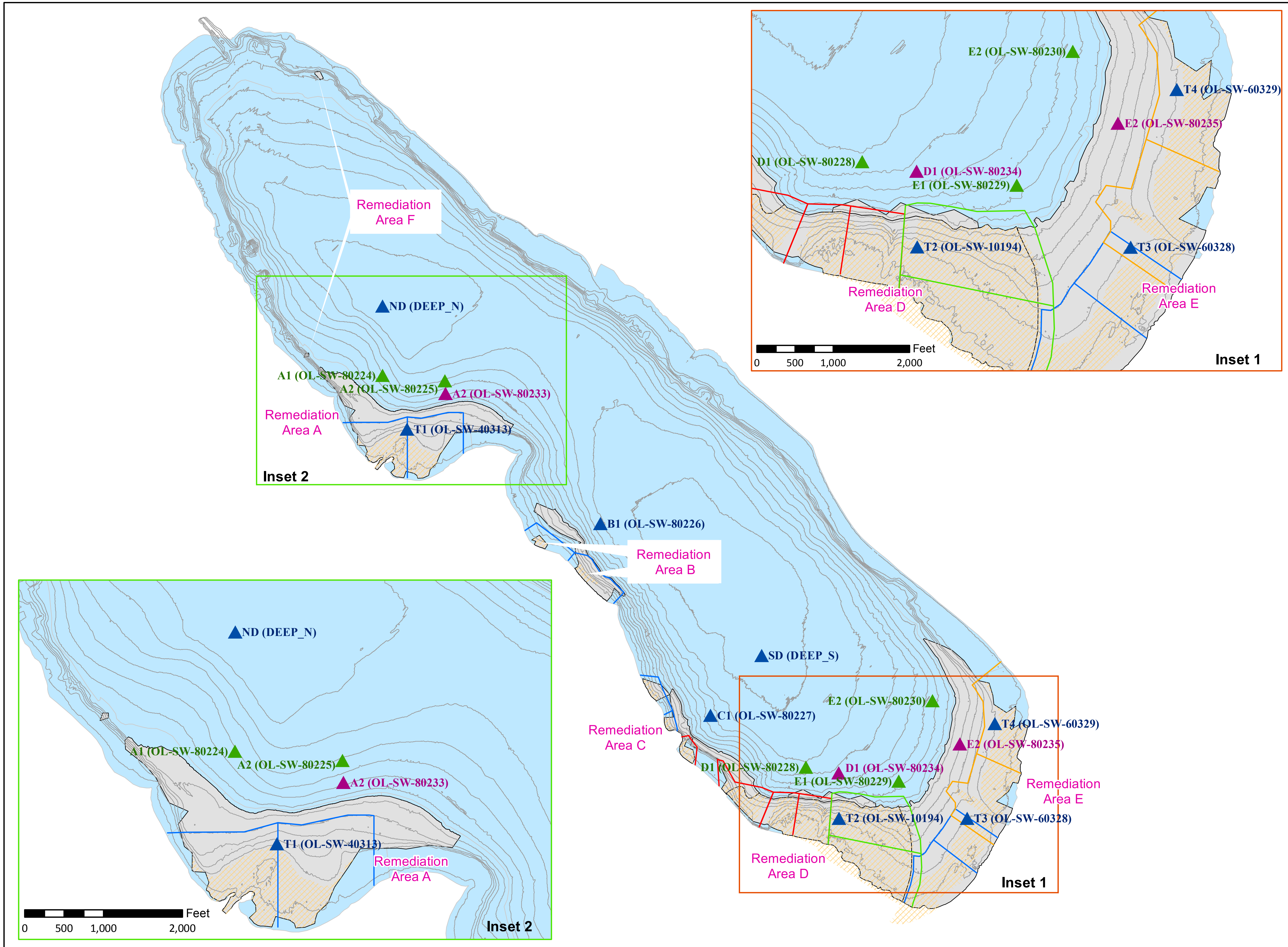
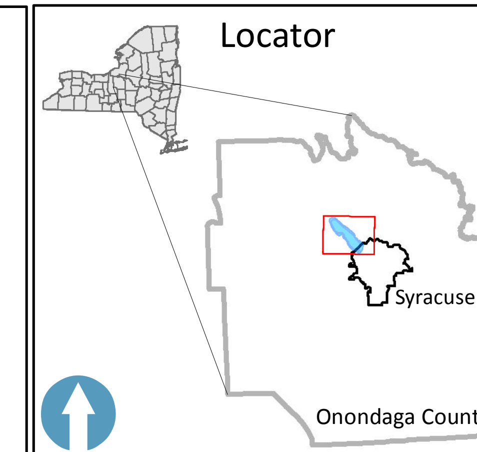
UPSTATE FRESHWATER INSTITUTE

Figure B-9
2010 and 2011 Average Surface (0 to 4 m) Turbidity Conditions
Water Quality Management and Monitoring Plan
Onondaga Lake





Scale

Feet

0 1,000 2,000 4,000

Legend

- Discrete Water Column Sample Locations (2010 and 2011)
- Discrete Water Column Sample Locations (2010 only)
- Discrete Water Column Sample Locations (2011 only)

Turbidity Curtain Locations (by year)*

- 2012
- 2013
- 2014
- 2015
- Dredge Areas
- 2005 Bathymetry (displayed every 5 ft)**
- Remediation Areas

* Turbidity curtain alignments presented herein are conceptual and will be updated in the field as necessary and placed with DEC concurrence.

** Bathymetric survey performed by CR Environmental, Inc. for Honeywell in 2005.

Figure B-10
2010/2011 Water Quality Monitoring for Construction Baseline Discrete Sampling Locations Onondaga Lake

Honeywell
PARSONS
ANCHOR QEA

120139-01.01 MAY 2012

H:\Honeywell\Onondaga_Lake_Remediation(090139-01)\WQMP\GIS\Figure B-9 - 2010&2011 Discrete Sampling.mxd - B.Solomon - 16APR2012

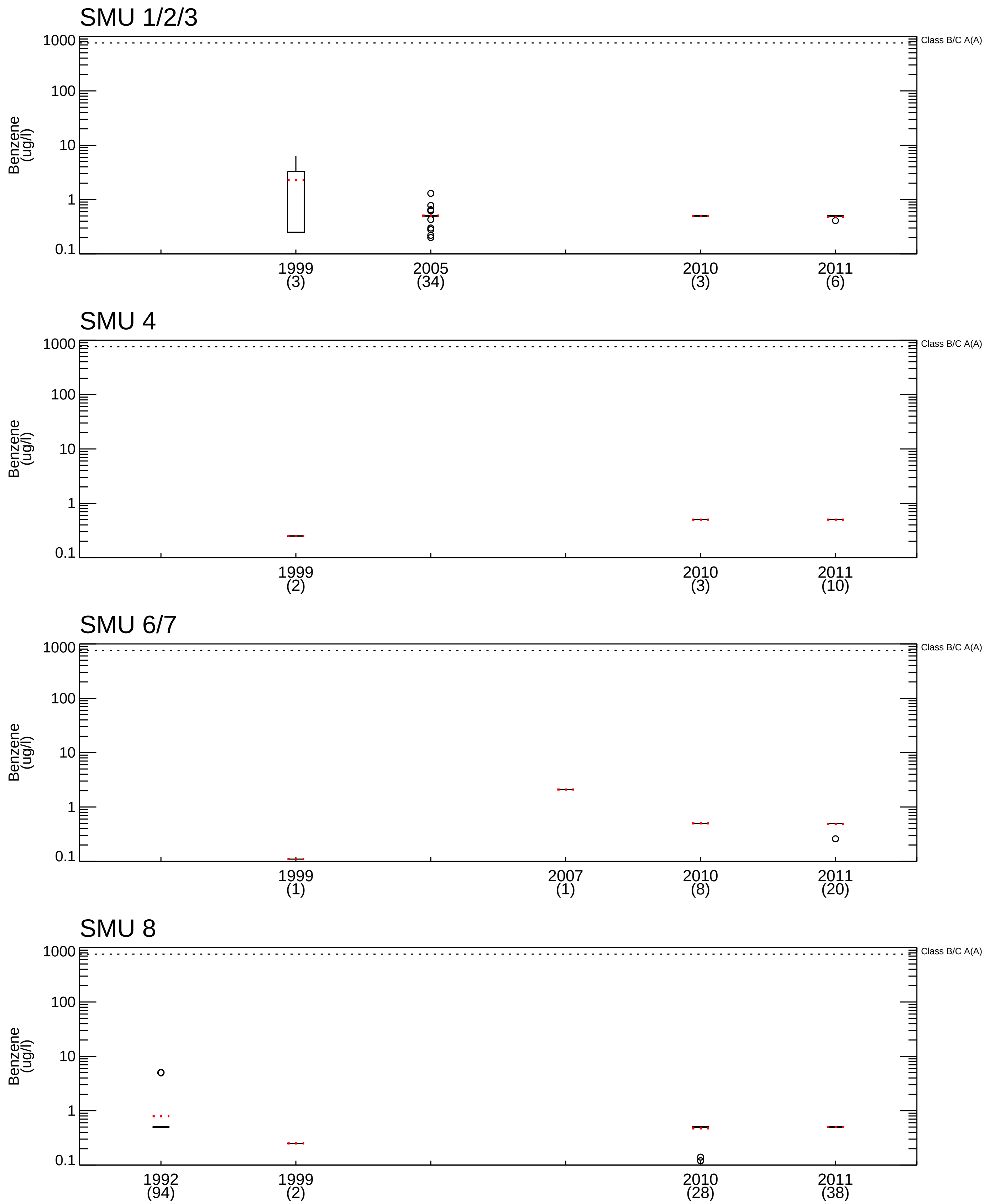


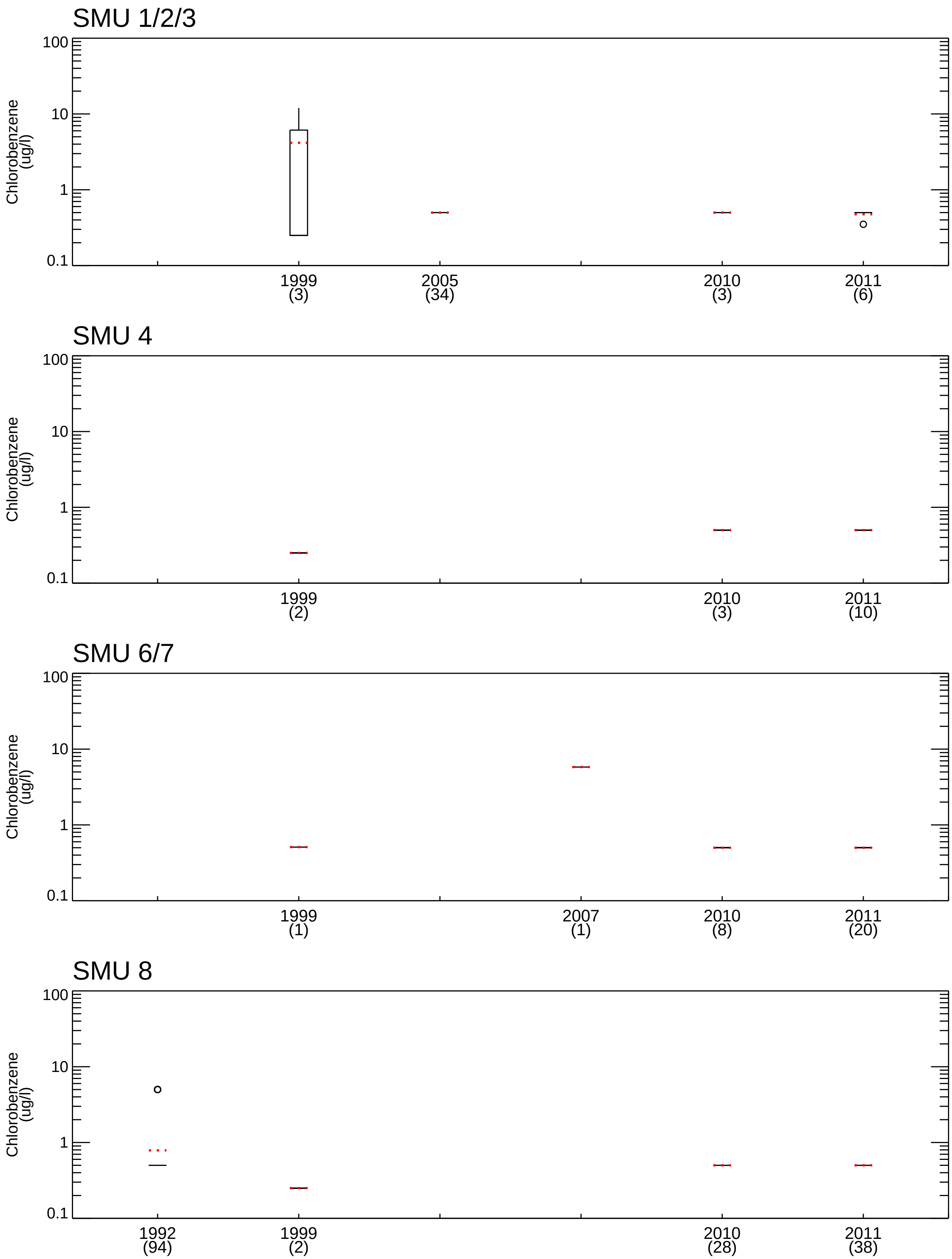
Figure B-11

Benzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:20 2012



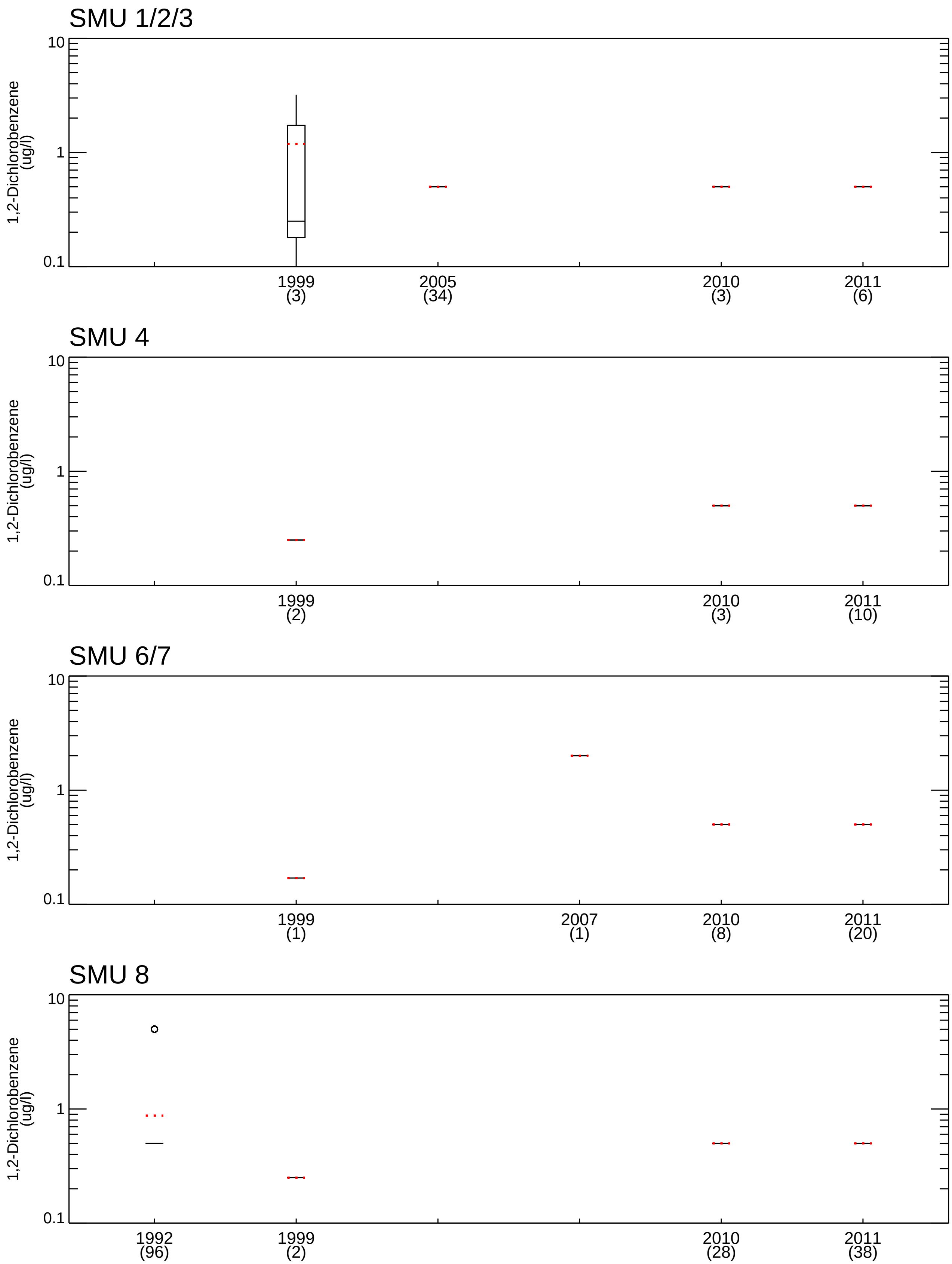
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Chlorobenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:21 2012

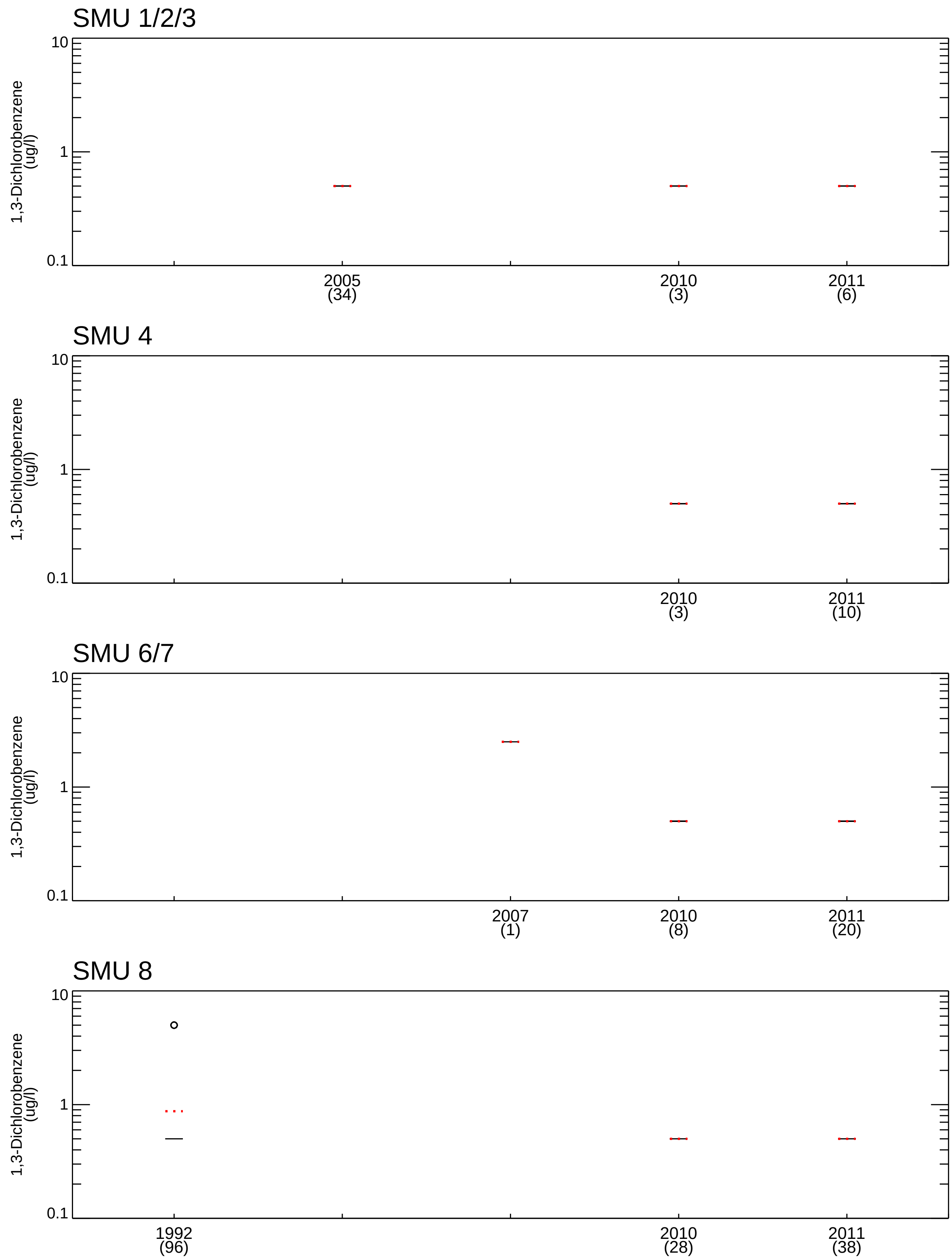


Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

1,2-Dichlorobenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).



ANCHOR QEA

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

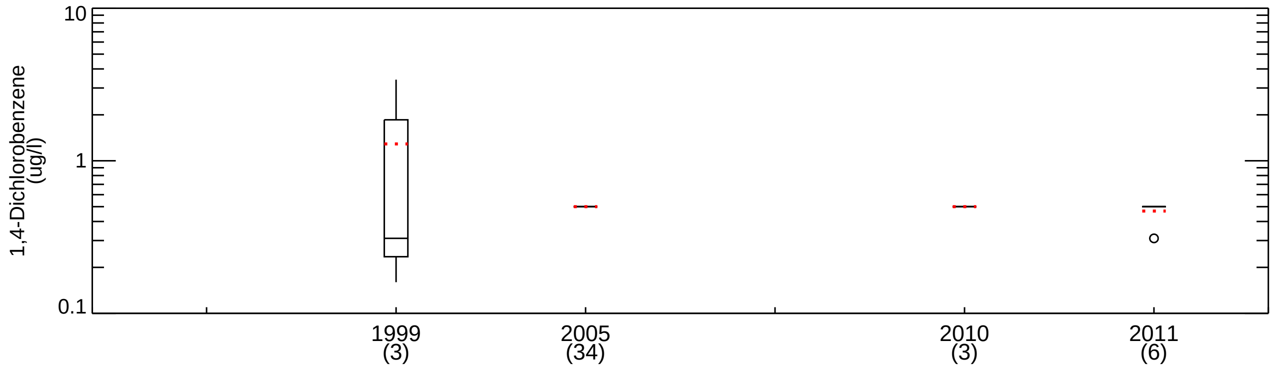
Figure B-11

1,3-Dichlorobenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

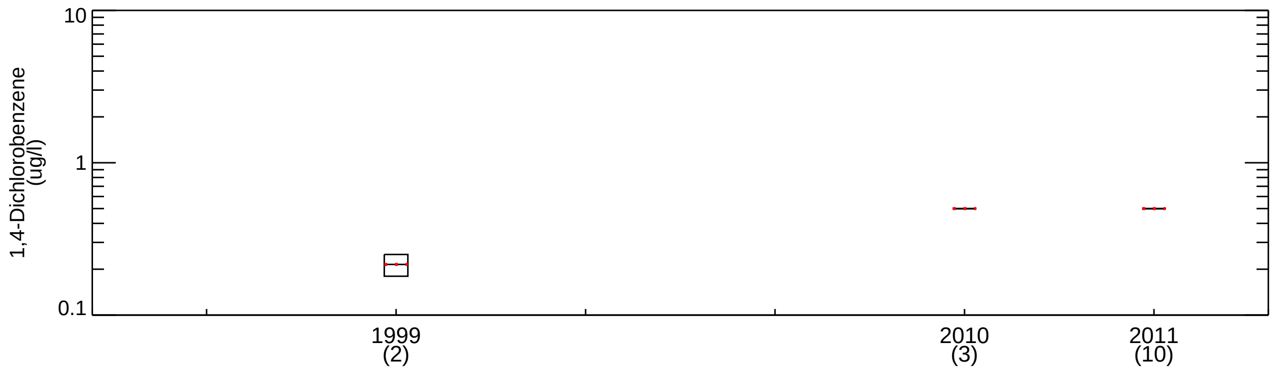
Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:21 2012

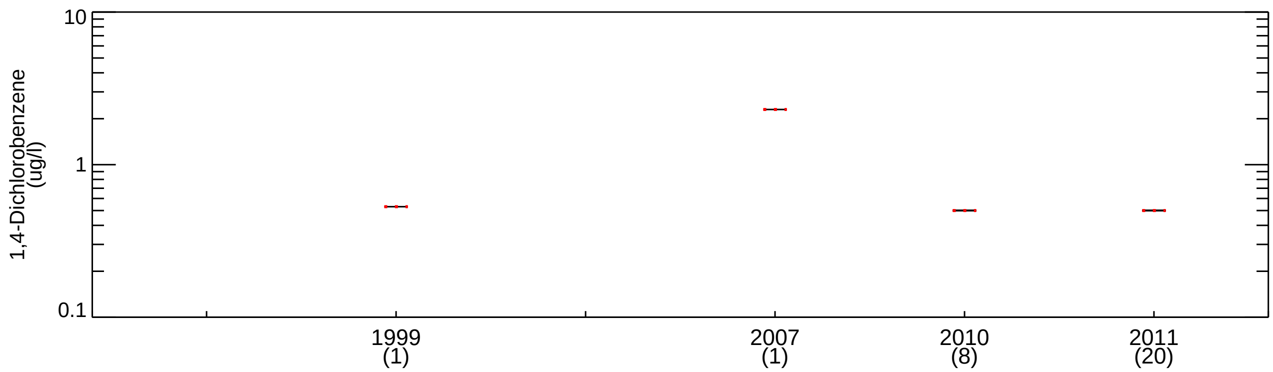
SMU 1/2/3



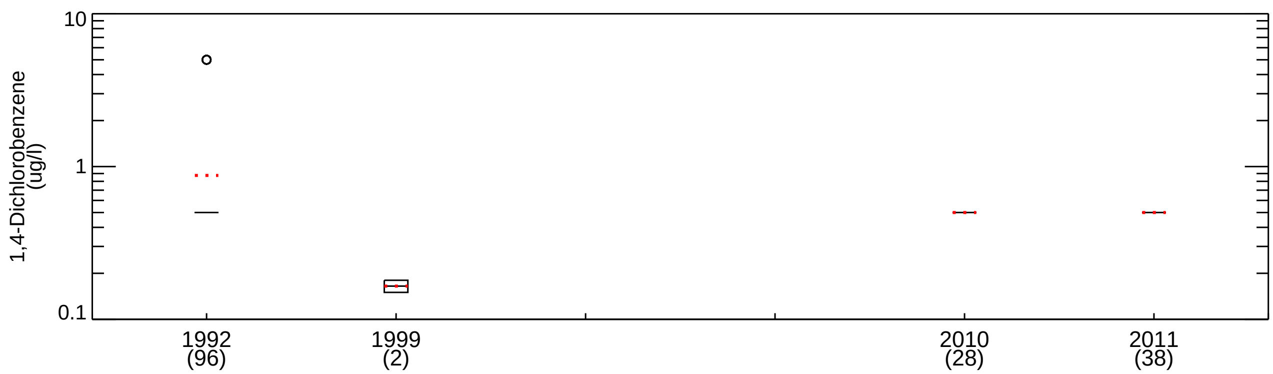
SMU 4



SMU 6/7



SMU 8



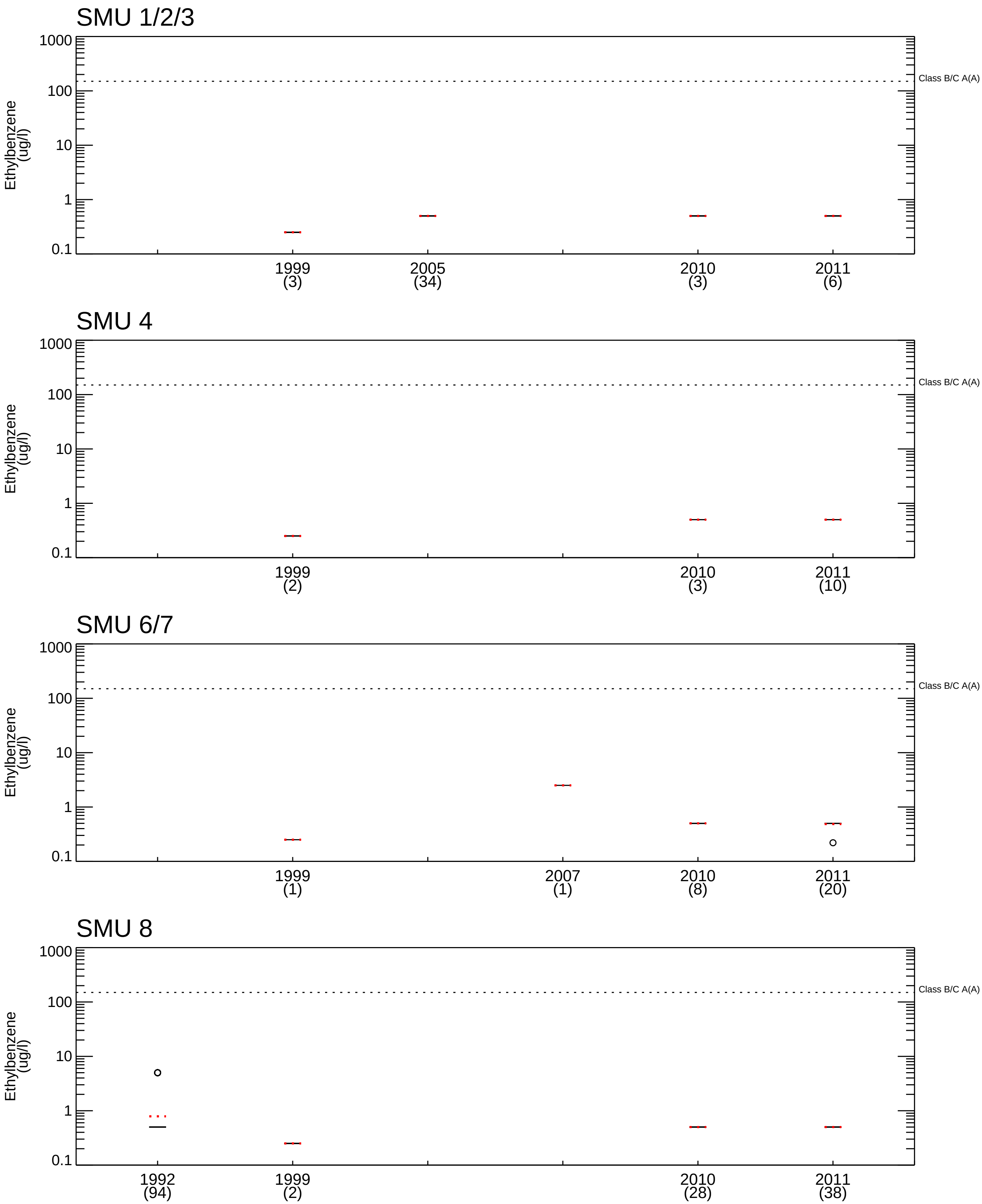
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

1,4-Dichlorobenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:22 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Ethylbenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

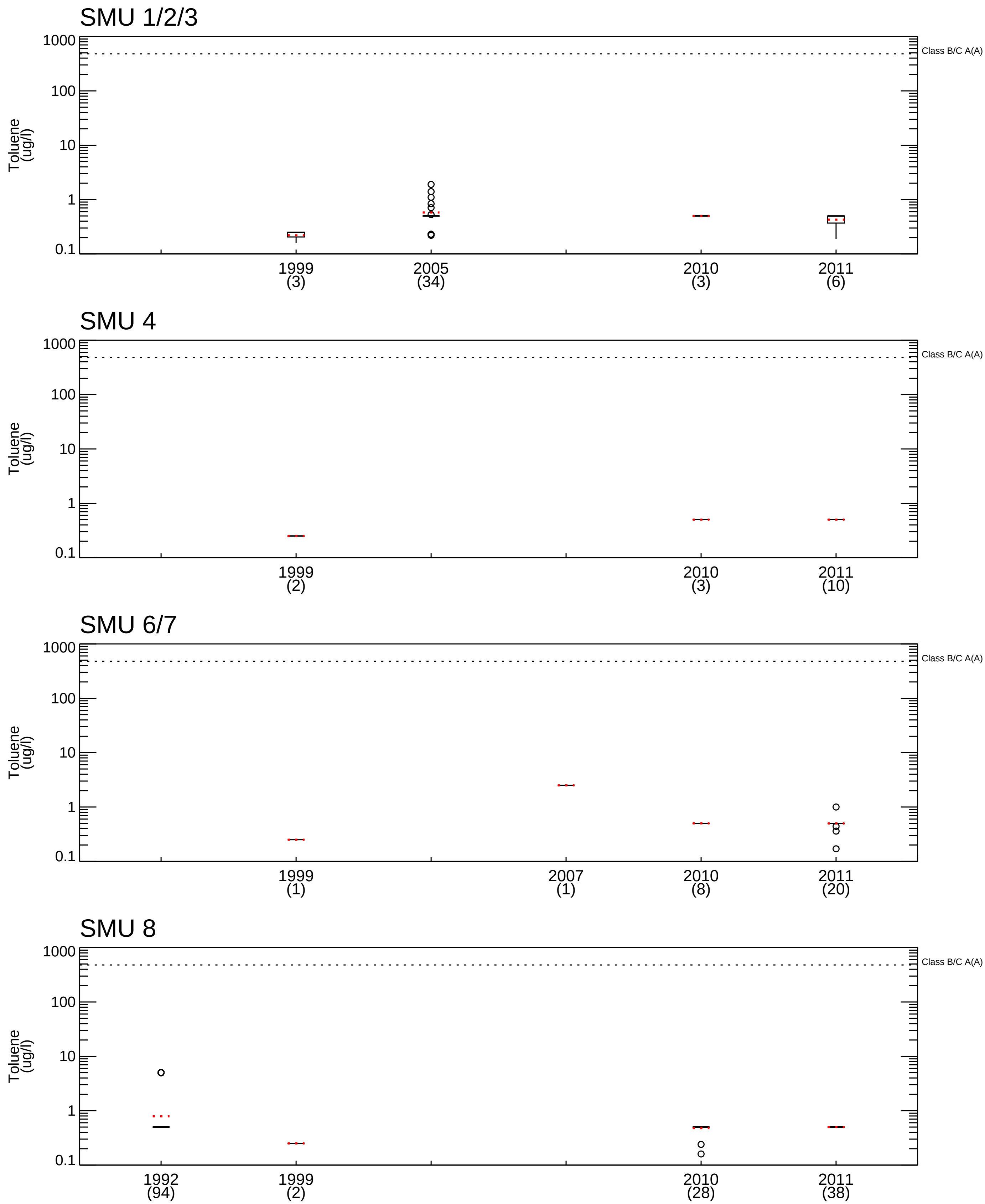


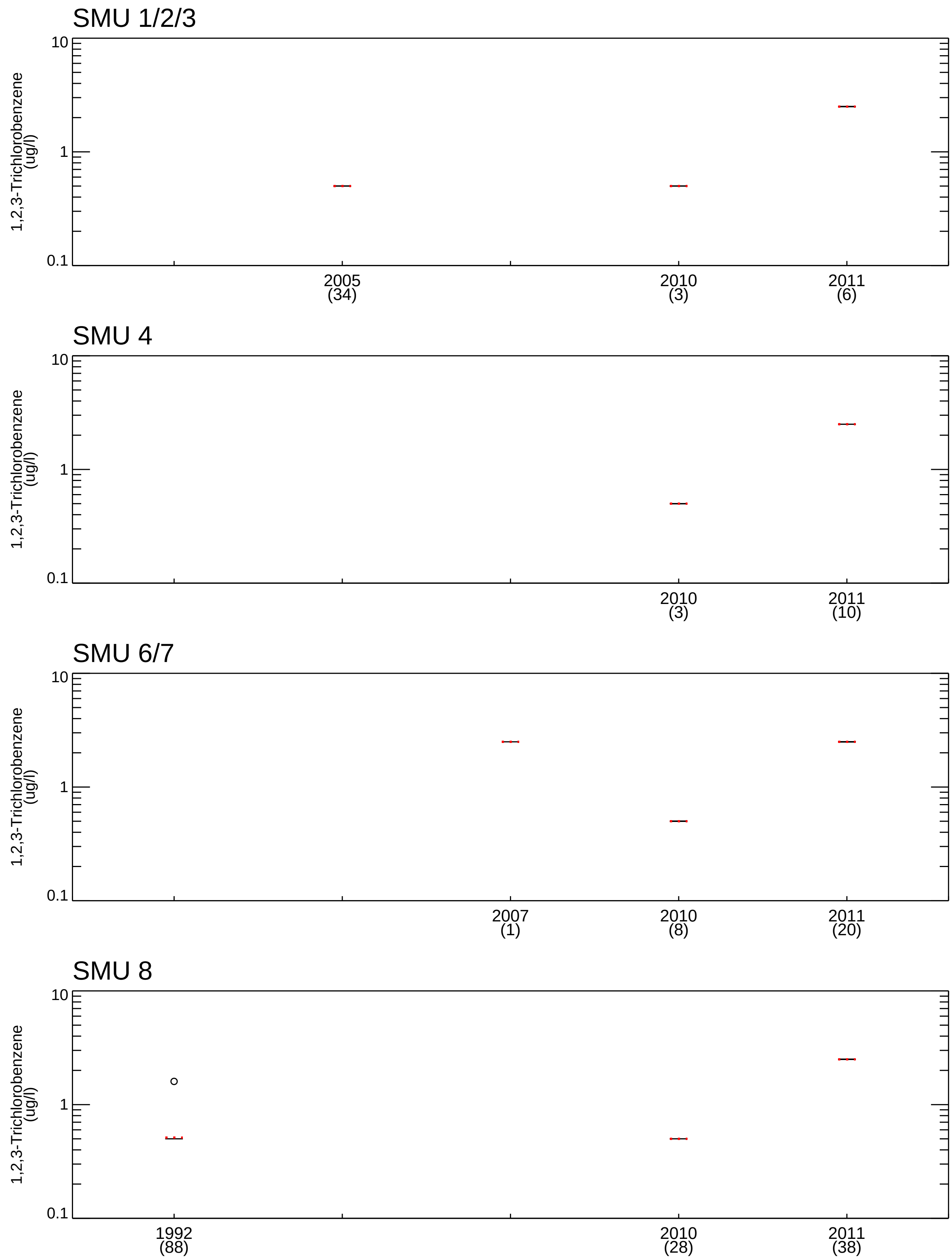
Figure B-11

Toluene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:34 2012



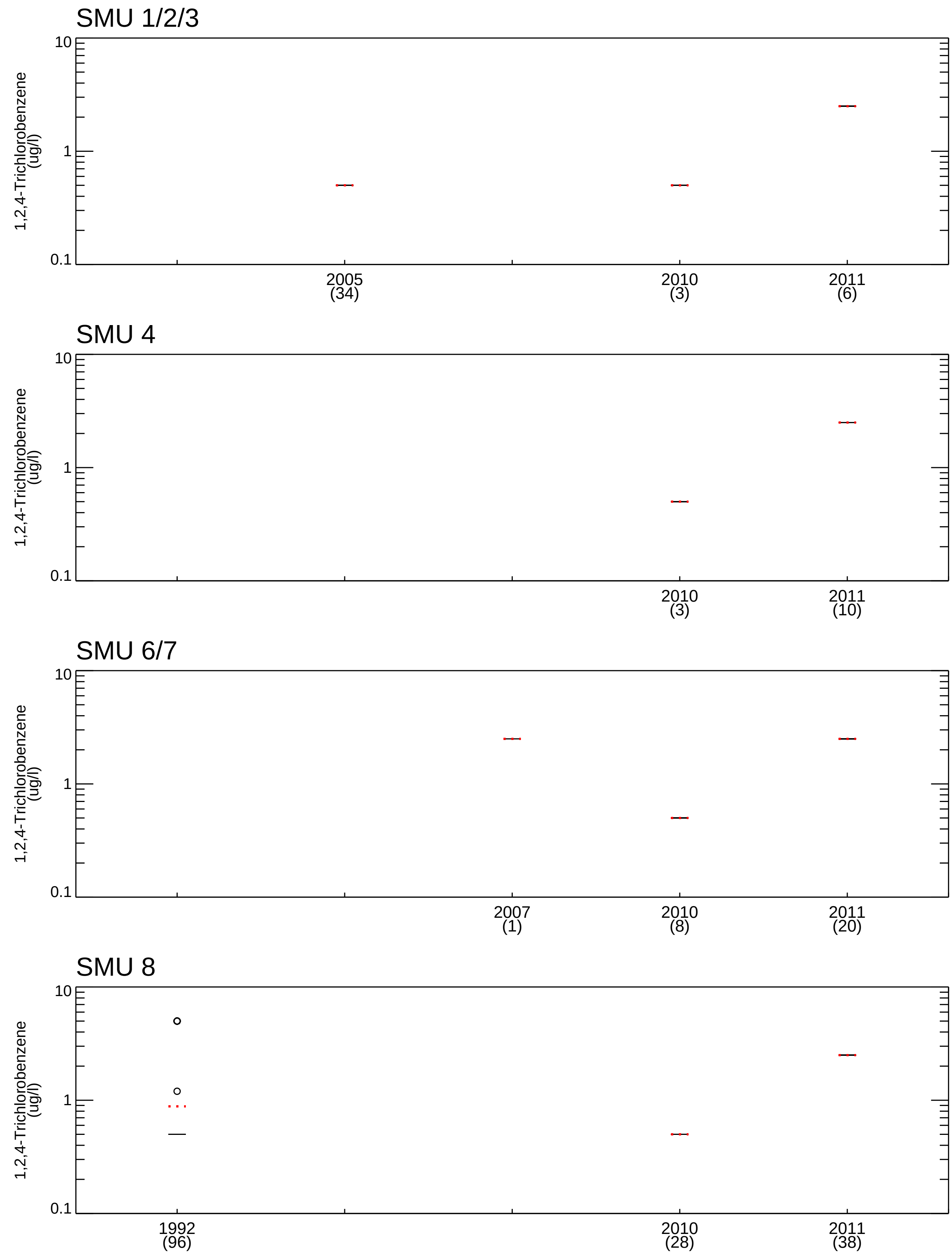
Upper and Lower Hinge
Median
Mean
● Inner Outlier
○ Outer Outlier

