Monitoring to Address 7 of 11 BUI's – Milwaukee River Estuary AOC

Task 1: Fish Community Surveys

Quality Assurance Project Plan

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TABLE OF CONTENTS

Distribution List

Each person listed on the approval sheet and each person listed under Project Organization will receive a copy of this Quality Assurance Project Plan (QAPP). Individuals taking part in the project may request additional copies of the QAPP from personnel listed under Project/Task Organization.

Executive Summary

The Milwaukee River Watershed Fish Passage Program (Program), a component of the Ozaukee County Planning and Parks Department's Ecological Division, and its project partners will begin activities during 2011-2012 (Project) to address seven of the Milwaukee Estuary Area of Concern (AOC) Beneficial Use Impairments (BUI's) and move toward proposed BUI Delisting Targets. These activities are federally funded through the Great Lakes Restoration Initiative (GLRI) and administered by the US EPA under grant # GL-00E00607-0, entitled "Monitoring to Address 7 of 11 BUI's – Milwaukee River Estuary AOC". The Project includes water quality, sediment, and fish surveys and analyses in portions of the AOC within Ozaukee County and other relevant reaches of the Milwaukee River Watershed in Ozaukee County. Significant benefits for portions of the AOC far beyond Ozaukee County are anticipated. This QAPP documents the work plan and quality control procedures for Task 1, Fish Surveys, under the aforementioned grant.

A. Project Organization

Personnel involved in Project implementation are listed in Table 1. Figure 1 illustrates the Project personnel hierarchical structure.

Table 1: Project Implementation Personnel

Individual	Role in Project	Organizational Affiliation
Rajen Patel	Project Officer	U.S. Environmental Protection Agency
Louis Blume	QA Manager	U.S. Environmental Protection Agency
Andrew Struck	Project Coordinator (Department Director)	Ozaukee County Planning and Parks Department
Thomas Dueppen	QA/QC Manager/Officer (Planning & Parks Specialist)	Ozaukee County Planning and Parks Department
Matt Aho	Fish Passage Program Manager	Ozaukee County Planning and Parks Department
Ryan McCone	Fish Passage Program Assistant	Ozaukee County Planning and Parks Department
Luke Roffler	Fish Passage Program Assistant	Ozaukee County Planning and Parks Department
Cynthia DeGroot	Office Assistant	Ozaukee County Planning and Parks Department
Kevin Hensiak	Fish Passage Program Intern	Ozaukee County Planning and Parks Department
Steven Kunst	Fish Passage Program Intern	Ozaukee County Planning and Parks Department

The EPA Project Officer will be responsible for the following activities:

- Review and approval of initial QAPP and subsequent versions
- Review and approval of all quarterly, semi-annual, and financial reporting

The EPA QA Manager will be responsible for the following activities:

- Review and approval of initial QAPP and subsequent versions

The Ozaukee County Planning and Parks Director (Project Coordinator) will be responsible for the following activities:

- Coordinate QAPP development and implementation with primary stakeholders
- Review and maintain official, approved QAPP (long-term retention policy)
- Issue quarterly and annual reports to the U.S. EPA

The Ozaukee County Planning and Parks Specialist (QA/QC Manager/Officer) will be responsible for the following activities:

- Administer QAPP quality control
- Coordinate geo-spatial data collection and transfer to partners
- Coordinate Ozaukee County GIS equipment calibration and/or maintenance

The Fish Passage Program Manager will be responsible for the following activities:

- Field team leader
- Develop amended QAPP
- Coordinate all field activities and assist Planning and Parks Specialist (QA/QC Manager/Officer) with field data acquisition
- Assist the Planning and Parks Director (Project Coordinator) with coordination of all QAPP development, coordination of stakeholder input

The Ozaukee County Program Assistants will be responsible for the following activities:

- Assist the Program Manager with field data collection
- Data processing, review, analysis, evaluation, and reporting

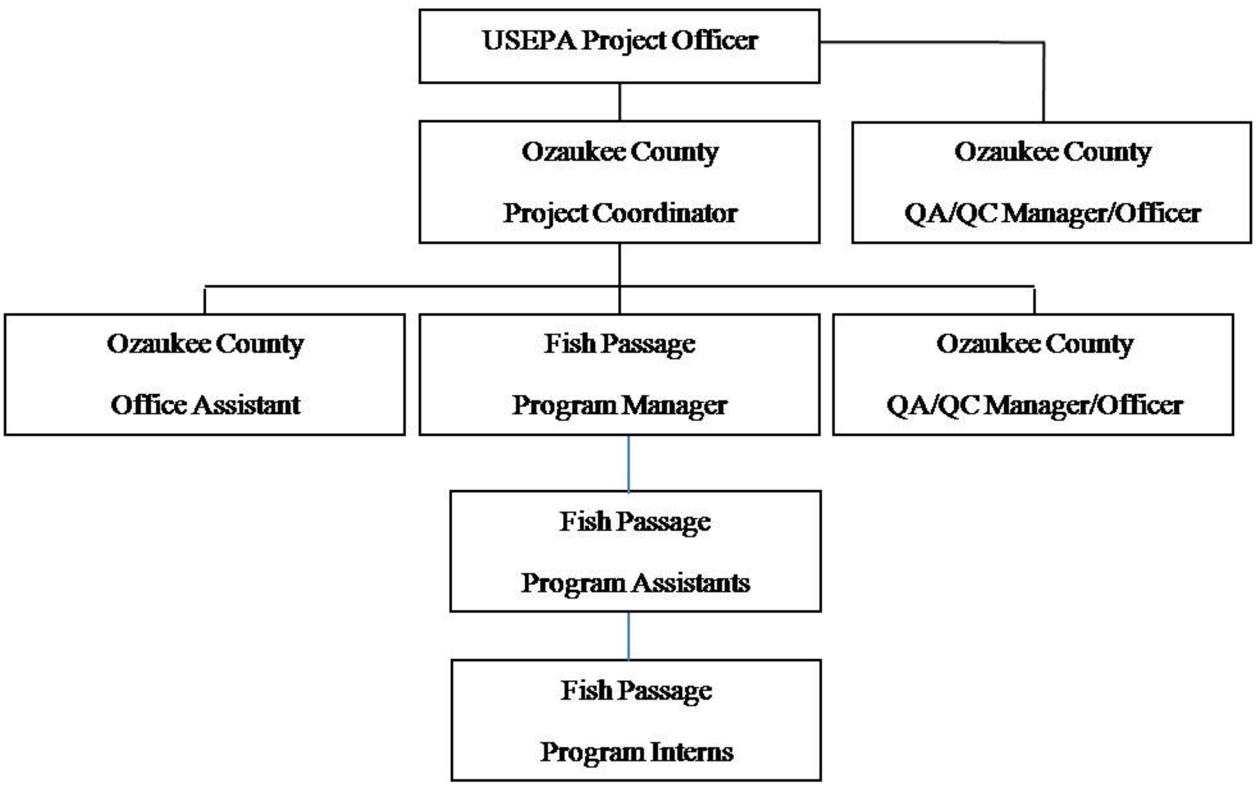
The Fish Passage Office Assistant will be responsible for the following activities:

- General administrative assistance
- Materials and supplies purchasing
- General reporting assistance to the Planning and Parks Director (Project Coordinator) and Program Manager

The Fish Passage Program Interns will be responsible for the following activities:

- Assist the Program Assistants with field data collection

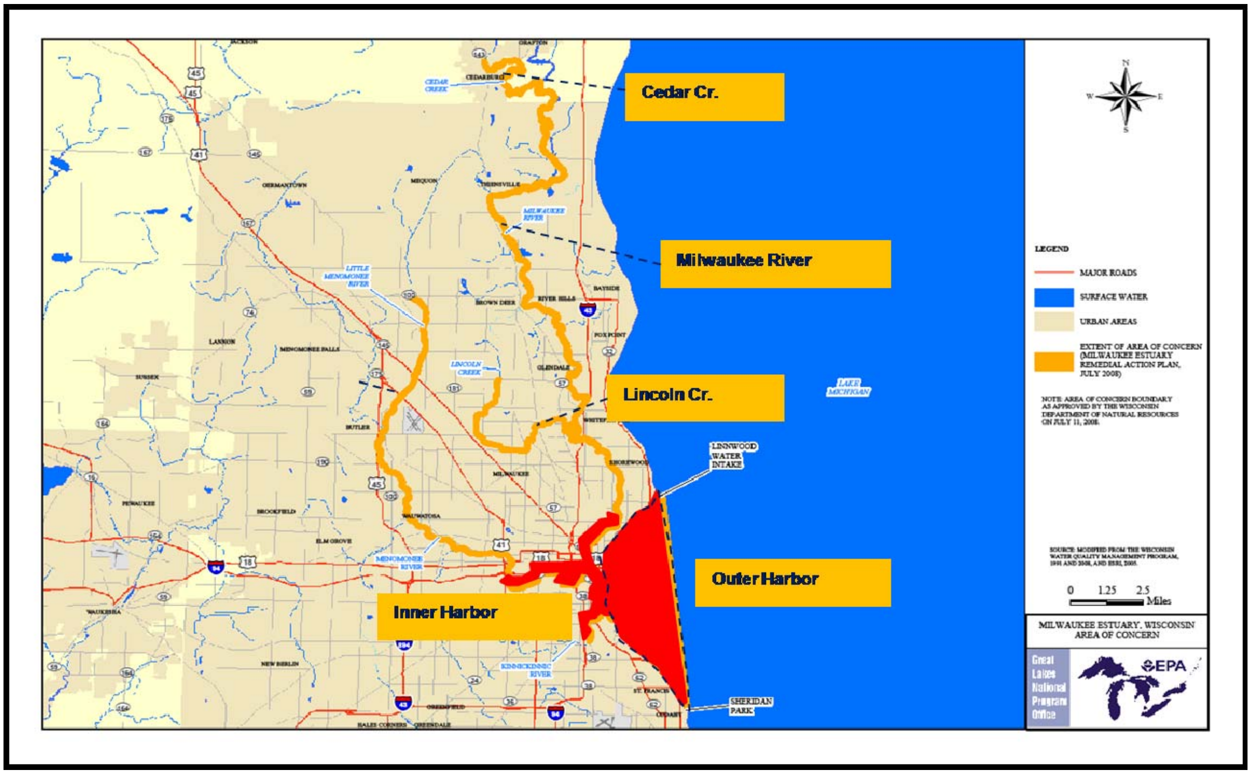
Figure 1: Project Organizational Chart



Problem Definition/Background:

The Milwaukee Estuary was designated an Area of Concern (AOC) during the 1980s due to historical modifications and pollutant loads. The Milwaukee Estuary Remedial Action Plan and Delisting Targets Report were subsequently released and updated (SEH and ECT 2008). They document 11 beneficial use impairments (BUIs) effecting the AOC as well as proposed delisting targets and actions for each BUI. The AOC includes the Milwaukee harbor and estuary, near shore areas of Lake Michigan, the Kinnickinnic and Menomonee Rivers, and portions of the Milwaukee River Watershed in Milwaukee and Ozaukee Counties (Figure 2).

Figure 2. Milwaukee Estuary Area of Concern



Ozaukee County (the County) will sample and assess existing fish communities and potential native indicator fish species populations in Ozaukee County portions of the Milwaukee River Watershed (Becker 1983; Greene 1935; Holey 2000; SEWRPC 2007; Zollweg et al. 2003). Through a measured, scientific approach this will serve as a pilot project that begins generating information that may, to certain degrees, be a suitable guide for subsequent efforts targeting two AOC BUIs identified by the WDNR and USEPA, specifically:

- Degradation of Fish and Wildlife Populations
- Degradation of Fish and Wildlife Habitat

A number of specific BUI delisting targets and actions established in the most recent Milwaukee Estuary AOC report guided Project goal determinations (SEH and ECT 2008). These delisting targets and actions included:

- Establishes site specific local population targets for native indicator fish and wildlife species within the AOC.
- Populations for native indicator fish species are statistically similar to populations in reference sites with similar habitat but little to no contamination.
- Determine population trends for native fish species in the AOC.
- A local fish and wildlife habitat management and restoration/rehabilitation plan has been developed for the entire AOC that, amongst other things, establishes site-specific habitat and population targets for fish and wildlife species within the AOC.
- The programs and actions necessary to accomplish the recommendations identified in the fish and wildlife management and restoration plan (see above) are implemented, and modified as needed to ensure continual improvement.

Ozaukee and Milwaukee Counties each contain a portion of the Milwaukee Estuary AOC. These two counties also contain 55 miles of mainstem Milwaukee River channel, approximately 28 miles (50.9%) of which is in the AOC and 37 miles (67.3%) of which are in the Project Area. Free flowing channel comprises 83.6% (46 miles) of the 55 mainstem river miles, with only 16.4% being comprised of standing water in the Bridge Street Dam (1.0 mile, 1.8%) and Mequon-Thiensville Dam (5.5 miles, 10%) Impoundments or potentially standing water in the Estabrook Dam (2.5 miles, 4.5%) Impoundment (NOAA 2010; WDNR 2005). Further, the Estabrook Dam Impoundment is currently dewatered under state order, thus increasing the total proportion of non-impounded, free-flowing reach to 88.2%.

The Environmental Assessment for Fish Passage in the Milwaukee River Watershed Project presents fish community data collected by the WDNR in impounded and free-flowing portions of the Milwaukee River in Ozaukee County (NOAA 2010). Specifically:

- Sampled free-flowing reaches contained 25 native fish species (83% of the total catch) while sampled impoundments contained only 8 native species (23% of the total catch). That is more than a three-fold difference in native fish species richness.
- The relative abundances of all fish species and native fish species were well over twice as great in free flowing reaches as in sampled impoundments.
- Common carp (*Cyprinus carpio*), an invasive, non-native "tolerant" species were relatively scarce (17% of the total catch) in sampled free-flowing reaches. In fact, in one free flowing reach (i.e., downstream of the now former Lime Kiln Dam impoundment) common carp were absent altogether. Conversely, they comprised the overwhelming majority (77%) of captured fish in sampled impoundments.