Figure B-11

1,2,3-Trichlorobenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:34 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

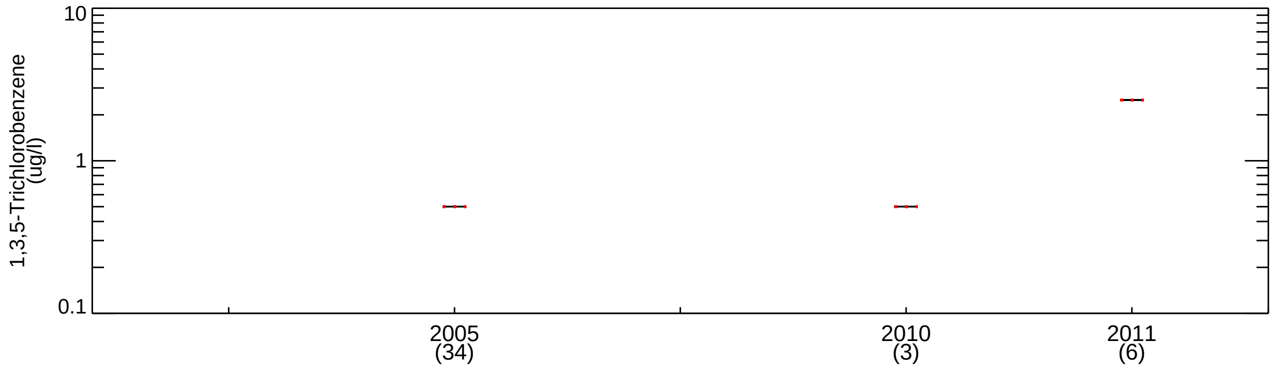
Figure B-11

1,2,4-Trichlorobenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

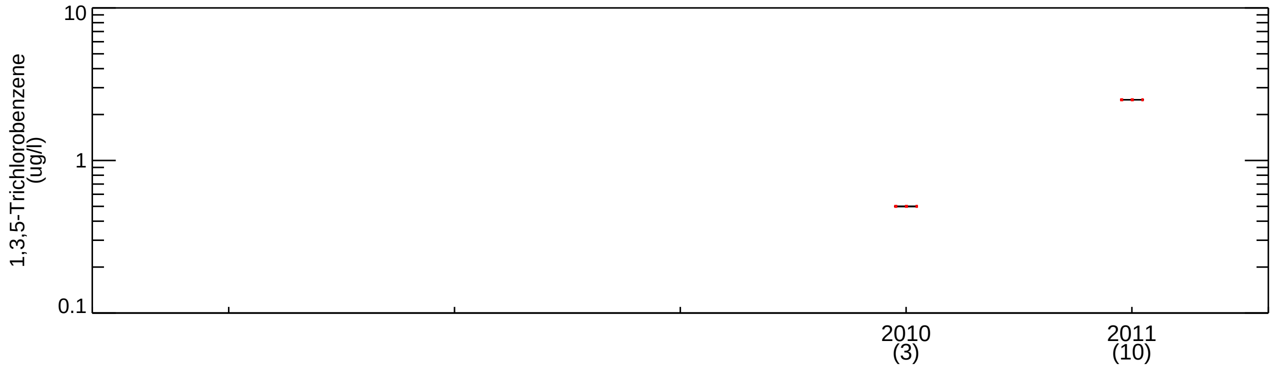
Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:51 2012

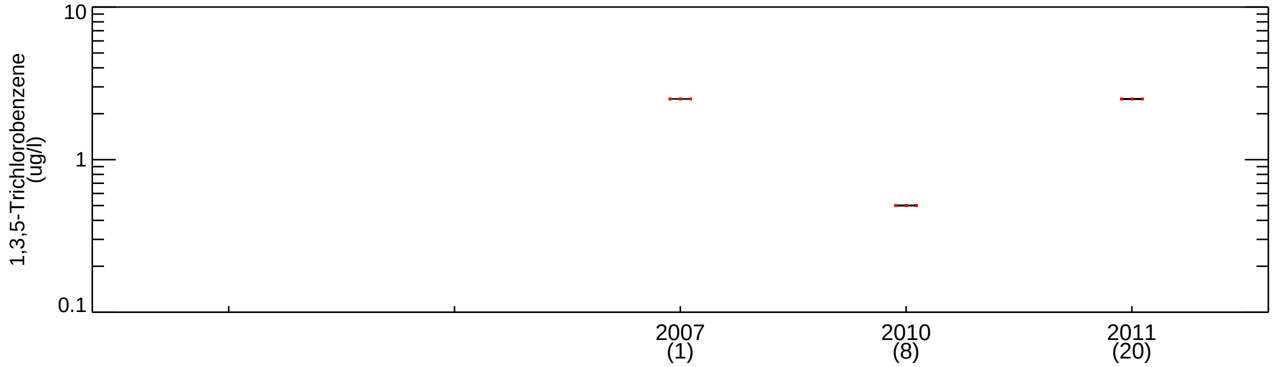
SMU 1/2/3



SMU 4



SMU 6/7



SMU 8

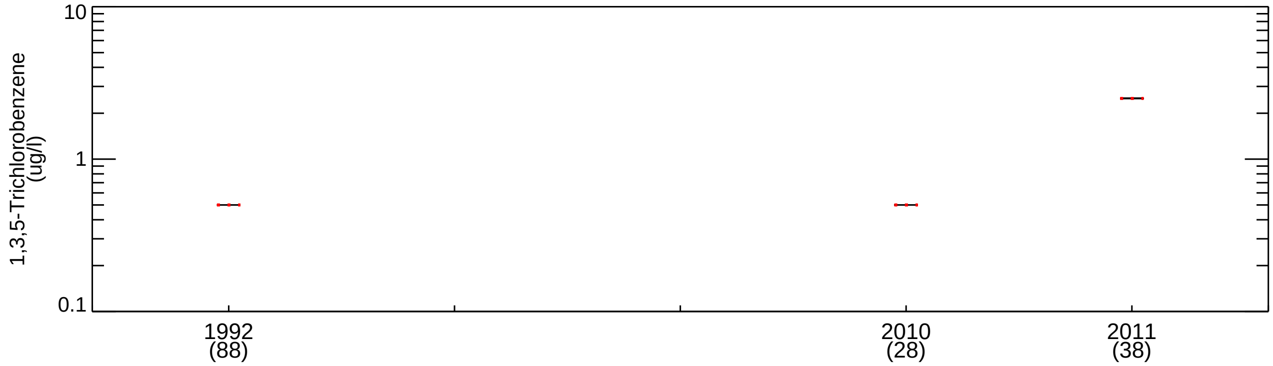


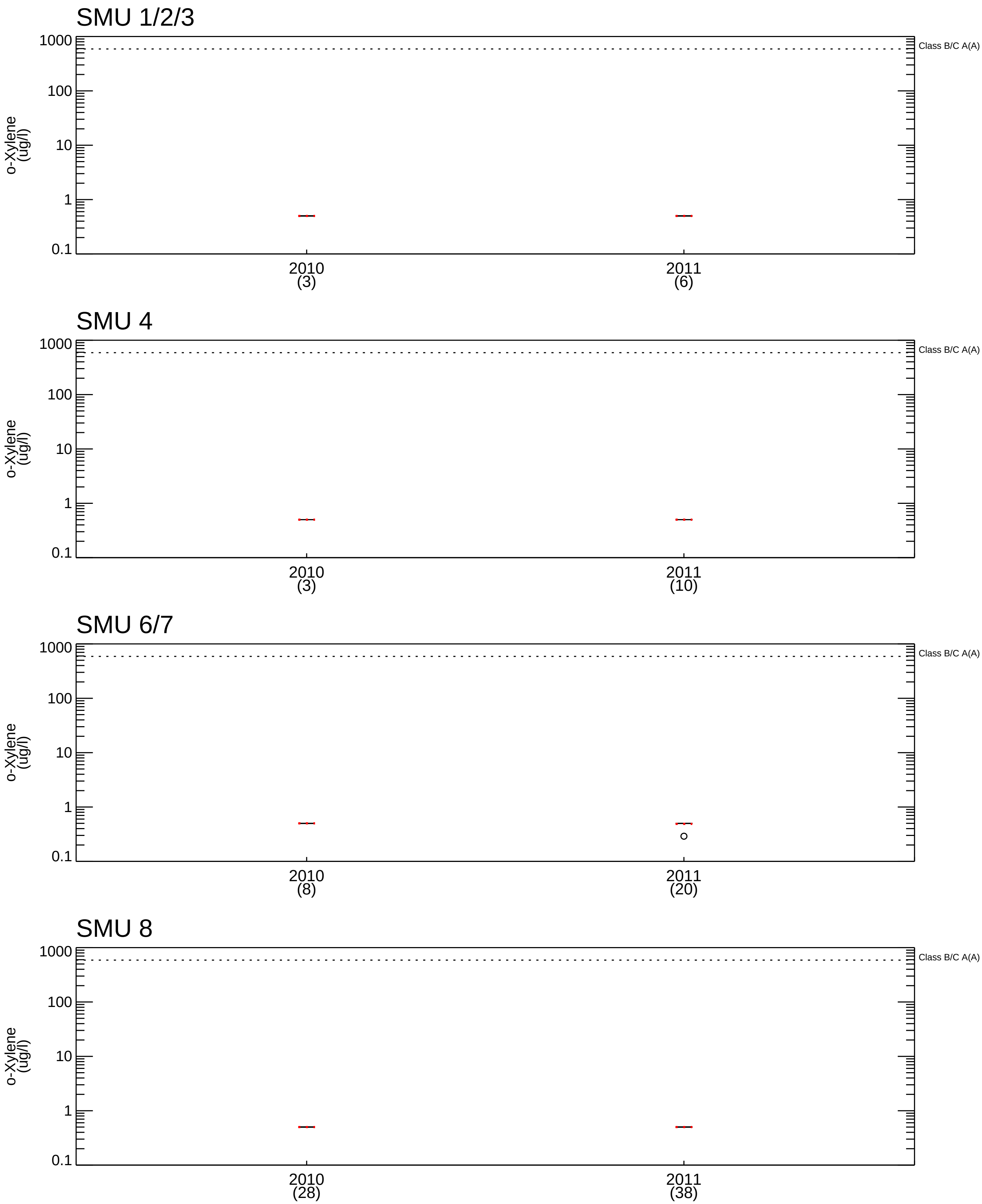
Figure B-11

1,3,5-Trichlorobenzene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:51 2012



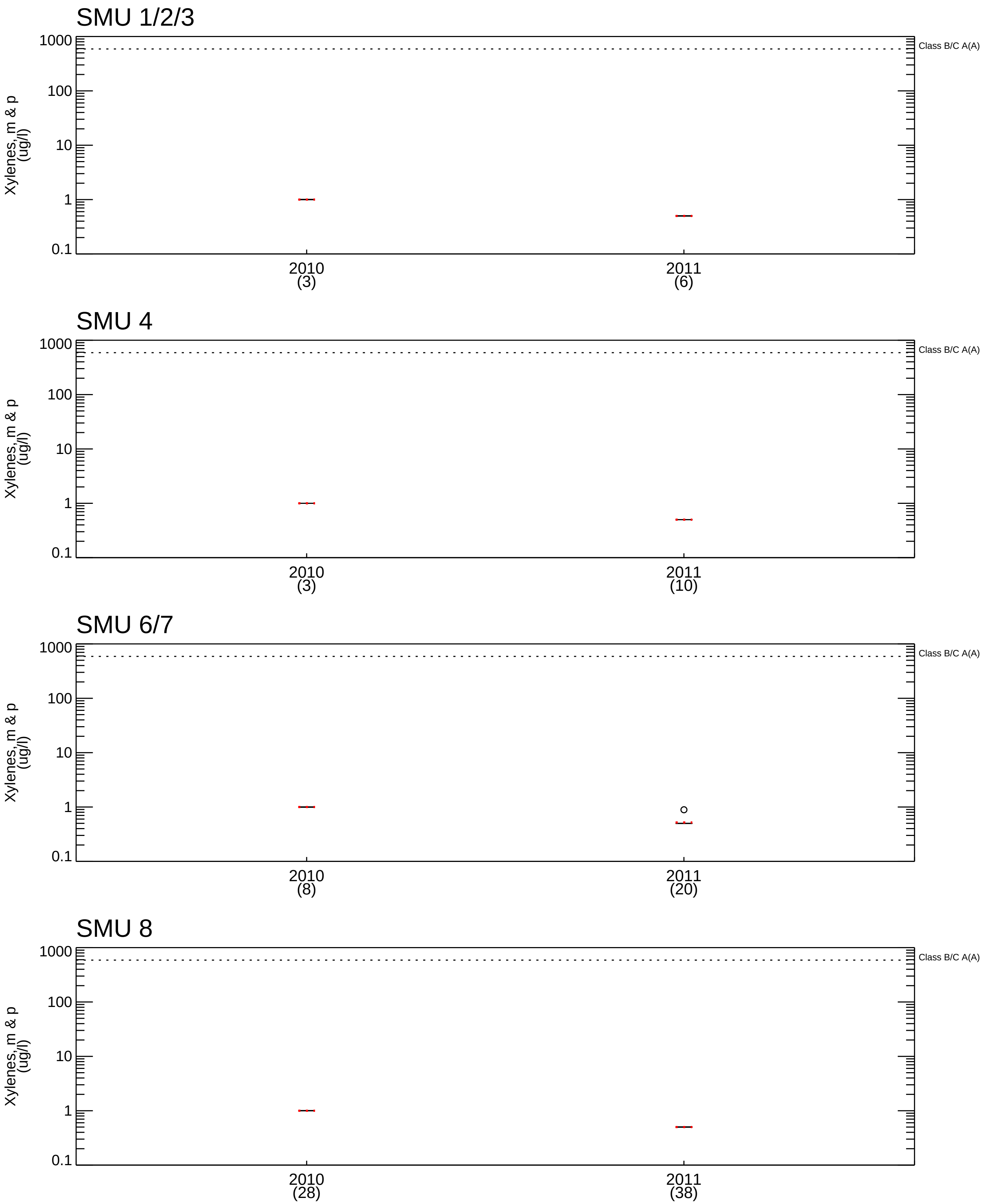
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

o-Xylene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:51 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Xylenes, m & p Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:52 2012

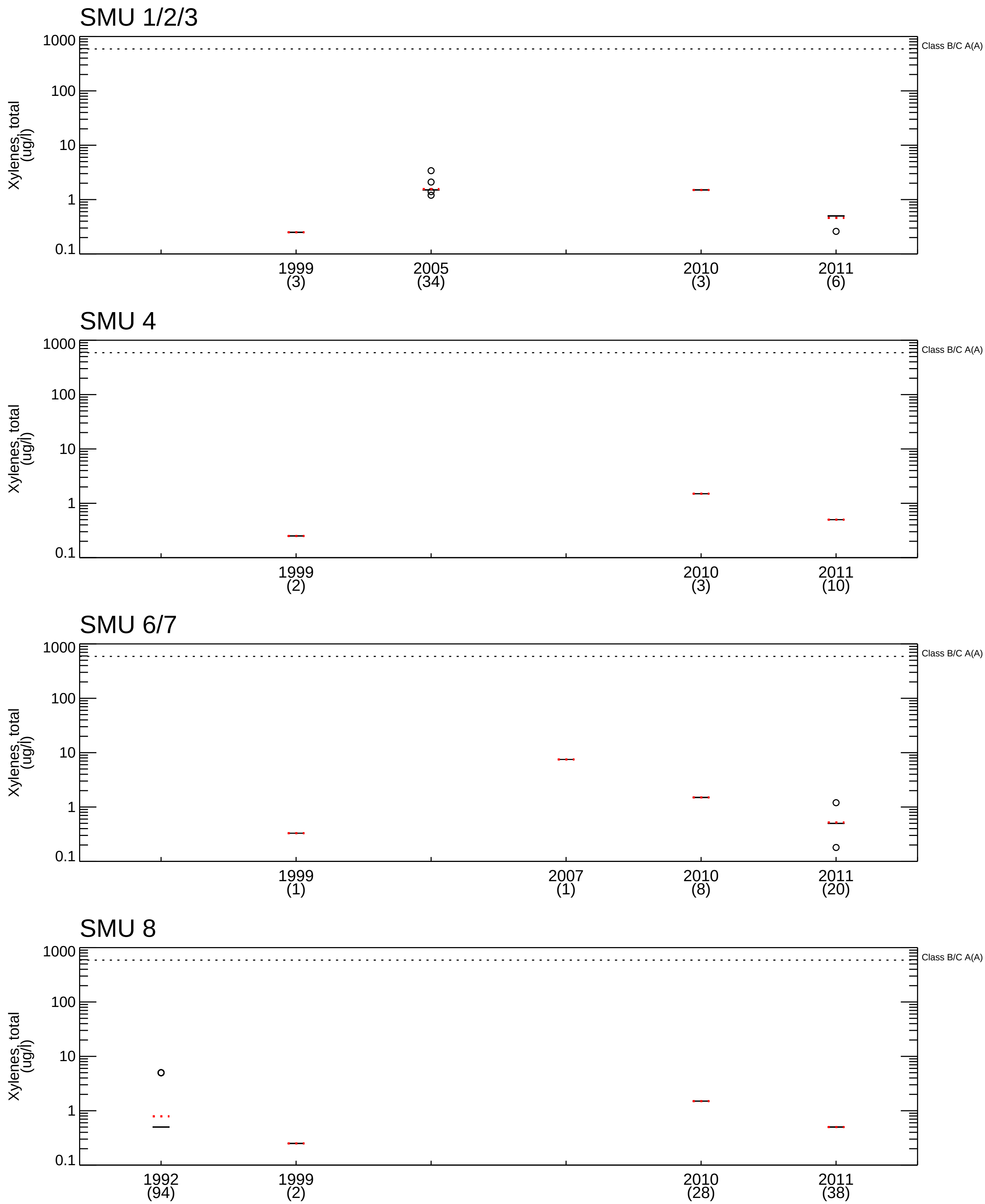


Figure B-11

Xylenes, total Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:53 2012

SMU 1/2/3

SMU 4

SMU 6/7

SMU 8

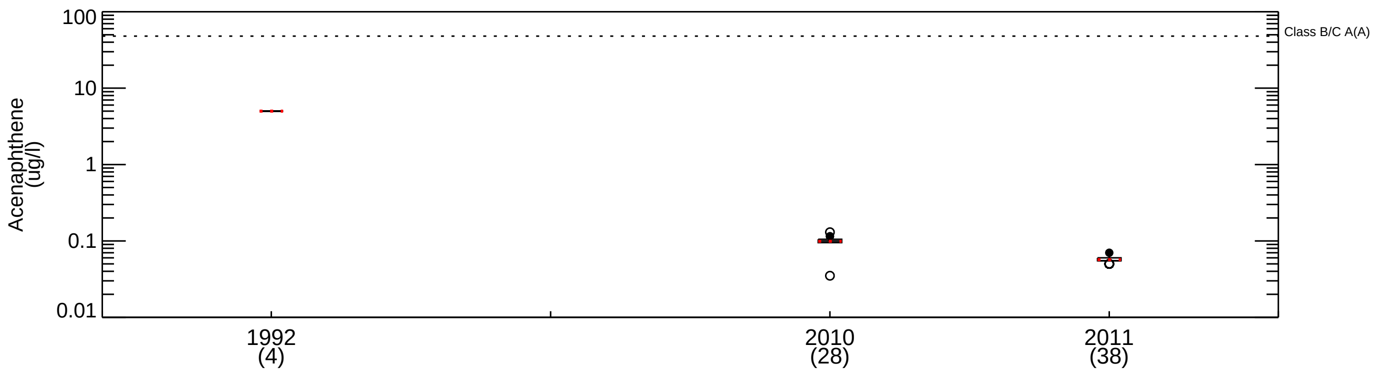


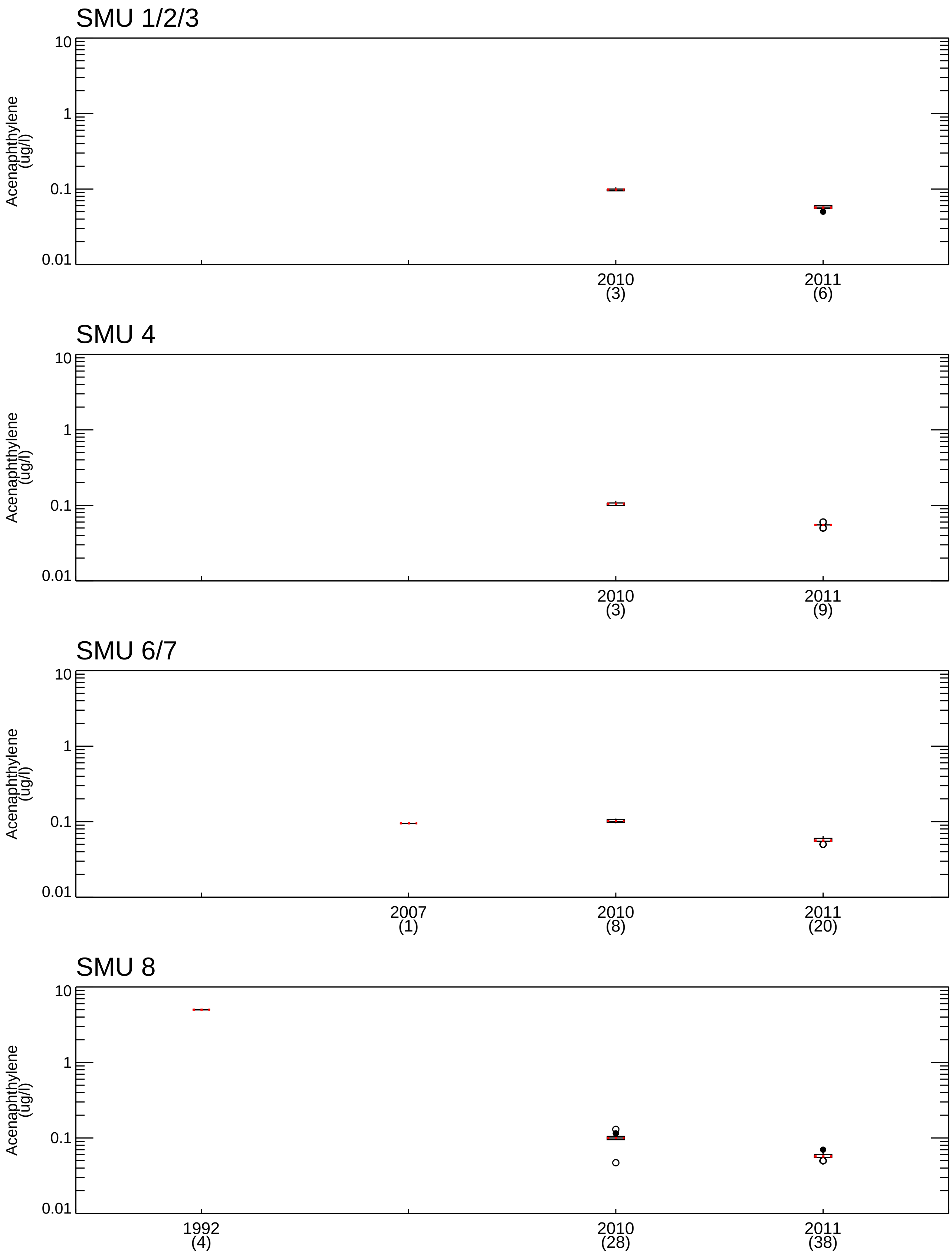
Figure B-11

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Acenaphthene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:44:53 2012

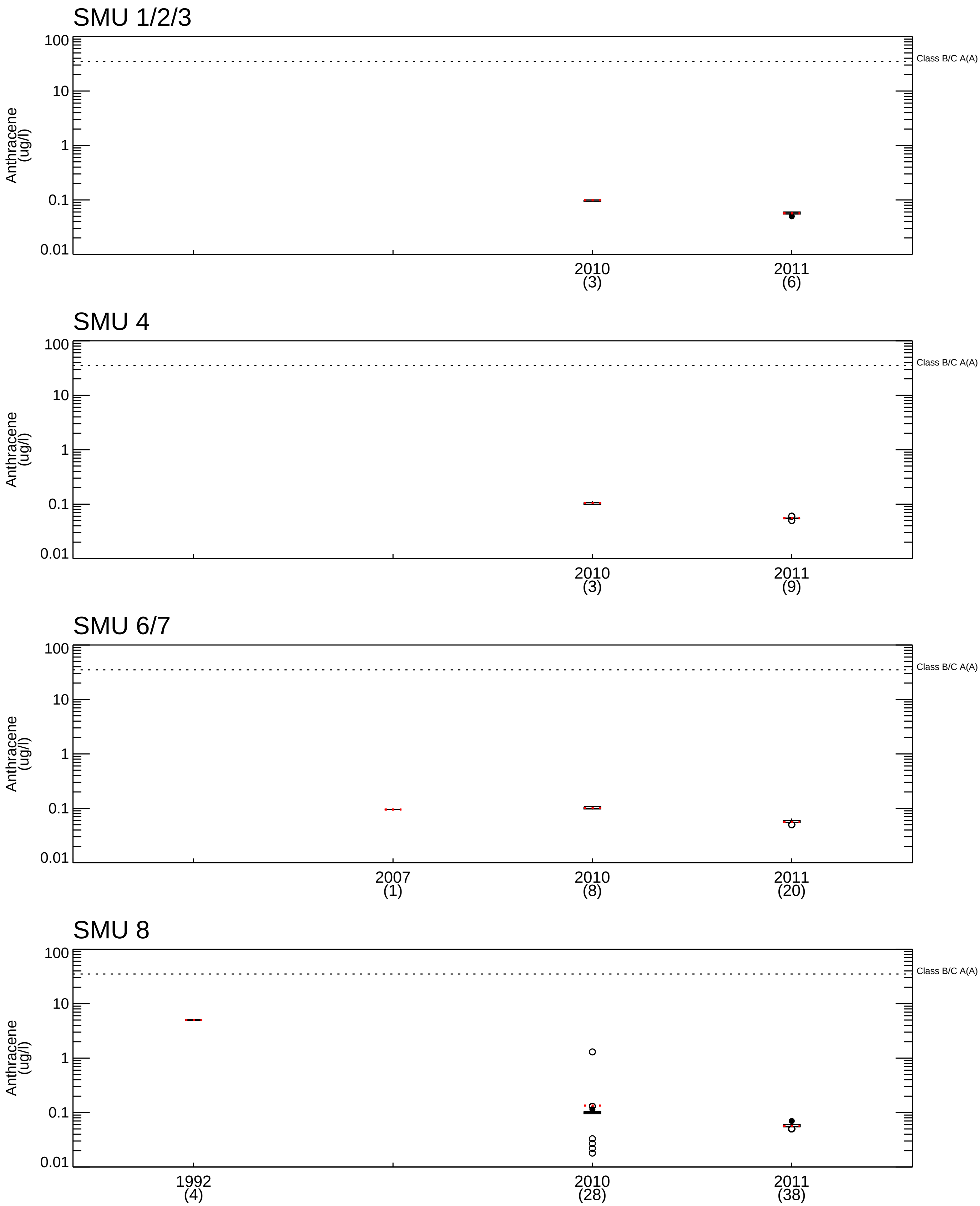


Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Acenaphthylene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).



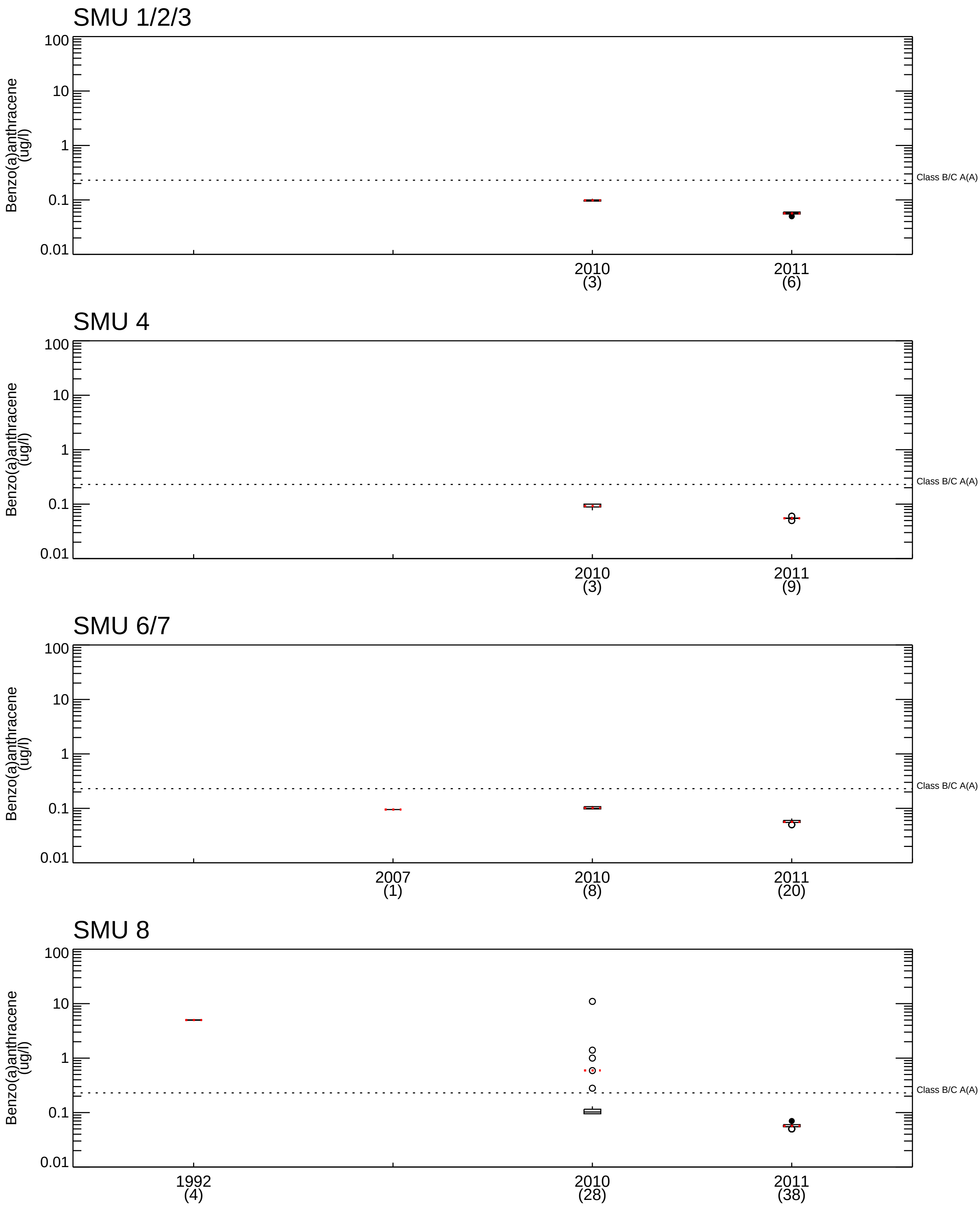
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Anthracene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:45:30 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Benzo(a)anthracene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

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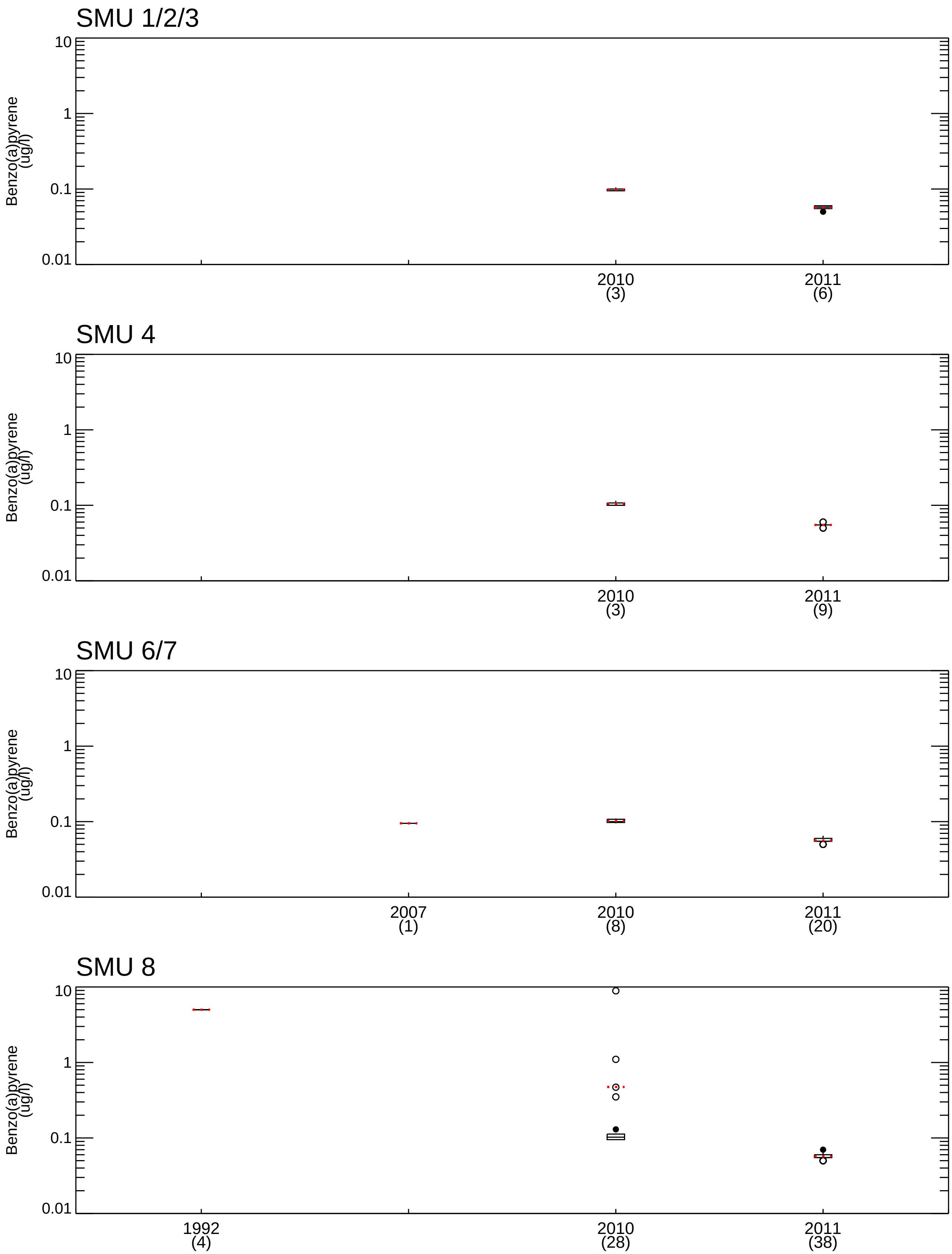


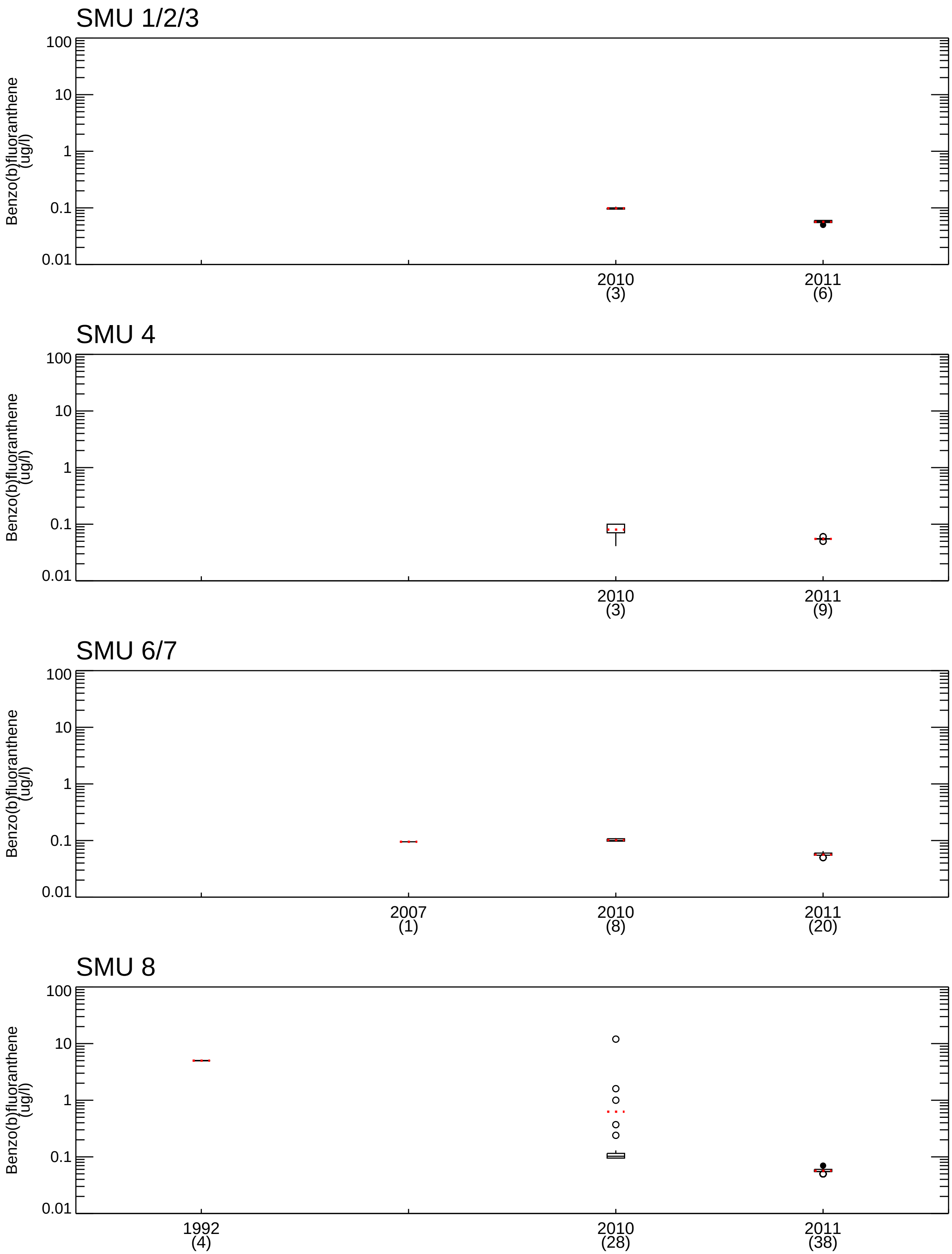
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Benzo(a)pyrene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:45:31 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

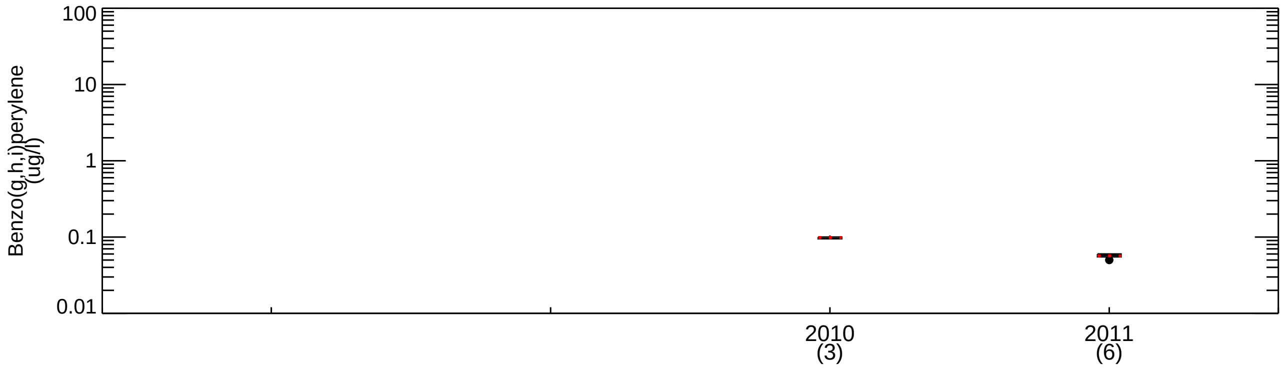
Figure B-11

Benzo(b)fluoranthene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

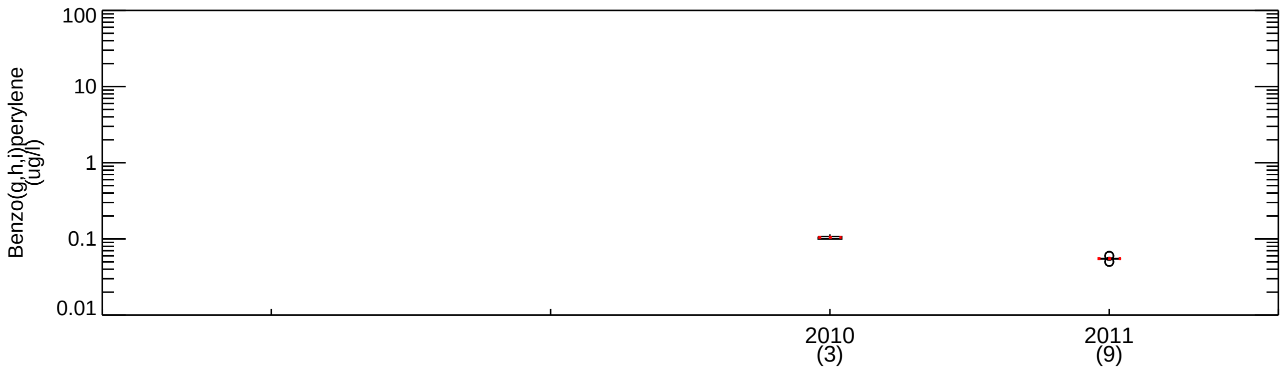
Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:45:33 2012

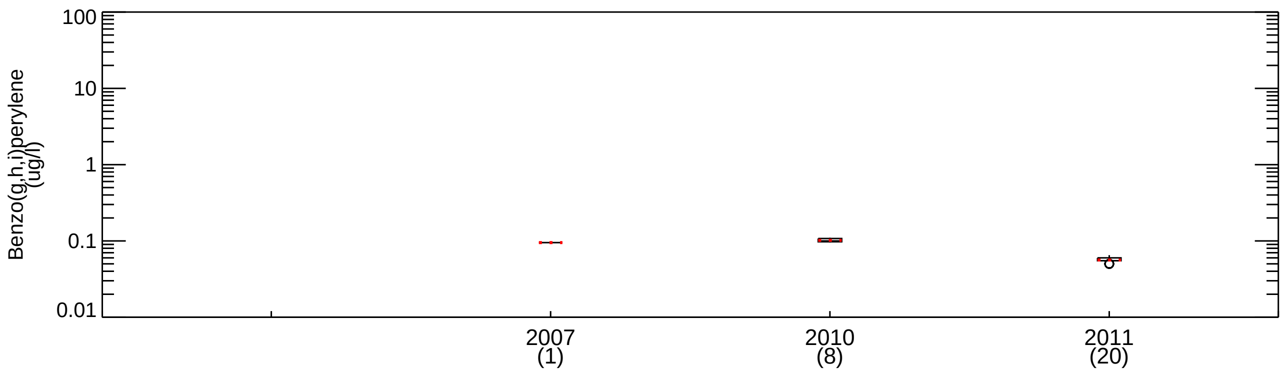
SMU 1/2/3



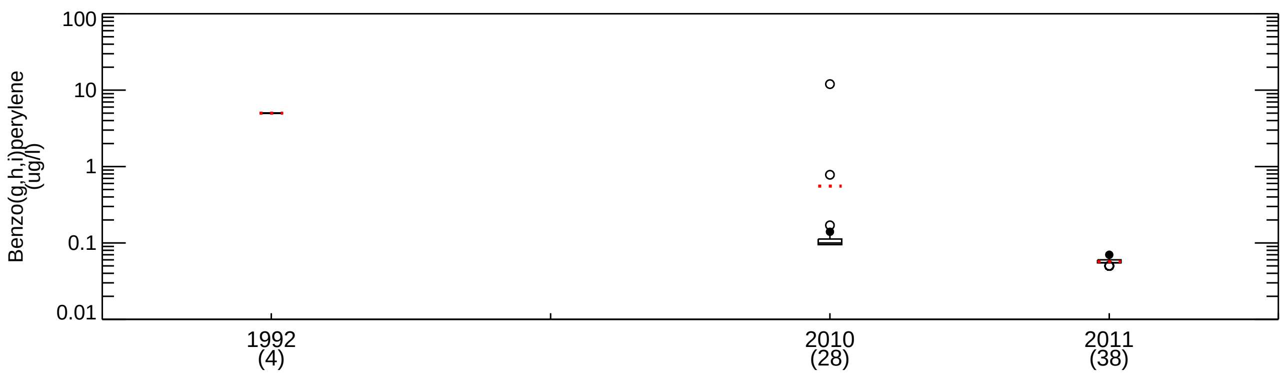
SMU 4



SMU 6/7



SMU 8



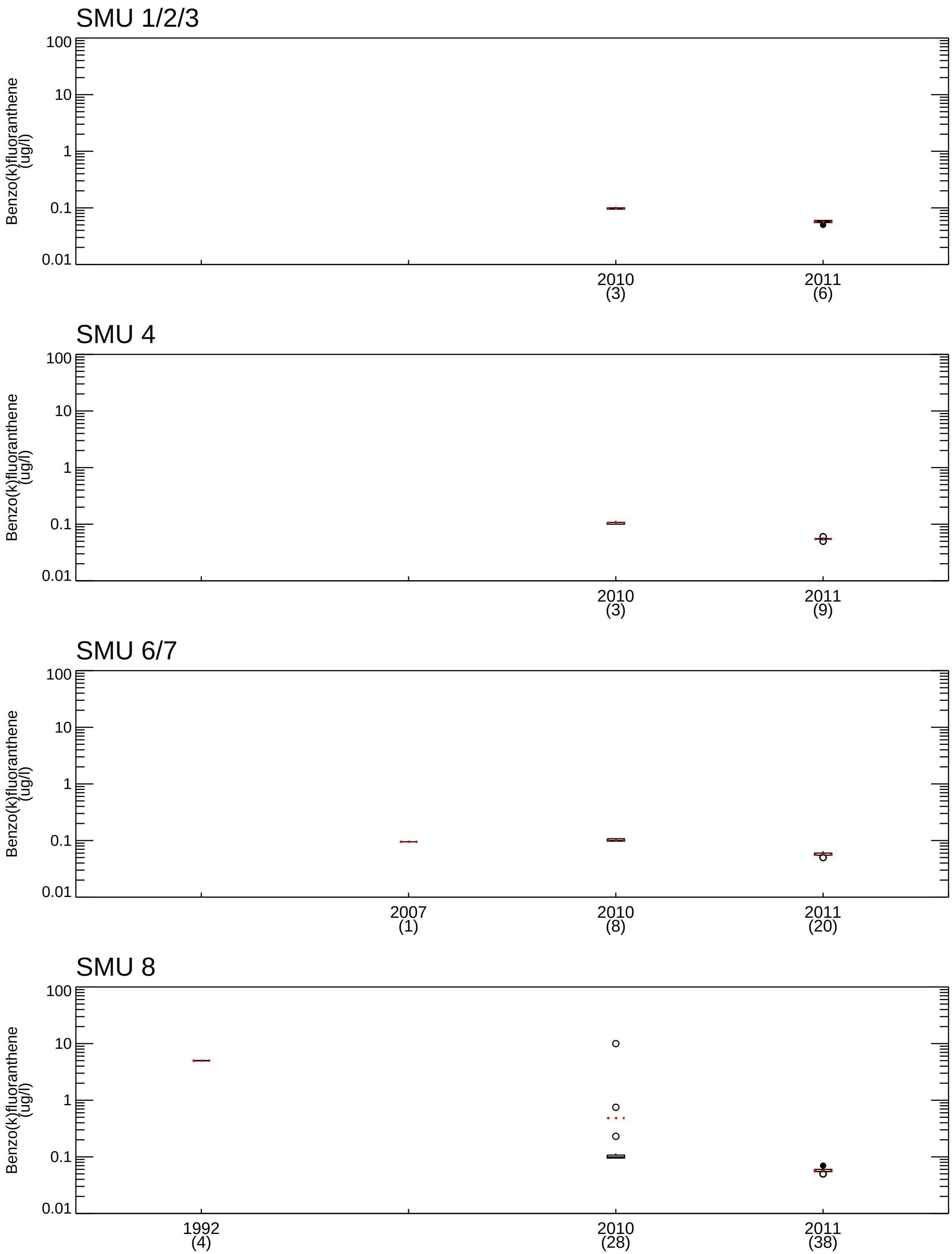
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Benzo(g,h,i)perylene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:45:33 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Benzo(k)fluoranthene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

ANCHOR QEA

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:01 2012

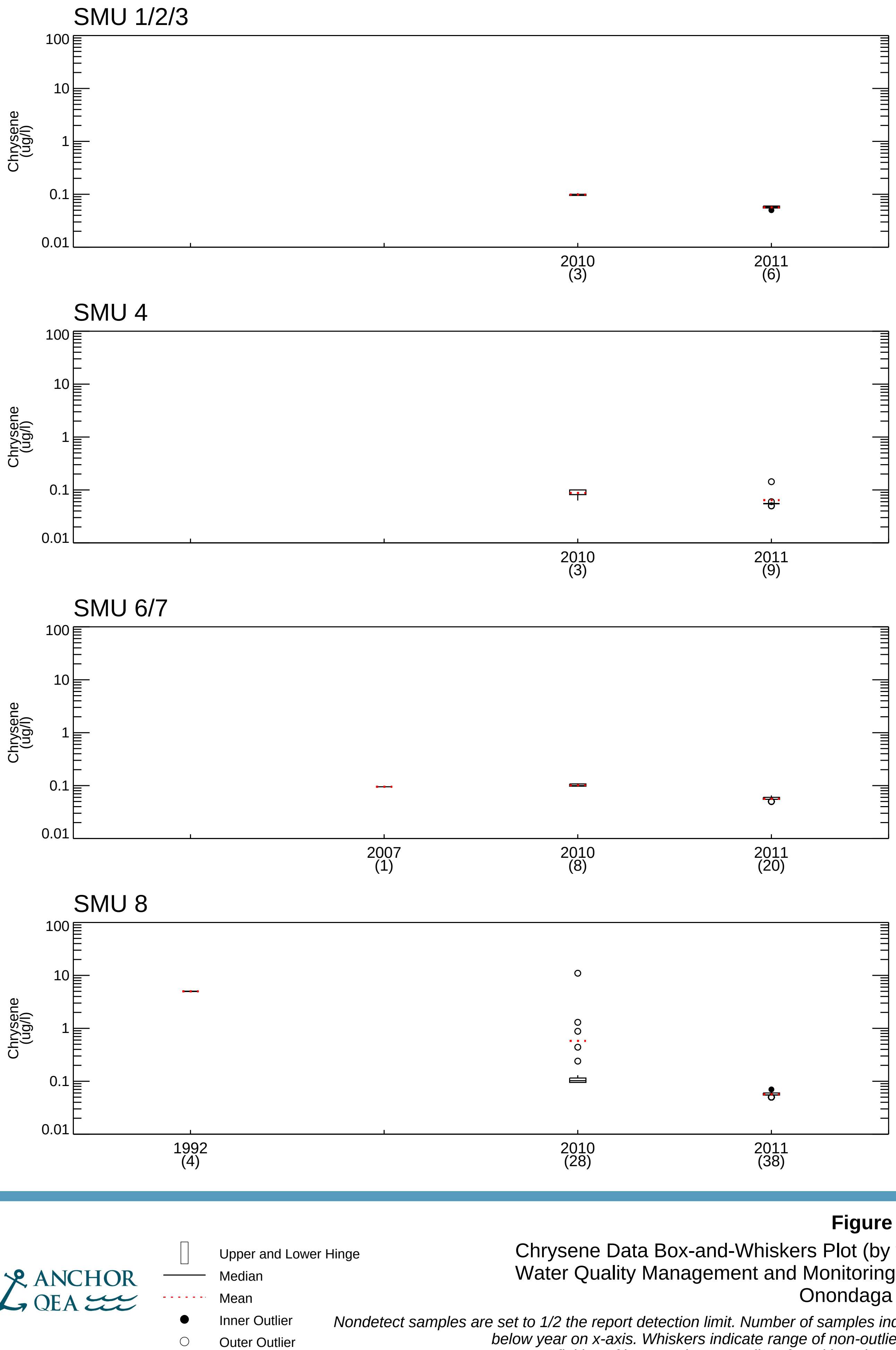


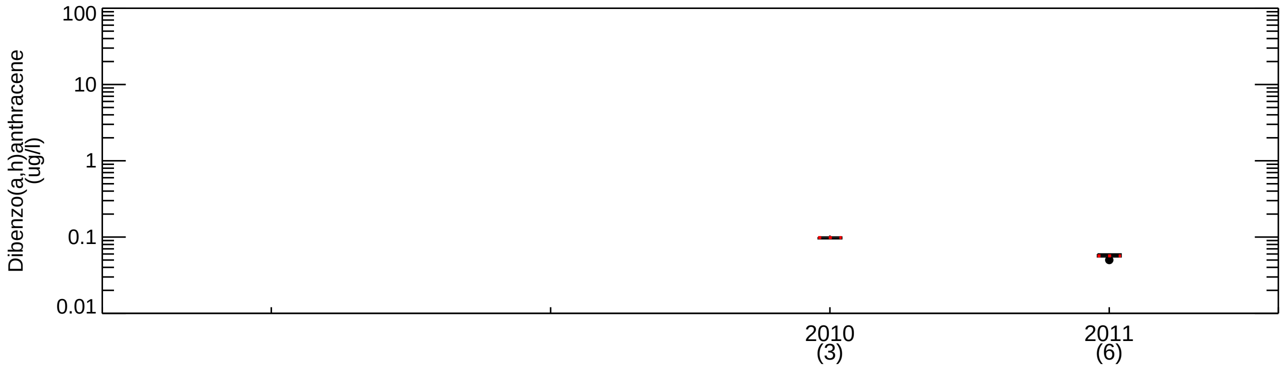
Figure B-11

Chrysene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

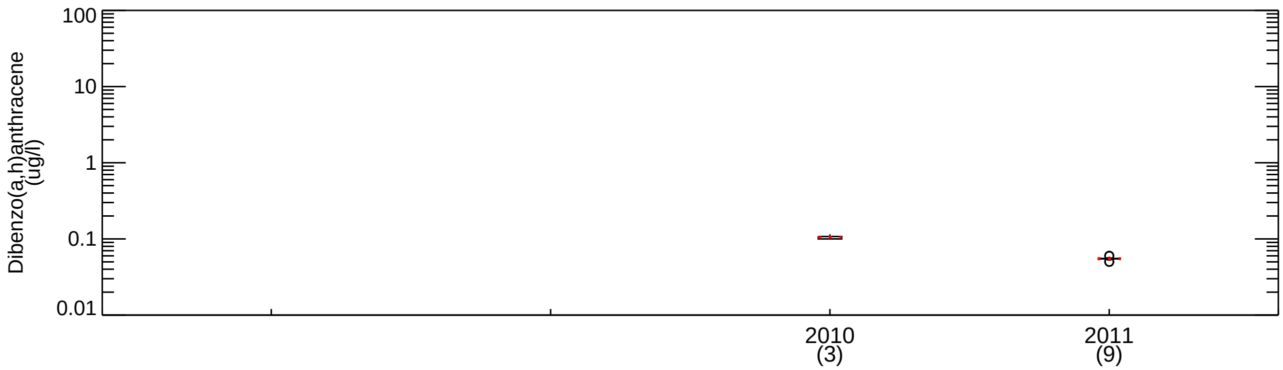
Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:08 2012

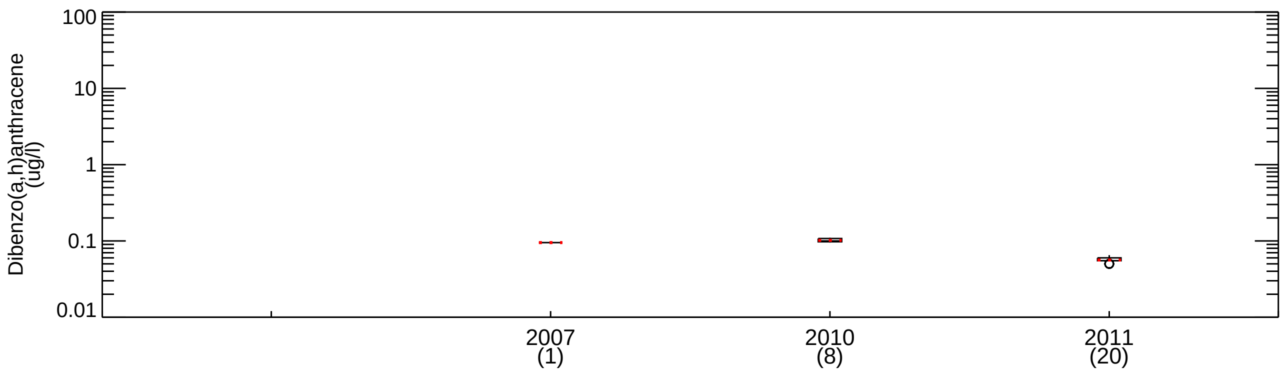
SMU 1/2/3



SMU 4



SMU 6/7



SMU 8

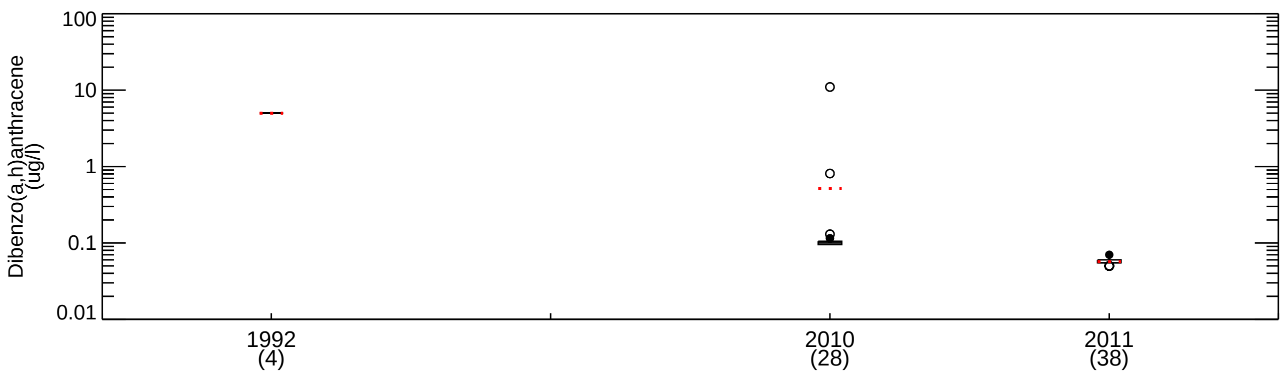
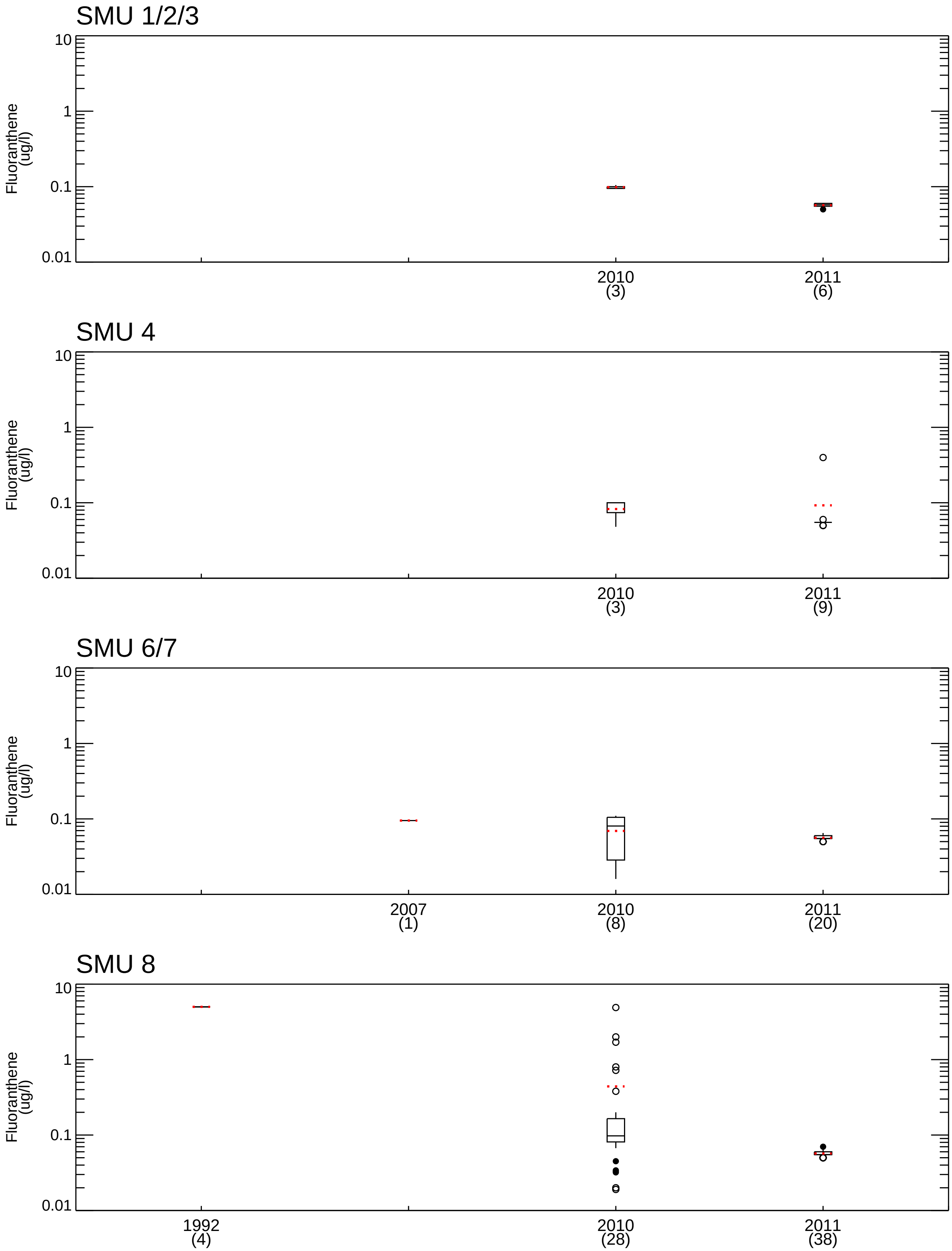


Figure B-11

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Dibenzo(a,h)anthracene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Fluoranthene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:15 2012

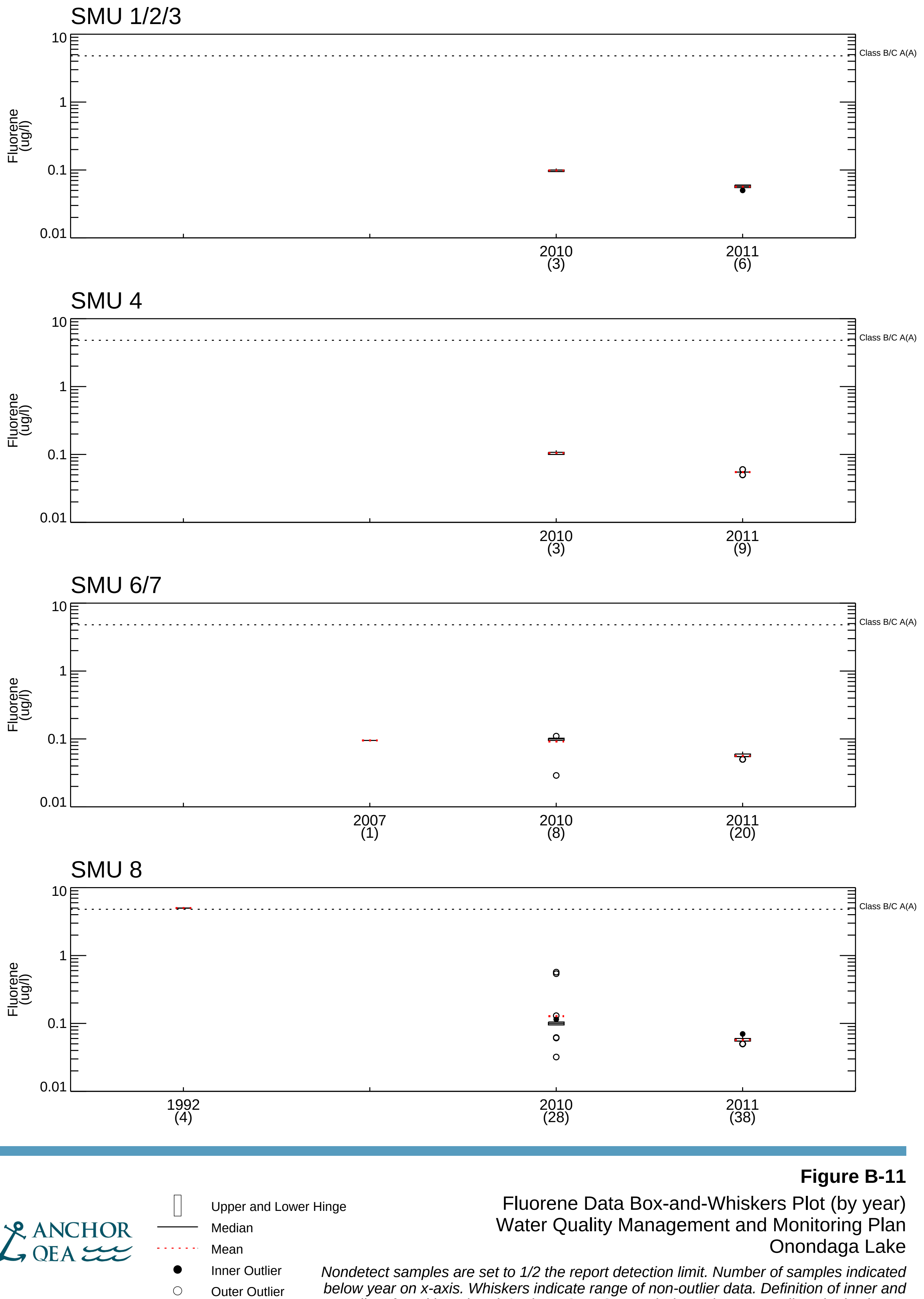
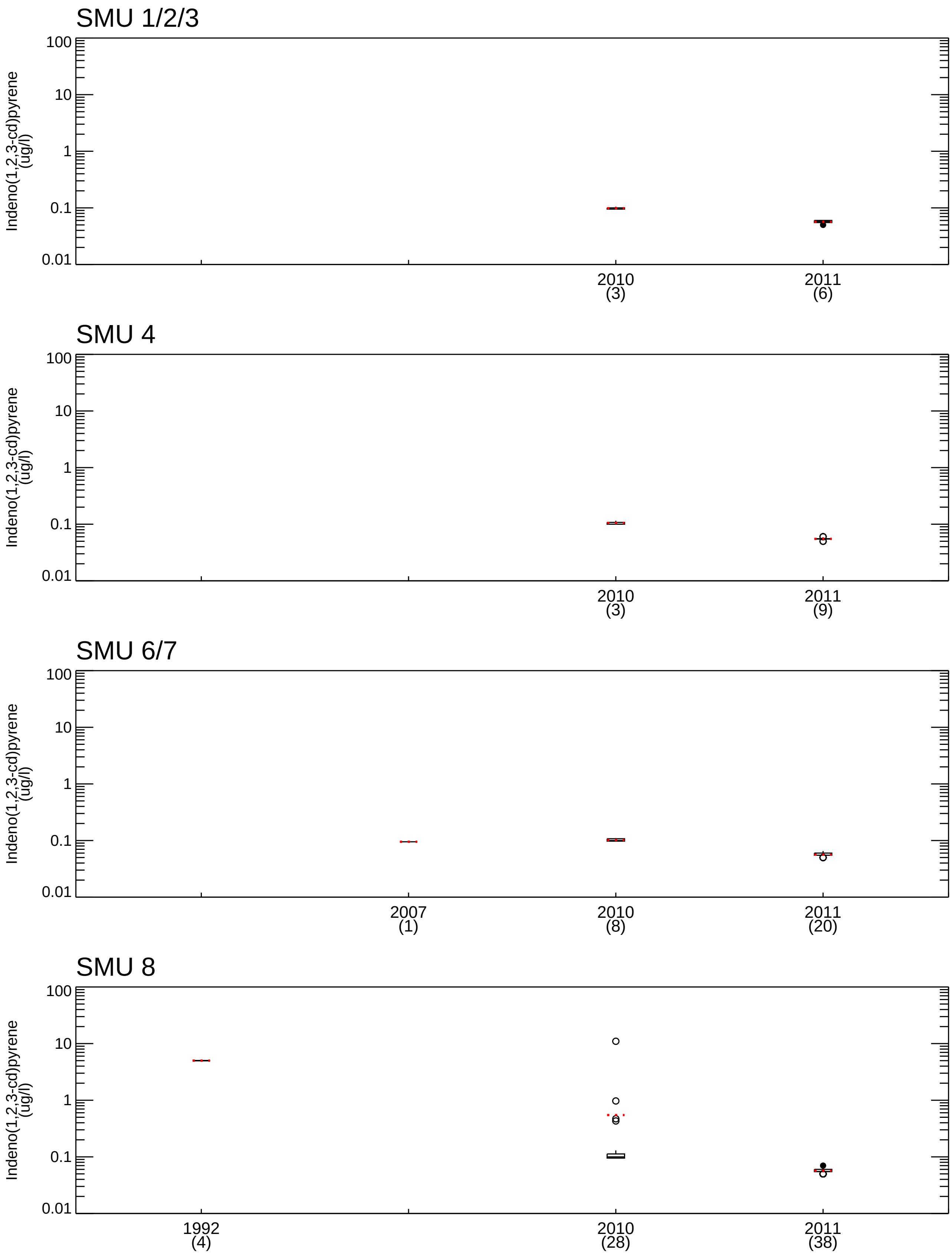


Figure B-11

Fluorene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:16 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Indeno(1,2,3-cd)pyrene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:27 2012

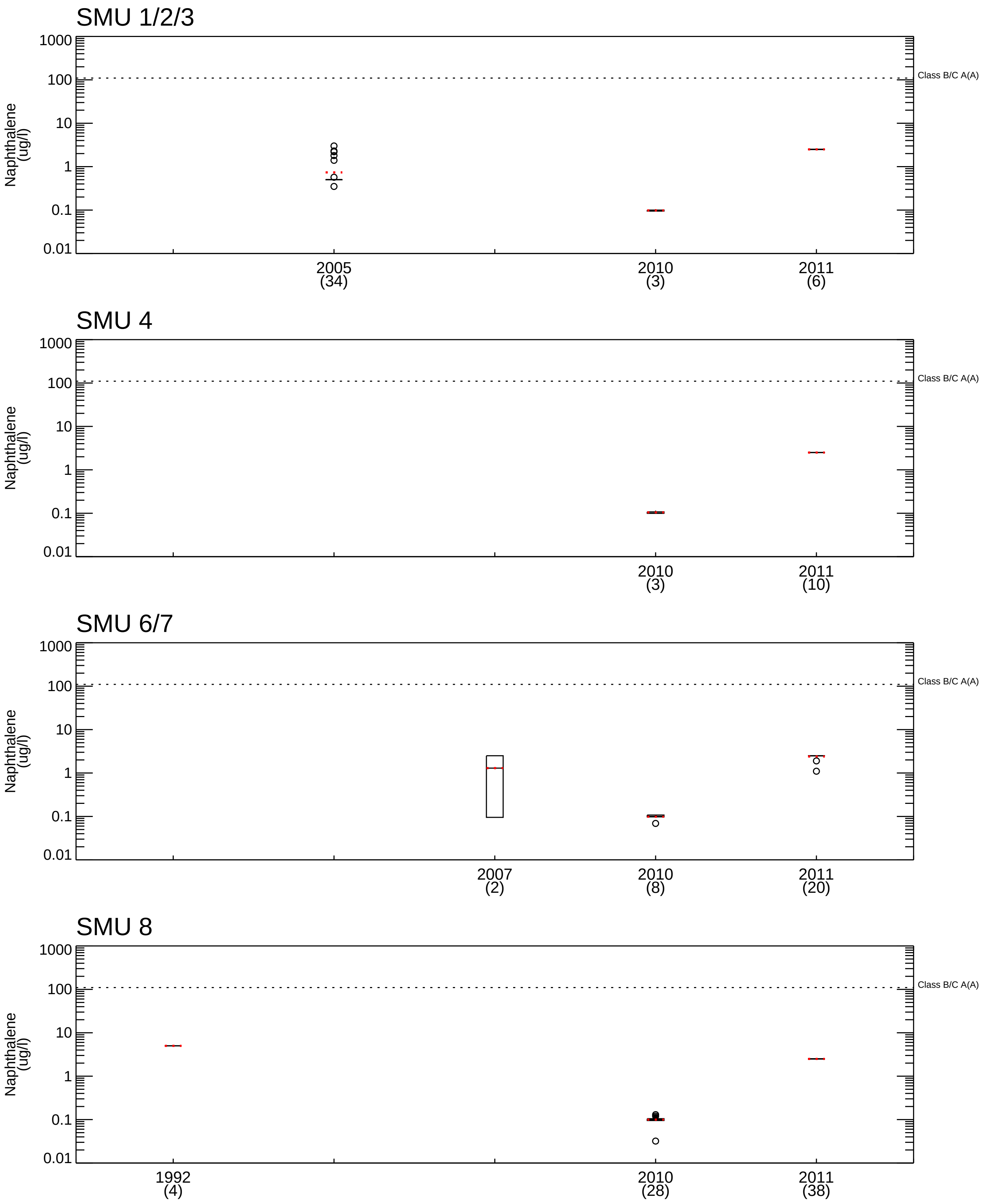
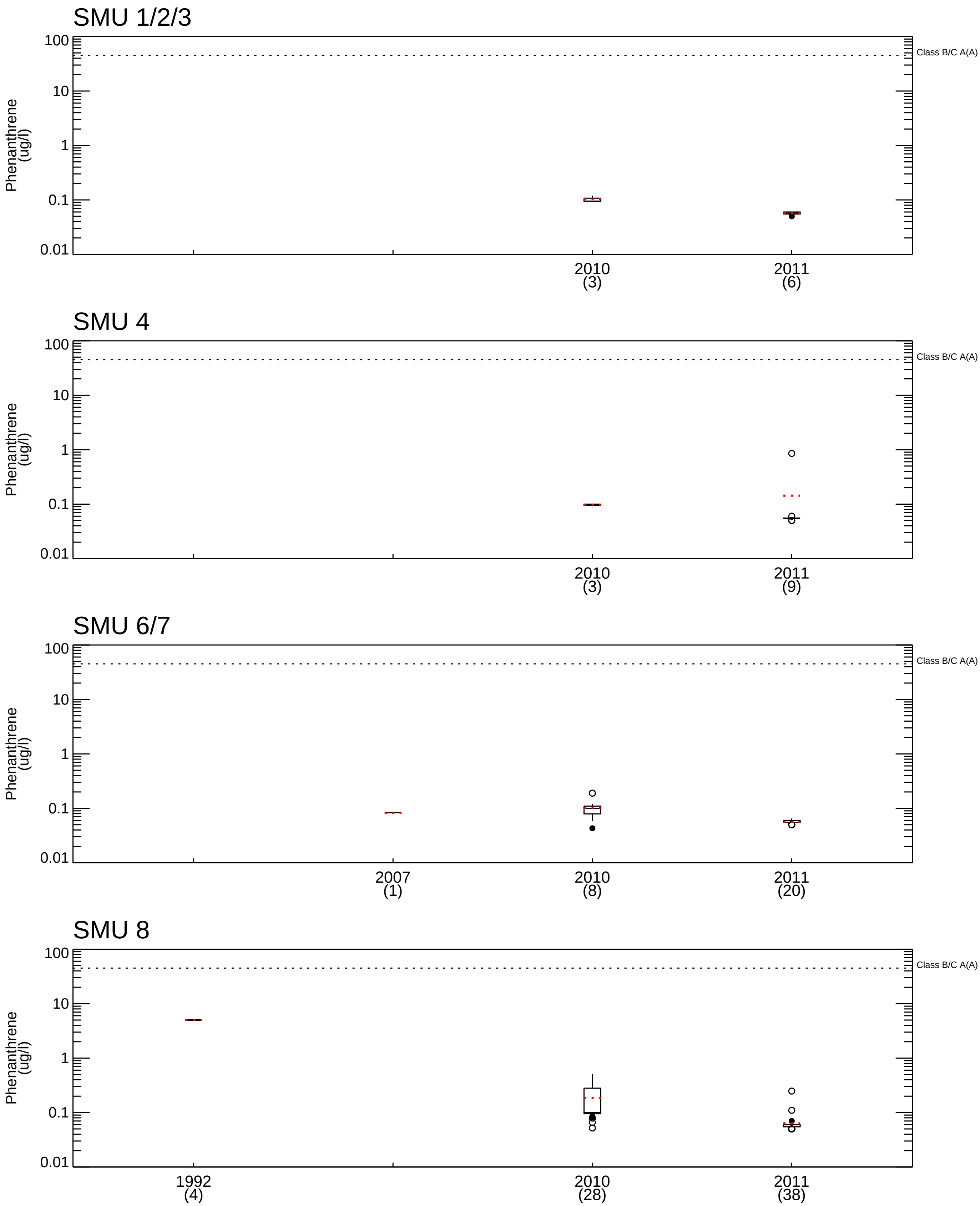


Figure B-11

Naphthalene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.