Many BUI delisting targets and actions place emphasis on restoring native indicator fish species in the AOC (SEH and ECT 2008). The information available to date suggests native fish species prefer lotic habitats in the Ozaukee County portions of the Milwaukee River.

<u>Milwaukee Estuary AOC Polychlorinated Biphenyl Contamination in Ozaukee County</u>

Cedar Creek, a major Milwaukee River Watershed tributary in Ozaukee County was historically contaminated with polychlorinated biphenyls (PCBs) from industrial sources in and near Cedarburg, Wisconsin (Baird and Associates Undated). This contamination resulted in an upstream extension of the original Milwaukee Estuary AOC boundary to include contaminated portions of Cedar Creek and all of the mainstem Milwaukee River reaches downstream of the terminal Cedar Creek confluence (SEH and ECT 2008; Figure 2). The Milwaukee River Watershed upstream of the terminal Cedar Creek confluence does not have known historical sources of PCB contamination. PCBs typically adhere to fine sediment particles, a condition that tends to accumulate the contaminant in dam impoundments and other fine sediment accretion locations. The Environmental Assessment for Fish Passage in the Milwaukee River Watershed Project presents WDNR sediment sampling results for two Milwaukee River impoundments within Ozaukee County located upstream of the Cedar Creek terminal confluence (NOAA 2010). Specifically, sediment sampled in the Lime Kiln Dam and Bridge Street Dam impoundments were not PCB contaminated. As such, Project fish community sampling conducted in Milwaukee River reaches upstream of the terminal Cedar Creek confluence will be referred to as sampling "uncontaminated" reaches. Conversely, Project fish community sampling conducted in Milwaukee River reaches downstream of the terminal Cedar Creek confluence will be referred to as sampling "contaminated" reaches.

<u>Potential Milwaukee River Reference Conditions</u>

Program staff discussions with WDNR staff directly involved with the AOC revealed WDNR interest in potentially using "uncontaminated" Ozaukee County reaches (i.e., those outside the AOC) as "reference reaches" or benchmark control sites for evaluating future restoration activities in other portions of the AOC (M. Burzynski and M. O'Shea, WDNR, personal communication, December 17, 2010). Similarly, it has been suggested that data gathered from the Project's "uncontaminated" reaches could potentially provide initial guidance to subsequent projects designed to establish restoration "targets" for BUI delisting efforts. It should be noted that this Project does not include an experimental design intended to provide inferential statistics applicable to the entire AOC and though the validity of such inferences could be tested, it is not a Project objective. With that disclaimer, Program staff members agree that with proper conditions and study designs (and taking into consideration a seemingly deficient number of alternatives) these data uses may be possible. Such comparisons and target values may only be valid for evaluating impacts associated with sediment contamination and in cases where Ozaukee County sites are adequately representative of habitat (or potential habitat) in other AOC sites targeted for restoration. The estuary, harbor, near shore areas of Lake Michigan, and potentially non-wadeable reaches of the Milwaukee River (i.e., downtown Milwaukee) are likely important exceptions.

Another important point is that current habitat assemblages and fish communities in Ozaukee County "uncontaminated reaches" most likely do not represent historical, pre-disturbance (i.e., "ideal") conditions. Site-specific and systematic improvements to fish habitat and populations in the Milwaukee River Watershed and AOC (particularly in regard to potential native indicator species) should lead to corresponding improvements in Ozaukee County "uncontaminated reaches". As such, Program staff members suggest using selected "uncontaminated reaches" as such for current conditions in the Milwaukee River Watershed and AOC. To the degree practicable, the following are also suggested:

- Ozaukee County and other AOC sampling results be compared and contrasted to available standardized fish population data (Brouder et al 2009).
- A "sliding scale" approach to the accepted habitat and fish community qualities that constitute a "reference" condition. The cumulative effects of systematic restoration of the watershed and AOC should ultimately result in improvements to fish and habitat far beyond specific treatment sites. As such, it is hoped that over time actual conditions (e.g., water quality, native species abundance, etc.) in "uncontaminated" reaches will increasingly resemble those of the pre-disturbance watershed thus increasingly refining the standards by which remediation activities and treatment sites are assessed and evaluated. Maintaining current standards in the future would ultimately be counterproductive.

<u>Potential Native Indicator Fish Species</u>

A primary AOC BUI remediation target is to establish site specific local population targets for native indicator fish and wildlife species within the AOC; however, native species suited to be "indicators" are not identified. Regardless, great potential exists for improving native fish species (indicators or otherwise) presence, abundance, and diversity in the Project Area, both within and outside the AOC. Much of the Milwaukee River Watershed in Ozaukee County has recently been managed to improve biological connectivity. Further, municipal and county efforts to improve water quality have been ongoing for decades. Specific native species, such as northern pike (*Esox lucius*), walleye (*Stizostedion vitreum*), and lake sturgeon (*Acipenser fulvescens*) are thought to exist in only very limited numbers in the AOC and Project Area. Despite some select species stocking efforts, dramatic abundance increases for these native species are unlikely during the next few years due to slow growth rates, low initial population abundances, inconsistent recruitment, and/or other factors. As such, other suitable native species are suggested as potential "indicators" of overall fishery condition, including smallmouth bass (*Micropterus dolomieu*), golden redhorse (*Moxostoma erythrurum*), and to a lesser extent greater redhorse (*M. valenciennesi*). Milwaukee River electrofishing by WDNR and Ozaukee County staff during 2010 confirmed the presence of these native species. Further, Lyons (1992) classifies smallmouth bass and greater redhorse as "intolerant" of environmental degradation. Finally, each of these three species preys on organisms inhabiting the benthic surface where contact and uptake of contaminated sediments is likely and degradation to benthos would be directly detrimental. As such, they are proposed as potential native indicators of fish habitat and population degradation. Positive presence/absence and relative abundance trends detected for these species, as well as for other, seemingly less abundant potential native indicator species (e.g., northern pike, walleye, lake sturgeon, etc.) could support the effectiveness of actions targeting delisting of BUIs.

Project Objectives

Project objectives, derived directly from salient points of the WDNR/USEPA BUI delisting targets and actions, include:

1. Collecting information about existing fish communities and potential native indicator fish species in up to six Ozaukee County reaches of the Milwaukee River within and outside the Milwaukee Estuary AOC (Project Area) to:
   i. Compare and contrast existing Project Area fish populations within and outside the Milwaukee Estuary AOC using sample statistics for descriptive, quantifiable population or community characteristics, metrics, and/or indices (Guy and Brown 2007; Kohler and Hubert 1993; Lyons 1992; Murphy and Willis 1996).
   ii. Compare and contrast existing fish community and population samples in the Project Area to standard sampling indices or other suitable references to the degree practicable in lieu of a known, suitable control or reference system (Brouder et al. 2009; Lyons 1992)
   iii. Collect baseline data to facilitate trending of sample statistics of fish population and/or community characteristics in the Project Area, concentrating on potential native indicator fish species.
2. Collecting some of the baseline information beneficial to the development and implementation of a fish and wildlife management and restoration plan for the AOC.

Applying robust statistical inferences to the entire Project Area or AOC is not a Project objective. This Project is an initial effort or pilot project to describe the fish communities and potential native indicator fish species populations sampled in the Project Area, both qualitatively and with some quantified sample statistics. Estimates of sample variability for many of the fish population and community characteristics listed late in this section may prove useful for estimating requisite sample sizes for subsequent projects. Further, WDNR staff indicated interest in examining the potential to infer Project findings to the Project Area and/or AOC in a statistically valid manner (A. Fayram and D. Dinsmore, Wisconsin Department of Natural Resource, personal communication, March 18, 2011). Such examination of Project data may be made in a limited capacity, however, that exercise is not a direct Project objective and is not a focus of the Project or this QAPP.

Estimating total abundance values for potential native indicator species in the Project Area and/or greater Milwaukee Estuary AOC is beyond the scope of this "monitoring" project. More specifically:

- Limited Project duration and resources are unlikely to accommodate adequate sample sizes to reliably infer absolute abundance estimates or make possible truly random sample site location.
- Program staff members are not aware of existing data sufficient to ensure representative sample site selection in terms of habitat quality and other varying factors.
- Practicable means of effectively isolating whole Milwaukee River reaches for depletion sampling and/or closed-population mark-recapture studies are not available.
- Program staff members are not aware of population dynamics information (i.e., mortality rates, immigration rates, emigration rates, etc.) for Milwaukee River fish populations sufficient for use in open-population mark-recapture designs.

The Project will yield significant, relative abundance data (e.g., catches per unit time, stream length, and water surface area) and other sample statistics for comparing, contrasting, and trending fish communities and potential native indicator species populations in sampled reaches of the Project Area (described more fully below). The quality and completeness of generated data are consistent with that previously collected by the WDNR in Ozaukee County portions of the mainstem Milwaukee River (NOAA 2010). Further, collected data will facilitate actions to address five BUI Delisting Targets by:

- Establishing preliminary estimates of site specific relative abundance targets for potential native indicator fish species in potentially "contaminated" reaches based on results from a limited number of samples collected from "uncontaminated" reaches in the Project Area.
- Allowing sample statistic comparison and contrast for potential native indicator species in potentially "contaminated" (e.g., PCBs) and "uncontaminated" reaches using relative population parameters, metrics, and indices.
- Making possible (to the degree practicable) comparison and contrast of sample statistics for potential native indicator species in potentially "contaminated" (e.g., PCBs), "uncontaminated"

reaches, and regionally-relevant population parameters (e.g., length-frequency distribution) and indices (i.e., IBI).

- Allowing initiation of potential native fish species sample statistic trending (e.g., relative abundance, length-frequency distribution, species richness, community diversity, guild distributions, etc.) within the Project Area of the AOC.
- Providing a pilot project that may assist subsequent projects by:
  - Suggesting potential native indicator species for population assessments, trending, and monitoring. Potential criteria may include fish species that are:
    - Native
    - Present in the Milwaukee River in detectable densities
    - Present in wadable portions of the Milwaukee River during the June 1 – September 30 sampling season
    - Relatively long-lived (i.e., life spans greater than a year or two)
    - Intolerant of environmental degradation (Lyons 1992)
    - Piscivorous and/or invertivorous
    - Associated with feeding along the benthic surface
  - Assessing/monitoring populations in "contaminated" reaches and uncontaminated "uncontaminated" reaches.
  - Providing sample variance values for use in an experimental design suited to produce inferential statistics.
- Materially contributing information relevant to developing a "fish and wildlife management and restoration plan" for the greater AOC, including:
  - Serving as a methods selection and implementation pilot project for subsequent work at a much larger scale.
  - Providing initial sample estimates of relative abundance for potential native indicator species.
  - Providing baseline fish community and potential native indicator species population sample evaluation for future comparison and contrast to portions of the AOC beyond Ozaukee County with similar habitat characteristics.
  - Clarifying and/or refining our understanding of BUI impacts on Project Area (and perhaps AOC) fish communities.
  - Raising awareness of AOC concerns in Ozaukee County through public outreach opportunities.
- Contributing to implementation of the aforementioned and as yet unwritten AOC "fish and wildlife management and restoration plan" through on-the-ground data collection.

The proposed monitoring is designed to yield sample statistics valuable as preliminary guides when considering fish community and population targets and to guide and facilitate subsequent projects larger in scale and sufficient to produce inferable statistics to fish populations and communities in similar reaches of the Milwaukee River Watershed.

Data required to achieve the stated Project objectives falls into two basic categories, sampled fish community characteristics and sampling effort. Fish community characteristics determined through direct measurement or observation for all samples will include:

1. Total species richness (i.e., the identification and enumeration of all sampled fish species)
2. Native species richness (i.e., the identification and enumeration of all sampled native fish species)
3. Familial richness (i.e., the identification and enumeration of all species with sampled fish families)
4. Intolerant species richness (i.e., the identification and enumeration of all sampled fish species classified as "intolerant" by Lyons (1992))
5. Total sample abundance (i.e., the enumeration of all fish in a sample)
6. Species-specific sample abundance (i.e., the enumeration of all individuals of a given species in a sample)
7. Tolerant species abundance (i.e., the enumeration of all individuals belonging to species classified as "tolerant" by Lyons (1992))
8. Species-specific individual length (cm) distribution (i.e., the distribution of individual fish lengths within each species included in a sample)

9. Sample abundance distribution amongst feeding and spawning guilds (Lyons 1992)
10. Total species frequency of external deformities and lesions (i.e., the frequency of external deformities and lesions across all species within a sample)
11. Native, species-specific frequency of external deformities and lesions (i.e., the frequency of external deformities and lesions within each sampled native fish species)

Sampling effort will be gauged in three ways, specifically:

1. Sample collection duration (i.e., the enumeration of hours expended sampling each site)
2. Sample site length (i.e., the channel centerline length measured in meters)
3. Sample site water surface area (i.e., measured in square meters, this is the channel centerline length multiplied by an estimate of average channel width determined to the nearest meter using the Ozaukee County GIS)

The above described data is intended for use in analyzing and evaluating:

1. Community level sample statistics, including sample means and variances for:
   i. Total Relative Abundance (i.e., Catch Per Unit Effort)
   ii. Native Species Relative Abundance (i.e., Catch Per Unit Effort)
   iii. Total Species Richness
   iv. Native Species Richness
   v. Shannon-Wiener Diversity Index – All Species (Kwak and Peterson 2007)
   vi. Shannon-Wiener Diversity Index – Native Species (Kwak and Peterson 2007)
   vii. Index of Biotic Integrity (Lyons 1992)
2. Population level sample statistics for potential native indicator species, including sample means and variances for:
   i. Species-Specific Relative Abundance (i.e., Catch Per Unit Effort)
   ii. Length-Frequency Distribution (Brouder et al. 2009)
   iii. Frequency of External Deformities and Lesions (i.e., Percentage of Species Catch)

Fish community sampling will generally conform to procedures developed by Lyons (1992) and will consist of single pass electrofishing with two tow barge style pulsed DC electrofishing units:

1. In wadeable, free-flowing mainstem reaches of the Project Area
2. During daylight hours and at or near baseflow conditions for consistent, maximized catch efficiency and operator safety
3. Using two tow barge electrofishing units (pulsed DC) with multiple operators
4. Along 400 meter long river reaches
5. During ice-cover free seasons of the year

Data quality objectives include sampling representative lotic Milwaukee River habitats in the Project Area, sample completeness and precision, data accuracy, and comparability of data within and between sampling sites.