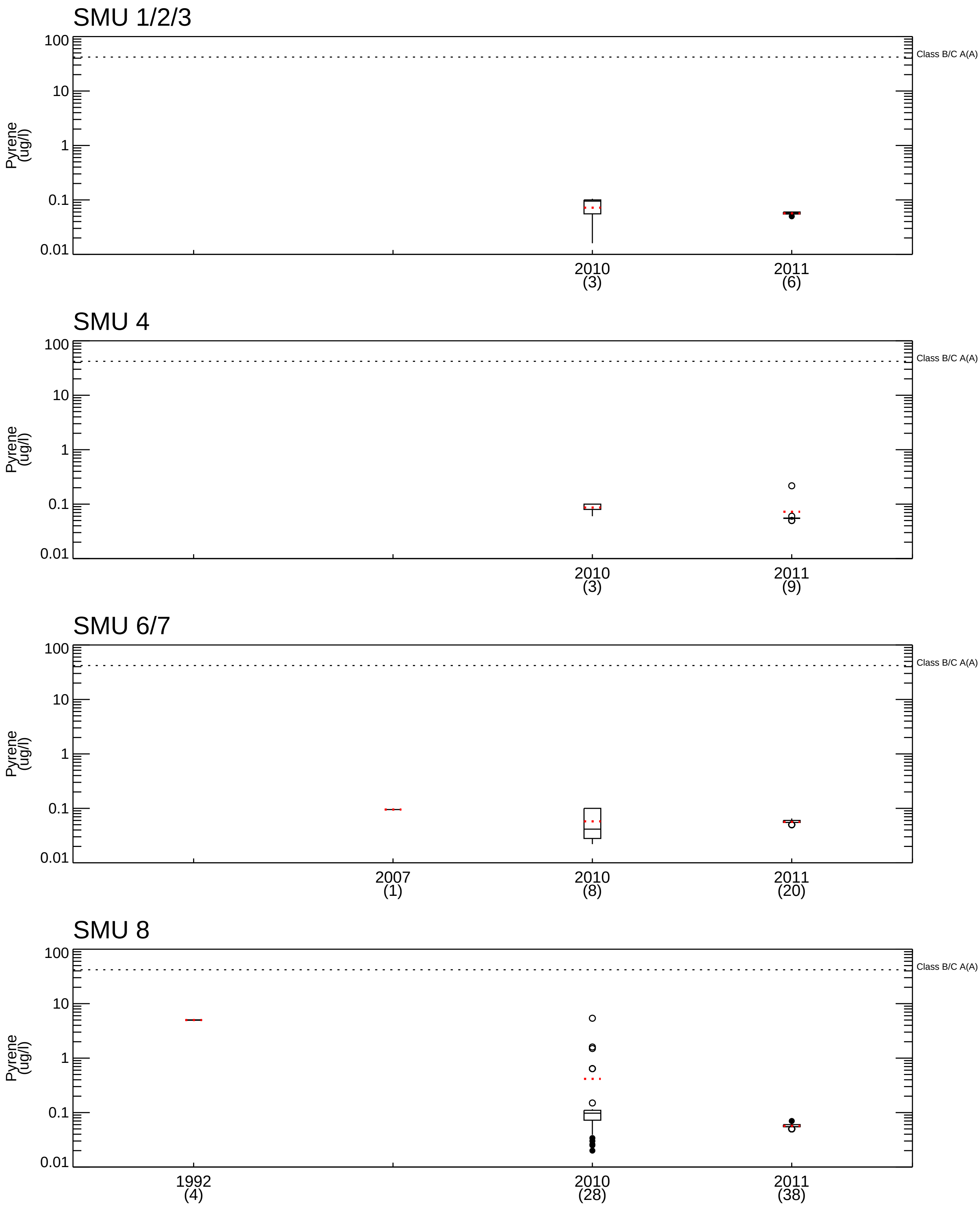
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Phenanthrene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:46 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

ANCHOR QEA

Figure B-11

Pyrene Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:46 2012

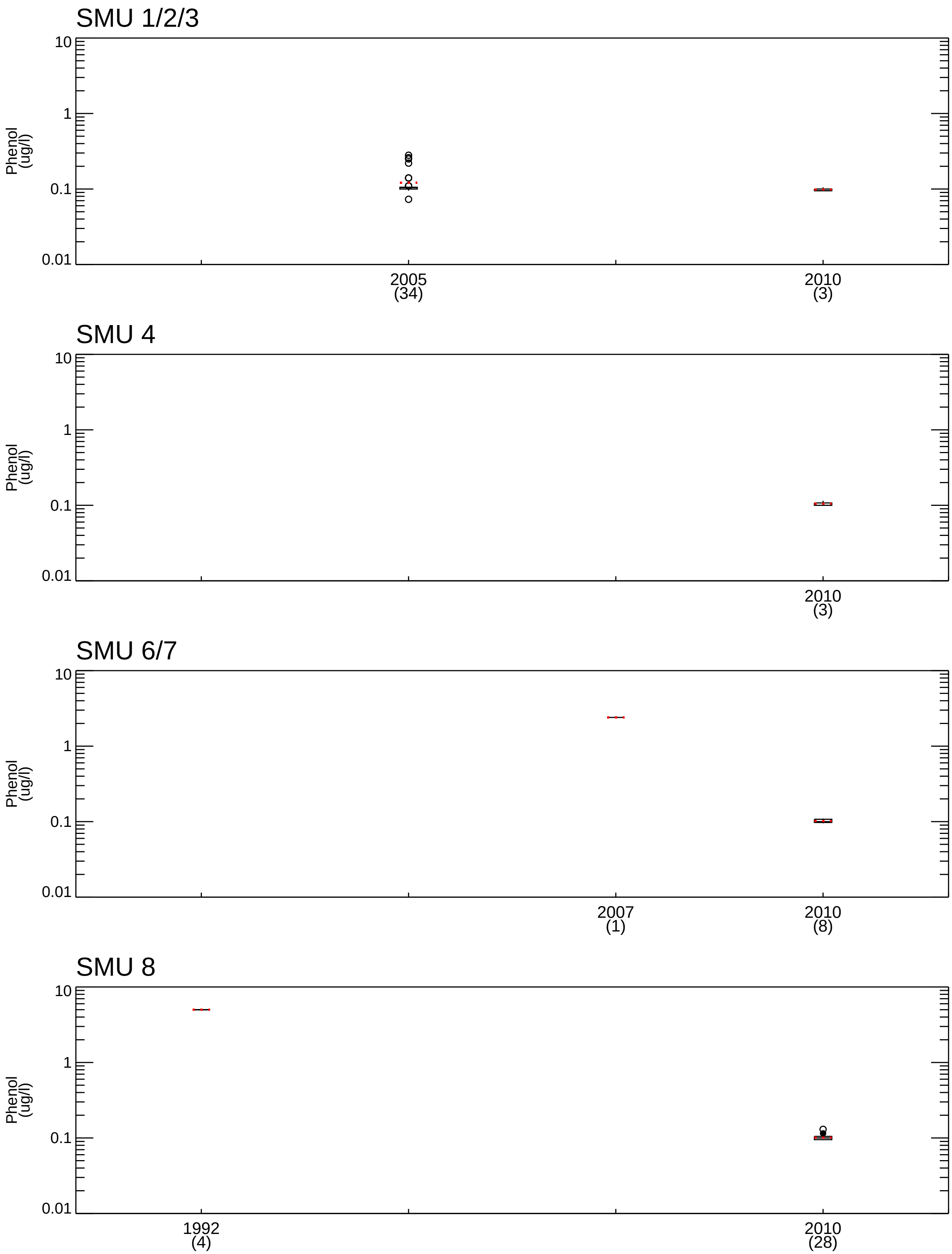


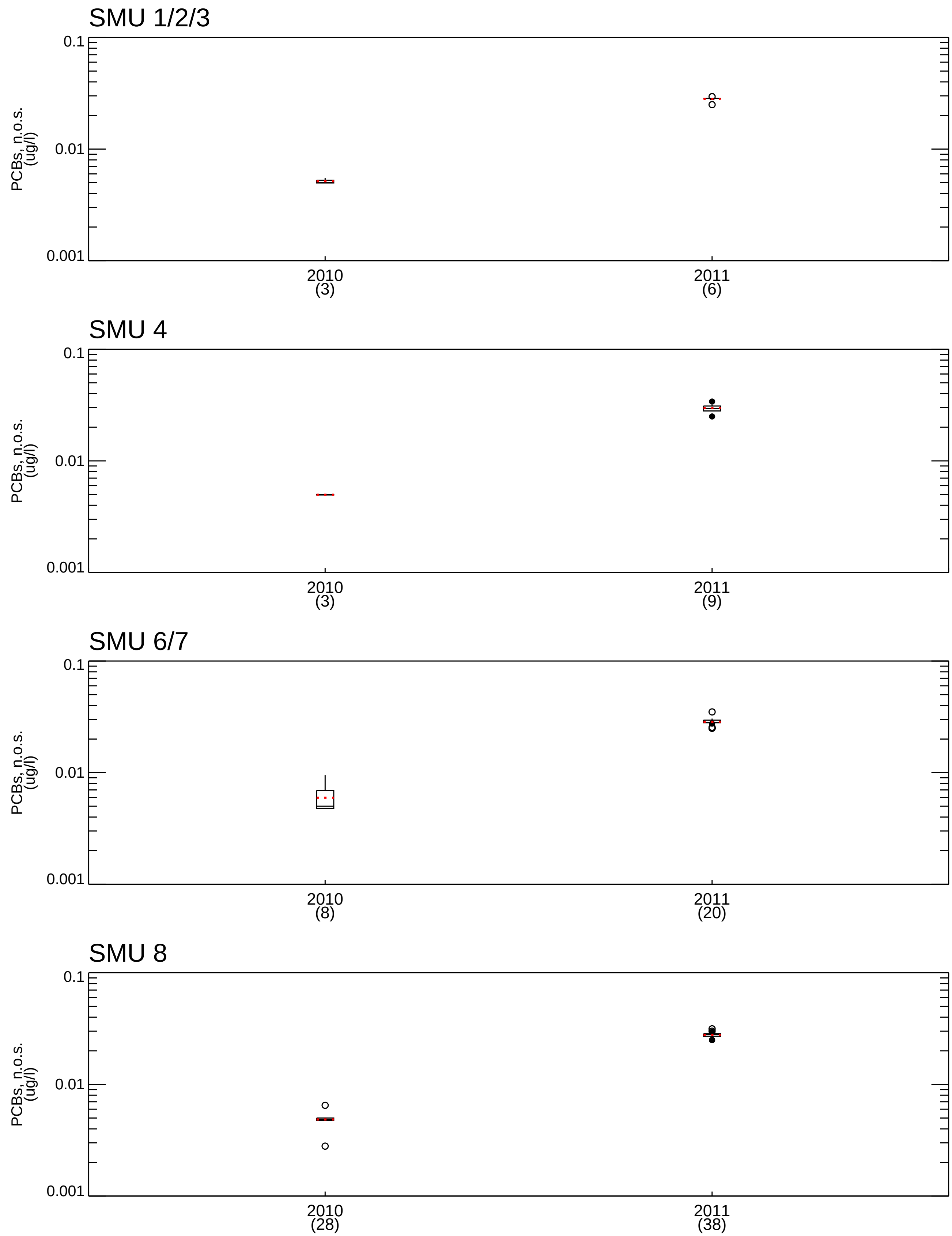
Figure B-11

Phenol Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:47 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

PCBs, n.o.s. Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:48 2012

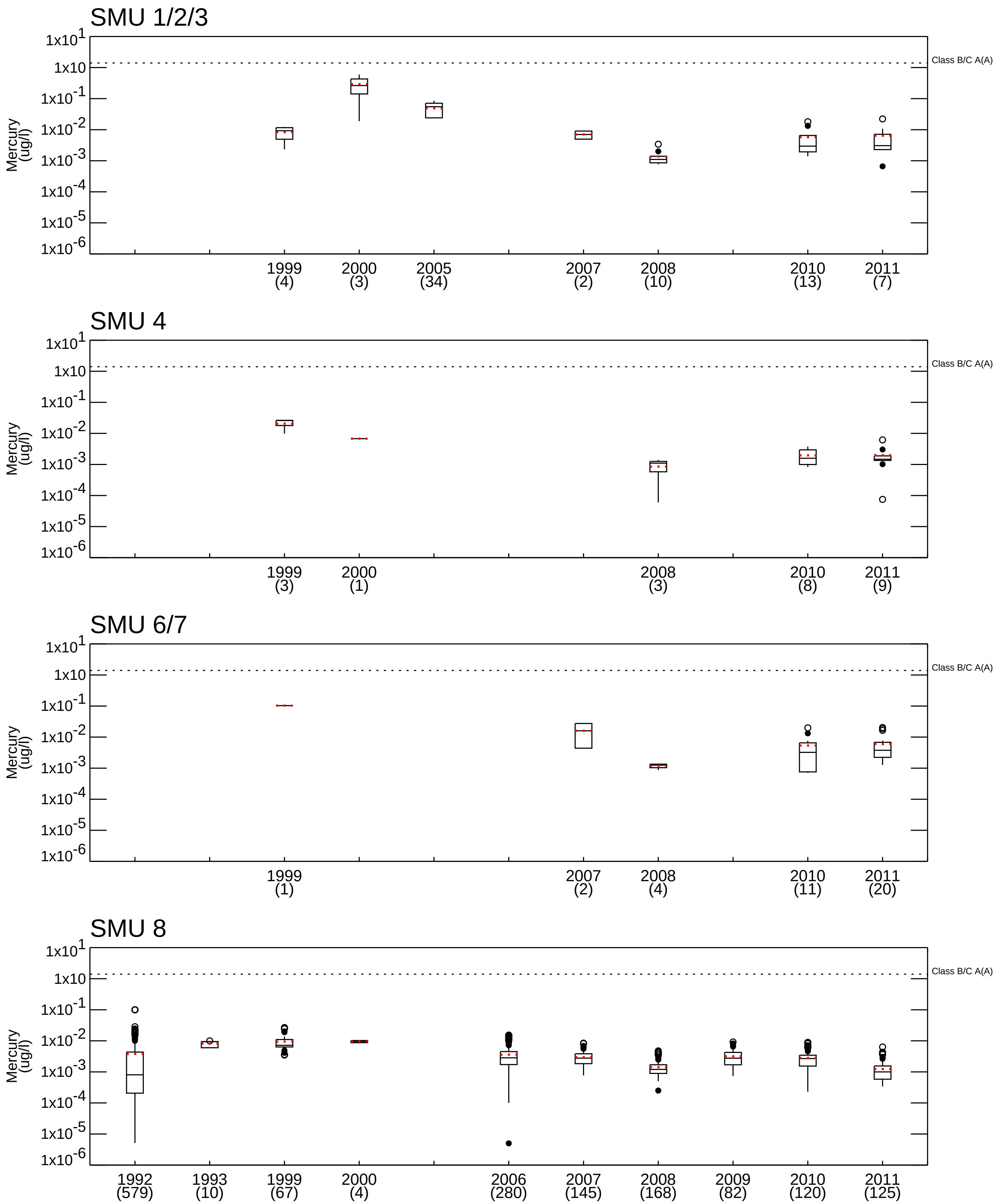
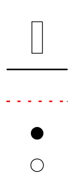


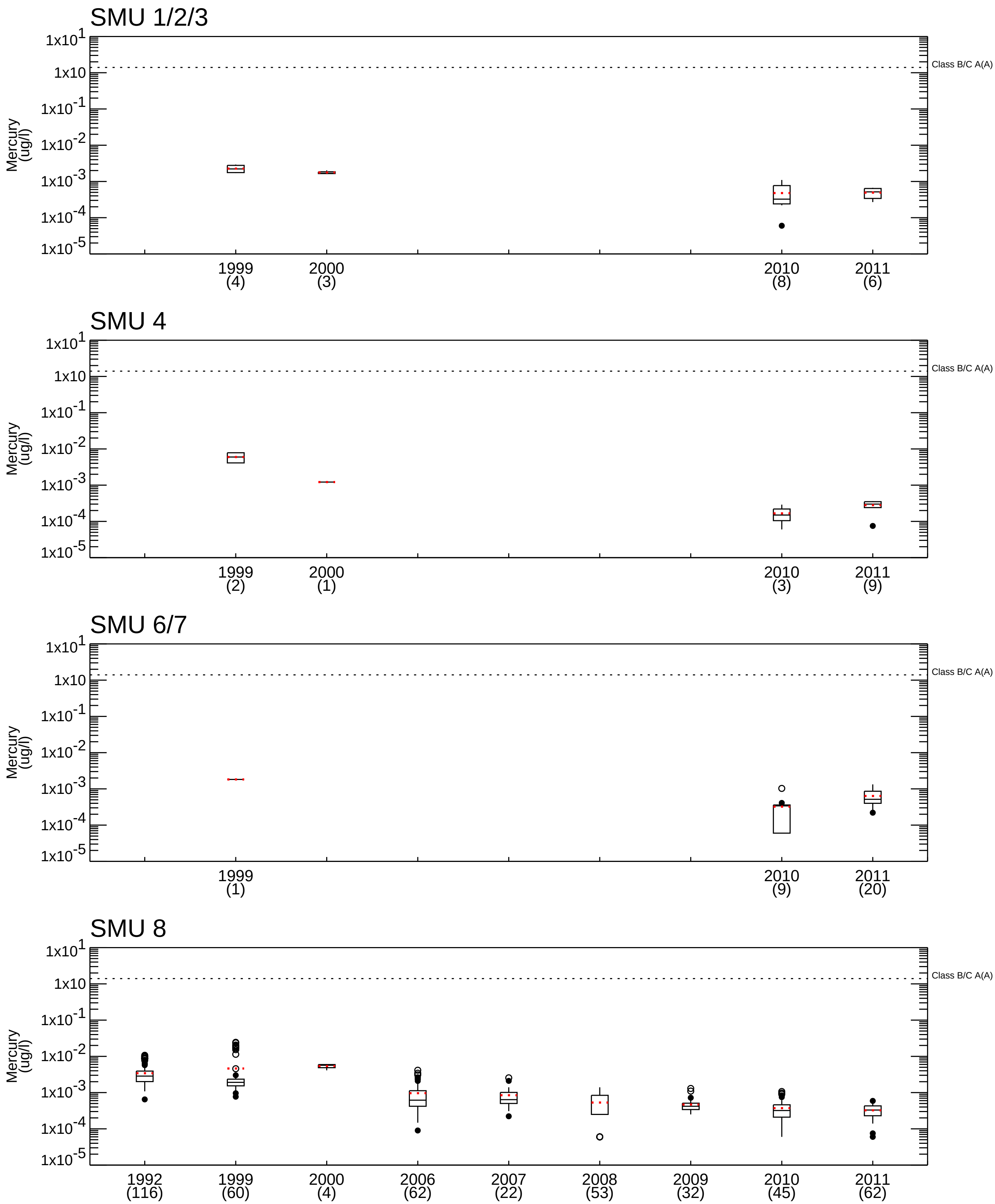
Figure B-11

Unfiltered Mercury Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake



Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:48 2012



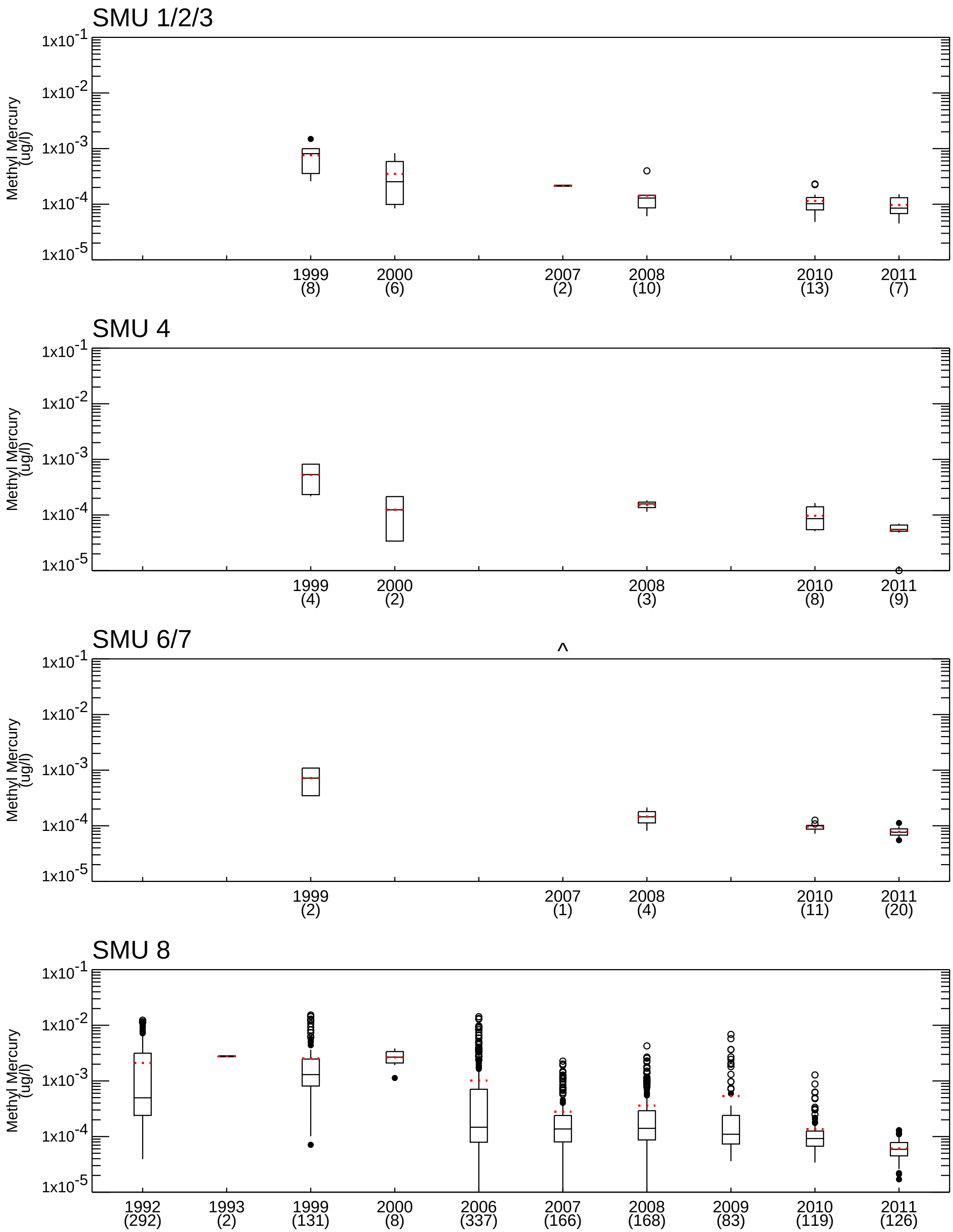
Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Filtered Mercury Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977). NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:49 2012



Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Figure B-11

Methyl Mercury Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:46:51 2012

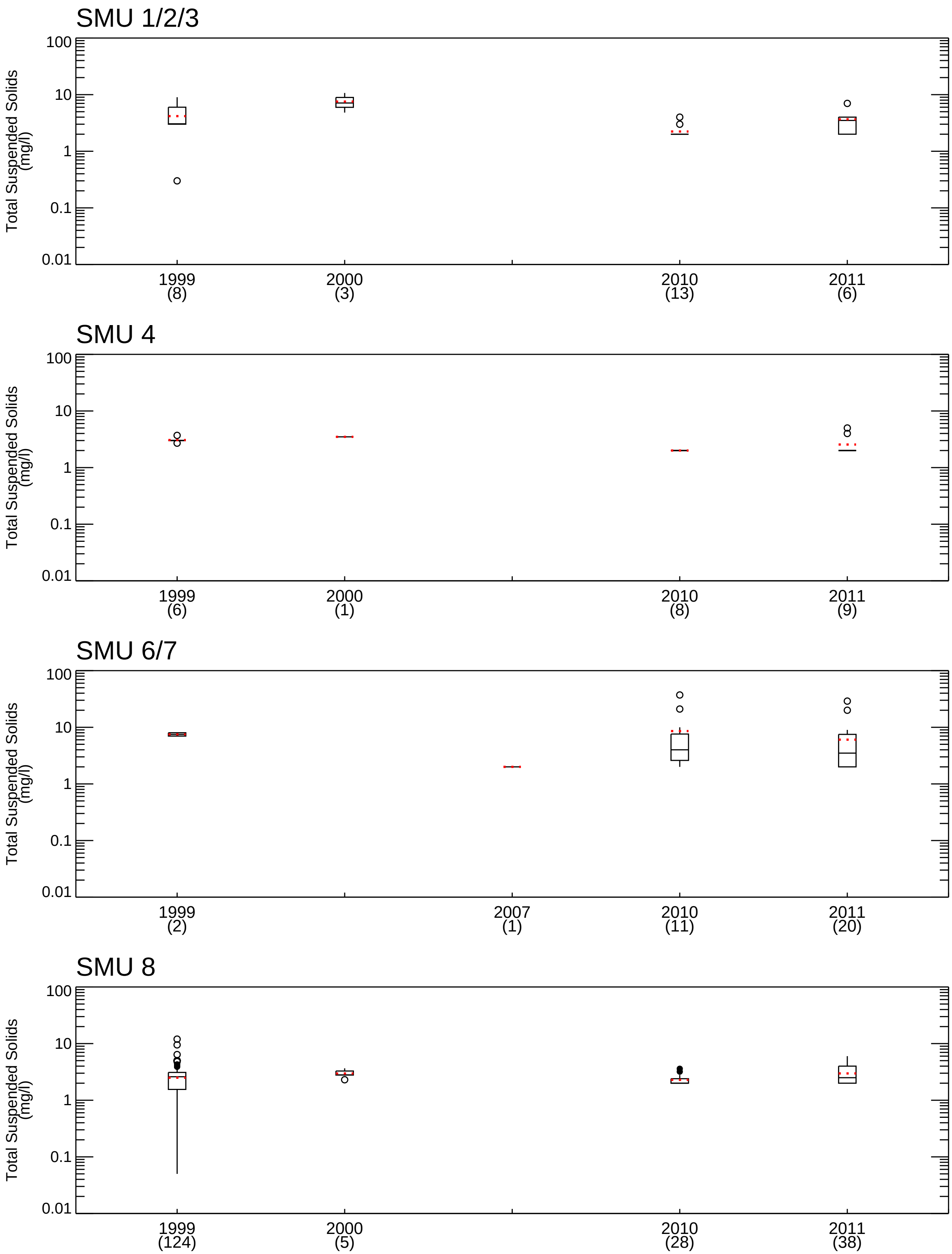


Figure B-11

Total Suspended Solids Data Box-and-Whiskers Plot (by year)
Water Quality Management and Monitoring Plan
Onondaga Lake

Upper and Lower Hinge
Median
Mean
Inner Outlier
Outer Outlier

Nondetect samples are set to 1/2 the report detection limit. Number of samples indicated below year on x-axis. Whiskers indicate range of non-outlier data. Definition of inner and outer outliers found in Tukey (1977).

ANCHOR QEA

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_boxwhiskers_chem_by_SMU.pro Wed Apr 18 12:47:15 2012

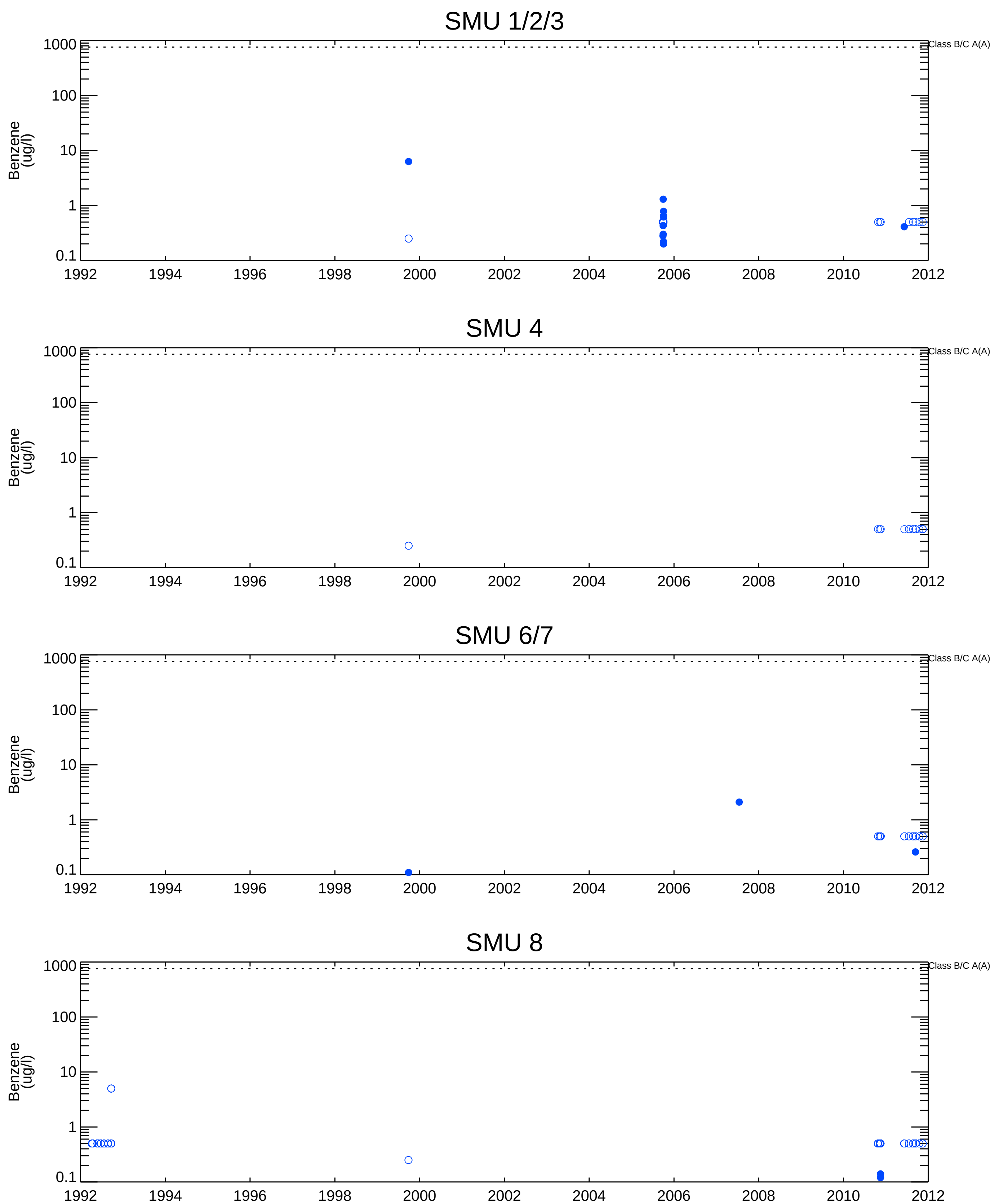


Figure B-12

Benzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

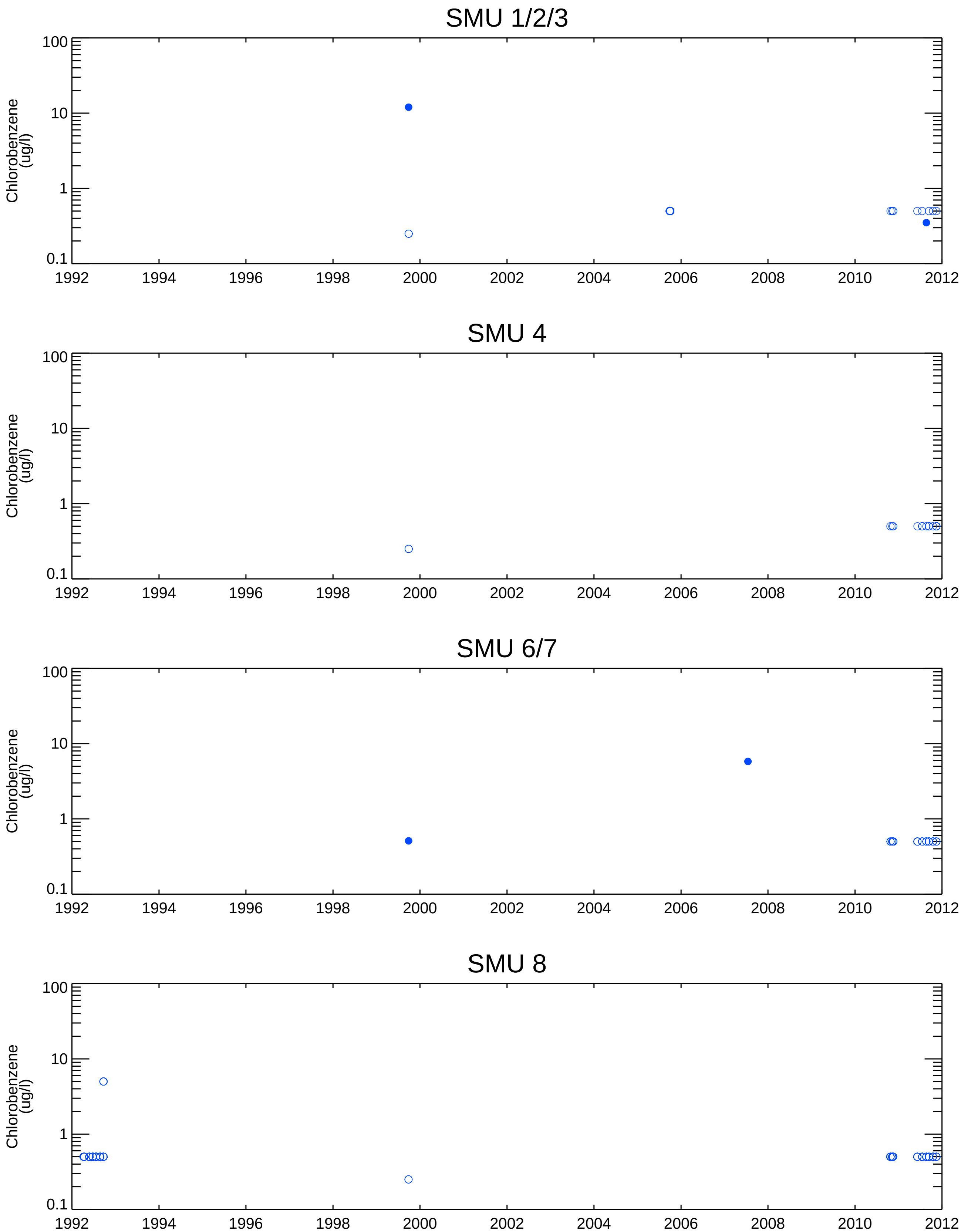


Figure B-12

Chlorobenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

ANCHOR QEA

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:29 2012

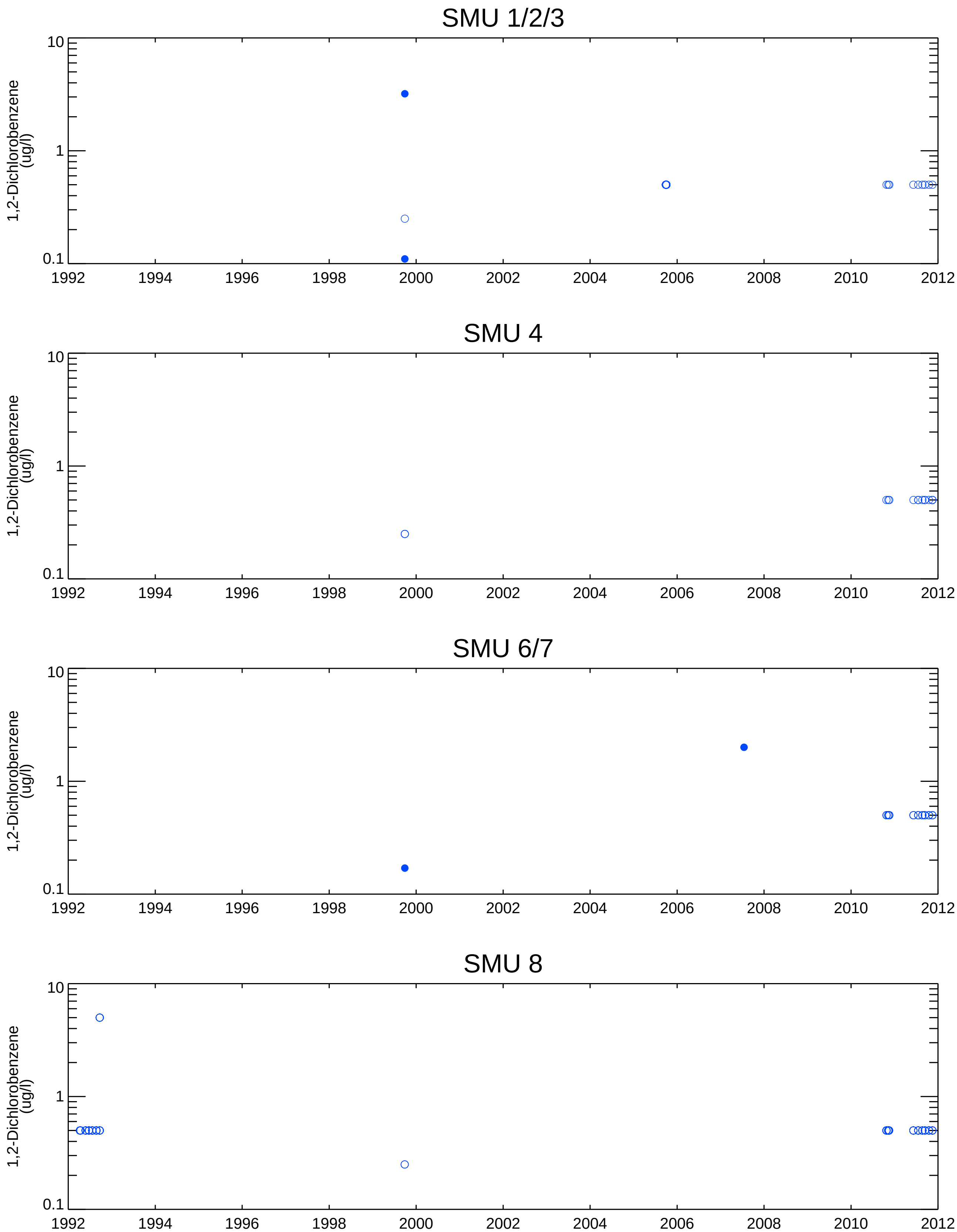


Figure B-12

1,2-Dichlorobenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

ANCHOR QEA

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:30 2012

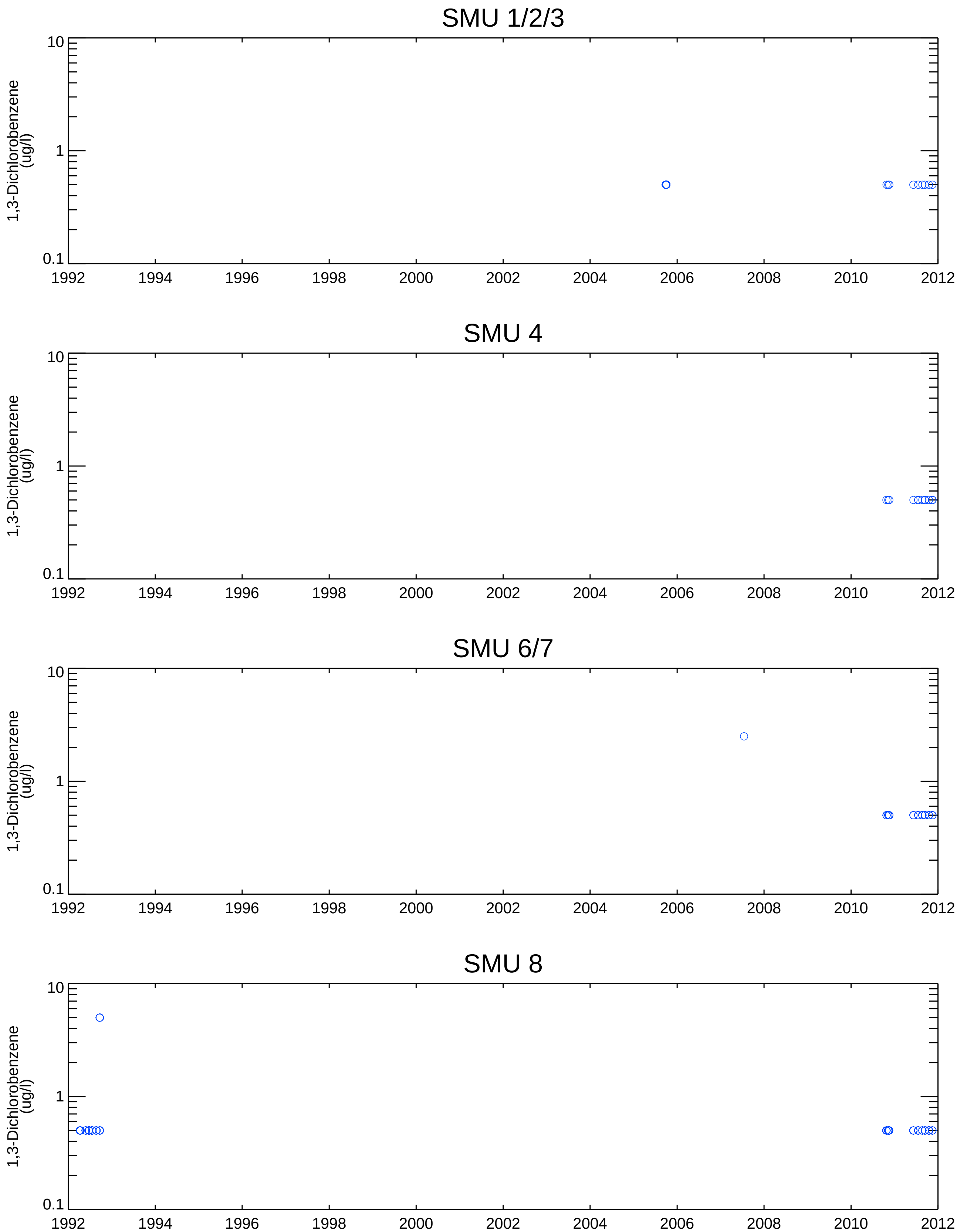


Figure B-12

1,3-Dichlorobenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:31 2012

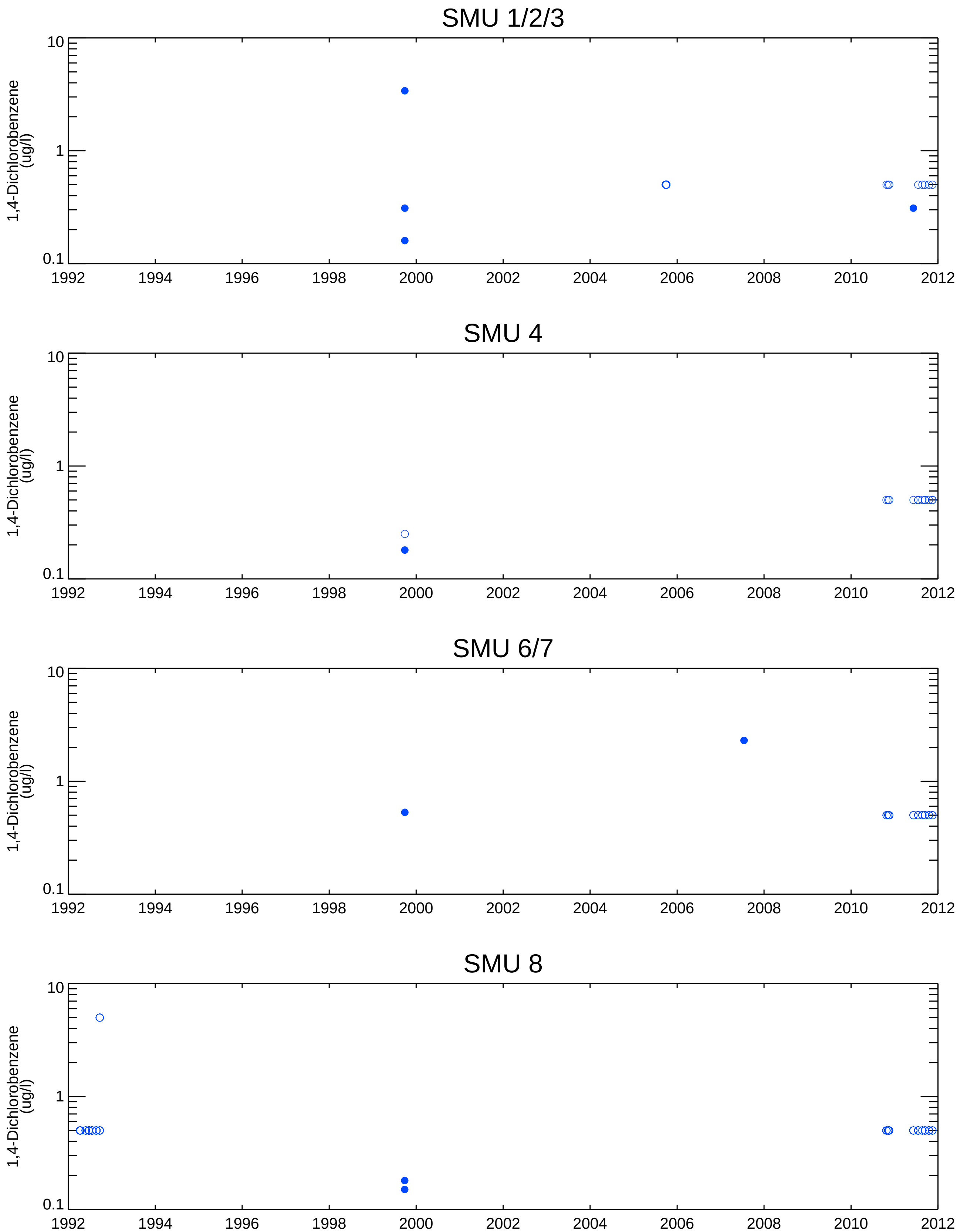


Figure B-12

1,4-Dichlorobenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

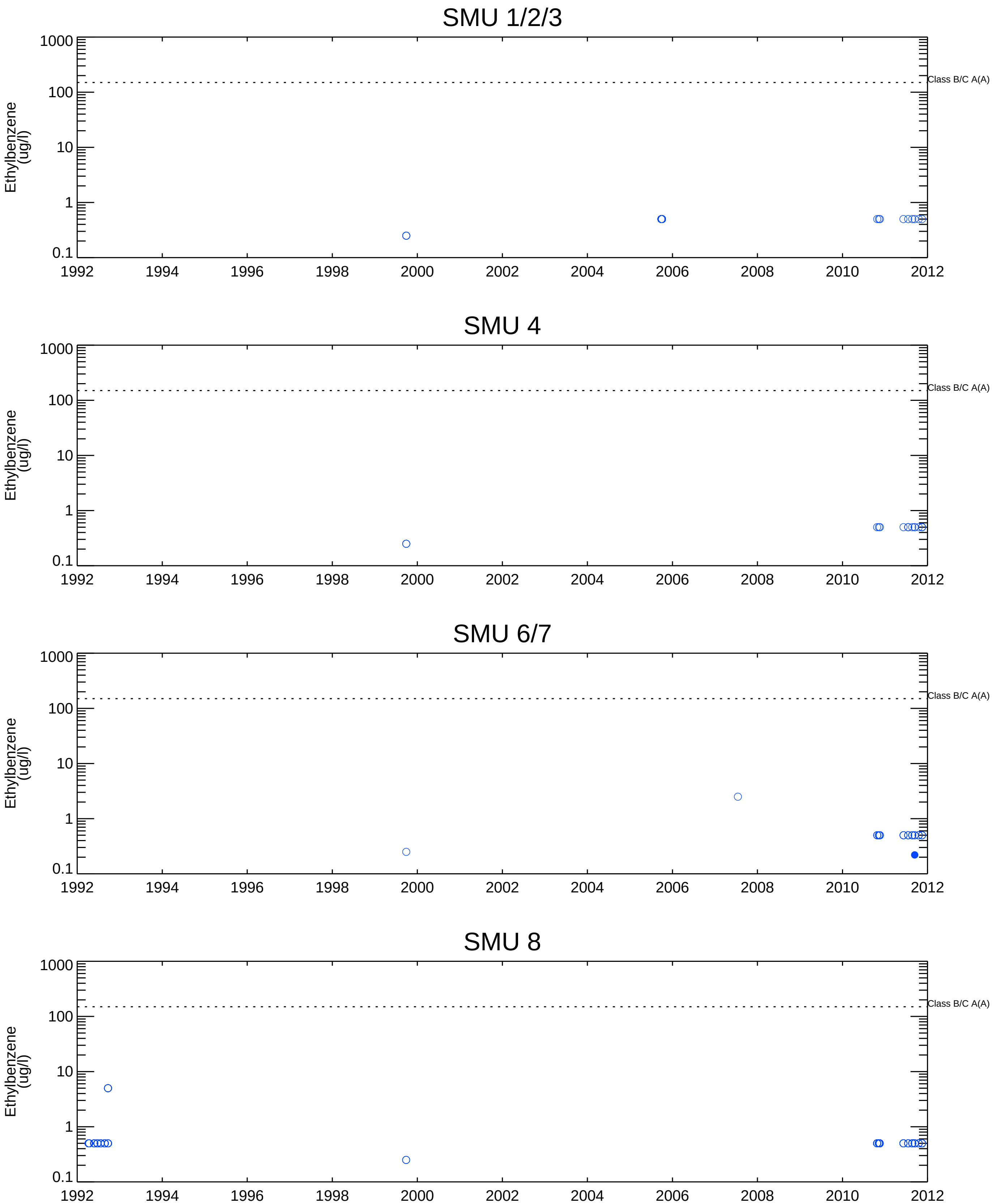


Figure B-12

Ethylbenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

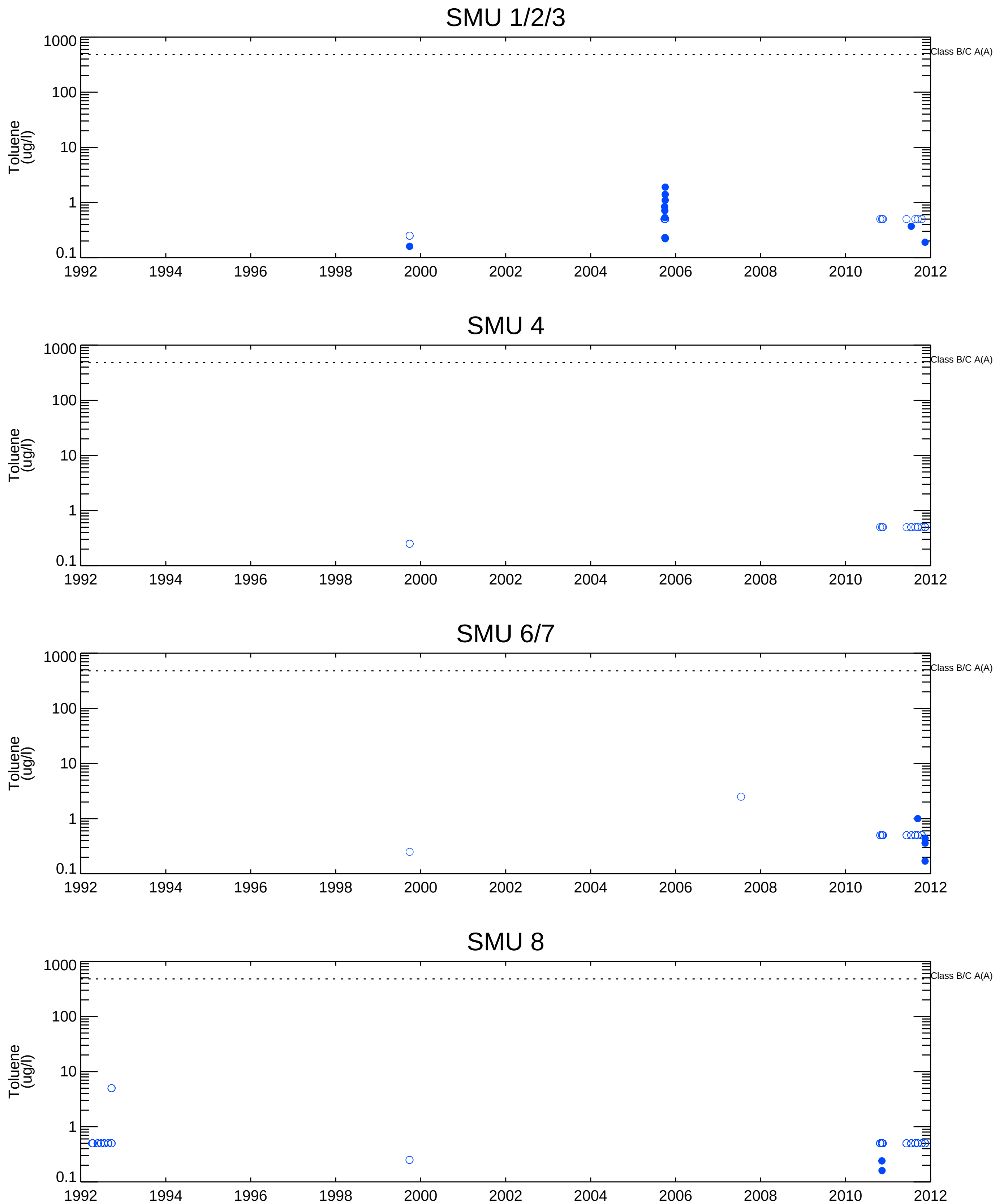


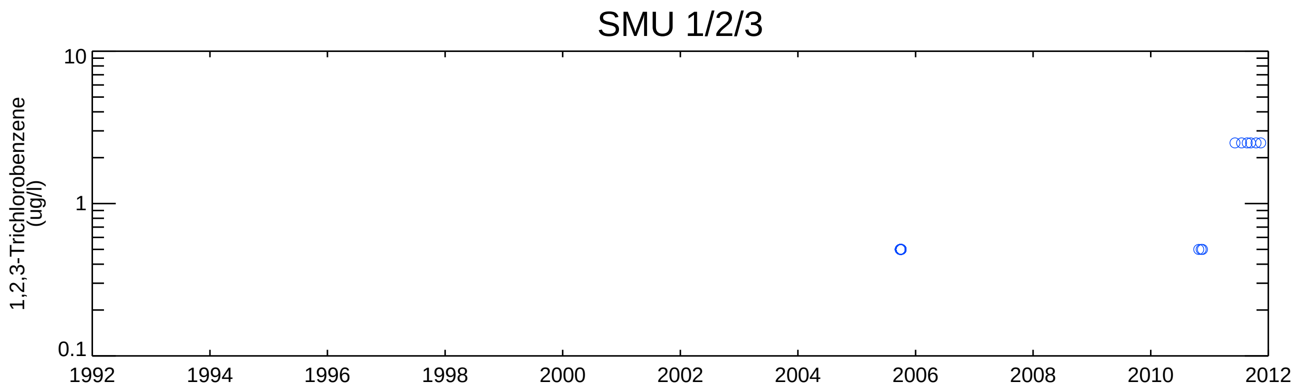
Figure B-12

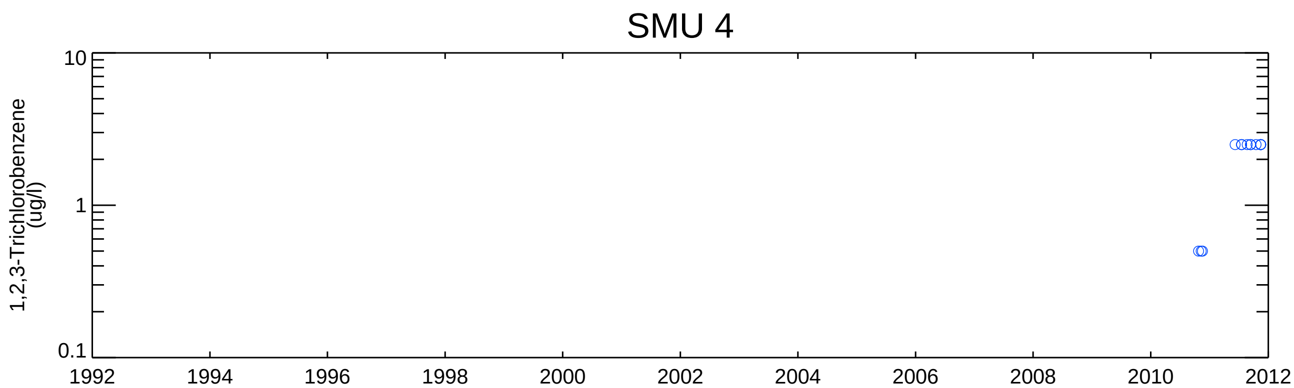
Toluene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

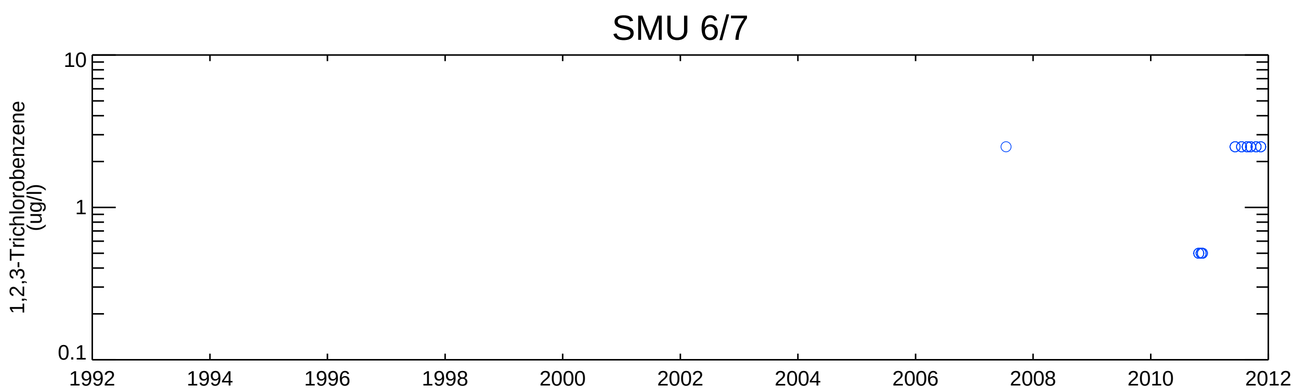
ANCHOR QEA

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:51 2012







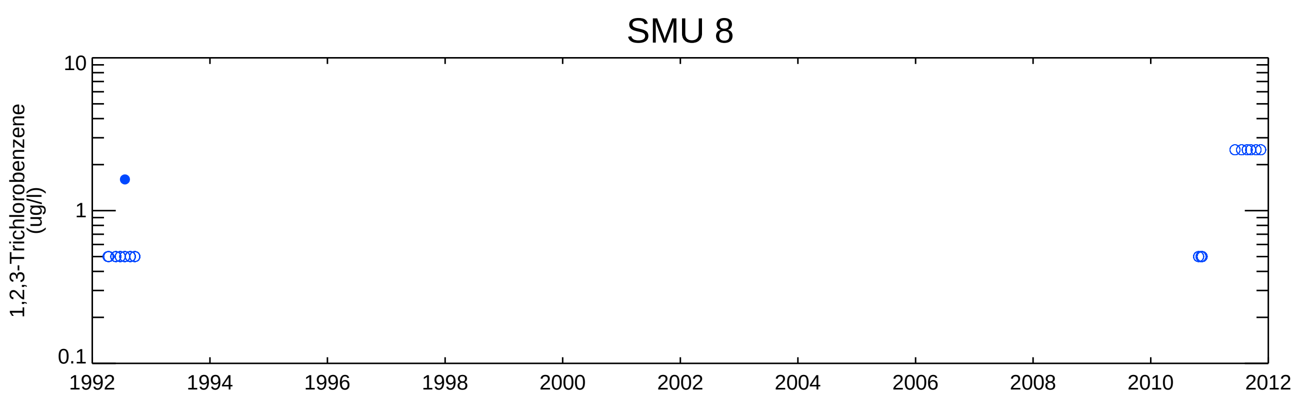


Figure B-12

1,2,3-Trichlorobenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

ANCHOR QEA

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:51 2012

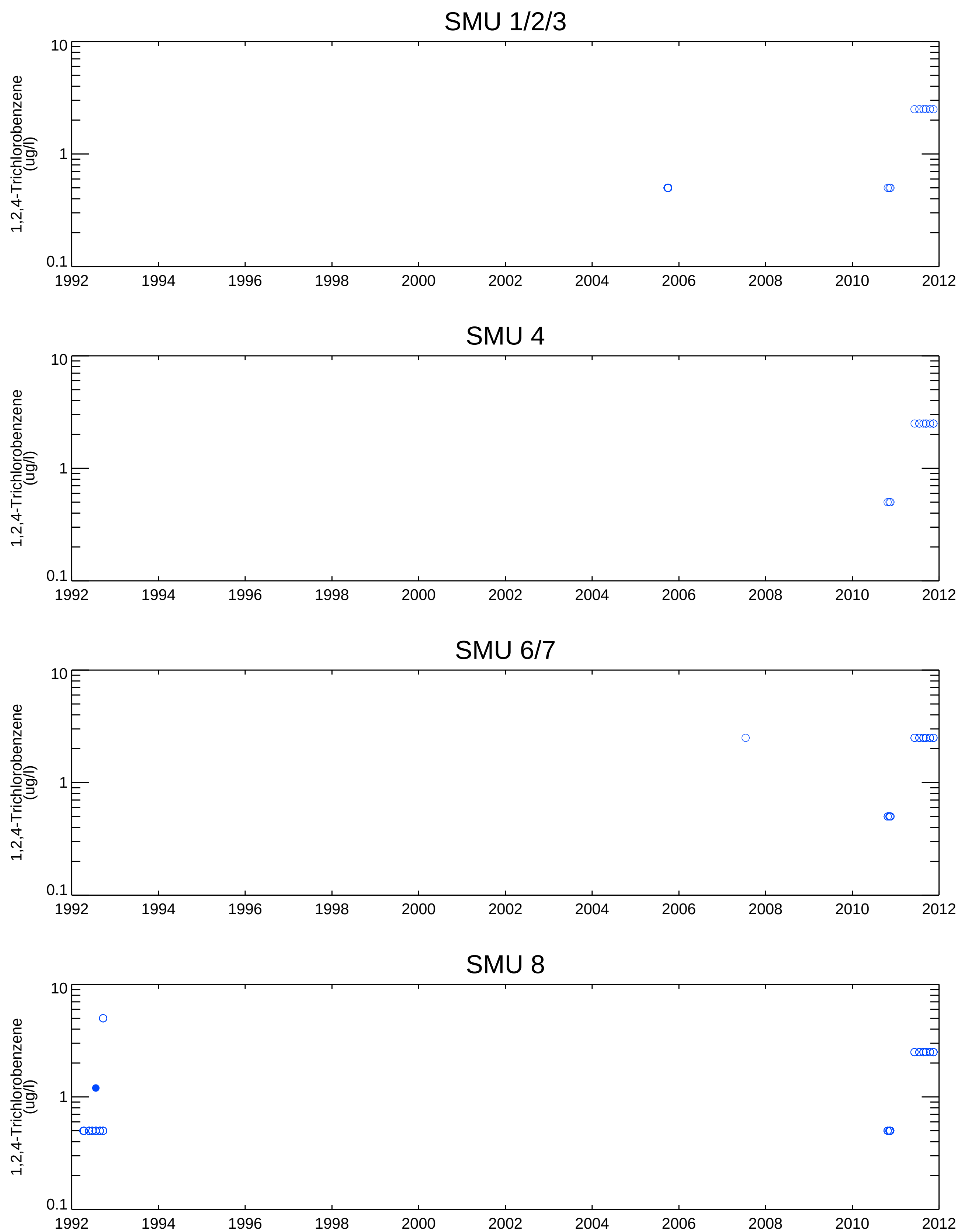


Figure B-12

1,2,4-Trichlorobenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

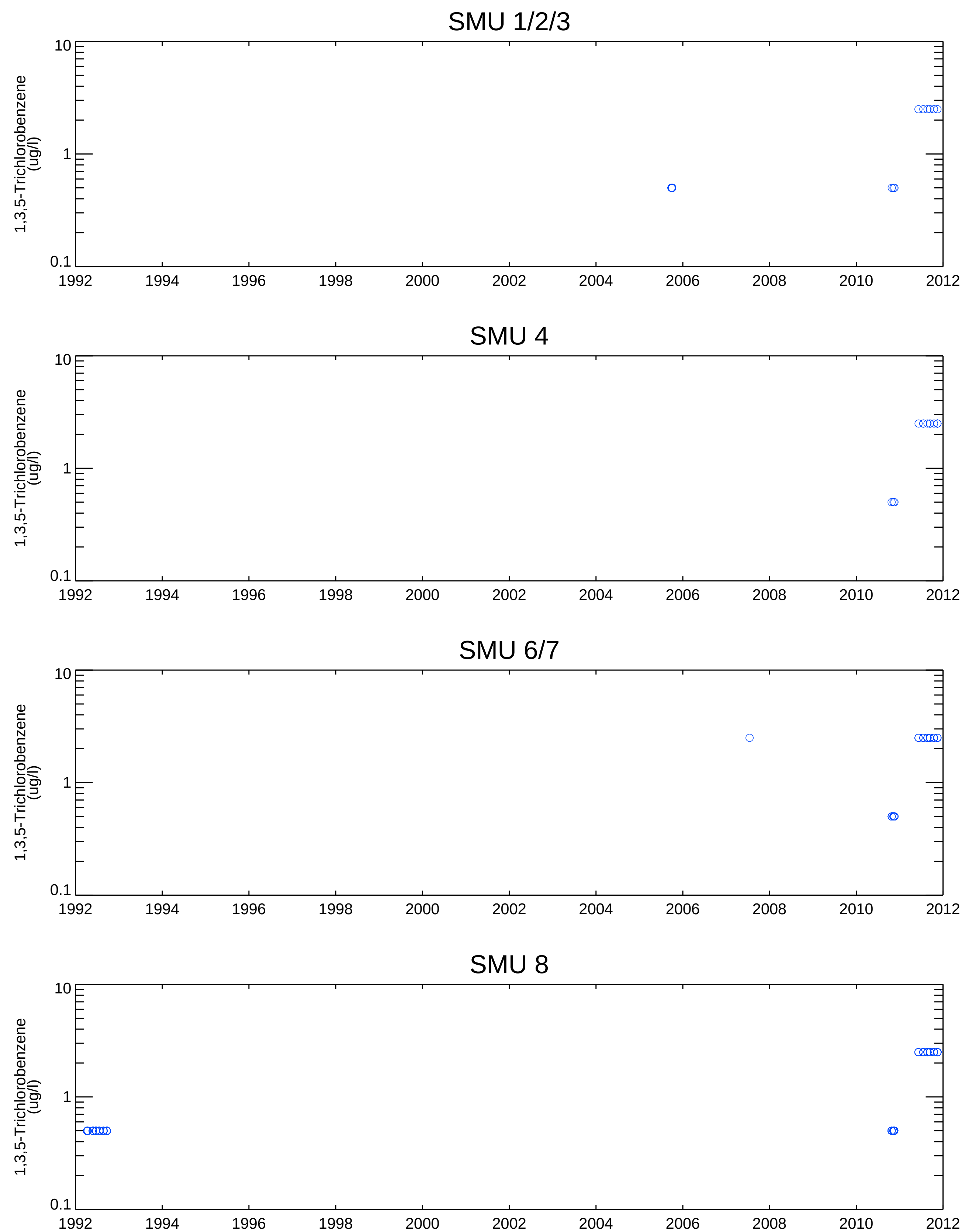


Figure B-12

1,3,5-Trichlorobenzene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

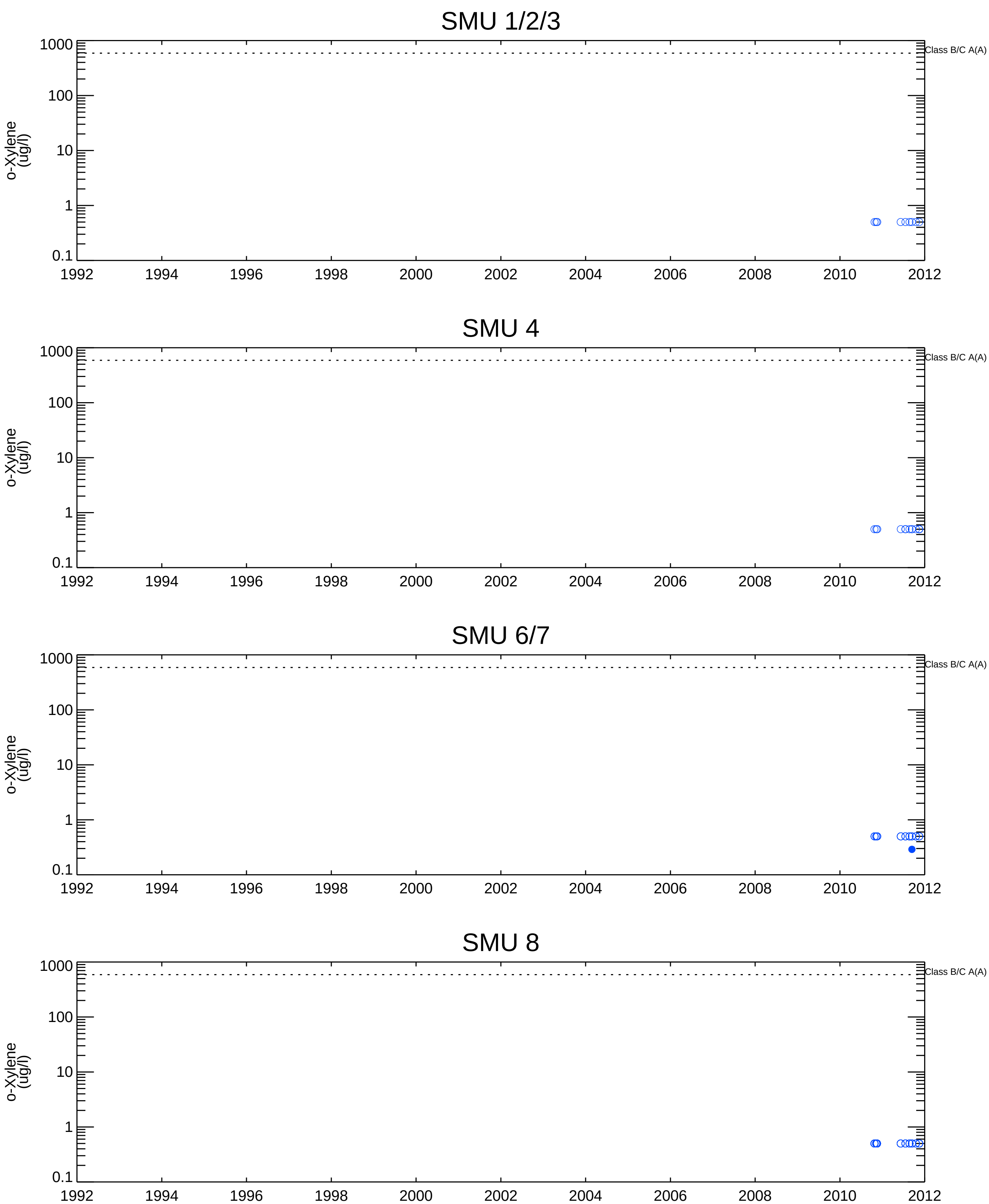
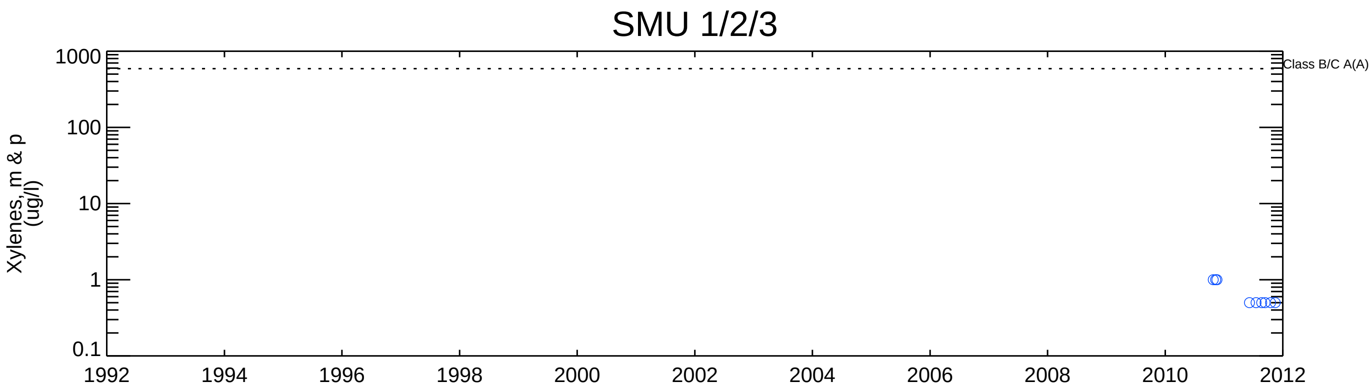
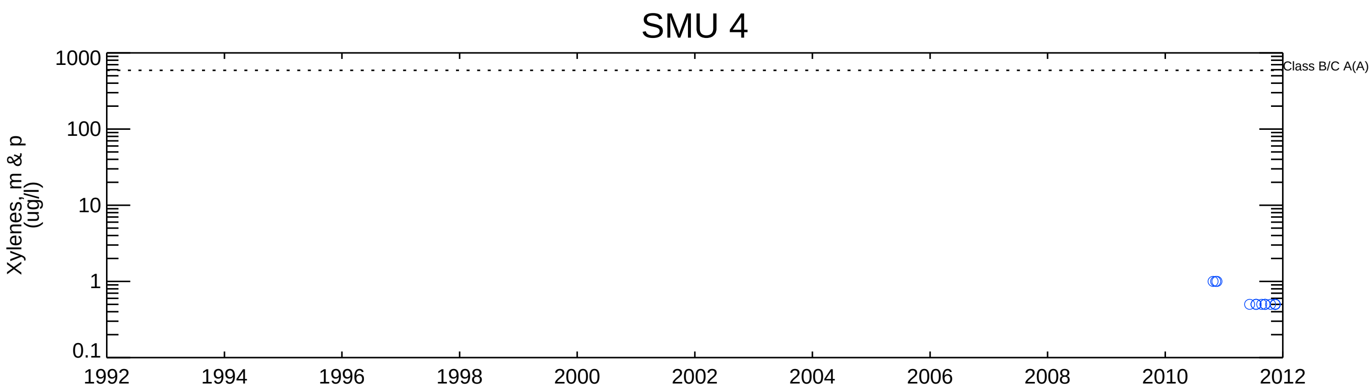


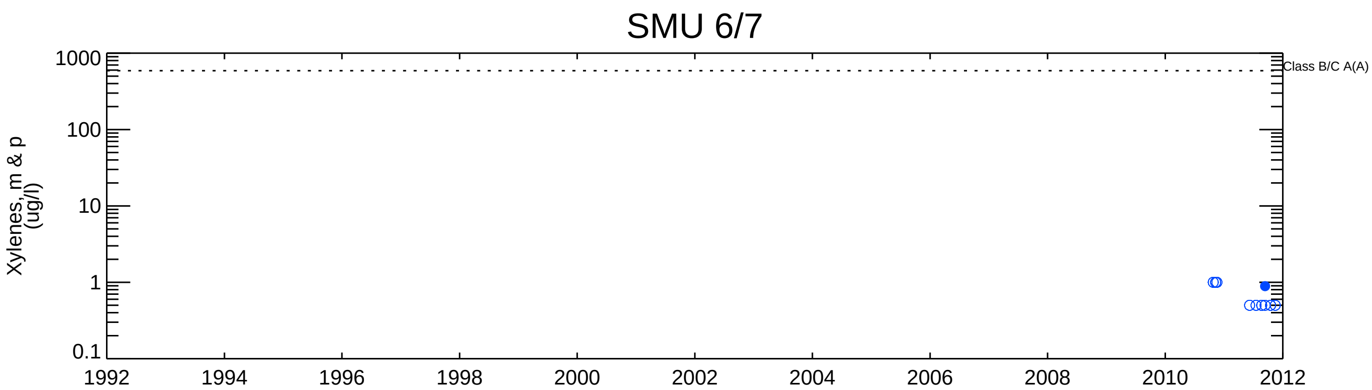
Figure B-12

o-Xylene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.