<u>Representativeness</u>

Large sample sites (e.g., at least 400 meters in river length) far exceed site length minimums set by Lyons (1992) for fish community sampling in large streams and rivers and will ensure that representative habitats are included in each sampling effort. The large sample site lengths and resultant assurance of habitat representativeness negates the need for detailed habitat mapping and/or evaluation. Further, the primary traits represented by sample groups are the potential presence or lack of potential presence of PCB contaminants in sampled reaches, not specific habitat feature assemblages.

<u>Data Accuracy</u>

Data accuracy for species identification will be ensured by having all identification done by Program biologists familiar with the Milwaukee River Watershed fish assemblage and with experience sampling it. Fish identification assistance will be provided by the WDNR's fish guide for southeastern Wisconsin (Matrise Undated).

Sampling Completeness, Precision, and Comparability of Data

Sampling completeness and precision, as well as comparability of data within and between sites, will be achieved by following an established, accepted fish community sampling protocol led by Program staff familiar with both the protocol and the Milwaukee River Watershed fish assemblage (Lyons 1992; WDNR Undated). The prescribed protocol is also congruent with WDNR fish sampling efforts.

Project/Task Description and Schedule

Tasks

The fish communities in six accessible, wadeable reaches within and outside AOC portions of the Project Area will be sampled. Fish collection will target all species present and will generally conform to the "all species" portion of the WDNR protocol for assessing smallmouth bass in wadeable streams (WDNR Undated). More specifically, sample site lengths will be 35-times mean bankfull channel width with a 400 meter length maximum (Lyons 1992; WNDR Undated). Program staff recognize that 35-times mean bankfull width will almost certainly exceed 400 meters at all or most sample sites, however, Lyons (1992) allows for minimum site lengths as low as 150 meters when sampling in larger streams and rivers. Site-specific constraints may affect site selection and length, although practicable efforts will be undertaken to avoid or mitigate this.

Of the six reaches sampled, three will be within the AOC portion of the Project Area (i.e., "Contaminated Sites") and three outside of it (i.e., the "Uncontaminated Sites" discussed in detail below). To the degree practicable given available resources, field conditions, and operator safety each site will be sampled up to four times. The proposed sampling sites are shown in Figure 1 and include:

- "Contaminated" Sites
  - Between the Cedar Creek terminal confluence and County Highway C (Pioneer Road)
    Township 10N, Range 21E, Section 36, Southwest Quarter of Northeast Quarter
  - Downstream of County Highway C (Pioneer Road)
    Township 9N, Range 22E, Section 6, Northwest Quarter or Northwest Quarter
  - Adjacent to the Trinity Creek Terminal Confluence
    Township 9N, Range 21E, Section 35, Southeast Quarter of Northeast Quarter
- "Uncontaminated" Sites
  - Adjacent to Firemen's Park in the Village of Newburg
    Township 11N, Range 20E, Section 12, Southwest Quarter of Northeast Quarter
  - Adjacent to Ehlers Park in the Town of Saukville
    Township 11N, Range 21E, Section 23, Northeast Quarter of Northeast Quarter
  - Former Lime Kiln Dam impoundment (further discussed below)
    Township 10N, Range 21E, Section 25, Northwest Quarter of Northeast Quarter

The above list may be revised pending preliminary site investigations conducted to determine site access and sampling feasibility, input from or unanticipated sampling effort overlap by Program partners, and/or other factors not presently known. Further, WDNR SER Fisheries staff have indicated that they tentatively plan to conduct baseline fish community sampling in three reaches near Grafton, WI (e.g., north of the Ozaukee Interurban Trail Bridge, between Falls Road and Bridge Street Dam, and immediately downstream of the former Lime Kiln Dam). 2010 electrofishing and recreational angler catches witnessed by Program staff indicate the reaches immediately downstream of Bridge Street Dam support desirable fish populations. These sites were excluded from the Project sampling site list above because comparable data from 2011 WDNR baseline monitoring will likely be available. However, the former Lime Kiln Dam impoundment was included for two reasons. First, if anticipated WDNR baseline monitoring does not occur during 2011, the Program will acquire data from an adjacent reach of the River. Second, although the former impoundment will still be recovering during 2011 and 2012 in terms of riparian habitat restoration and riverbank vegetation re-establishment, its position relative to remnant, native species populations and good benthic habitat quality suggest it may be colonized quickly. As such, it may provide important snapshots of fish community re-establishment following dam removal that can be compared to WDNR data presented in the Environmental Assessment for Fish Passage in the Milwaukee River Watershed Project (NOAA 2010; Schmaus 1987).

Schedule

All sampling will be completed during periods of ice-free flow during 2011 and 2012, concentrating efforts to the degree practicable on the period from June 1 to September 30 of each year. Flood events, resource limitations, field equipment issues, and other uncontrollable factors may affect the sampling schedule, making more exact schedule predictions difficult. To the degree practicable, Program staff will try to avoid or mitigate any negative affects to the proposed schedule.

All field data entry into the Ozaukee County fish community sampling spreadsheet will be concurrent with the fish community sampling season (i.e., June 1 through September 30).

A final report of sampling data, findings, and conclusions will be submitted to the USEPA by December 31, 2012.

Special Equipment or Supplies

Routine supplies and equipment common to fish surveying activities used during this Project include, but are not limited to:

- Dip nets
- Buckets
- Fish boards (i.e., to measure lengths)
- Battery-operated aerators
- Clip boards
- Field data forms
- Pencils
- Weight Scales
- Surgical Fin Clippers

Equipment with greater potential to affect sample quality include two ETS Electrofishing tow barge shocking units that will be used to sample fish and a Topcon GRS-1 handheld GPS unit that will be used to document sample site extents with sub-foot accuracy. The Program maintains a hard copy and digital file of the Topcon GRS-1 and TopSurv software user manual. The online version is located at http://www.top-survey.com/top-survey/downloads/TpSrv_rm.pdf..

Personnel, Special Training Requirements or Certifications

Andrew Struck has a M.S. in Applied Ecology/Regional Planning from Indiana University - Bloomington and more than 20 years of experience. He is the Director of the Planning and Parks Department for Ozaukee County and specializes in regional planning, natural resource planning, protection and restoration, education, park and open space design and implementation. He has lead collaborations with numerous governmental agencies, non-governmental organizations and private sector firms on planning and natural resource design, protection, education and restoration projects including: the USEPA, NOAA, US FWS, WDNR, Wisconsin Coastal Management Program, WisDOT, and other conservation organizations. He is the Program Director and main point of contact for the federally funded Milwaukee River Watershed Fish Passage Program. Andrew also served as program director for the nationally recognized, USEPA-funded sustainable brownfield redevelopment of the Menomonee River Valley in Milwaukee, Wisconsin.

Matt Aho has a M.S. in Urban Planning from the University of Wisconsin-Milwaukee and has extensive experience in watershed planning and restoration activities. As manager of the Milwaukee River Watershed Fish Passage Program, he is involved in landowner contacts, education and outreach, permitting, drafting environmental assessments, volunteer training, bid solicitation, proposal review, and high-level reporting on all program progress. He actively managed the Milwaukee Estuary AOC BUI Delisting Targets report, soliciting comments and feedback from area and national experts through technical advisory team processes. Matt also has experience with brownfield restorations, stormwater management facilities, and coordinating community clean-ups and events.

Tom Dueppen has a M.S. in Environmental Science/Resource Management from the University of Wisconsin - Green Bay, is a registered Professional Geologist (PG), and has more than 14 years of experience in conducting group meetings and in presenting research results and environmental issues before the general public, clients, and other professionals. He has conducted many investigations and numerous comprehensive planning reports. His experience in report writing includes associated maps and supporting tables and graphs. Tom's experience includes directing remediation activities and leading public education meetings. Tom has assisted the Milwaukee River Watershed Fish Passage Program with numerous tasks including survey and site inspections, GIS mapping, GPS utilities, environmental site assessments, groundwater and soil sampling, geophysical testing, and numerous other tasks.

Ryan McCone has a M.S. in Biological Science from California University of Pennsylvania and is a member of the American Fisheries Society. He has regularly led or contributed to projects involving stream ecology and aquatic habitat evaluation and restoration/reclamation planning. He has led or contributed to several aquatic resources improvement projects in the Great Lakes Region, was directly involved in Ozaukee County's *Stream Passage Impediments and Aquatic Habitat Fragmentation Inventory*, and now serves as Program Assistant for the Milwaukee River Watershed Fish Passage Program. In his current capacity, Ryan is involved with barrier removal oversight, data management, engineering plan review/approval, permitting, landowner contacts/coordination, public outreach and education, technical document composure and editing, work order review, fish community monitoring, and field investigation.

Luke Roffler has a M.S. in Natural Resources-Fisheries from the University of Wisconsin-Stevens Point and several years of experience in natural resources management, particularly fisheries monitoring and research. Following his research into genetic diversity concerns at various Great Lakes lake sturgeon rearing facilities, Luke worked in fisheries management with WDNR. He has experience with a wide array of fisheries monitoring approaches, as well as project development, grant procurement, data management and quality oversight, habitat improvement, invasive species control, volunteer and cooperator coordination, and field crew oversight. Through his lake sturgeon research and fisheries monitoring efforts on the Milwaukee River, Luke has been directly involved with Milwaukee River restoration even prior to becoming a Program Assistant in the Milwaukee River Watershed Fish Passage Program. Luke is now involved with fish barrier inspection and removal planning, engineering plan review and approval, fish community monitoring, coordination of contractors, drafting and review of technical documents, and equipment coordination.

Cindy DeGroot has over 30 years work experience in various positions in both private sector and government employment. As Contracting Secretary for Laidlaw Environmental Services, Inc., she was responsible for error free proposal preparation to insure the company's qualification for the solicitation process. As Laidlaw's Transportation Secretary, she was responsible for scheduling and dispatching approximately 40 hazardous waste pickup and disposals at various government facilities across the U.S. on a weekly basis. She has worked as the Town Board Administrative Assistant to both the Town of Grafton, WI and the Town of Saukville, WI assisting the general public and working directly with the Town Chairman, Supervisors, Engineers, Plan Commission, Treasurer, Clerk, Town Attorney and Building Inspector with various requests, projects and meetings in addition to assisting with elections. She has been with Ozaukee County since August of 2002, initially with the Ozaukee County Sheriff's Department. In 2003, she accepted a position with Ozaukee County Land and Water Department and since November 2008 has been Office Assistant in the Ozaukee County Planning and Parks Department, providing clerical support to staff, information to the general public and county residents, and assisting in managing grants.

Documentation and Records

The following sections describe the types of records the project will generate as well as how they will be stored and information will be reported

Field Records

All fish community sampling will be documented in the field using a standardized field data form (Attachment 2). All field data forms will be kept on file in the Ozaukee County Planning and Parks Department office.

Project Records

Anticipated Project records include this QAPP and a spreadsheet to track fish community sample data. The Project Coordinator and QA/QC Manager/Officer will be responsible for maintaining this QAPP and all individuals on the distribution list will receive and file a copy. The revision number is located in the header section of this document. Subsequent QAPP revisions (if necessary) will be forwarded to all project partners in hard copy and digital (Adobe PDS) format. Fish community sample data will be entered into a single spreadsheet saved on the Ozaukee County network server, which is backed up daily. All hard copy and digital files will be shared upon request with the WDNR and USEPA.

Final Report

The Project final report will be saved in MSWord and Adobe versions on the Ozaukee County network server and in hardcopy in the Ozaukee County Planning and Parks Department. The final report will be shared with all project partners in digital and hardcopy format.

Project File Final Disposition and Record Retention

All Project files will be retained in the Ozaukee County Planning and Parks Department (hardcopy) or, if available digitally, on the Ozaukee County network server. All records will be retained according to federal grant contract requirements and/or Ozaukee County policy, whichever is most restrictive.

B. Measurement/Data Acquisition

Sample Process Design (Experimental Design)

The number (six) of fish community sampling sites and sampling frequency (up to four times) are dictated by a balance between the best biological and ecological outcome and the available funding, staffing, and timeline as described in the grant narrative. The sample design includes equal representation of Milwaukee River reaches within and outside the AOC and is based around accessible, free-flowing reaches suitable for sampling with available gear and resources and known to support native fish species (NOAA 2010). Sampling sites are dispersed throughout the Project Area; however, true sample site selection randomization is not possible due to practical concerns including site access and safety.

Additional information regarding sample site selection, sample protocol, and data collection are included in the above "Project Objectives" and "Project/Task Description and Schedule" sections.

Sampling Method Requirements

The fish communities in six accessible, wadeable reaches within and outside AOC portions of the Project Area will be sampled. Fish collection will target all species present and will generally conform to the "all species" portion of the WDNR protocol for assessing smallmouth bass in wadeable streams (WDNR Undated). More specifically, sample site lengths will be 35-times mean bankfull channel width with a 400 meter length maximum (Lyons 1992; WNDR Undated). Program staff members recognize that 35x mean bankfull width will almost certainly exceed 400 meters at all or most sample sites, however, Lyons (1992) allows for minimum site lengths as low as 150 meters when sampling in larger streams and rivers. Site-specific constraints may affect site selection and length, although practicable efforts will be undertaken to avoid or mitigate this.

All sampling will be completed during periods of ice-free flow during 2011 and 2012, concentrating efforts to the degree practicable on the period from June 1 to September 30 of each year. Flood events, resource limitations, field equipment issues, and other uncontrollable factors may affect the sampling schedule, making more exact schedule predictions difficult. To the degree practicable, Program staff will try to avoid or mitigate any negative affects to the proposed schedule.

Sampled fish community measurements and metric values will largely be "for information only" because the Project is an initial effort (i.e., a pilot project) to describe fish communities and potential native indicator fish species populations sampled in the Project Area. Further, the collected fish community data are not considered "critical" because they are not intended to drive specific contamination remediation activities.

The proposed sampling method is intended to facilitate analyzation and evaluation of:

1. Community level sample statistics, including sample means and variance estimates for:
    i. Total Relative Abundance (i.e., Catch Per Unit Effort)
    ii. Total Species Richness
    iii. Native Species Richness
    iv. Shannon-Wiener Diversity Index – All Species (Kwak and Peterson 2007)
    v. Shannon-Wiener Diversity Index – Native Species (Kwak and Peterson 2007)
    vi. Index of Biotic Integrity (Lyons 1992)
2. Population level sample statistics for proposed indicator species, including sample means and variance estimates for:
    i. Species-Specific Relative Abundance (i.e., Catch Per Unit Effort)
    ii. Length-Frequency Distribution (Brouder et al. 2009)
    iii. Frequency of External Deformities and Lesions (i.e., Percentage of Species Catch)

Fish community characteristics determined through direct measurement or observation for all samples will include:

1. Total species richness (i.e., the identification and enumeration of all sampled fish species)
2. Native species richness (i.e., the identification and enumeration of all sampled native fish species)
3. Familial richness (i.e., the identification and enumeration of all species with sampled fish families)
4. Intolerant species richness (i.e., the identification and enumeration of all sampled fish species classified as "intolerant" by Lyons (1992))
5. Total sample abundance (i.e., the enumeration of all fish in a sample)
6. Species-specific sample abundance (i.e., the enumeration of all individuals of a given species in a sample)
7. Tolerant species abundance (i.e., the enumeration of all individuals belonging to species classified as "tolerant" by Lyons (1992))
8. Species-specific individual length (cm) distribution (i.e., the distribution of individual fish lengths within each species included in a sample)
9. Sample abundance distribution amongst feeding and spawning guilds (Lyons 1992)
10. Total species frequency of external deformities and lesions (i.e., the frequency of external deformities and lesions across all species within a sample)
11. Native, species-specific frequency of external deformities and lesions (i.e., the frequency of external deformities and lesions within each sampled native fish species)

Sampling effort will be gauged three ways, specifically:

1. Sample collection duration (i.e., the enumeration of hours devoted to sampling each site)
2. Sample site length (i.e., the channel centerline length measured in meters)
3. Sample site water surface area (i.e., measured in square meters, this is the channel centerline length multiplied by an estimate of average channel width determined to the nearest meter using the Ozaukee County GIS)

Project Coordinator, Program Manager, and QA/QC Manager/Officer approval will be required for any sampling method corrective actions. Corrective action outcomes will be reported by the Program Assistants and/or Office Assistant to the Program Manager and QA/QC Manager/Officer for determination of effectiveness by comparison to relevant Project measurement / data acquisition method(s) and/or objectives. Effectiveness will be recorded as a written report to the Project Coordinator.

Analytical Requirements

Much of the data generated by the Project will be qualitative in nature and intended to facilitate preliminary, non-quantitative and non-inferential comparison and contrast of fish assemblages sampled in "contaminated" and "uncontaminated" sites of the Project Area. Some quantitative analysis will be completed, however. This analysis will be geared toward suggesting, even if only preliminarily and with some anticipated uncertainty, whether or not detectible differences exist between the sample means of community and population characteristics for sampled fish assemblages in "contaminated" and "uncontaminated" sites of the Project Area. Anticipated data collection will occur during two sampling seasons (i.e., 2011 and 2012) in both "contaminated" and "uncontaminated" sites. Proposed variables for potential analysis include fish community and potential native indicator species population characteristics, metric values, and indices values. Specifically:

1. Community level sample statistics:
    i. Total Relative Abundance (i.e., Catches Per Units Time, Site Length, and Site Water Surface Area)
    ii. Native Species Relative Abundance (i.e., Catches Per Units Time, Site Length, and Site Water Surface Area)
    iii. Total Species Richness
    iv. Native Species Richness
    v. Shannon-Wiener Diversity Index – All Species (Kwak and Peterson 2007)
    vi. Shannon-Wiener Diversity Index – Native Species (Kwak and Peterson 2007)

vii. Index of Biotic Integrity (Lyons 1992)

2. Potential indicator species population level sample statistics:
   i. Species-Specific Relative Abundance (i.e., Catches Per Units Time, Site Length, and Site Water Surface Area)
   ii. Length-Frequency Distribution (Brouder et al. 2009)
   iii. Frequency of External Deformities and Lesions (i.e., Percentage of Species Catch)

Prior to conducting any statistical analyses, Program staff will trend the above sample statistics against time for each site over the duration of the Project. Plotting the sample statistics against time will help elucidate some preliminary temporal or spatial trends in sampled reaches beneficial for guiding and/or designing subsequent studies or projects. Further, trended community and/or population sample characteristics that appear dissimilar between "uncontaminated" and "contaminated" will be statistically analyzed. Parametric data will be analyzed using two-factor analysis of variance to compare sample data collected in "contaminated" and "uncontaminated" sample sites during 2011 and 2012 (Zar 1999). Non-parametric data (e.g., length-frequency distributions) will be analyzed using chi-square goodness of fit test (Guy and Brown 2007; Zar 1999). The alpha value for all analyses will be set *a priori* at 0.10 because all comparisons will be based on a relatively limited number of samples sites (i.e., six at most) and over a fairly small number of sampling events (i.e., 4 per site). It should be noted that this Project does not include an experimental design intended to provide inferential statistics applicable to the entire AOC or Project Area and though the validity of such inferences may be tested, it is not a specific Project objective.

Quality Control Requirements

Data quality control and assurance is required for data collected, processed, analyzed, evaluated, and reported for this Project.

a. Sampling site boundaries will be documented using a GPS unit with sub-foot accuracy that is checked for accuracy and precision by collecting location data for known points (benchmarks) before and after sample site boundary locations are documented. U.S. Public Land Survey System (USPLSS) control stations containing information about the monumented corners of the USPLSS in the Southeastern Wisconsin Region will be used to establish benchmarks near each sample site. Benchmarks will consist of a buried 3/8" metal rod, driven railroad spike into the base of a mature large tree, or saw cut "x" into a concrete curb, sidewalk, or bridge or culvert abutment. Each benchmark location will be fully documented with witness corners identified. Monumented corner and/or benchmark location information are available at:
   i. http://maps.sewrpc.org/regionallandinfo/survey.shtm
   ii. http://www.co.ozaukee.wi.us/Highway/Survey_Monuments_Main.htm

b. All fisheries field data collection will:
   i. Be led by experienced Program staff familiar with the Milwaukee River watershed fish community
   ii. Follow a suitable, standard methodology (WDNR Undated)
   iii. Be completed using appropriate sampling gear
   iv. Be documented on standardized forms kept on file in the Ozaukee County Planning & Parks Department
c. All Project data will be processed by Program staff by entering into MS Excel spreadsheets to facilitate analysis and evaluation. A sub-set equaling no less than 10% of the data entered will be verified for both accuracy and consistency with Project goals by the QA/QC Manager/Officer or their designee.
d. All Project data analysis, evaluation, and/or presentation use accepted methods, metrics, and indices (Guy and Brown 2007; Lyons 1992; Murphy and Willis 1996; Zar 1999). A sub-set equaling no less than 10% of the data analyses will be verified for both accuracy and consistency with Project goals by the QA/QC Manager/Officer or their designee.
e. Voucher specimens of fish unidentifiable in the field will be preserved in general accordance with techniques recognized by the American Fisheries Society (Kelsch and Shields1996). All voucher

specimens will be analyzed for taxonomic identification by experiences Program staff using recognized reference documents (Becker 1983, Eddy and Underhill 1978) and kept in Ozaukee County's Planning & Parks Department.

f. All data analysis will be performed by experienced Program staff and verified for accuracy by the QA/QC Manager/Officer or their designee.
g. All findings, conclusions, and recommendations reported will be verified for both accuracy and consistency with Project goals by the QA/QC Manager/Officer or their designee. Draft and/or final Project reports will be submitted to the WDNR and US EPA. Final reports will also be available for public viewing through the Ozaukee County Planning & Parks Department.
h. All sampling reports will contain at minimum:
    i. Sampling locations and dates
    ii. Sampling methods
    iii. Analytical methods
    iv. Relevant assumptions
    v. Results
    vi. Conclusions and recommendations

Data Acquisition Requirements for Non-Direct Measurements

Several non-direct measurement data sources may be used by the Project. These sources include:

- Standardized fish population data (Brouder et al 2009)
- WDNR fish community surveying data (NOAA 2010)
- Ozaukee County GIS orthorectified aerial photographs

The acceptance criteria for each of these data sets is that they come from published scientific literature, were generated by the WDNR using field methods analogous to those proposed for this Project, or are part of a County-accepted database.

The standardized fish population data presented by Brouder (2009) is part of a peer-reviewed scientific publication from the American Fisheries Society. It provides standardized length-frequency ratios for length classes of smallmouth bass sampled via summertime electrofishing of wadeable streams in the same ecoregion as the Project Area. Most of the Milwaukee River and its watershed have been historically disturbed by agricultural, industrial, and urban development. There are no known "reference" reaches within the watershed (or adjacent watersheds) that reliably represent the pre-disturbance condition of the Milwaukee River fish assemblage. As such, the smallmouth bass data presented by Brouder (2009) provides a reliable data set against which Project sample data for smallmouth bass can be compared. Further, Brouder (2009) also presents data for other Project target species and/or potential indicator species (e.g., northern pike, walleye, etc.) however the sampling methods and locations are less congruent with proposed Project sampling. Thus, their applicability for comparison/contrast is limited.

Summary analyses of WDNR fish community survey data collected in various Project Area reaches during the past 3 decades is presented in the Environmental Assessment for Fish Passage in the Milwaukee River Watershed Project (NOAA 2010). The WDNR's semi-quantitative monitoring protocols are the basis for Project sampling methods (WDNR Undated) and provide some reasonable baseline information for comparison and/or contrast to newly collected data. Further, anticipated baseline monitoring by WDNR during 2011 (i.e., concurrent with Project sampling) may provide additional "new" data to bolster that collected by the Project. Efforts by Project staff will be made to avoid sample site duplication with WDNR monitoring activities during 2011. The primary limitation of using WDNR baseline monitoring data is that the timing of its availability for analysis by Project staff may not be ideal.

The Ozaukee County GIS includes high-resolution aerial photography taken during April 2010 (typically scaled to 1 inch to 300 feet) available through the Ozaukee County Planning and Parks Department and viewed through ArcMap 9.3.1. This will be the primary resource for remotely measuring sample site water surface area. All 2010 orthophotographs have orthorectified to account for the curvature of the earth. ArcMap positions the photos based on the current projection (NAD 1927) which is the same projection of all County and Southeastern Wisconsin Regional Planning Commission (SEWRPC) GIS layers. As such, no distortions or off-sets in the photos are anticipated since the spatial reference of the photos and existing GIS layers are in the same projection. A limitation of this data source is that some waterways are obscured by foliage. This is not anticipated to affect Project use as the Milwaukee River is sufficiently larger (in terms of channel width) that foliage cover is rarely an obstacle. As needed, use of Ozaukee County's orthorectified aerial photos will be supplemented with color aerial photographs taken annually by the U.S. Department of Agriculture Farm Service Agency (FSA). Though not orthorectified, the FSA aerial photographs are taken during a different season than Ozaukee County's aerial photographs and can be useful as supporting and/or illustrative resources.

Data Management

All raw data generated by the Project will be entered electronically in the Ozaukee County fish community sampling spreadsheet and stored on the Ozaukee County network server. All data entry and quality control reviews will be documented within the spreadsheet using the involved personnel's initials and the date of entry/review.

All statistical analysis will also occur within the County fish community sampling spreadsheet.

No data will be stored off site. Digital data will be retrieved by County Project staff directly through the Ozaukee County network server. Digital data transfer not practicable via email or traditional means (e.g., in person meetings, mailing a CD, etc.) will be done via a Program File Transport Protocol (FTP) site being developed by Ozaukee County. No data storage will be done on the FTP site.

C. Assessment/Oversight

Assessments and Response Actions

The Project includes quarterly, semi-annual, and final reporting requirements built around the schedule outlined in the Project grant narrative. The Project is considered "on schedule" if pertinent milestones are reached.

Each sample site is scheduled for sampling twice a year during 2011 and 2012, with efforts concentrated to the degree practicable on the period between June 1 and September 30 of each year. Flood events, resource limitations, field equipment issues, and other uncontrollable factors may affect the sampling schedule, making more exact schedule predictions at this time impractical. To the degree practicable, Program staff will try to avoid or mitigate any negative affects to the proposed schedule. If the sampling plan requires revision, modification, or alteration, approvals from the Project Coordinator, Program Manager, and QA/QC Manager/Officer are required.

The Program Assistants will be involved in all field operations used to generate Project data. All field operation problems detected by the Program Assistants will be reported directly to the Project Coordinator and Program Manager. Internal field operation assessments will be completed by the Program Manager and QA/QC Manager/Officer twice per year. The first field operation assessment will occur prior to and during the initial sampling event and will include a field readiness review and full analysis of all operation procedures to ensure consistency with procedures detailed in this QAPP. The second field operation assessment will occur during approximately the sixth sample event (midway through each season's sampling schedule) and also include a field readiness review and full analysis of all operation procedures. The Program Manager and QA/QC Manager/Officer will provide immediate verbal feedback and a subsequent written analysis to the Program Assistants prior to the next sample event. The Program Assistants are responsible for determining actions suitable for addressing detected problems and proposing them to the Project Coordinator and Program Manager for approval throughout the sampling schedule. Any changes to sampling protocol, methods, sites, or frequencies approved by the Project Coordinator and Program Manager will be reported to the QA/QC Manager/Officer by the Program Manager for inclusion in a revised QAPP. Pursuant to Section 2.3.1 of EPA QA/G-5, no independent assessments will be completed as this is not a long-term project.