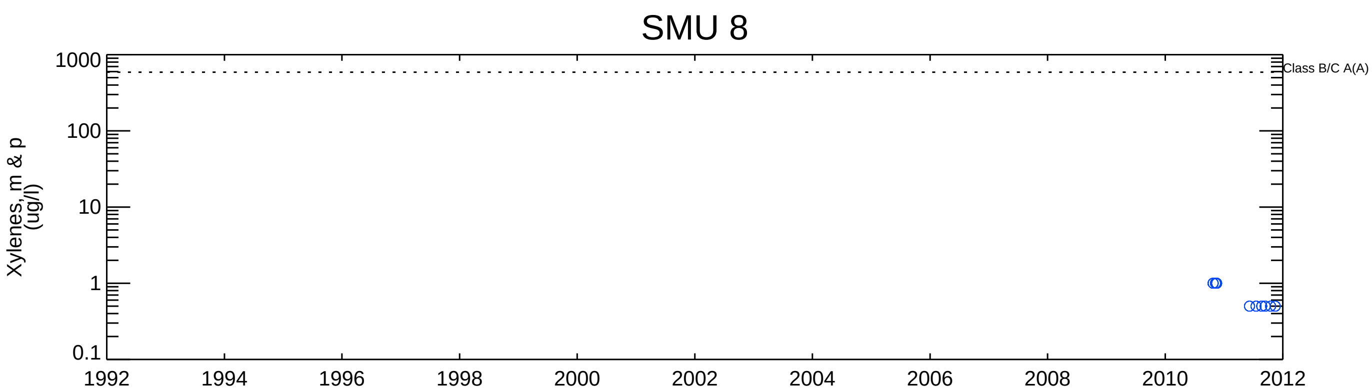


Figure B-12

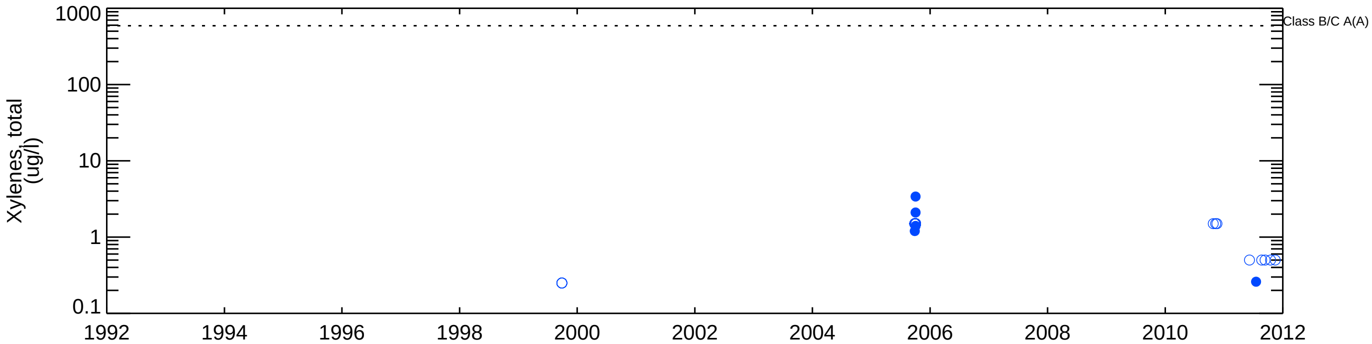
Xylenes, m & p Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

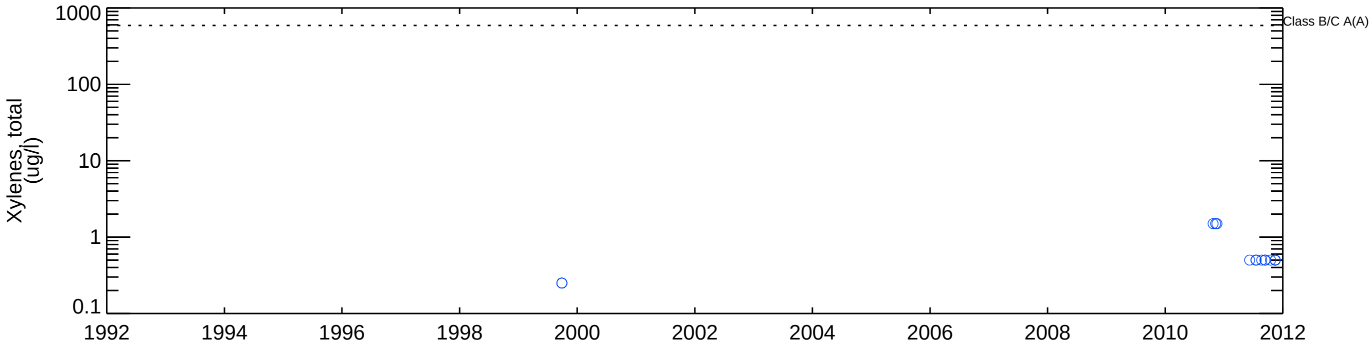
Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:55 2012

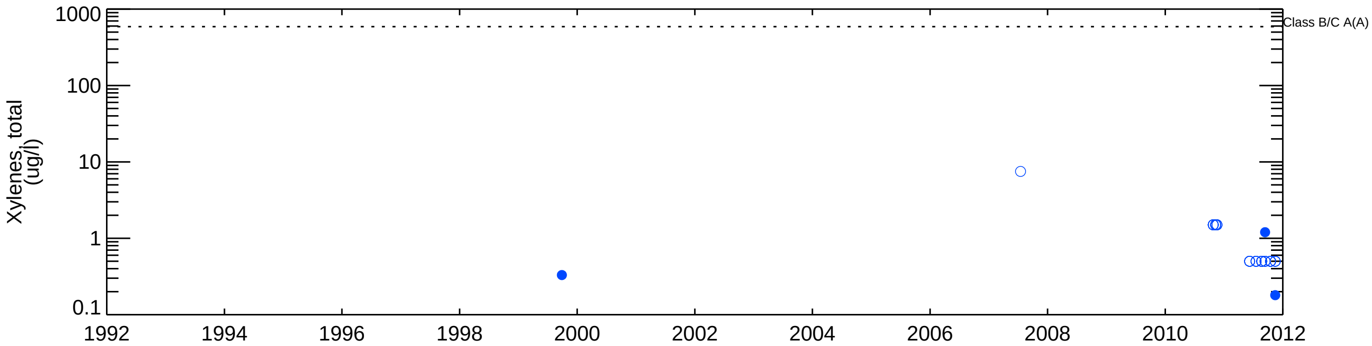
SMU 1/2/3



SMU 4



SMU 6/7



SMU 8

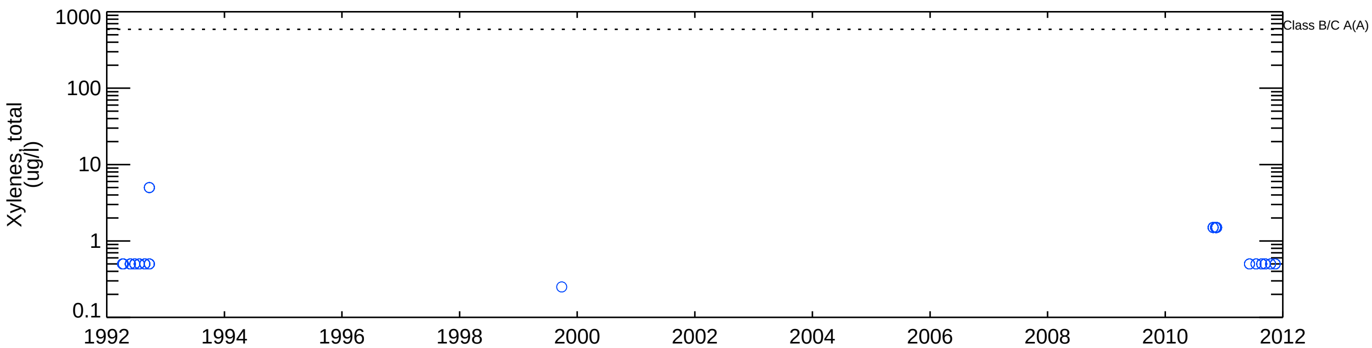


Figure B-12

Xylenes, total Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:56 2012

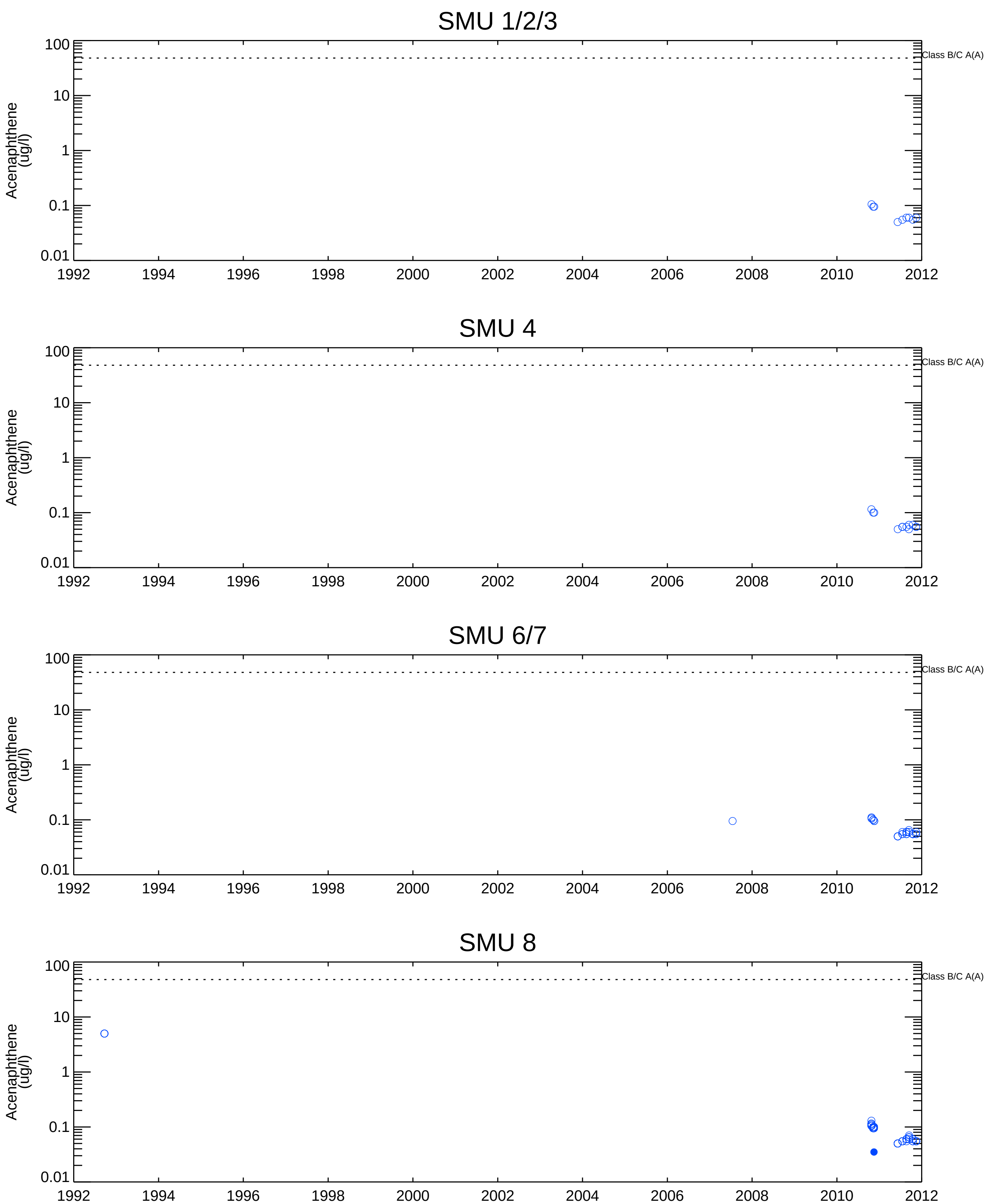


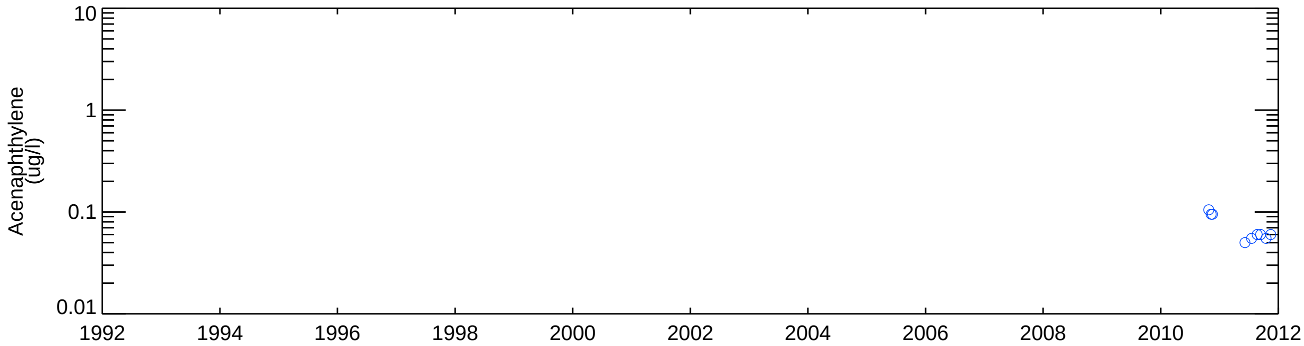
Figure B-12

Acenaphthene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

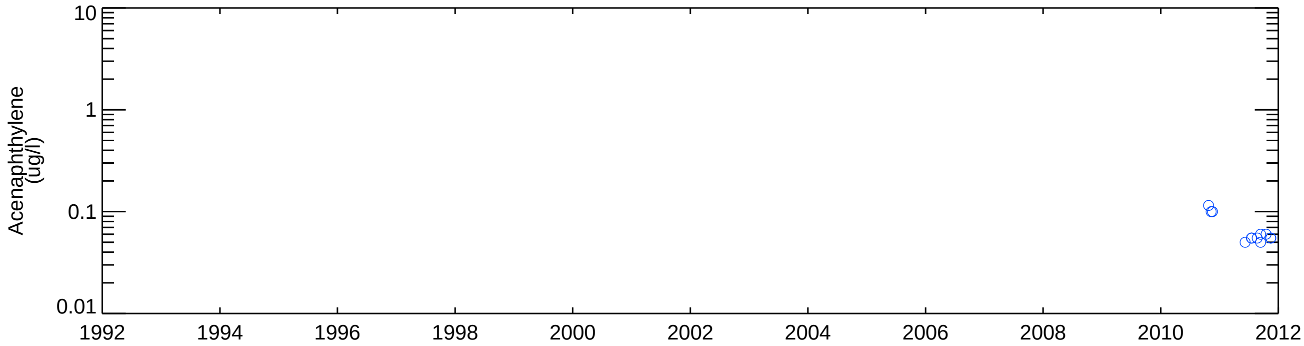
Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:45:57 2012

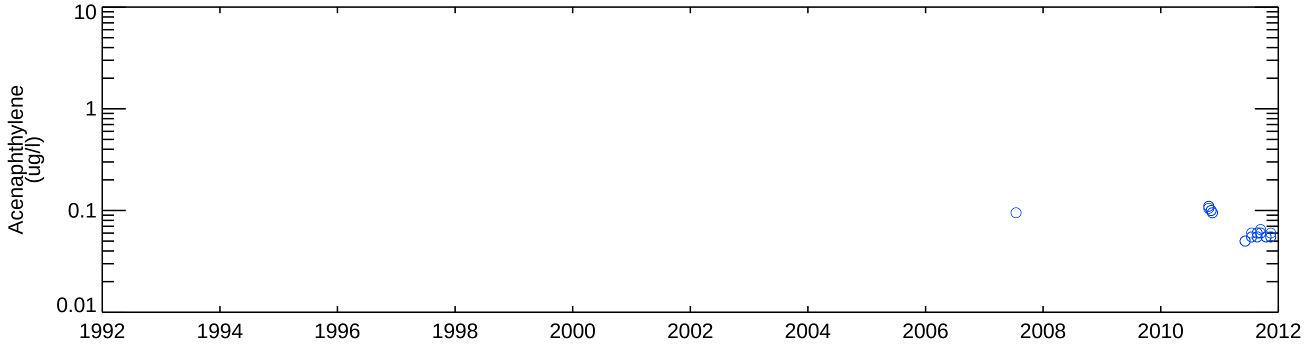
SMU 1/2/3



SMU 4



SMU 6/7



SMU 8

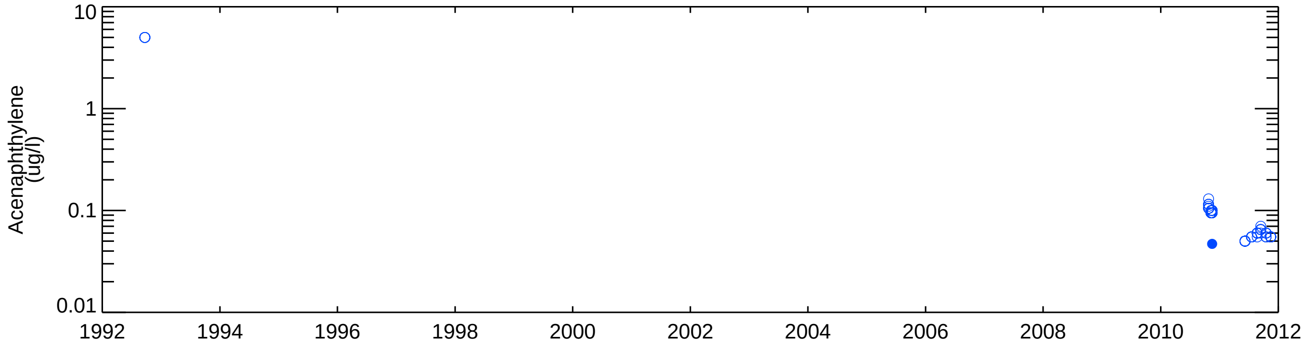


Figure B-12

Acenaphthylene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

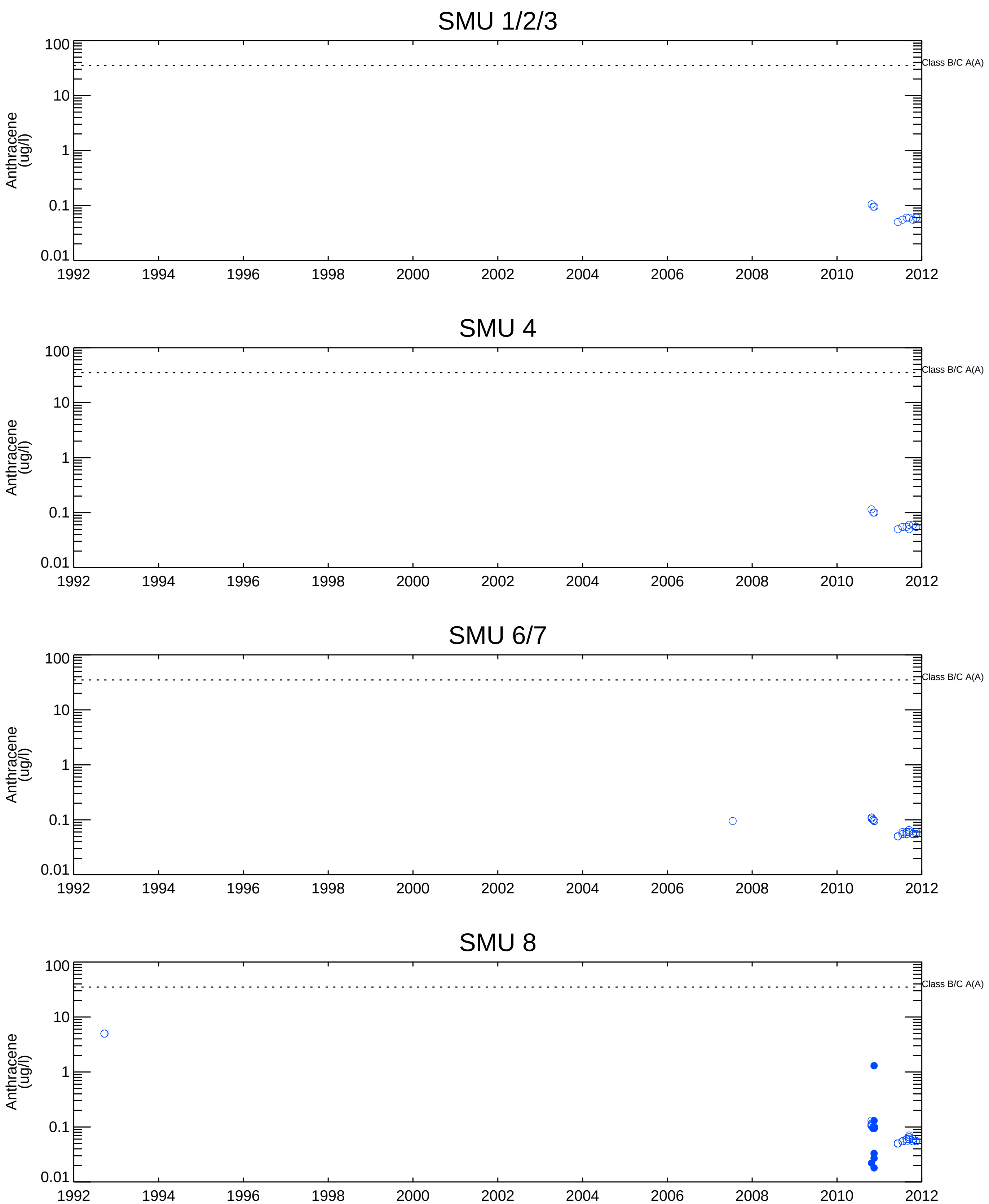


Figure B-12

Anthracene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

ANCHOR QEA

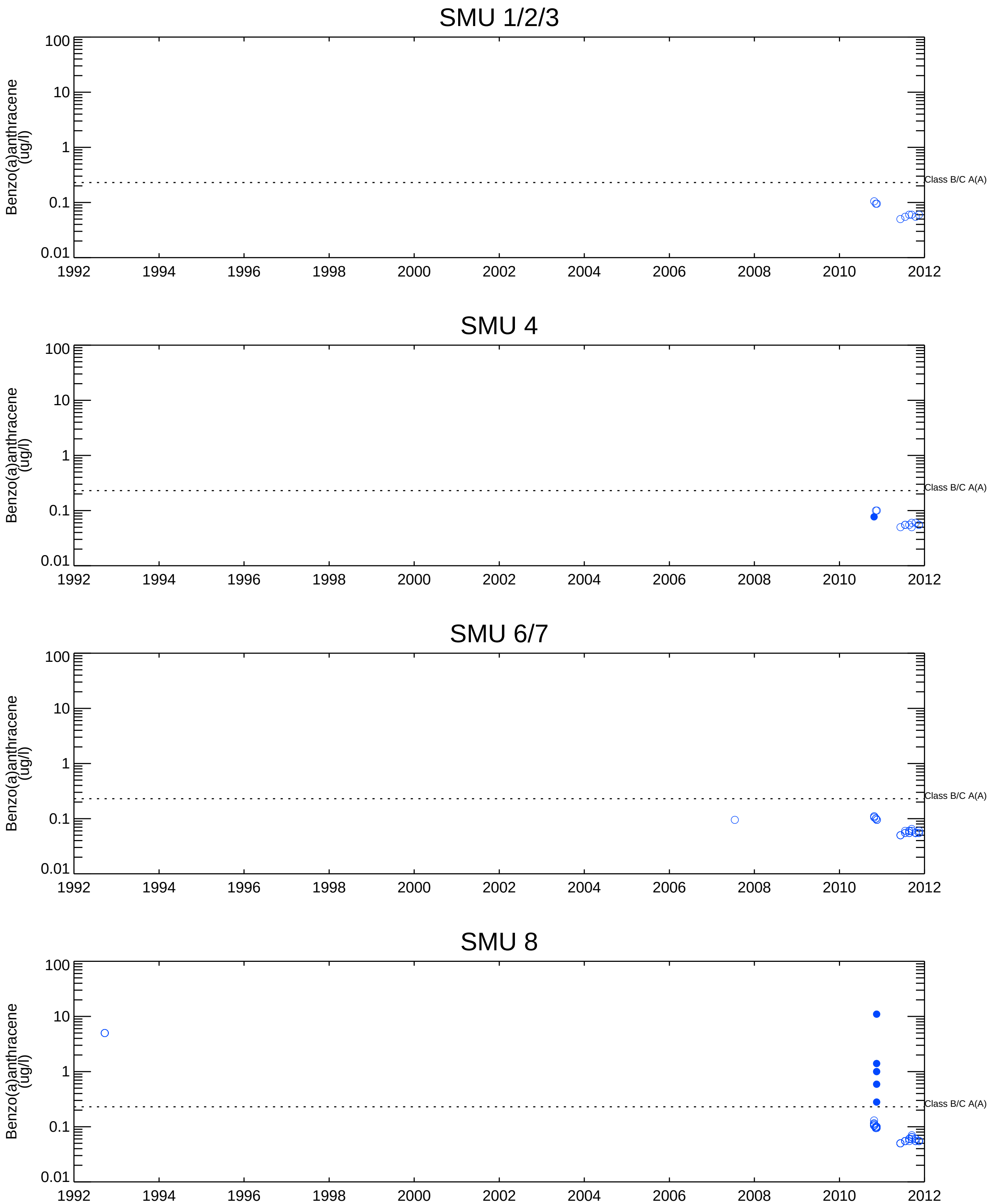


Figure B-12

Benzo(a)anthracene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:46:06 2012

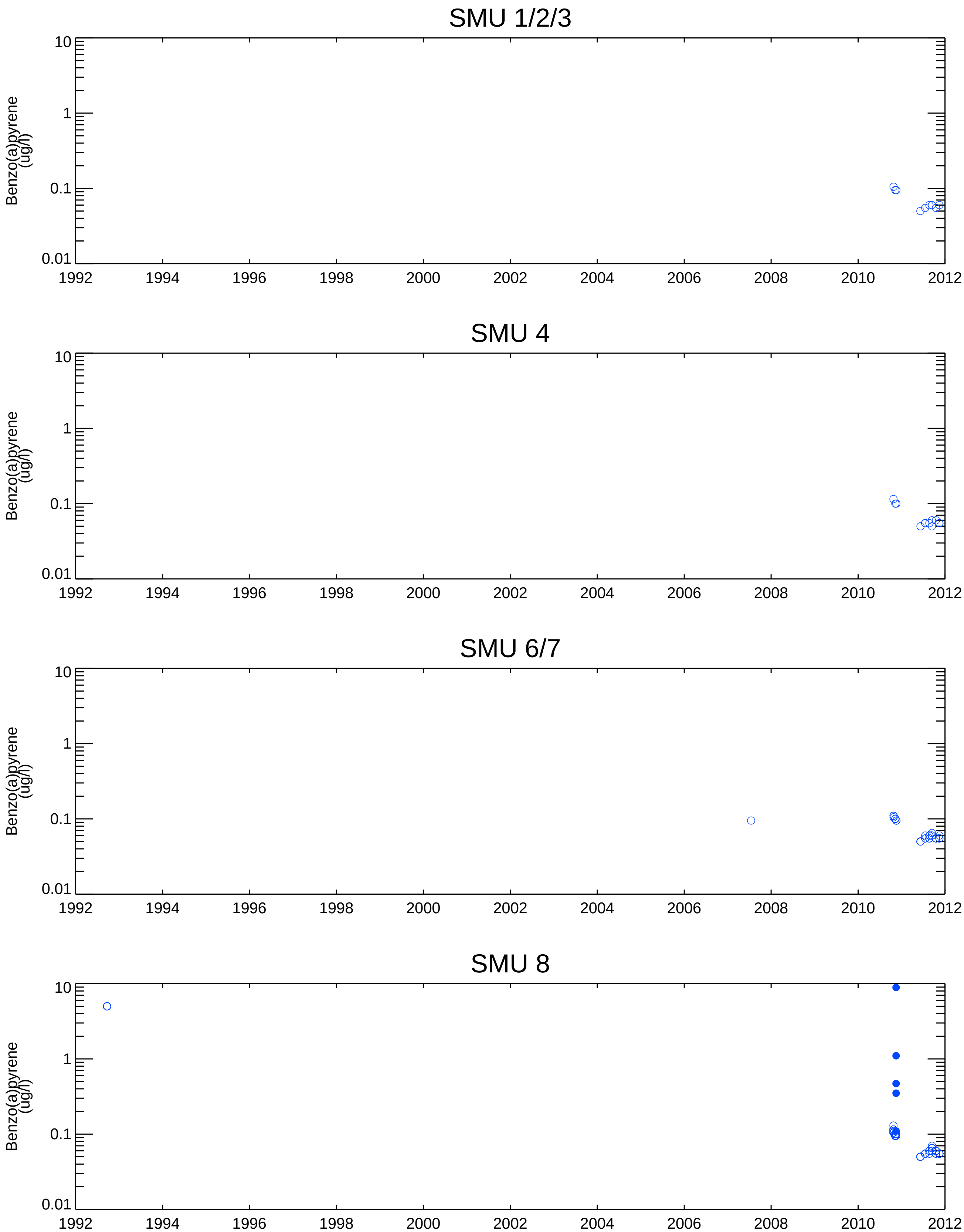


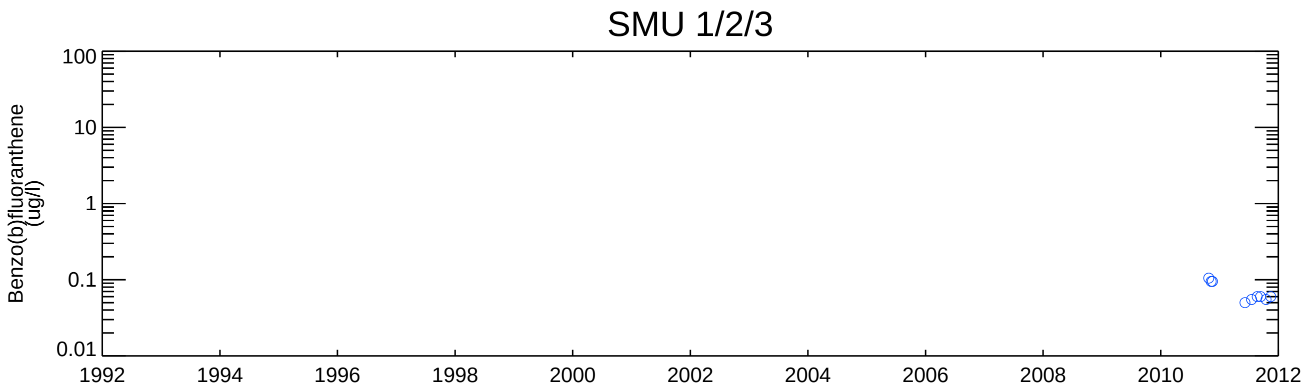
Figure B-12

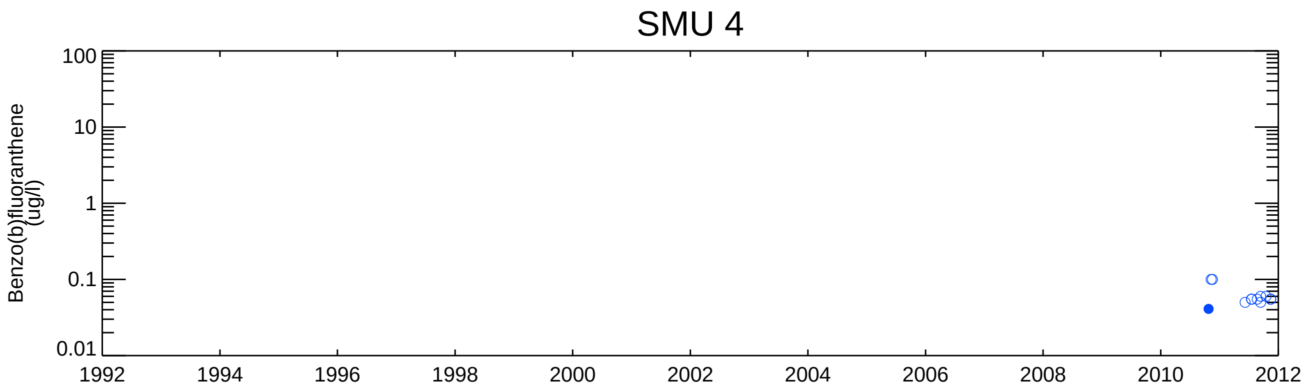
Benzo(a)pyrene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

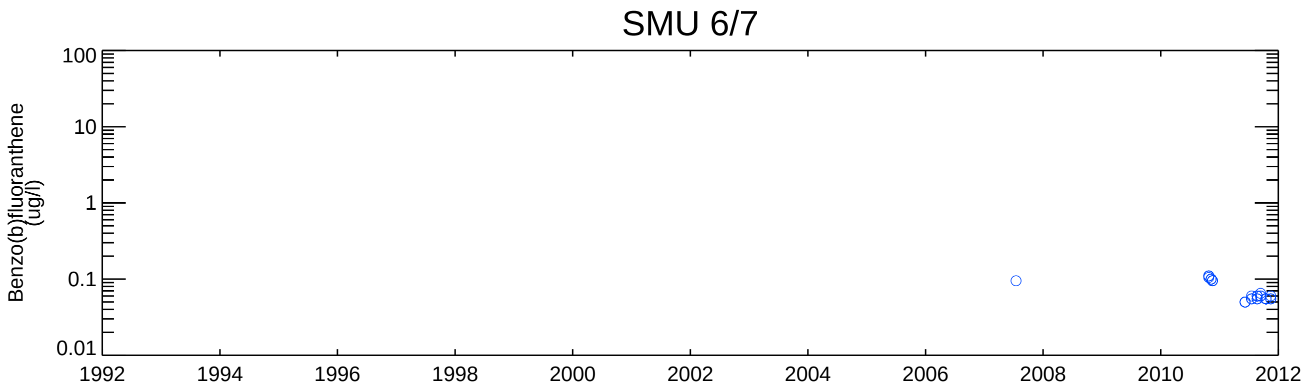
Nondetect samples are plotted with open symbols at 1/2 the report detection limit

ANCHOR QEA

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:46:11 2012







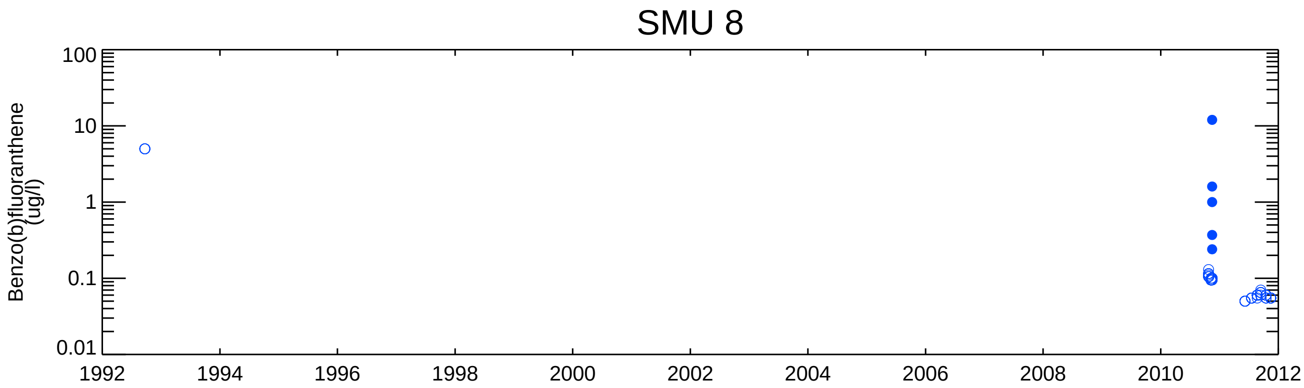


Figure B-12

Benzo(b)fluoranthene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:46:15 2012