A sub-set equaling no less than 10% of the Project data analyses will be verified for both accuracy and consistency with Project goals by the QA/QC Manager/Officer or their designee to detect any analysis problems.

Reports to Management

The Project includes mandatory quarterly, semi-annual, and final reports to USEPA. The Program Manager and Project Coordinator, with assistance from the Program Assistants, are responsible for preparing and submitting all management reports to the Project Officer. Quarterly reporting is conducted through the Great Lakes Accountability System (GLAS) and quantitatively tracks progress toward established Project milestones. Semi-annual reporting is also submitted digitally to the Project Officer. Semi-annual reports are due April 30 and October 30 of each Project year and include summary information regarding:

1. Work accomplished during the reporting period
2. Object class category changes
3. Corrective actions
4. Projected new work
5. Percent completion of scheduled work
6. Percent budget spent
7. Changes to principal investigator
8. Needed changes to Project period
9. Date and amount of latest drawdown request
10. Delays and/or adverse conditions that materially impair meeting Project outputs/outcomes specified in the assistance agreement work plan
11. Field operations assessment results
12. Data quality assessment results

Project Officer consideration of and potential approval for necessary revisions and modifications to Project timelines and outputs/outcomes would be management actions directly driven by semi-annual reporting.

The final Project report will include summary information pertaining to Project nature and extent, as well as information regarding Project outputs/outcomes. Applied methodologies, significant events and/or experiences, data compilation (i.e., a spreadsheet or database) and analysis, conclusions and recommendations, and pertinent photos, figures, and maps will be included. The draft final report will be submitted by the Program Manager and Project Coordinator to the Project Officer electronically no more than 45 days after the Project period. Hardcopy and digital copies of the final report will be submitted by the Program Manager and Project Coordinator to the Project Officer electronically no more than 90 days after the Project period.

The QA/QC Manager/Officer and Program Manager will be responsible for identifying considerable Project quality assurance problems continually throughout the project. Considerable quality assurance problems will be reported by the QA/QC Manager/Officer and Program Manager to the Project Coordinator in writing immediately after identification, the Project Coordinator will be responsible for determining and implementing necessary corrective actions. Significant Project quality assurance problems and resulting corrective actions will be described in the semi-annual report to the Project Officer.

D. Data Validation and Usability

Data Review, Validation, or Verification

Raw data entries and statistical analyses performed by Program Assistants in the Ozaukee County fish community sampling spreadsheet will be subject to review and verification by the QA/QC Manager/Officer or their designee(s). Specifically, a sub-set equaling no less than 10% of the Project data entries and analyses will be verified for both accuracy and consistency with Project objectives. A root-cause analysis will be completed by the QA/QC Manager/Officer or their designee(s) for substantive, detected data entry and/or analysis errors. Raw data entry root-cause analyses may include field data form entry verification, data entry person interview, and other tactics. Data analysis root-cause analyses may include method/equation reference verification, spreadsheet accuracy evaluation, and analyzer interviews.

All detected errors will be corrected by the QA/QC Manager/Officer or their designee(s) and re-verified by the Program Manager. Additional verifications of data entered or analyzed will be at the Program Manger's discretion. Erroneous raw data entries will be corrected by replacement with the correct data. Data analysis errors will be resolved by determining and correcting the root equation or calculation error(s). All findings of the root-cause analysis will be reported to the Project Coordinator with a request for approval of proposed corrective actions. All significant, substantive corrective actions for serial-type errors will be reported to the QA/QC Manager/Officer by the Program Manager for inclusion in a revised QAPP.

No data validation or qualification is required. The Project objectives do not include direct statistical inferences to the Project Area and/or AOC, but instead represent a pilot project to describe, qualitatively and with some quantified sample statistics, fish community aspects and potential native indicator fish species populations in the Project Area.

Project calculations will conform to equations, methods, and guidance available presented in scientific literature and reference documents. Specific references for these equations and methods include:

- Catch Per Unit Effort Relative Abundance (Hubert 1996; Ney 1993)
- Taxonomic Richness (Kwak and Peterson 2007)
- Shannon-Wiener Diversity Index (Kwak and Peterson 2007)
- Index of Biotic Integrity (Lyons 1992)
- Length-Frequency Distribution (Anderson and Neumann 1996; Brouder et al. 2009)
- Sample abundance distribution amongst feeding and spawning guilds (Lyons 1992)

Total sample abundance will be calculated for each sample by enumerating all fish included in the sample.

Finally, the frequency of external deformities and lesions will be calculated for each sample using the following equation:

Frequency Deformities/Lesions = 100[(Number individuals with deformities or lesions)/(Total sample abundance)]*

Reconciliation with Data Quality Objectives

Data generated by the Project will be both qualitative and quantitative in nature and intended to facilitate preliminary, non-inferential comparison and contrast of fish assemblages sampled in "contaminated" and "uncontaminated" sites of the Project Area. This analysis will be geared toward suggesting, even if only preliminarily and with some anticipated uncertainty, whether or not detectible differences may exist between sampled fish communities and potential native indicator fish species populations. Further, it directly accomplishes the Project objectives including:

1. Collecting information about existing fish communities and potential native indicator fish species in up to six Ozaukee County reaches of the Milwaukee River within and outside the Milwaukee Estuary AOC (Project Area) to:
   i. Compare and contrast existing Project Area fish populations within and outside the Milwaukee Estuary AOC using sample statistics for descriptive, quantifiable population or community characteristics, metrics, and/or indices (Guy and Brown 2007; Kohler and Hubert 1993; Lyons 1992; Murphy and Willis 1996).
   ii. Compare and contrast existing fish community and population samples in the Project Area to standard sampling indices or other suitable references to the degree practicable in lieu of a known, suitable control or reference system (Brouder et al. 2009; Lyons 1992).
   iii. Collect baseline data to facilitate trending of sample statistics of fish population and/or community characteristics in the Project Area, concentrating on potential native indicator fish species.
2. Collecting some of the baseline information beneficial to the development and implementation of a fish and wildlife management and restoration plan for the AOC.

Acceptance or rejection of fish community sample raw data will be determined based on if it was collected:

- Under wadable river conditions (i.e., to standardize catch efficiency between sites)
- During daylight hours of the June 1 – September 30 sampling season (or outside that season if approved by Program Manager)
- By fully sampling the targeted reach
- With a field crew of at least six individuals
- With two tow barge electrofishing systems
- And all individual fish are identified to species
- And followed by full entry of field data into the County fish community sampling spreadsheet

Statistical analysis will be applied to fish community and potential native indicator species population characteristics, metric values, and indices values that sample trending (e.g., histographs) suggest dissimilarities may exist between "uncontaminated" and "contaminated" sample statistics over the duration of the Project. Parametric data will be analyzed using two-factor analysis of variance to compare sample data collected in "contaminated" and "uncontaminated" sample sites during 2011 and 2012 (Zar 1999). Non-parametric data (e.g., length-frequency distributions) will be analyzed using chi-square goodness of fit test (Guy and Brown 2007; Zar 1999). These analytical methods are consistent with those in the USEPA's Guidance for Data Quality Assessment (USEPA 2000). The alpha value for all statistical analyses will be set *a priori* at 0.10. This relatively large alpha value was chosen because all analyses will be based on a relatively limited number of samples sites (i.e., six at most) and over a fairly small number of sampling events (i.e., 4 per site).

The Project does not include an experimental design intended to provide inferential statistics applicable to the entire AOC or Project Area and though the validity of such inferences may be tested it is not a specific Project objective. If sample size power analysis is undertaken it will use an appropriate software package proposed by the Program Manger and Program Coordinator and approved by the Project Officer.

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Attachment 1

Equipment Manuals

Attachment 1

SDC-1 OPERATOR'S MANUAL (rev. 2-23-10)
UNITS WITH APC PLASTIC CORD REELS

SAFETY FIRST: PRECAUTIONARY STATEMENTS

(ALSO READ IMPORTANT GENERATOR NOTE)

WARNING: HIGH VOLTAGE EQUIPMENT!

Electronic fish capture devices mounted on tow barges (Stream Electrofishing Systems) are designed to introduce high voltage DC into the water via one or more insulated anode poles (probes) with an electrode at the base. This voltage HAS THE POTENTIAL TO CAUSE BODILY HARM OR DEATH if the operator does not observe proper precautions, and comes in direct contact with the output of the device.

READ AND UNDERSTAND ALL DIRECTIONS, OPERATING WARNINGS, AND CAUTIONS IN THIS MANUAL. Use insulating waders and gloves approved by the agency having jurisdiction in your area. Training by experienced operators or attending a formal course is strongly recommended. Operation of this equipment without another individual in the vicinity is strongly discouraged. CPR certification of all operators is strongly recommended.

NEVER DEFEAT, BYPASS, OR MODIFY THE MOMENTARY ANODE SWITCH! (Applies to anode poles being used by individuals standing in stream)

NOTICE: NOT FOR PERSONAL USE

This equipment may only be used by federal or state agencies, or independent agencies that have been authorized to use electronic fish capture devices by the federal or state agency having jurisdiction in the operator's area. Use for personal purpose is unlawful. Observers and assistants who are not empoyed by said agencies must be notified of the hazards of electrofishing and related safety procedures, and must be appropriately supervised.

WARNING: EQUIPMENT INSPECTION AND MAINTENANCE

Prior to each use inspect the control box and accessories for loose connectors, and missing or damaged parts. Verify that cables are intact with no cuts or tears in the insulation. Inspect waders and gloves for any cuts or tears. Do not use defective gear.

WARNING: WATER IMMERSION AND RAIN

THE SDC-1 CONTROL BOX IS SPLASH RESISTANT, BUT IS NOT WATER TIGHT. In the event the box is submerged in water or exposed to heavy rainfall, open the box in a dry location and verify that no water infiltration has occurred. If water is observed within the box allow box to thoroughly dry out before use. If corrosion is observed, return to factory for inspection. The anode pole (wand) is only water tight if the nylon cable connector at the top of the pole is tightly screwed on to the pole. The metal connectors are not water tight. If immersed in water or exposed to rain, the metal connectors must be opened and properly dried. Contact factory for specific instructions.

WARNING: AVOID ANODE ELECTRODE CONTACT

DO NOT RAISE ANODE POLE (WAND) ELECTRODE OUT OF THE WATER WHILE ENERGIZING THE CONTROL BOX WITH THE ANODE SWITCH, particularly when other members of the field crew are nearby. Accidental contact with another individual's skin could subject them to serious electrical shock. Always release the anode switch before raising the anode electrode out of the water.

DO NOT TOUCH THE ANODE ELECTRODE UNTIL YOU HAVE SWITCHED OFF THE MAIN POWER SWITCH AND WAITED 5 MINUTES, SHUT DOWN THE GENERATOR, AND WAITED 5 MINUTES. Alternatively disconnect the anode cable plugs from the control box, or turn the voltage set dial to zero and discharge the remaining power in the control box into the water by depressing the anode switch(es) before turning off the main power switch. Although the control box should disable the output instantly, in the event of a malfunction, there could be sufficient energy to cause a brief electrical discharge.

WARNING: AVOID CONTACT WITH EQUIPMENT IN BARGE

Do not touch any metal housings or frames of components mounted in or on the boat while the control box is powered-up (anode switches closed). If any part of your body is in contact with the water, or if your waders or thin or leaky, or if a pin-hole exists in your gloves simultaneously with the occurrence of an equipment short, electrical shock is possible.

CAUTION: AVOID EXCESSIVE STRESS ON ANODE CORD

The use of a waist harness and tow rope is strongly recommended. Using the electrical cord attached to the anode pole (wand) to pull the tow barge will subject the cord connector and cord to excessive stress, and may result in premature failure of the cord or connector, and will void their warranty.

CAUTION: PERFORM ANODE SWITCH SAFETY TEST BEFORE EACH USE

BEFORE STARTING GENERATOR PULL OUT POWER SWITCH KNOB AND TEST EACH ATTACHED ANODE SWITCH TO VERIFY IT CAUSES THE RELAY INSIDE THE CONTROL BOX TO AUDIBLY CLOSE (CLICK) AND RELEASE. VERIFY THAT ALL ANODE SWITCHES MUST BE CLOSED TO CLOSE THE CONTROL BOX RELAY.

GENERATOR IMPORTANT NOTE:

FOR LONGEST LIFE, WARM-UP GENERATOR 3-4 MINUTES BEFORE APPLYING LOAD (SHOCKING). WHEN DONE SHOCKING ALLOW GENERATOR TO COOL DOWN 3-4 MINUTES BEFORE SHUTTING IT OFF.

GENERAL:

The SDC-1 Electrofishing Unit is a direct current (DC) Electrofishing Unit designed for connection to a 240 VAC, 2500 to 2750 Watt alternator. It has 3 anode connectors each with a safety interlock circuit, 2 dummy interlock plugs (for use when only 1 or 2 anode poles is connected),1 cathode connector, 1 battery connector, and 1 generator connector. All connectors are Amphenol type 97-3102A. Voltage is selected by a dual range switch and is adjustable within each range by a side panel control knob. Two analog meters monitor average output voltage and current.

SPECIFICATIONS:

INPUT: NOMINAL 240VAC, 60 HZ, 2500-2650 Watts, SUPPLIED BY MOTOR-POWERED GENERATOR ONLY. **CONNECTION OF SDC-1 TO BUILDING AC POWER MAY DAMAGE UNIT DUE TO LACK OF SUFFICIENT INDUCTANCE TO LIMIT INRUSH CURRENT. GENERATOR MUST HAVE NEUTRAL-TO-FRAME BOND DISCONNECTED.**

OUTPUT: POSITIVE OUTPUT VOLTAGE IS AVAILABLE ON PIN A OF EVERY ANODE CONNECTOR. THE RETURN FOR THE VOLTAGE IS VIA PINS A AND B OF THE CATHODE CONNECTOR (WHICH ARE INTERNALLY JUMPERED TOGETHER). VOLTAGE IS D.C. WITH SIGNIFICANT A.C. 60 HZ RIPPLE THAT IS NECESSARY FOR OPTIMUM PERFORMANCE.

MAXIMUM OUTPUT VOLTAGE DEPENDS ON THE CAPABILITY OF THE ALTERNATOR POWER SOURCE. THERE ARE TWO VOLTAGE RANGES, LOW, AND HIGH. LOW RANGE WILL PERMIT APPROXIMATELY A MAXIMUM OF 300 VOLTS D.C. TO BE DELIVERED, AND HIGH RANGE, APPROXIMATELY A MAXIMUM OF 600 VOLTS D.C. TO BE DELIVERED. CURRENT SHOULD BE KEPT BELOW 10 AMPS. HIGH RANGE IS FOR LOWER CONDUCTIVITY WATER ONLY.

INTERLOCK: CONNECTION MUST BE MADE BETWEEN PINS B AND C ON EVERY ANODE CONNECTOR BEFORE OUTPUT CAN BE OBTAINED. WHEN THE ANODE POLES ARE ATTACHED, THE POLE SWITCHES PROVIDE THIS CONNECTION WHEN THEY ARE DEPRESSED. ANY UNUSED ANODE CONNECTORS ON THE SDC-1

MUST HAVE PINS B AND C CONNECTED BY MEANS OF A WIRED DUMMY PLUG. THE VOLTAGE FOR OPERATING THE INTERLOCK IS NOMINALLY 12 VOLTS D.C. AND IS SUPPLIED BY AN EXTERNAL BATTERY. SEE OPERATING INSTRUCTIONS FOR MORE DETAIL.

METERING (ONLY THE D.C. OUTPUT IS MONITORED):

VOLTAGE: ANALOG METER, 500 OR 600 VOLTS D.C., 5 % ACCURACY, 2 1/2 INCH SCALE.

CURRENT: ANALOG METER, 10 AMPS D.C., 5 % ACCURACY, 2 1/2 INCH SCALE.

DIMENSIONS: 9" x 12" x 4.5" OR 8”x 8” x 4.5” DEPENDING ON CASE STYLE.

OPERATING INSTRUCTIONS:

1. The generator motor must be OFF. Connect anode(s) to unit. Be sure to bypass any unused anode connectors with dummy connectors whenever fewer than 3 anodes are to be used. Check to see that the generator plug is inserted in the receptacle and that the battery and cathode connections from the SDC-1 are secure. The polarity of the battery connections (red and black cables is not important, but depending on the battery type, the positive and negative quick disconnects may only fit the battery one way. If you are using a rechargeable battery be sure the battery has been charged before starting out.

2. Before starting the generator engine, check the anode safety circuit. Pull out the ON/OFF power switch (labeled “Push OFF”). Close all the anode switches. An audible click should be heard from the SDC-1 relay closing inside the box. Open and close each anode pole switch in turn while the other switches are held closed. Verify that the relay clicks on and off each time any one of the anode switches is closed and opened.

3. Push OFF the power switch. Always start with the voltage control dial on the side of the unit fully counterclockwise (minimum voltage) and the power switch pushed off.

4. Start the generator engine. Pull out the power switch (ON position). The boat should be in the water.

WARNING: FOR SAFETY REASONS, ALWAYS TREAT THE ANODE POLE ELECTRODES AS "HOT" WHENEVER THE GENERATOR MOTOR IS RUNNING, EVEN IF THE POWER SWITCH IS OFF (PUSHED IN). NEVER TAKE AN ANODE ELECTRODE OUT OF THE WATER WHILE PRESSING DOWN THE ANODE SWITCH.

5. Put all pole electrodes in the water. Select Low or High voltage range on the box. Low range should be used when conductivity is moderate to high, and High range used only when conductivity is low. When ready to start shocking, press the anode switches down. Turn the voltage knob clockwise until the voltmeter indicates the desired voltage. The ammeter should read current flowing from the anodes through the water to the cathode plate attached to the boat bottom.

6. If any ONE of the anode switches is released, the volts and amps must drop to zero.

   WARNING: IF THE METERS DO NOT GO TO ZERO UPON RELEASING ANY ANODE SWITCH, THE POLE SWITCH OR UNIT IS DEFECTIVE AND MUST BE REPAIRED TO INSURE SAFE OPERATION. DO NOT USE THE SYSTEM UNTIL THIS IS CORRECTED.

7. You are now ready to proceed with fish capture. When finished shocking, shut down the generator motor, and turn the voltage set dial on the stream shocker box fully counterclockwise (OFF position). Leave the ON/OFF power switch of the box pulled out in the ON postion. With all electrodes still in the water, hold down all anode switches for 10 to 15 seconds. This will allow most of the electrical charge on the electrodes to dissipate in the water. Verify that the Voltmeter reads zero before removing the electrodes or boat from the water.

   PRESS THE ON/OFF power switch of the box in (OFF position)

8. Do not allow the anode pole switch or top connector to remain under water.

9. Do not jerk on the anode poles. This subjects the connector at the top of the anode pole to extreme stress and may cause internal wire breakage. <u>The use of a waist harness and tow rope is strongly recommended.</u> Using the electrical cord attached to the anode to pull the boat will subject the cord connector and cord to substantial stress and may result in premature failure, and will void their warranty. A sash chain strain relief attachment for the electrical cord is provided to minimize the chance of connector breakage at the top of the anode pole.

10. Avoid allowing debris (weeds, etc.) to be retracted into the cord reel housing if your boat is equipped with cord reels. They are difficult to disassemble and clean internally.

11. If you need to open the cord reels, turn off the generator, wait 5 minutes for the power inside the control box to dissapate, then unscrew the 4 wing nuts at the top of each bolt. **These are special nylon-insert lock wing nuts. Do not lose them!** Also unscrew ONE of the sheet metal screws that holds the clear plastic insulating strip on top of the reel housing. **The insulating strip and two screws must be replaced after cleaning the reel.** The center screw can become electrically “HOT” during operation and must be shielded by the strip. Do not use a longer screw than that provided to secure the plastic strip to the reel housing. It could penetrate the plastic take-up spool inside the reel. Next unscrew the front sheet metal screws on the housing that hold the upper and lower halves together. Lastly remove the shaft screw in the center of the reel housing. You can now work the upper half of the reel free from the lower half. **Be careful not to allow the cord to release. It will spin around the take-up spool.** Secure it or have someone hold it. Clean out the debris and dab off moisture with a paper towel internally. Put the top back on being careful that the rubber grommet fits properly in between the two halves of the reel, and that the cord exits properly.

12. Battery maintenance: Keep battery on charger when not in use, or at least cycle through charger once/month. Do not allow battery to remain in discharged state for a long period. Use only a fully automatic charger, not a so-called trickle charger. Initial charge rate should not exceed 2 amps.

L. Burke O’Neal
ETS Electrofishing, LLC
3737 Eldorado Court
Verona, WI 53593

Phone: 608-833-2088
Email: ets@etselectrofishing.com

ADDENDUM: TECHNICAL DISCUSSION OF GROUNDING PHILOSOPHY FOR STREAM SHOCKER ELECTROFISHING

Conventional ground bonding practices cannot be applied safely to stream shocker electrofishing since the operators are in a conductive medium (water) which intentionally has been electrified by current originating in the generator on-board the towed barge. The philosophy for reducing the risk of electrical shock primarily consists of two components:

a. Preventing the metal components on the towed barge from acting as a current return path for an operator who may touch them while part of his or her body is in contact with the water.

b. Isolating the metal components so that if one component becomes electrically "hot", the high voltage potential is not transmitted to all the other components.

The following is a discussion of how this philosopy has been applied to each component of the system:

1. MOTOR/GENERATOR: The neutral winding of the generator supplied by ETS has intentionally been disconnected internally from its frame. This is done to minimize the likelihood of electrical shock to an operator standing in the water should he or she reach up and touch the generator. Although good electrofishing practice such as wearing high quality insulating rubber waders and gloves can minimize shock hazard, pin-hole leaks can occur. By removing the neutral-frame bond, significant current cannot be conducted from the water through the operator back to the generator winding via the generator frame.

2. ANODE CORD SHIELD: The electrical cable within the metal cord reel is shielded (wrapped) with a metal braid to improve the strength of the cable. This shield is electrically conductive. The connection of this shield to the metal housing of the cord reel has intentionally been broken inside the cord reel. This prevents the reel housing from becoming electrically "hot" with respect to the water should an internal short or moisture within the shielded cable create a conductive pathway between the "hot" wire and the shield.

3. METAL SWITCHES AND CONNECTORS ON THE CONTROL BOX: These components have NOT been electrically bonded to each other or to the metal frame of the motor/alternator. If any one of these components should become electrically "hot" with respect to the water, at least the high voltage potential cannot be transmitted to all the other components in the system.

L. Burke O'Neal, Mgr., ETS Electrofishing, LLC 12-17-08 & 2-23-10

Attachment 2

Sample Field Data Collection Sheet

Attachment 2

Sample location:	Station Length (m):	Air Temp (°C):	Water Temp (°C):	Date:	Start Time:
Collectors:		Duty:	Rate:	Voltage:	End Time:
Species Tally	Common Name (Abrv)	Total Length (cm)	Net Wt. (g)	Tagged No.	Fin Clip Description

If Found, Please Contact Ozaukee County Fish Passage Program (Planning & Parks Dept). 262-236-2005

Monitoring to Address 7 of 11 BUI's – Milwaukee Estuary AOC

Task 2: Water Quality Sampling

Quality Assurance Project Plan

EPA Grant Funding Source: Great Lakes Restoration Initiative
Grant #: GL-00E00607-0

Project Coordinator: Andrew Struck
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Prepared: April 1, 2011
Revision #: 2

Approvals: **Date:**

Andrew T. Struck — 5-25-11
Andrew Struck, Director, Ozaukee County Planning & Parks Department
Project Coordinator

5-24-11
Rajen Patel, U.S. Environmental Protection Agency
Project Officer

L Blume — 5-24-11
Louis Blume, U.S. Environmental Protection Agency
Great Lakes National Program Office QA Manager

Matt Aho — 5-25-11
Matt Aho, Program Manager, Ozaukee County Planning & Parks Department
Fish Passage Program

Thomas Dueppen — 5/26/11
Thomas Dueppen, Specialist, Ozaukee County Planning & Parks Department
Quality Assurance Manager/Officer

TABLE OF CONTENTS

Distribution List

Personnel listed on the approval sheet and listed under Project/Task Organization will receive a copy of this Quality Assurance Project Plan (QAPP). Individuals taking part in the project may request additional copies of the QAPP from personnel listed under Project/Task Organization.

Executive Summary

The Milwaukee River Watershed Fish Passage Program (Program), a component of the Ozaukee County (County) Planning and Parks Department (Department) Ecological Division, and its project partners will begin water quality monitoring, sampling, and analysis during 2011-2012 (Project) to provide data useful for addressing two of the Milwaukee Estuary Area of Concern (AOC) Beneficial Use Impairments (BUI's) and to provide information for several proposed BUI delisting targets. These activities are federally funded through the Great Lakes Restoration Initiative (GLRI) and administered by the United State Environmental Protection Agency (USEPA) under grant # GL-00E00607-0, entitled "Monitoring to Address 7 of 11 BUI's – Milwaukee Estuary AOC." The Project will focus on portions of the AOC within Ozaukee County and other relevant reaches of the Milwaukee River Watershed in Ozaukee County. This QAPP documents the work plan and quality control procedures for Task 2, Water Quality Monitoring, under the aforementioned grant.

The Project directly pertains to two BUI's for the Milwaukee Estuary AOC:

- Eutrophication or Undesirable Algae
- Beach Closings and Body Contact

Information pertinent to specific BUI delisting targets and actions will be garnered through water quality sampling at 30 strategically chosen sites in the Milwaukee River and its tributaries in Ozaukee County, as well as continuous water quality monitoring in the Milwaukee River to "establish baseline conditions and trends" for various nutrients and pollutants, address "traditional point sources, non point sources, and stormwater," and potentially identify "known sources of bacterial contamination to the AOC and tributary watershed" (SEH and ECT 2008).

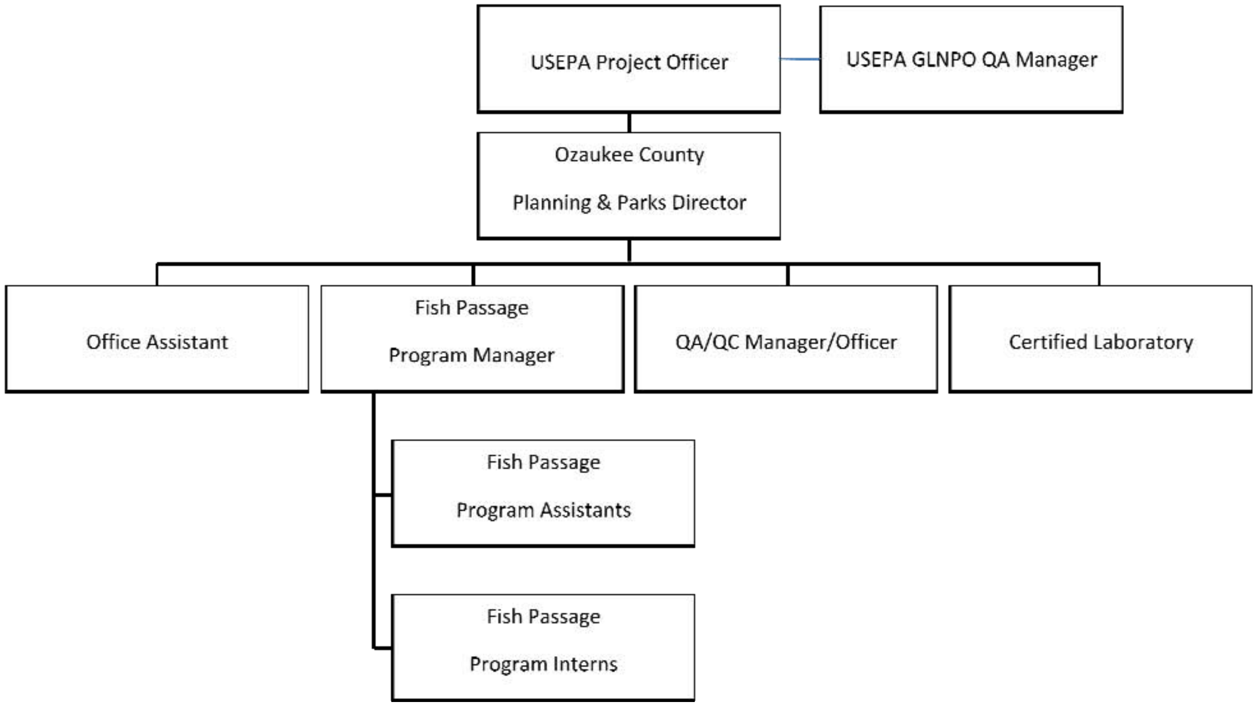
A. Project Organization

Personnel involved in project implementation are listed below (Table 1 and Figure 1).