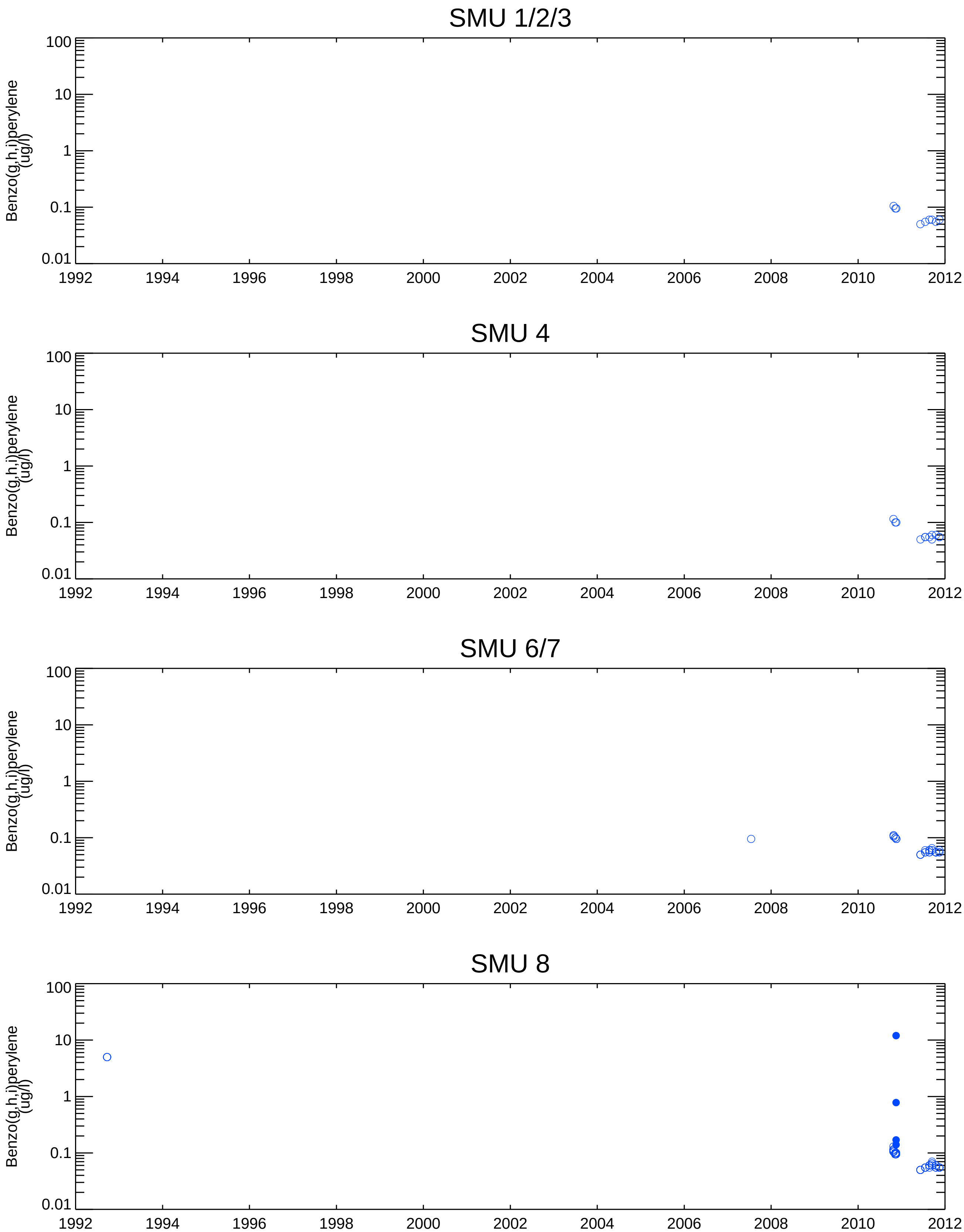


Figure B-12

Benzo(g,h,i)perylene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:46:24 2012

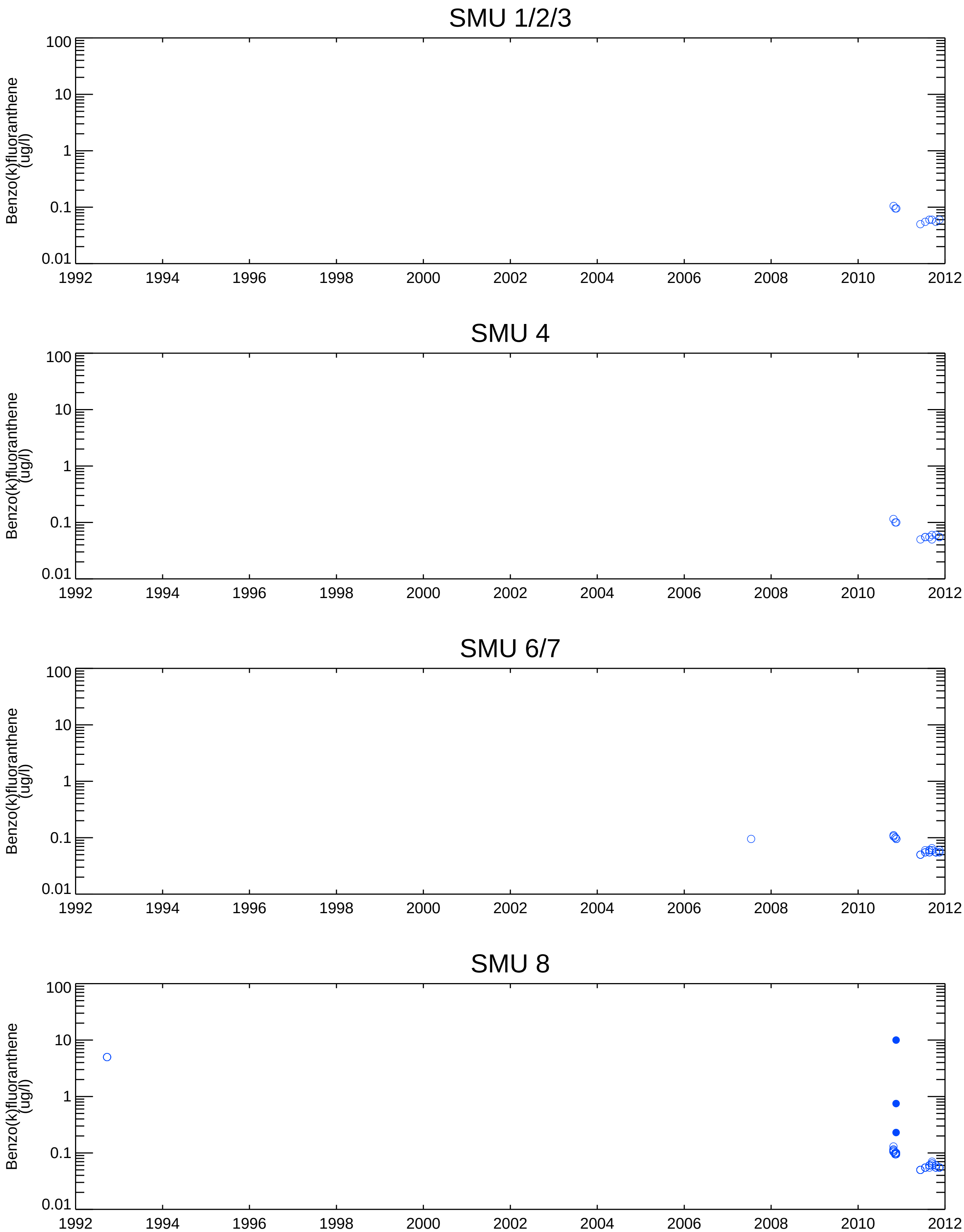


Figure B-12

Benzo(k)fluoranthene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

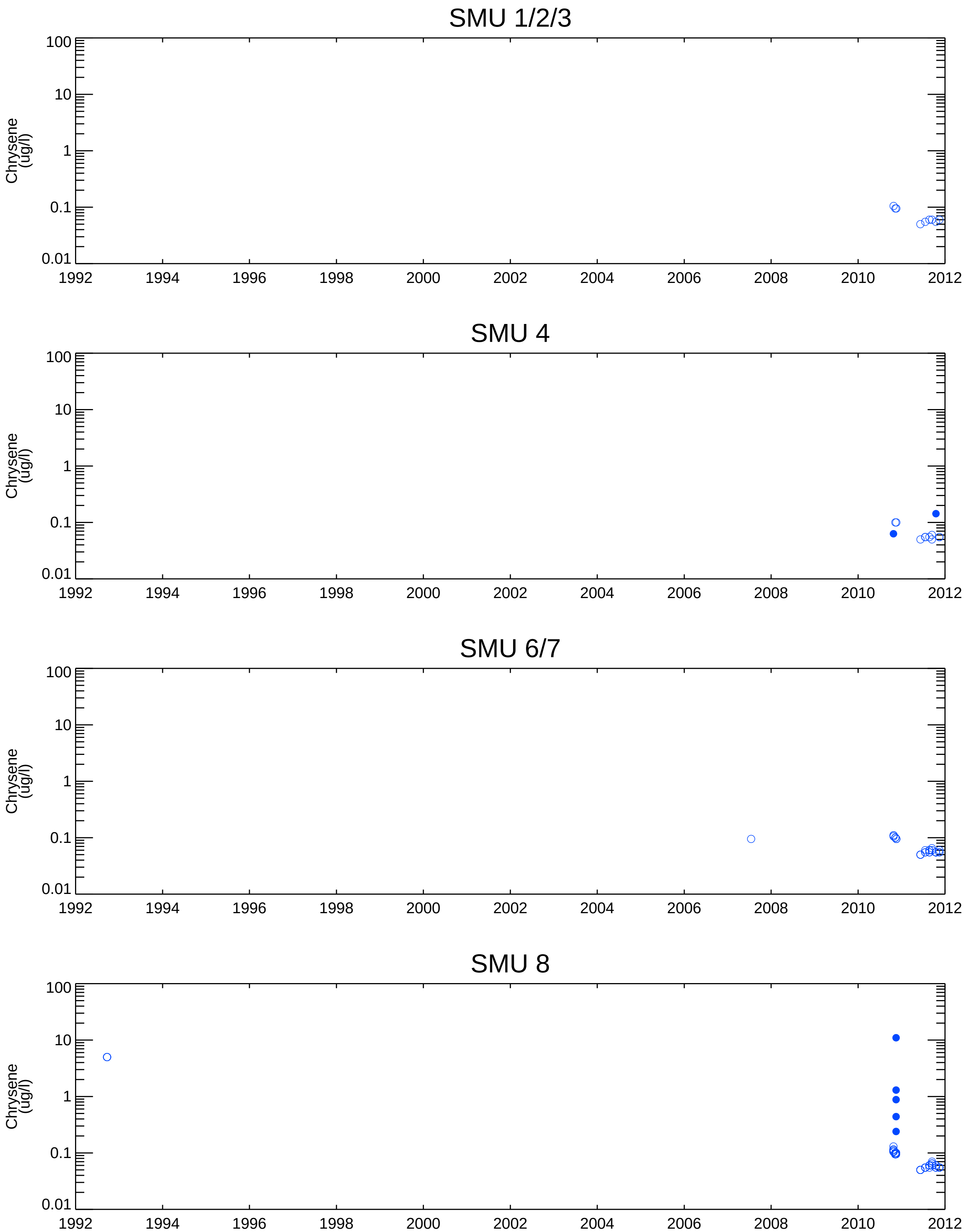


Figure B-12

Chrysene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

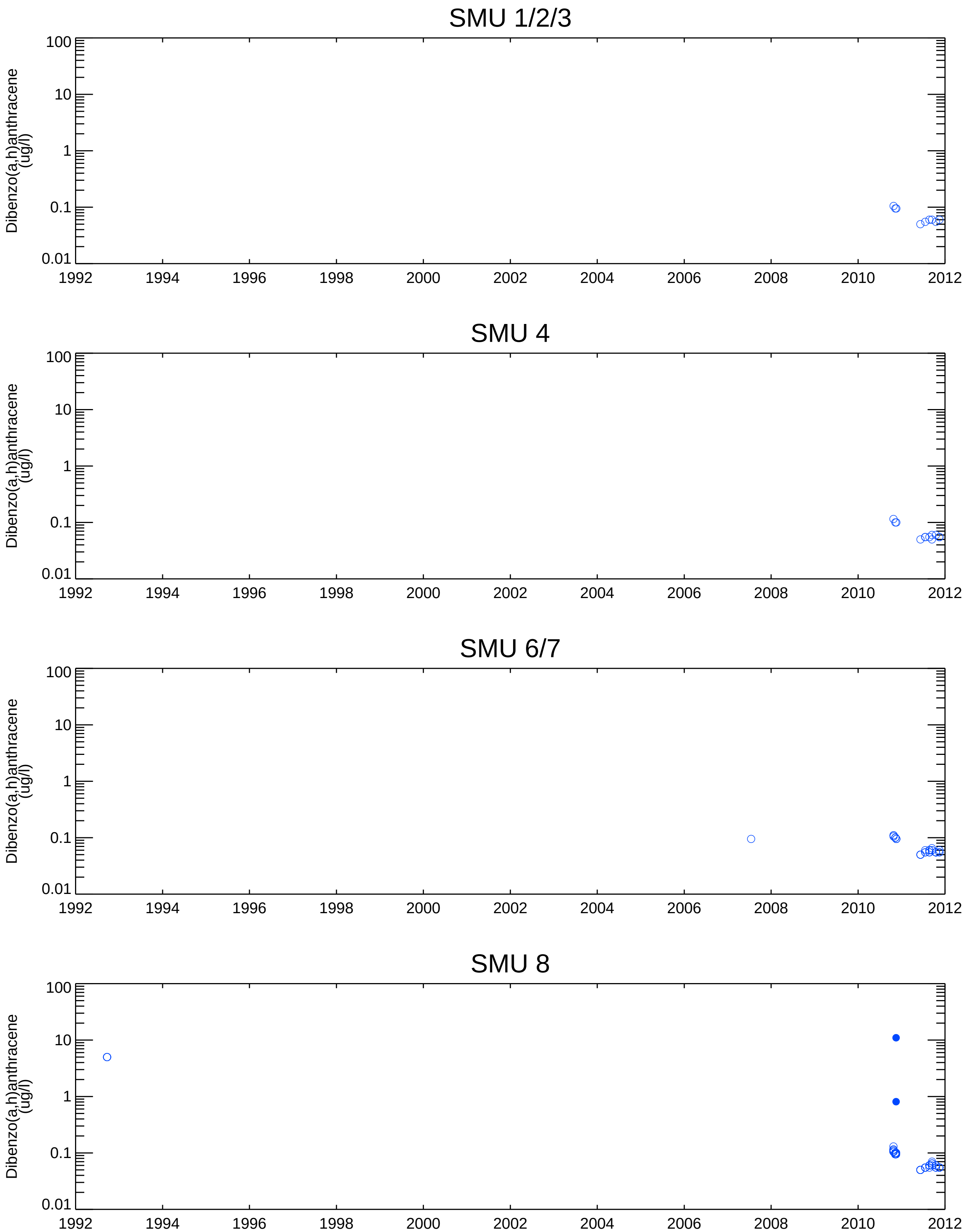


Figure B-12

Dibenzo(a,h)anthracene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:46:50 2012