Table 1: Project Implementation Personnel

Individual	Role in Project	Organizational Affiliation
Rajen Patel	Project Officer	U.S. Environmental Protection Agency
Louis Blume	GLNPO QA Manager	U.S. Environmental Protection Agency
Andrew Struck	Department Director and Project Coordinator	Ozaukee County Planning & Parks Department
Thomas Dueppen	QA/QC Manager/Officer	Ozaukee County Planning & Parks Department
Matt Aho	Fish Passage Program Manager	Ozaukee County Planning & Parks Department
Ryan McCone	Fish Passage Program Assistant	Ozaukee County Planning & Parks Department
Luke Roffler	Fish Passage Program Assistant	Ozaukee County Planning & Parks Department
Kevin Hensiak	Fish Passage Program Intern	Ozaukee County Planning and Parks Department
Steven Kunst	Fish Passage Program Intern	Ozaukee County Planning and Parks Department
Cynthia DeGroot	Office Assistant	Ozaukee County Planning & Parks Department
Certified Laboratory	Water Sampling and Laboratory Analysis	To Be Determined

Figure 1: Project Organizational Chart



The USEPA Project Officer will be responsible for the following activities:

- Review and approval of initial QAPP and subsequent versions
- Review and approval of all quarterly, semi-annual, and financial reporting

The USEPA Great Lakes National Program Officer (GLNPO) QA Manager will be responsible for the following activities:

- Review and approval of initial QAPP and subsequent versions

The Ozaukee County Planning and Parks Director (Project Coordinator) will be responsible for the following activities:

- Coordinate QAPP development and implementation with primary stakeholders
- Issue quarterly, semi-annual and annual reports to USEPA
- Maintain official, approved QAPP

The Ozaukee County QA/QC Manager/Officer will be responsible for the following activities:

- Administer QAPP quality control
- Coordinate geo-spatial data collection and transfer to partners
- Maintain Ozaukee County GIS software

The Ozaukee County Fish Passage Program Manager will be responsible for the following activities:

- Field team leader
- Maintain official, approved QAPP
- Develop amended QAPP
- Coordinate all field activities and assist QA Manager/Officer with field data acquisition
- Assist the Project Coordinator with coordination of all QAPP development, coordination of stakeholder input

The Ozaukee County Fish Passage Program Assistants will be responsible for the following activities:

- Assist the Program Manager with field data collection

- Data processing, review, analysis, evaluation, and reporting

The Ozaukee County Fish Passage Program Interns will be responsible for the following activities:
- Assist the Program Manager with field data collection
- Data processing, review, analysis, evaluation, and reporting

The Ozaukee County Office Assistant will be responsible for the following activities:
- General administrative assistance
- Materials and supplies purchasing
- General reporting assistance to the Project Coordinator and Program Manager

The Certified Laboratory will be responsible for the following activities:
- Collection and laboratory analysis of water quality samples
    - The Certified Laboratory will be chosen as part of a qualification-based selection process and must be certified to perform or subcontract all requisite analyses

Problem Definition/Background

The Milwaukee River Estuary was designated an AOC during the 1980s due to historical dredging and other modifications, as well as heavy pollutant loads from local industry and agriculture. The Milwaukee Estuary Remedial Action Plan (RAP) was subsequently released and updated and documents 11 BUI's affecting the AOC as well as proposed delisting targets and actions for each BUI (WNDR 1991; WDNR 1994; SEH and ECT 2008). The AOC includes the Milwaukee harbor and estuary, nearshore areas of Lake Michigan, the Kinnickinnic and Menomonee Rivers, and portions of the Milwaukee River Watershed in Milwaukee and Ozaukee Counties.

Various water quality contaminants are closely tied to many of the BUI's listed for the Milwaukee Estuary AOC, particularly those related to algal blooms and exposure to bacteria and other pathogens (SEH and ECT 2008). Poor water quality and excessive nutrient loading adversely affect benthic organisms, fish, wildlife, and plankton (WDNR 1994). Eutrophic conditions caused by excessive nutrient levels often lead to large algal blooms, which can result in low dissolved oxygen levels, fish kills, and poor aesthetics (WDNR 1994). Influxes of pathogens into the system, particularly during high flow events, can have a direct effect on fish and wildlife populations and are a major concern for safe public enjoyment of affected waterbodies (SEH and ECT 2008).

The Project aims to establish baseline nutrient and pathogen information for baseflow conditions, identify potential sources of nutrient and/or pathogen loading, and gauge the effect of various flow events throughout the Milwaukee River Watershed reaches in Ozaukee County (Project Area) by sampling strategic locations on the mainstem Milwaukee River and its tributaries. Continuous in-stream monitoring stations will also be placed at three locations on the mainstem Milwaukee River to assess standard parameters including water temperature, depth, dissolved oxygen concentration, pH, and conductivity. Together, this information will gauge preliminary baseline water quality for the Project Area, while establishing spatial trends for nutrient and pathogen loading within the system during and/or immediately after rain (surface runoff) events. They will also provide information about water quality changes that occur in the Milwaukee River as it passes through Ozaukee County.

Project Objectives

The Project, through a measured and science-based approach, will begin targeted water quality sampling and continuous in-stream monitoring in Ozaukee County portions of the Milwaukee River Watershed. The water quality assessment will provide baseline water quality information and preliminary trends within the Milwaukee River Watershed in Ozaukee County. Specifically, the Project aims to address the following objectives:

- Collecting baseline data for select chemical or physical water quality parameters and pathogens at strategic points within the mainstem Milwaukee River and select tributary streams in Ozaukee County.
- Monitoring basic water quality parameters (e.g., water temperature, dissolved oxygen, water depth, etc.) continuously in the mainstem Milwaukee River to evaluate baseflow conditions and high flow trends.

Based on available daily (2009-2010) and monthly (1982-2010) Milwaukee River discharge measurements from USGS Gaging Station No. 04086600 (http://waterdata.usgs.gov/nwis/nwisman/?site_no=04086600&agency_cd=USGS) baseflow conditions for this Project will discharges of no more than 400 cfs measured at USGS Gauging Station No. 04086600.

The Project will follow guidelines established in the *Wisconsin 2010 Consolidated Assessment and Listing Methodology* (WDNR 2010) to maintain comparability with other water quality monitoring efforts throughout the watershed and AOC and repeatability for future studies. The Project aims to "provide the pre-data for determining how well a waterbody responds to management," categorizing it as Tier 2 monitoring or "site-specific monitoring of targeted areas" (WDNR 2010). All Program and Certified Laboratory staff will be required to conform to the sampling and data quality requirements necessary to assure representative and applicable data for usage by WDNR and other cooperating agencies and groups (WDNR 2010). Laboratory accuracy and precision will be assessed and ensured through as described in the "Quality Control Requirements" section below.

Water sample analysis precision will be evaluated in by the Certified Laboratory in accordance with their SOPs (included in a future QAPP revision) through field and laboratory duplicate samples. Quantitative measures of accuracy will be estimated using laboratory QC approaches (e.g., laboratory blanks, laboratory duplicates, etc) specified in the SOPs of the as yet unchosen Certified Laboratory. The discrete water quality sampling and continuous water quality monitoring site locations are comprised of systematically chosen strategic points aimed at representing the mainstem Milwaukee River and select tributary streams in Ozaukee County.

Ozaukee County has full confidence in the value of the proposed work for all agencies involved with AOC management and restoration. Project staff will routinely communicate output, outcome, and results progress with the Project Officer through scheduled progress reports and regular correspondence.

Project/Task Description and Schedule

Tasks

A comprehensive water quality monitoring program will be implemented for portions of the Milwaukee River Watershed in Ozaukee County to establish baseline data and trends for nutrients and pathogens of concern, as well as general habitat-related parameters. The Project includes the following tasks:

Task 1 - Water Quality Monitoring: A variety of water quality monitoring activities will be completed at up to 30 locations on the Milwaukee River and its tributaries within the County. Water quality sampling by the Certified Laboratory will be focused on specific nutrients, contaminants, and/or pathogens that relate to particular BUI's. The County will also deploy 3 continuous monitoring stations to assess general water quality parameters that relate to the broader habitat-related BUI's. All sampling and continuous monitoring will occur during late-spring through autumn of 2011 and 2012, with particular focus on baseflow conditions and high-flow rain events. The monitoring program will supplement and enhance several existing water quality monitoring programs currently being performed by Milwaukee Riverkeepers, Riveredge Nature Center, and Ulao Creek Partnership, as well as students and faculty at Homestead High School (Mequon, WI).

Task 2 - QAPP Preparation, Project Reporting and Outreach: Members of the Program staff have undertaken all project planning and QAPP preparation to date. Milestones are defined in Table 2 below.

Table 2. Project Progress Indicators

Task Category	Activity Description	Indicator or Status	Explanation
Water Quality Monitoring	Submittal / Approval of Sampling and Analysis Plan		
	Start Monitoring Process		
	Substantial Completion		
	Submittal of Final Report		
QAPP Preparation, Reporting, and Outreach	Submittal / Approval of QAPP		
	BUI Progress Measures		
	Quarterly and Annual Financial / Progress Reports		
	Project Outreach Activities		

Quarterly and annual progress and/or financial reporting will be performed by County staff in accordance with USEPA requirements as specified in the Cooperative Agreement. Outreach and educational activities will be performed by Program staff with assistance from partner groups and/or engineering/environmental consulting firms. Outreach/educational activities include public meetings and presentations, posting of information on the Ozaukee County website, presentations at conferences, and other activities performed with various project partners as indicated in the grant workplan.

All Project work will be completed in Ozaukee County, USA. For reference, a relatively central point of reference for the project is: HUC code: 04040003 (Milwaukee River), Latitude and Longitude: 43.230007 and -87.9800889 (these are the coordinates for the Mequon-Thiensville Dam), State: Wisconsin, County: Ozaukee, City: Thiensville, ZIP Code: 53092.

Schedule

Table 3 describes project milestones and anticipated schedule of achievements as reflected in the first quarterly GLAS report. Select target dates will be modified in subsequent QAPP revisions to reflect updated/revised scheduling considerations. The table is organized into two technical areas representing each task as described above.

Table 3. Project Milestones and Target Dates

Task #	Task Category	Milestone Description	Target Date
1	**Water Quality Monitoring**	Sampling and Analysis Plan: *Initiate Plan/QAPP coordination with WDNR/EPA*	2/15/2011
		Sampling and Analysis Plan: *Submittal of final plan within QAPP for WDNR/EPA approval*	4/15/2011
		Start of initial water quality monitoring	5/1/2011
		Completion of final water quality monitoring	9/15/2012
		Reports: *Submittal of final water quality report to WDNR/EPA*	12/31/2012
2	**QAPP Preparation, Reporting, and Outreach**	Award: *Formal announcement by EPA*	9/20/2010
		Cooperative Agreement: *Execution of final agreement by County*	11/15/2010
		Staff Initiation or Consultant Procurement: *Issue requests for proposals (per 40 CFR 31.36)*	12/17/2010
		Consultant Procurement (as needed): *Execution of consulting agreement*	3/10/2011
		QAPP: *Submittal of initial draft to WDNR*	2/15/2011
		Quarterly Financial/Progress Reports: *Submittal of initial GLAS report to EPA*	1/15/2011
		QAPP: *Submittal of final plan to WDNR/EPA for approval*	4/15/2011
		Outreach: *Completion of final project outreach activities*	12/31/2012
		Annual Financial/Progress Reports: *Submittal of final report to EPA*	12/31/2012
Final Report			12/31/2012

Personnel, Special Equipment or Supplies

The Certified Laboratory chosen for sampling and analysis of water quality will provide and utilize all necessary sampling equipment based on their standard operating procedures (SOPs) and the guidance found in WDNR (2010). The lab will also provide and utilize all equipment and protocols for estimating sample site channel discharge (e.g., cross-section measurements, flow depths, flow velocity, etc.) during water quality sampling. Bain and Stevenson (1999) provide some general guidance for estimating flow velocities and discharge.

Continuous water quality monitoring will be performed by use of three water quality monitoring systems (WQMS DP0000) purchased from Global Water Instrumentation, Inc (http://www.globalw.com/products/wqms.html). These units will measure and log water temperature, dissolved oxygen, pH, conductivity, and water depth (via an additional sensor -WL400, http://globalw.com/products/levelsensor.html) several times per hour. Operating manuals for the monitoring stations and additional water depth sensor are included as Attachments 1 and 2. Program staff will check each system every month for data downloading, battery replacement, and general maintenance and cleaning.

Quality Objectives & Criteria for Measurement Data

Several common water quality contaminants are linked to Milwaukee Estuary AOC BUI's, particularly those related to algal blooms and human exposure to bacteria and other pathogens (SEH and ECT 2008). Poor water quality and excessive nutrient loading also adversely affect benthic organisms, fish, wildlife, and plankton (WDNR 1994). Eutrophic conditions caused by excessive nutrient loading can trigger large algal blooms, ultimately leading to hypoxic or anoxic conditions, fish kills, and poor aesthetics (WDNR 1994). Influxes of pathogens into the system, particularly during high flow events, can directly affect fish and wildlife populations and threaten safe public enjoyment of affected water bodies (SEH and ECT 2008).