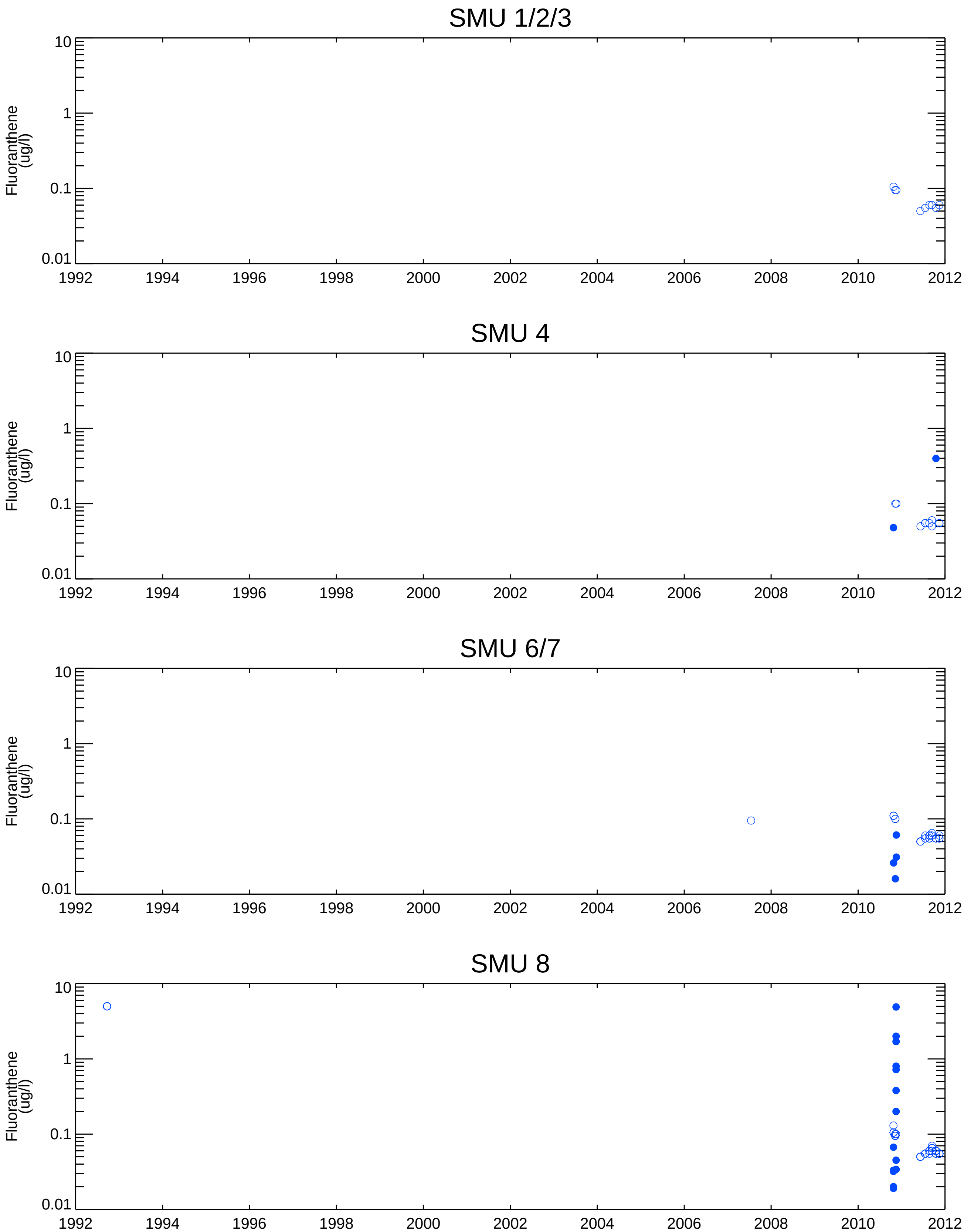


Figure B-12

Fluoranthene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:46:55 2012

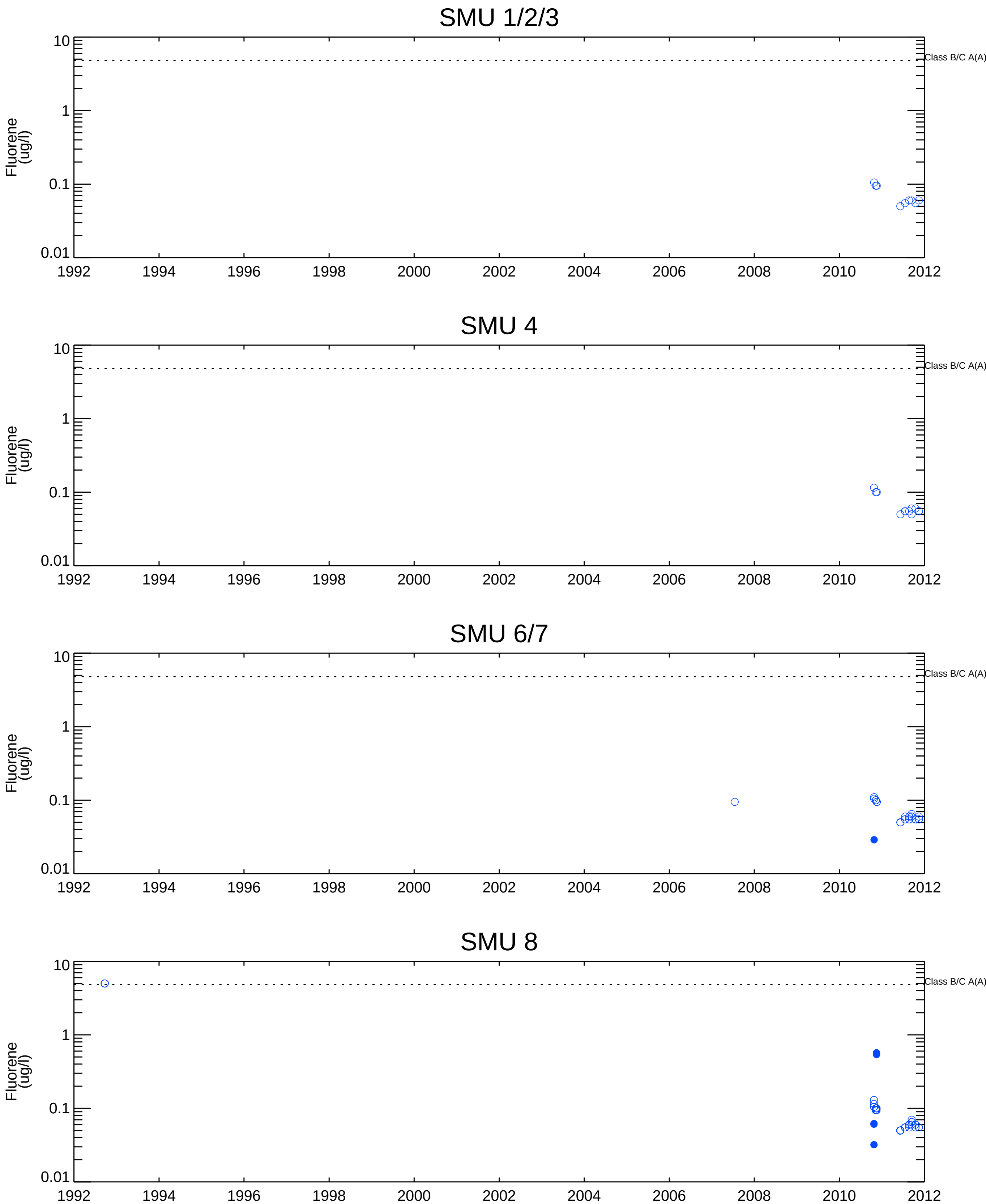


Figure B-12

Fluorene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

ANCHOR QEA

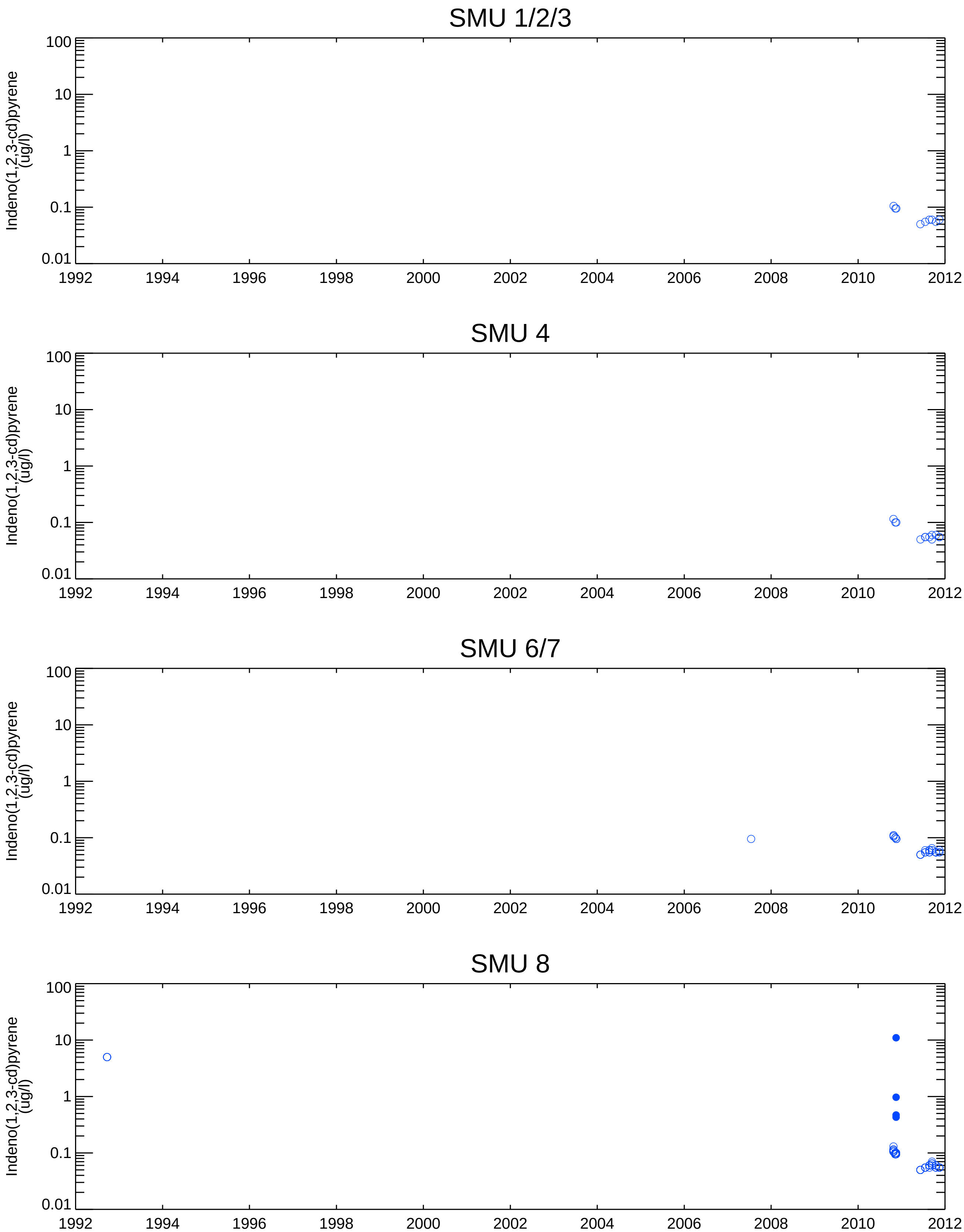


Figure B-12

Indeno(1,2,3-cd)pyrene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

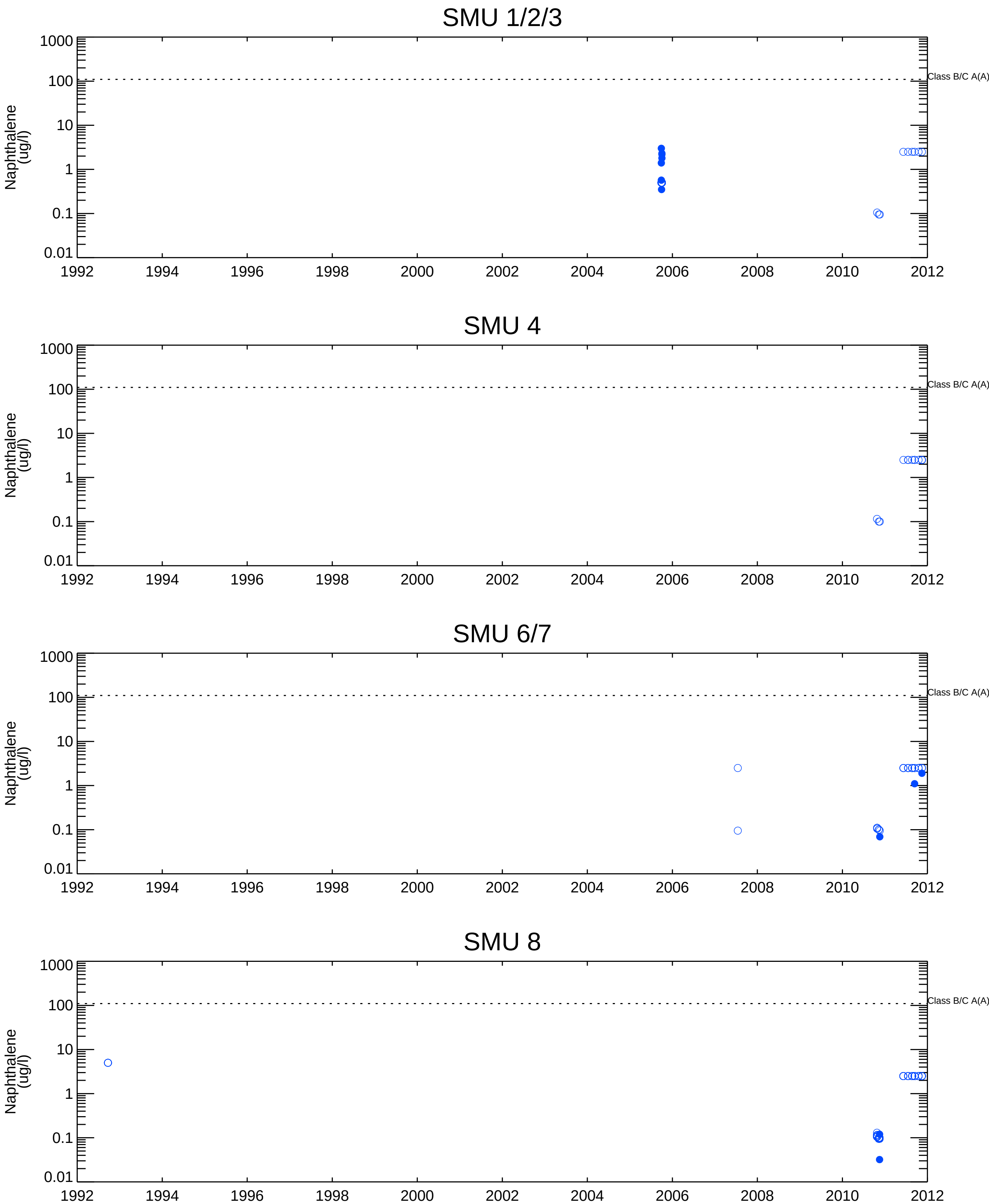


Figure B-12

Naphthalene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:46:58 2012

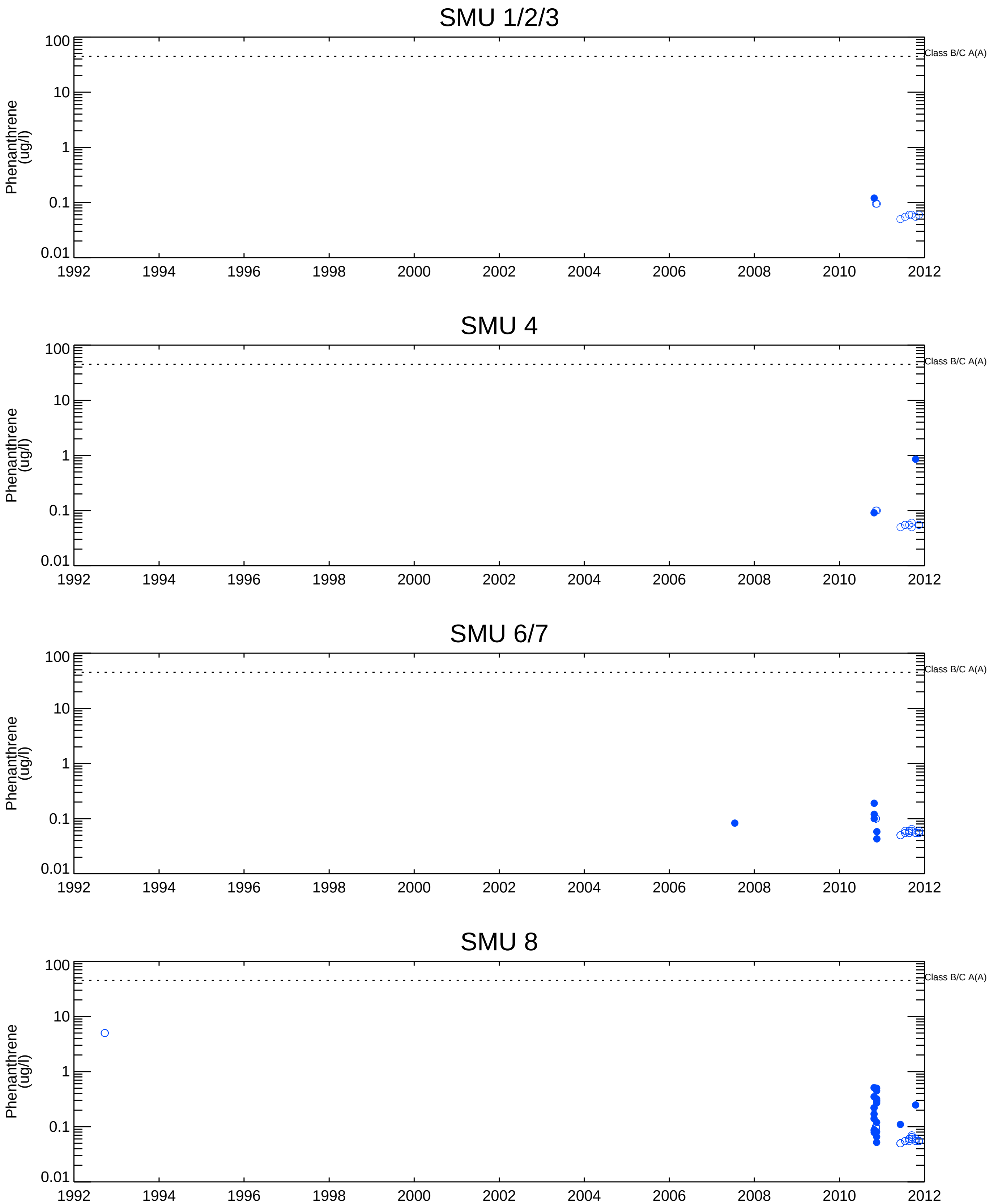


Figure B-12

Phenanthrene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

ANCHOR QEA

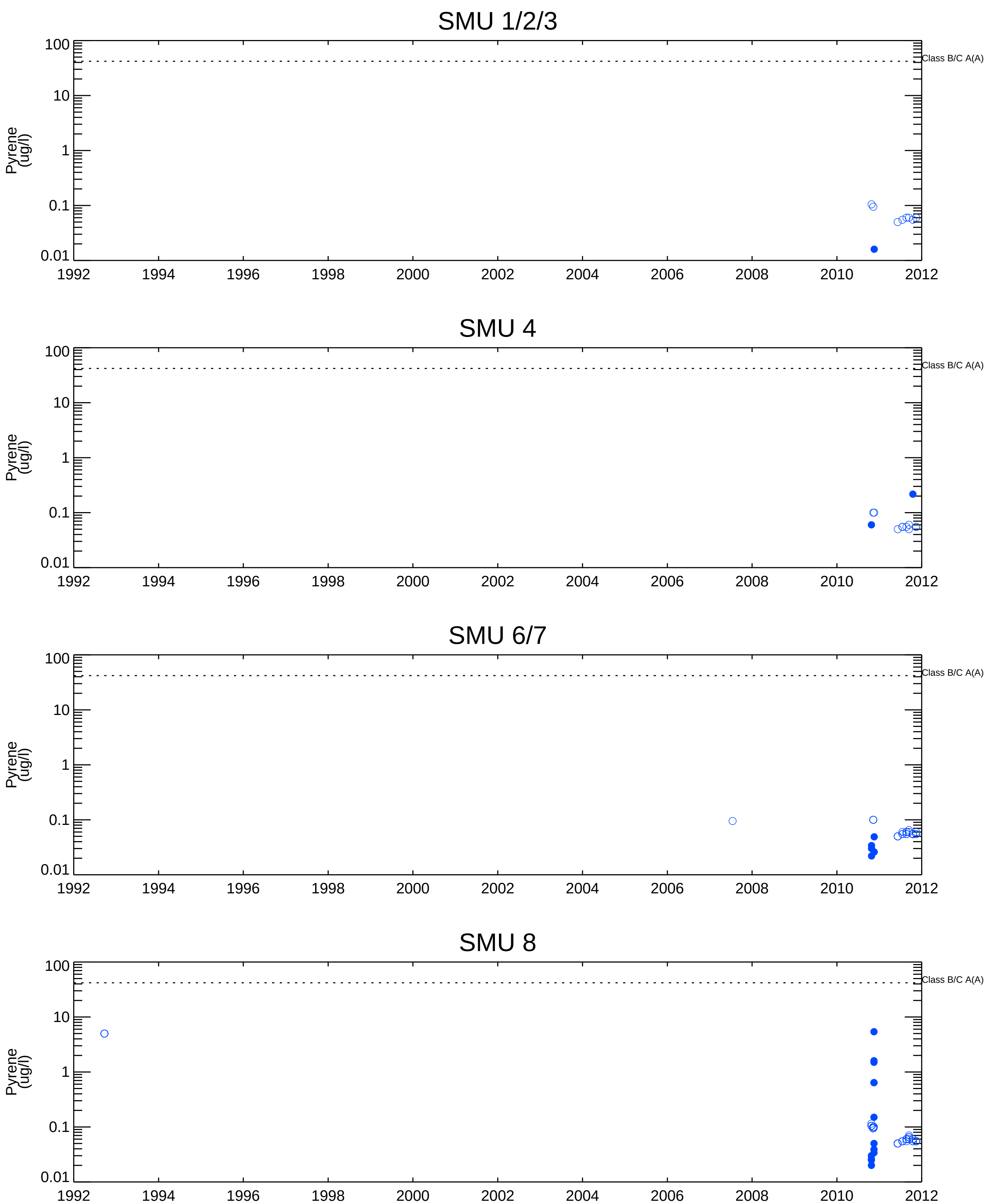


Figure B-12

Pyrene Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

ANCHOR QEA

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:47:10 2012

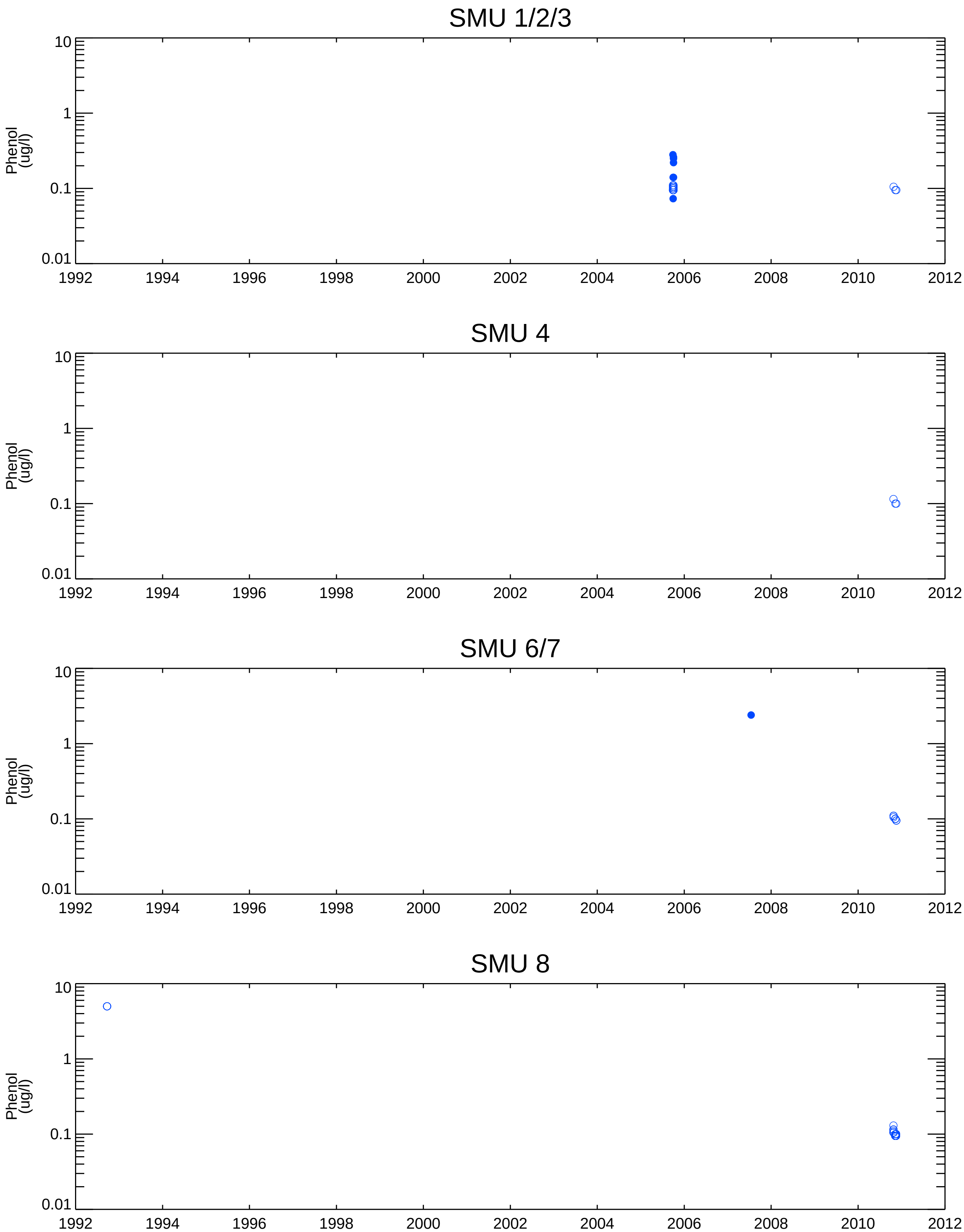


Figure B-12

Phenol Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:47:10 2012

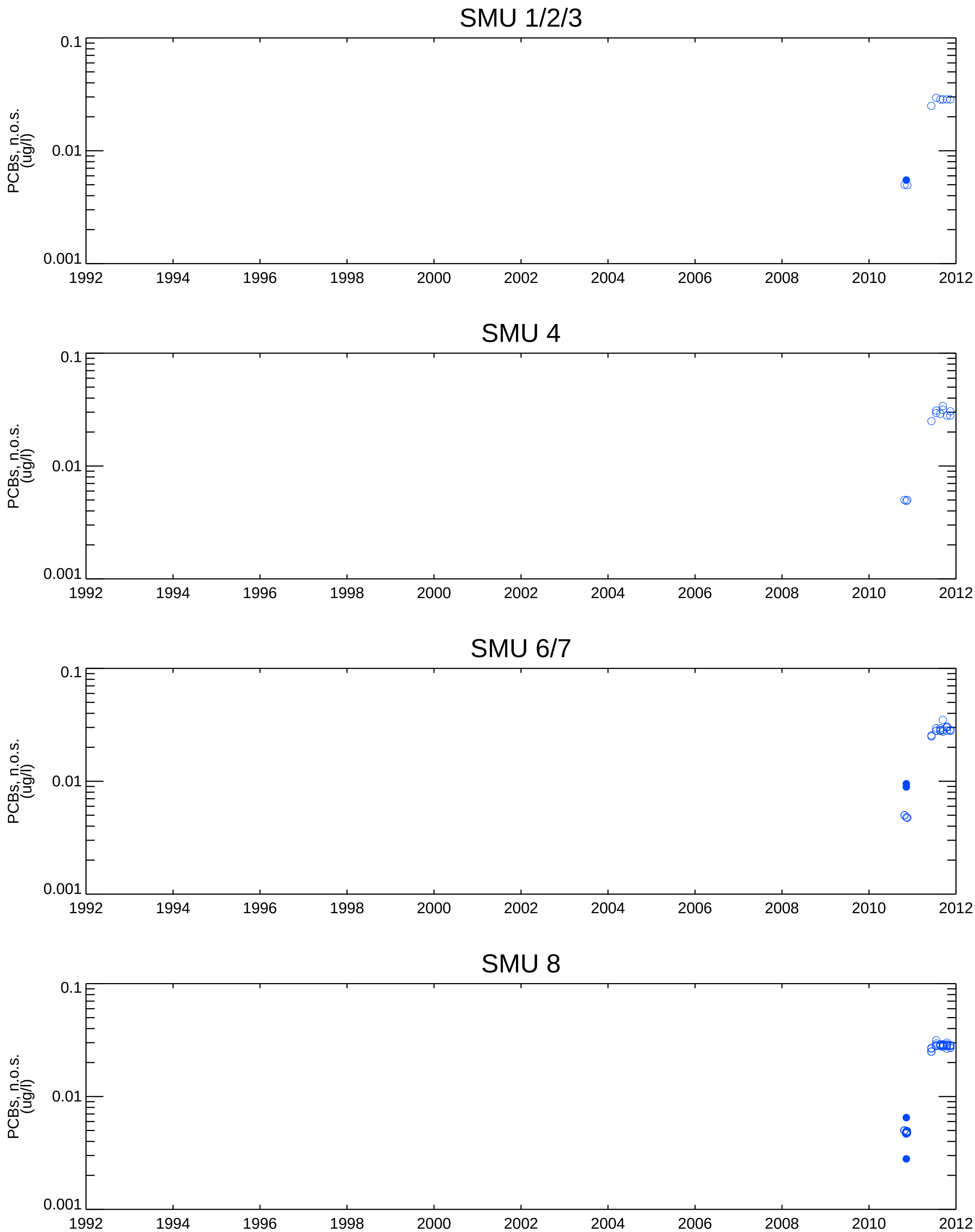


Figure B-12

PCBs, n.o.s. Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

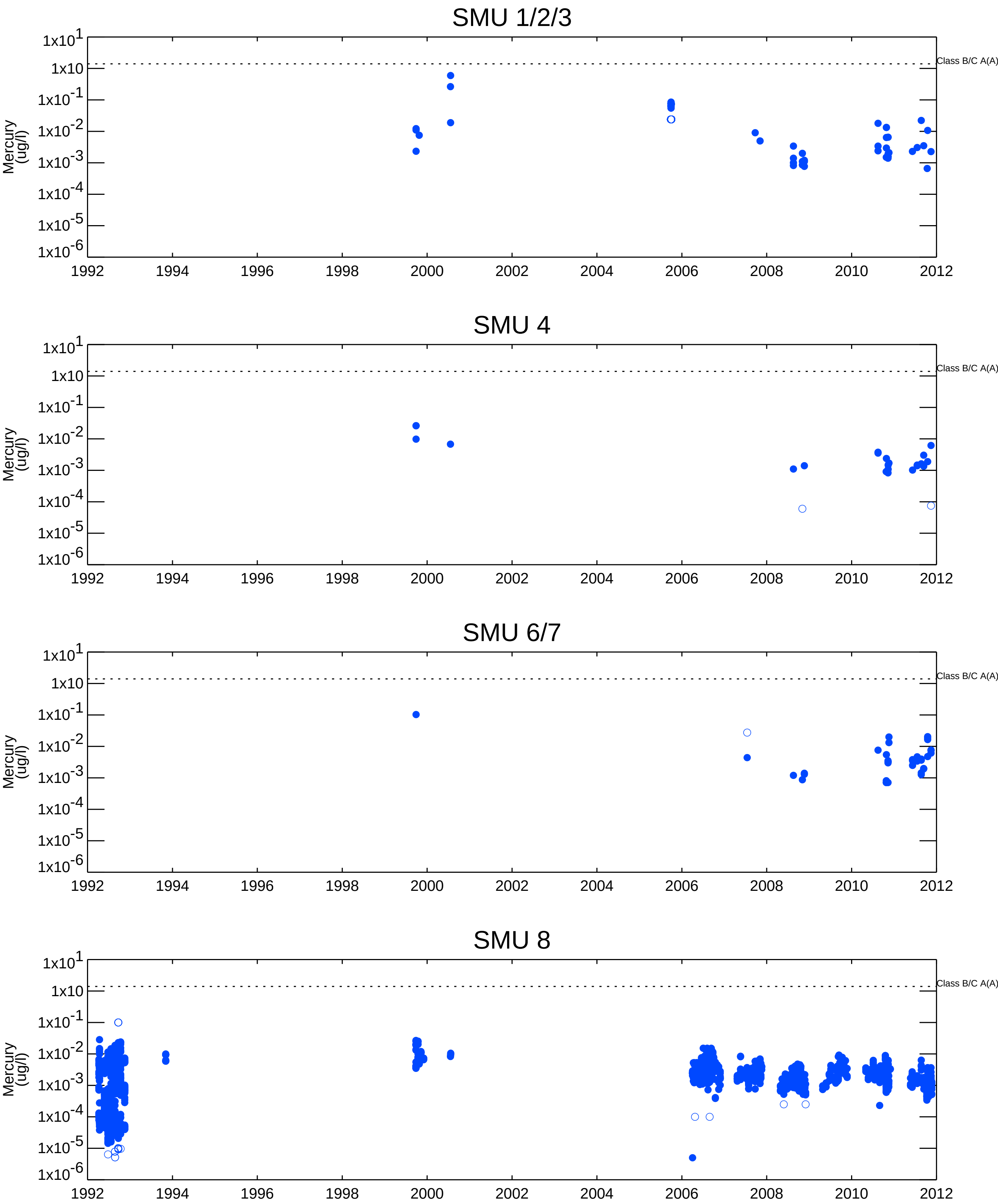


Figure B-12

Unfiltered Mercury Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

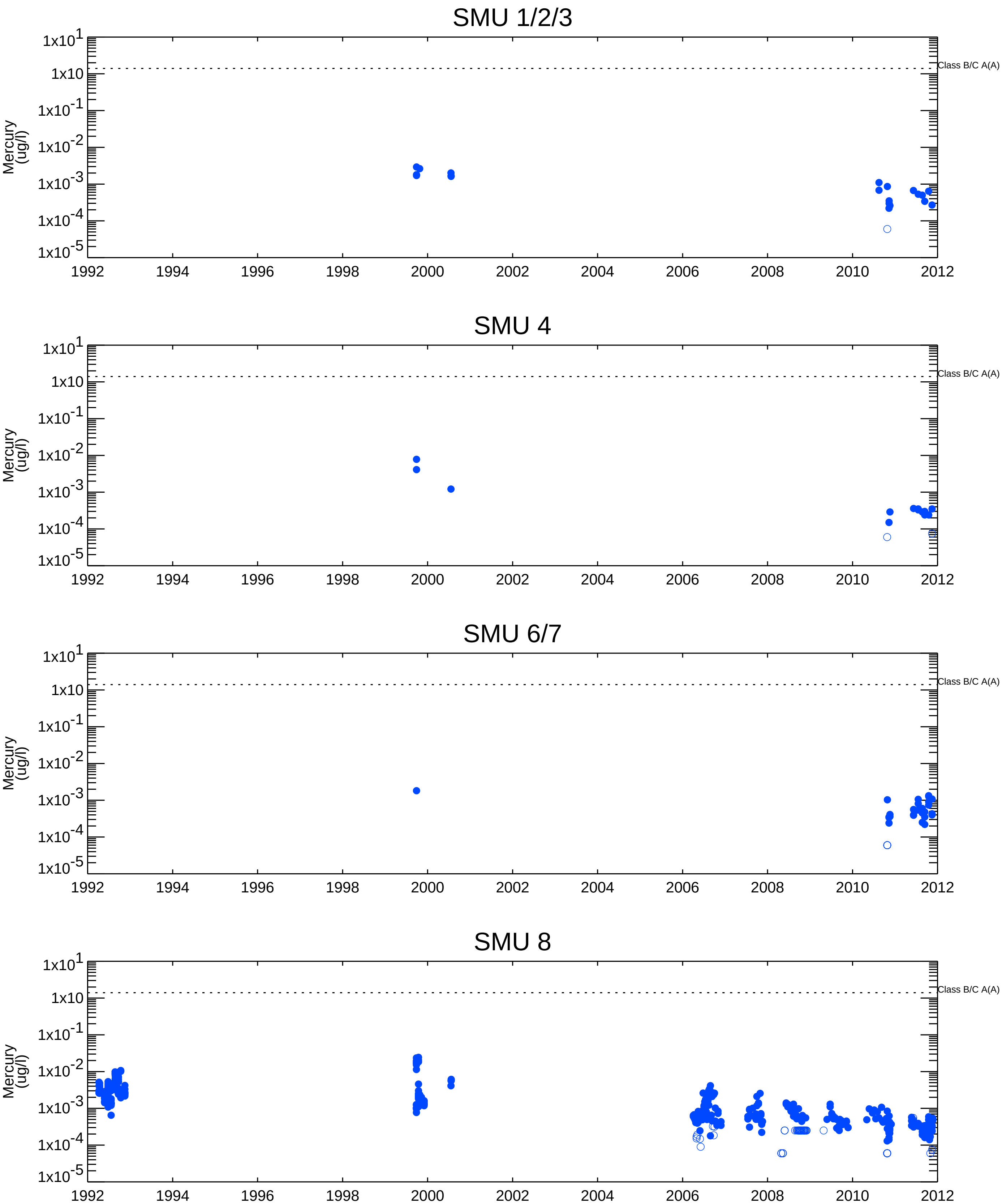


Figure B-12

Filtered Mercury Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

ANCHOR QEA

Nondetect samples are plotted with open symbols at 1/2 the report detection limit
NYS DEC Aquatic (Acute) water quality criteria shown.

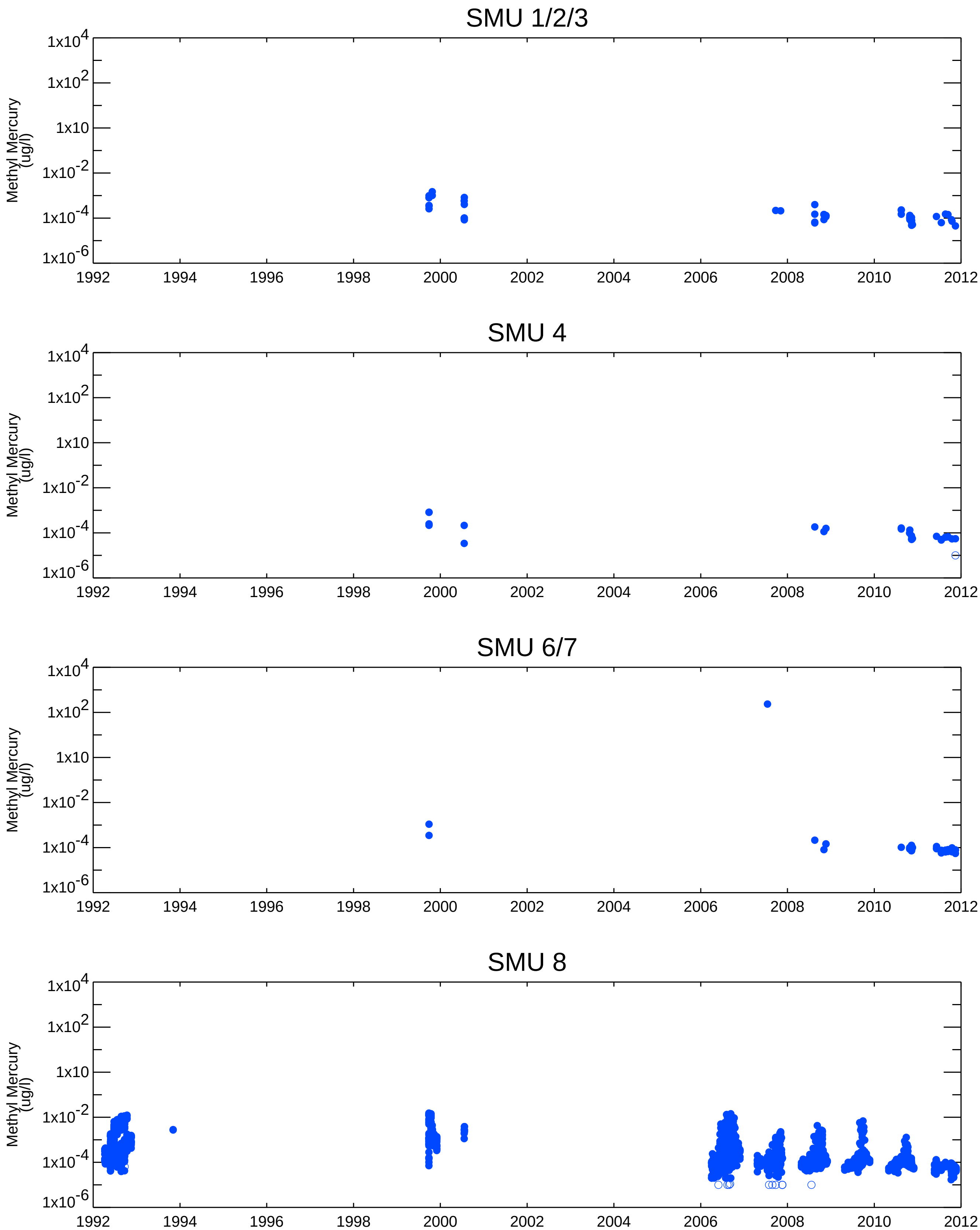


Figure B-12

Methyl Mercury Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

MJR - B:\Projects\Honeywell\Onondaga_Lake_(090139-01)\WQMMP\Analysis\WQ_const_mon_temporal_chem_by_SMU.pro Fri Jan 20 15:47:13 2012

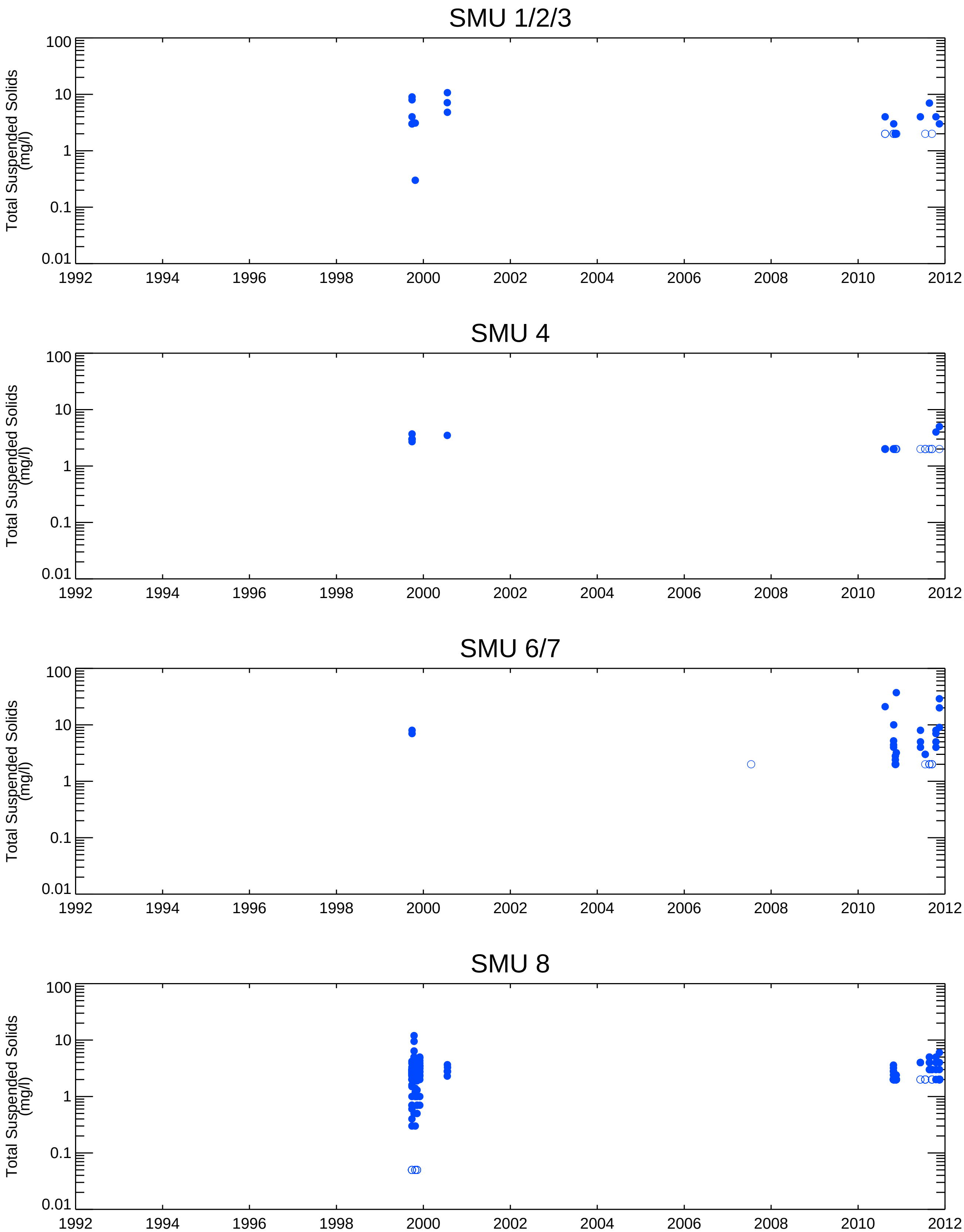


Figure B-12

Total Suspended Solids Data Temporal Plot
Water Quality Management and Monitoring Plan
Onondaga Lake

Nondetect samples are plotted with open symbols at 1/2 the report detection limit

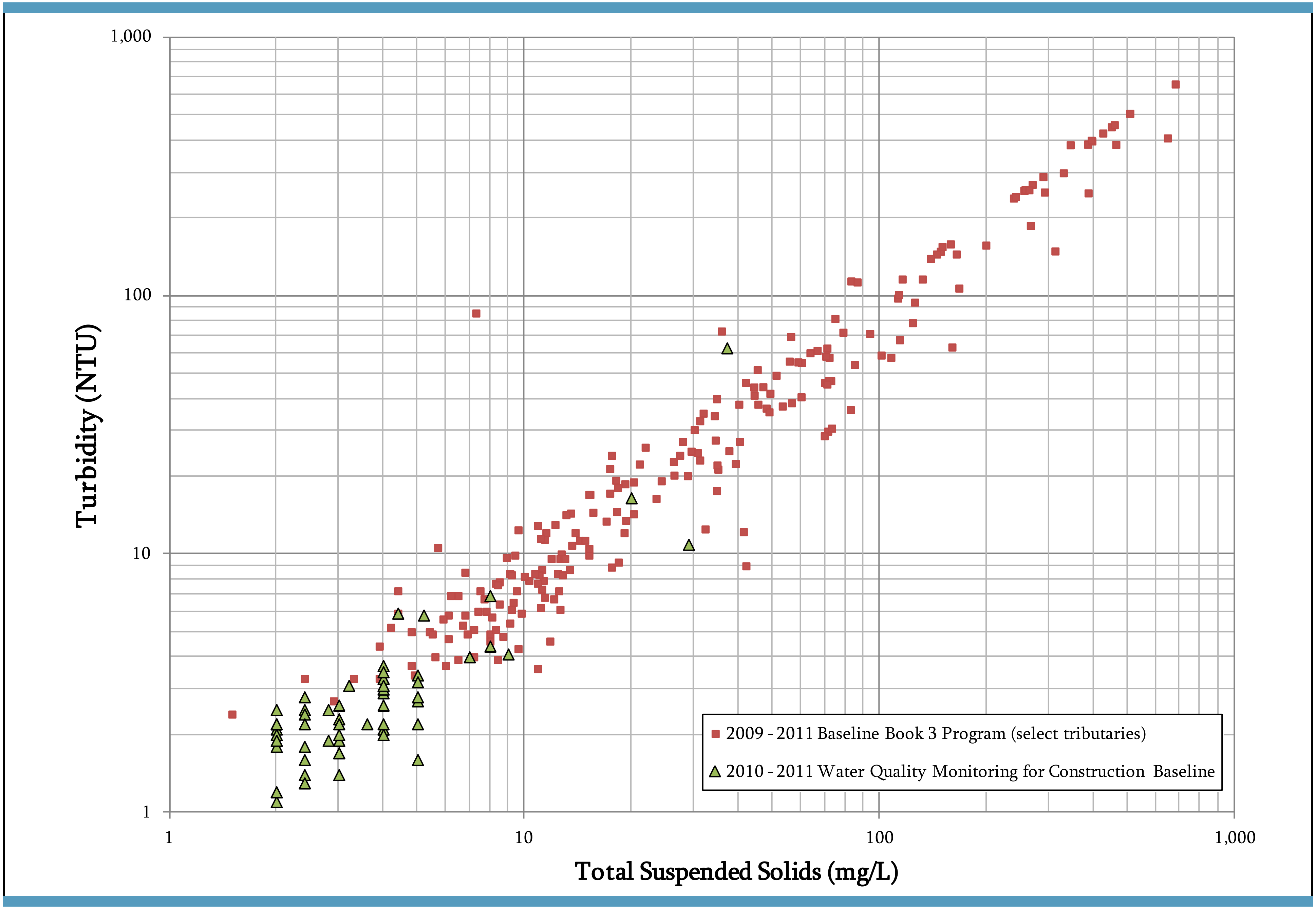


Figure B-13
Turbidity vs. Total Suspended Solids (TSS)
Water Quality Management and Monitoring Plan
Onondaga Lake

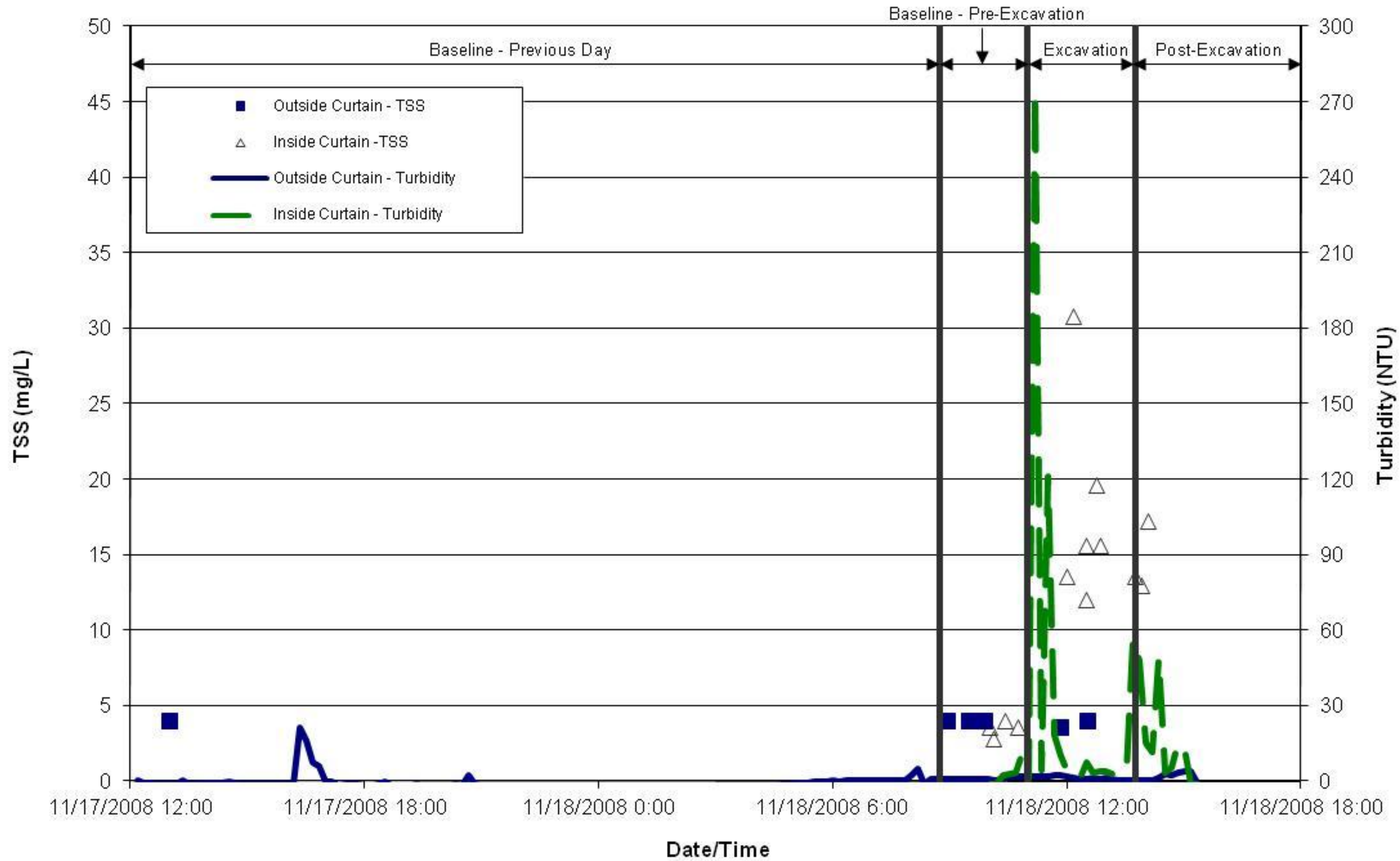
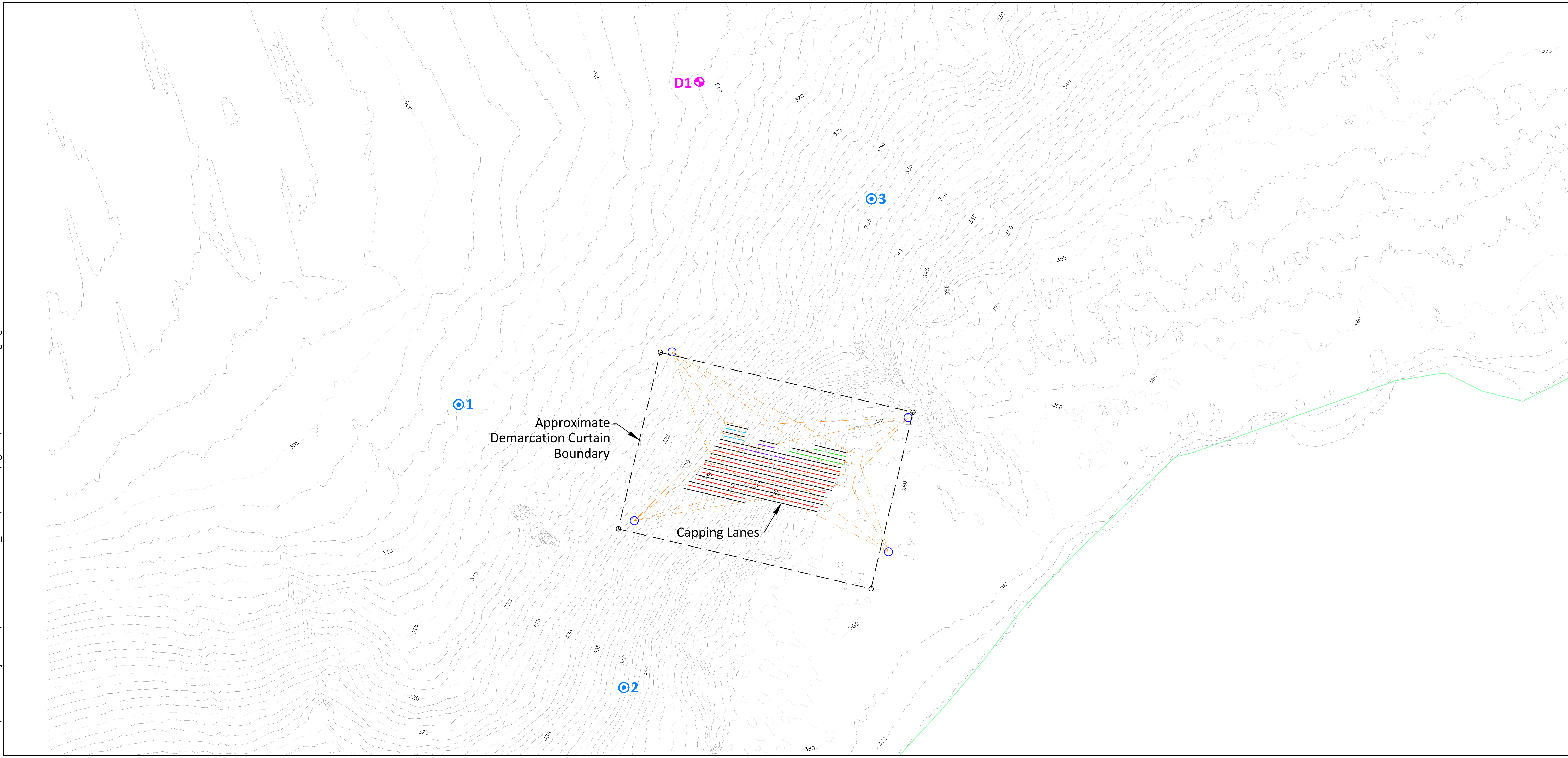


Figure B-14

Total Suspended Solids (TSS) and Turbidity Results during Bulk Sediment Sampling Event
Water Quality Management and Monitoring Plan
Onondaga Lake



L:\AutoCAD Project Files\010139-ONONDAGA_LAKE\01013902\Figures\01013902-RP-19.dwg Fig-B-15

Jan 20, 2012 12:38pm ghowell

SOURCE: Bathymetric data performed by CR Environmental, INC. 2005
HORIZONTAL DATUM: New York state plane, central zone, North American datum of 1983 (nad83), U.S. survey feet.
VERTICAL DATUM: North American vertical datum of 1988 (NAVD88), U.S. survey feet.

LEGEND:

Capping Lanes

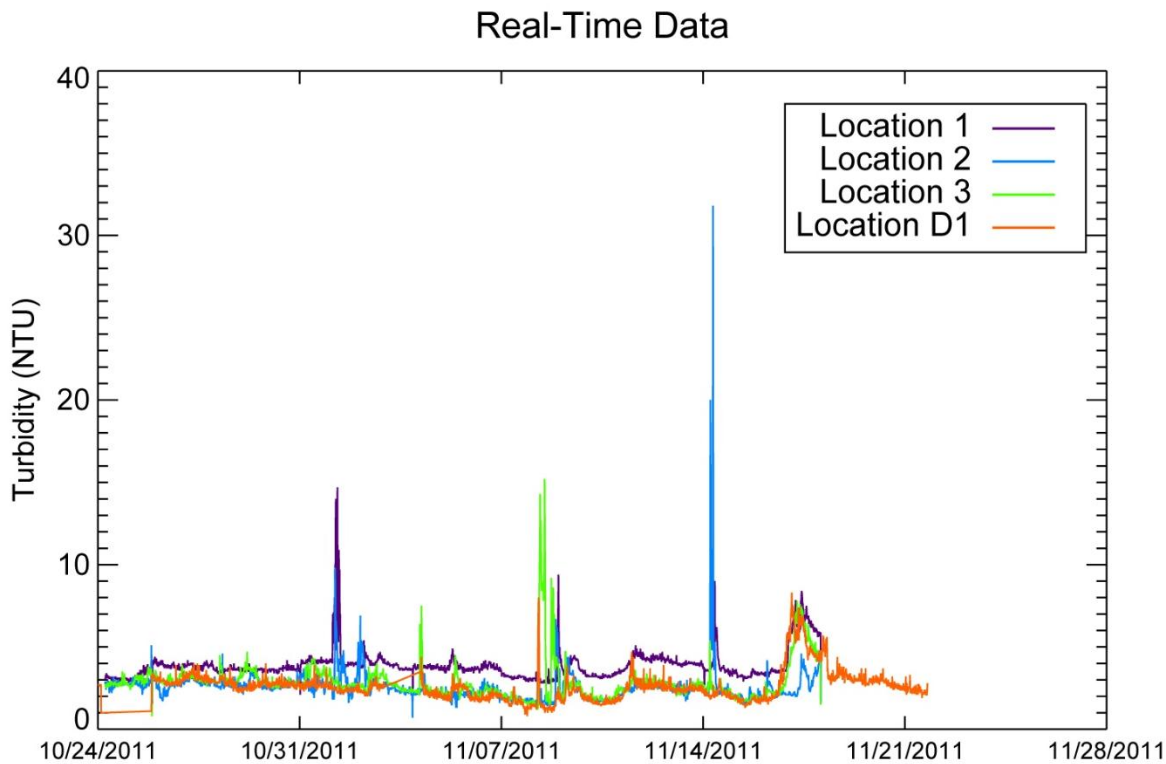
1 Compliance Monitoring Station

2 Performance Monitoring Station

0 250
Scale in Feet

ANCHOR QEA

Figure B-15
Capping Field Demonstration Water Quality Monitoring Locations
Water Quality Management and Monitoring Plan
Onondaga Lake



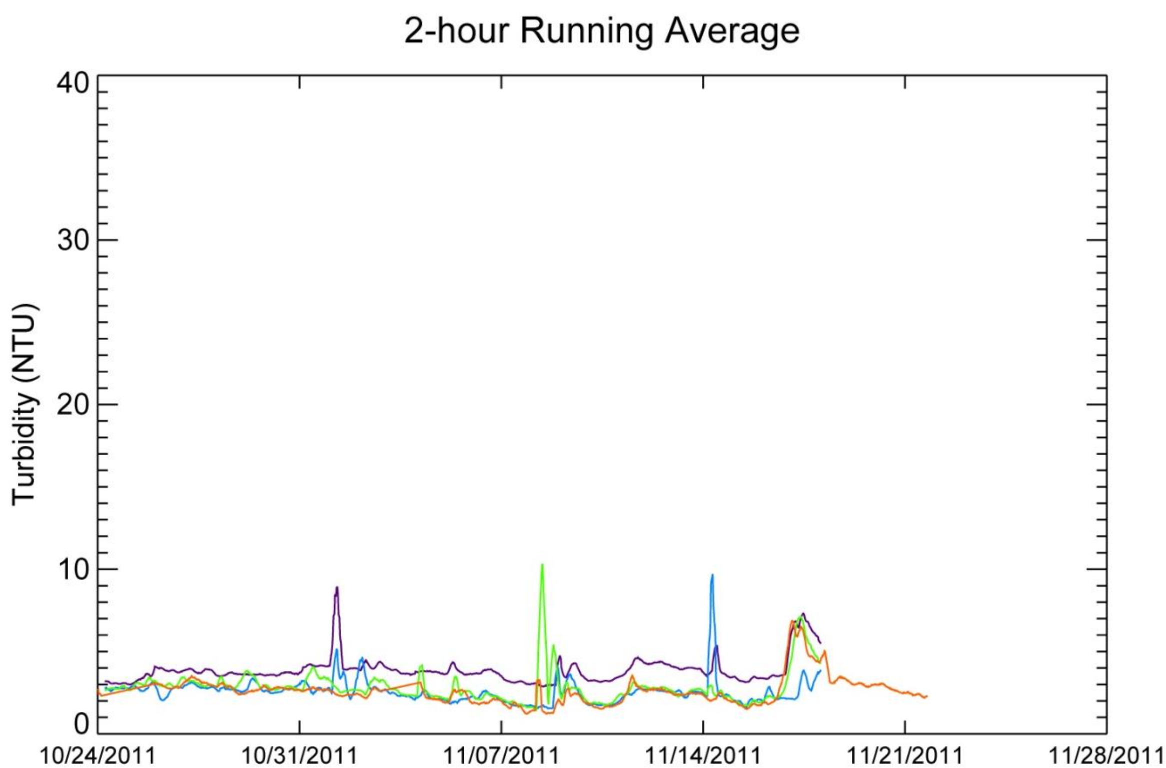


Figure B-16
Turbidity Measurements during Capping Field Demonstration
Water Quality Management and Monitoring Plan
Onondaga Lake