Discrete water quality samples will be collected and analyzed for:

- Total Phosphorus
- Total Kjeldahl Nitrogen (TKN)
- Ammonia
- Nitrites/Nitrates
- Fecal Coliform
- E. coli
- Total Suspended Solids (TSS)
- Orthophosphate
- Chlorophyll a

Laboratory analysis for these parameters is required because field measurement is either not practicable or not possible.

Continuous water quality monitoring will be performed using deployable systems designed to measure:

- Water temperature
- Water depth
- Dissolved Oxygen (DO) Concentration
- Hydrogen Ion Concentration (pH)
- Conductivity

Field measurements, though typically yielding lower quality analytical data compared to laboratory equipment in a controlled environment, provide "real-time" results that help elucidate changing field conditions.

This Project is an initial effort or pilot project to describe, qualitatively and with some quantified sample statistics, Milwaukee River water quality as it enters, passes through, and exits Ozaukee County on its way to the Milwaukee Estuary. Generated data will be shared with local WDNR AOC staff for consideration while finalizing BUI delisting criteria. Variability estimates for many sampled water quality parameters listed later in this section may prove useful for estimating requisite sample sizes for subsequent projects. However, applying robust statistical inferences to the entire Project Area or AOC is not a Project objective. This is a monitoring project, not an experimental design. Thus, the data quality objectives are that data collected in the field or generated in a laboratory is done in accordance with the items below to ensure it provides accurate representation of water quality at the time of sampling/measurement.

Results from discrete water quality samples (see parameters listed above) will be considered data of acceptable quality if the samples were:

1. Collected in accordance with certified laboratory SOPs
2. Preserved (if required) in accordance with certified laboratory SOPs
3. Documented in accordance with certified laboratory SOPs
4. Analyzed in accordance with certified laboratory SOPs

The as yet unselected Certified Laboratory will be required to submit full SOPs detailing sampling and analysis procedures for inclusion in a subsequent QAPP revision. These SOPs will detail requirements for precision, accuracy, representativeness, completeness, and comparability.

The Project is intended to describe general characteristics and broad water quality changes across the Project Area. As stated in the Project workplan and grant narrative, Project objectives do not include developing critical water quality criteria for prescription to the Project Area of AOC. As such, detecting, confirming, and/or remedying fine level continuous water quality monitoring equipment inaccuracies and/or imprecision are beyond the necessary and practicable scope of this pilot project. Measurements collected from continuous water quality monitoring systems will be considered data of acceptable quality for the Project if the deployed systems:

1. Have been factory calibrated within the past year
2. Are field calibrated no more than 6 months after deployment (pre- and post-field calibration checks will be completed to assess instrument drift during deployment)
3. Are repaired and recalibrated in cases of damage

The above criteria for measurement quality assurance are consistent with manufacturer recommendations. Corrective actions and calibration will occur if instrument drift exceeds the manufacturer-specified accuracy range.

Special Training Requirements or Certifications

The Certified Laboratory will be required to submit full SOPs detailing sampling procedures and methodology consistent with the guidelines established by WDNR (2010). These SOPs must adequately address quality issues related to sample collection, contamination, and data management. The lab must possess current certification from WDNR to perform all of the required analyses or have the ability to subcontract with another certified lab as necessary. SOPs and certification documents will be included in subsequent QAPP revisions following the Certified Laboratory selection.

Program staff will fully review operating manuals and other supporting documentation prior to deployment of the three continuous monitoring stations. All Program staff will be well-versed in the maintenance, calibration, and data download procedures for the units prior to field deployment. Global Water Instrumentation, Inc. also maintains an extensive collection of support documents and offers staff technical support.

Program personnel, including the Program Manager and Program Assistants, have received GPS unit operation training from the QA/QC Manager/Officer and are experienced operators of the Program GPS unit. Post processing of GPS data will include 'joining' data in ESRI ArcMap 9.3.1.

Documentation and Records

Field and Laboratory Records

The Certified Laboratory will be required to maintain detailed field logs and/or collection sheets. These will document location, date, time, air and water temperature, cross section measurements, average flow velocity during sampling, and other relevant field conditions at each sampling site. The lab will be required to conform to Level 2 reporting standards, including analytical results, QA/QC reports, and chain of custody documentation.

Program staff downloading the data from the continuous monitoring stations will record general observations regarding monitoring station maintenance and relevant field conditions during each monthly visit. Data downloaded from the continuous monitoring stations will be spot-checked for suspicious or potentially erroneous readings upon upload to a Program computer. Program staff will perform the appropriate recalibration and/or consultation with the manufacturer as necessary.

Project Records

Anticipated Project records include this QAPP and all subsequent revisions, field records from Certified Laboratory and Program staff, QA/QC documentation, laboratory analysis results, and a spreadsheet containing data from continuous water quality monitoring stations. The Project Coordinator and QA/QC Manager/Officer will be responsible for maintaining this QAPP and all individuals on the Distribution List will receive and file a copy. The revision number is located in the header bar of this document. Subsequent QAPP revisions (if necessary) will be forwarded to all project partners in hard copy and digital PDF format. Field records and other hard copy documents will be scanned to PDF and stored in perpetuity along with any digital data on the Ozaukee County network server, which is backed up daily. All hard copy and digital files will be shared upon request with the WDNR and USEPA.

Final Report

The Project final report will be saved in MSWord and PDF format in perpetuity on the Ozaukee County network server and in hardcopy in the Ozaukee County Planning and Parks Department. The final report will be shared with all project partners in digital and hardcopy format.

Project File Final Disposition and Record Retention

All Project hardcopy files will be retained in the Ozaukee County Planning and Parks Department and/or digitally on the Ozaukee County network server. All files will be stored in perpetuity. All data will be readily accessible to Program staff and no files or data will be stored off site.

B. Measurement/Data Acquisition

Sample Process Design (Monitoring Design)

The Project, through a measured and science-based approach, will begin targeted water quality sampling and continuous monitoring of water quality in Ozaukee County portions of the Milwaukee River Watershed. The water quality assessment will provide baseline water quality information and trends within the Milwaukee River Watershed in Ozaukee County. Specifically, the Project aims to address the Ozaukee County portions of the AOC through the following objectives:

- Collecting baseline data for select chemical or physical water quality parameters and pathogens at systematic, strategic points within the mainstem Milwaukee River and select tributary streams in Ozaukee County
- Monitoring basic water quality parameters continuously at systematic, strategic points in the mainstem Milwaukee River

The number of water quality samples (approximately 150) and continuous water quality monitoring systems (three) are dictated by a balance between the best biological and ecological outcome and the available funding, staffing, and timeline as described in the grant narrative. Baseflow water quality will be sampled twice during the 2011-2012 period. Water quality will also be sampled during and/or immediately after three rain (surface runoff) events during the period of 2011-2012. Applying robust statistical inferences to the entire Project Area or AOC is not a Project objective. This Project is an initial effort or pilot project to describe water quality sampled or measured in the Project Area, both qualitatively and with some quantified sample statistics. All measurement and analysis parameters are for information only. Estimates of sample variability for many of the monitored parameters may prove useful for estimating requisite sample sizes for subsequent projects. Such examination of Project data, however, is not a direct Project objective and is not a focus of the Project or this QAPP.

The collection of baseline and trend data for nutrients and pathogens throughout the County has been designed to incorporate impounded and free-flowing stretches of the mainstem Milwaukee River, as well as the influence of multiple tributary streams within the watershed (Figure 2 and Table 4). Specific tributaries were designated for sampling based on land use (agricultural, residential, freeway, etc.), known contaminants (e.g., Cedar Creek) or concerns raised by Program personnel based on previous field inspection (e.g., Hawthorne Drive Creek). Sampling will occur during late-spring through autumn of 2011 and 2012, encompassing at least five distinct sampling events. All sites will be sampled during baseflow conditions each year (i.e., 60 total sample collections) to establish baseline conditions, as well as following three rain events (i.e., 90 total sample collections) during the 2011-2012 period to sample conditions influenced by surface runoff within the watershed. Sampling baseflow conditions, as well as confining sampling to the late-spring through autumn time period was requested by the WDNR (D. Dinsmore, M. Burzynski, and M. O'Shea, personal communication, March 15, 2011). The staff from a Certified Laboratory will determine cross section measurements at each sampling site and take multiple flow measurements during the collection of each water quality sample (Bain and Stevenson 1999). These measurements will facilitate the estimation of discharge during sampling and will be recorded alongside other sampling information and/or field observations. Other means of estimating discharge may be acceptable buy must be governed by approved protocols and SOPs.

The parameters that will be assessed during these sampling events are based on guidance from WDNR (2010), as well as conversations with WDNR Water Resources and Great Lakes staff (D. Dinsmore, M. Burzynski, and M. O'Shea, personal communication, March 15, 2011). Final detection and reporting limits for each parameter will depend largely on the Certified Laboratory chosen for the Project, as well as future feedback from USEPA and WDNR personnel. Limits within the capabilities of several local prospective laboratories are listed below (Table 5). Locations that return high fecal coliform counts (i.e., 200-400 CFU/100 mL) will also be tested for *Escherichia coli* (E. coli) during later sampling (WDNR 2010). The detection of E. coli "hotspots" may also result in limited bacteroides sampling through the Great Lakes Water Institute.

Figure 2. Water Quality Sampling Locations and Continuous Monitoring Stations

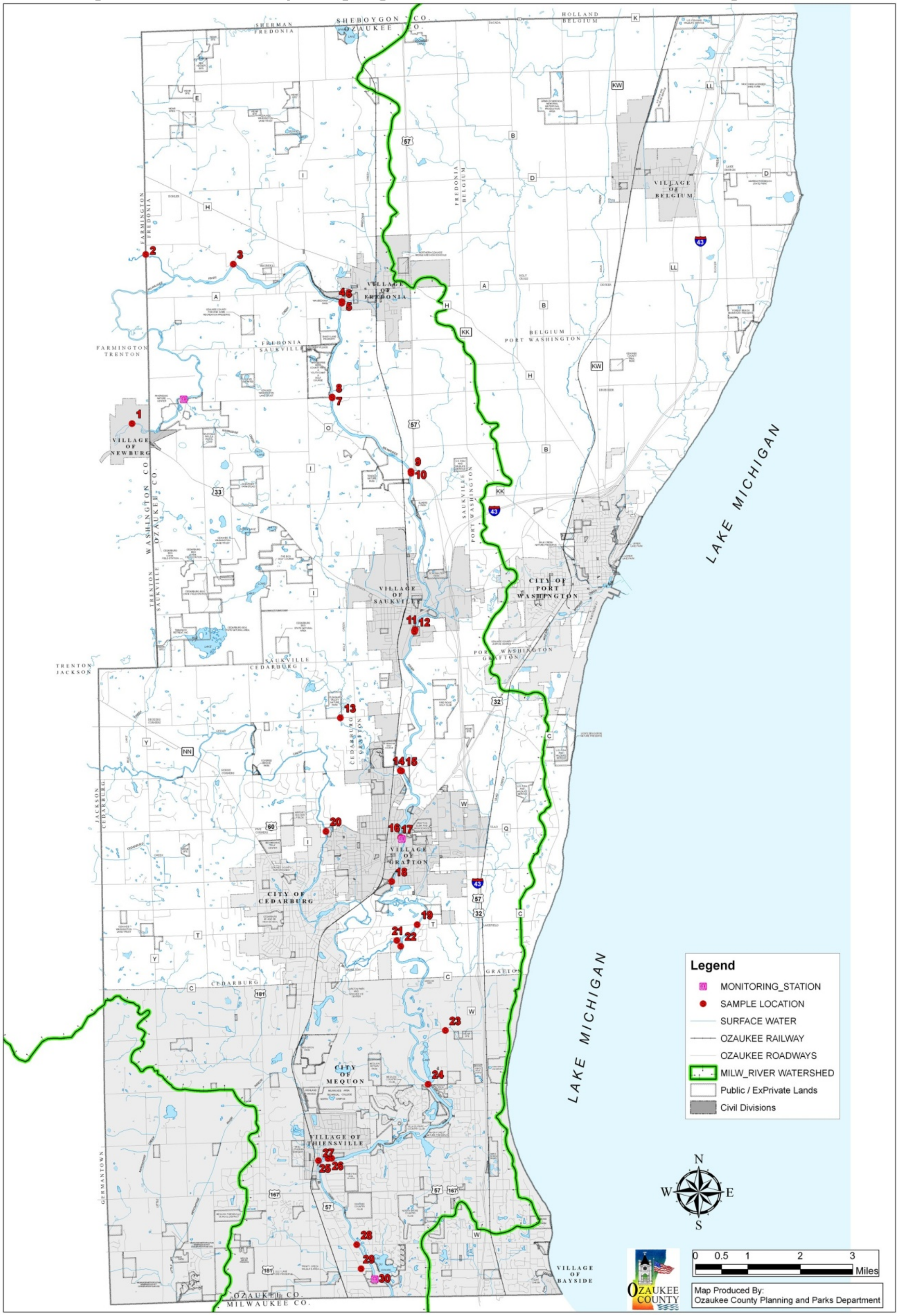


Table 4. Water Quality Sampling Sites, Descriptions, and Locations

Site	Description	Location[1]	Selection
1	M.R.[2] at Newburg Dam tailwater	Fireman's Park (43° 26' 3.32", -88° 2' 54.93")	Most upstream location in County
2	N. Branch M.R. near terminus	Riverside Road (43° 28' 52.47", -88° 2' 26.12")	Major tributary
3	M.R. upstream of River Road Creek	River Road (43° 28' 38.12", -88° 0' 31.50")	Major tributary confluence
4	Fredonia Creek near terminus	Waubedonia Park (43° 28' 0.61", -87° 57' 57.76")	Major tributary
5	M.R. downstream of Fredonia Creek, upstream of Fredonia Wastewater Treatment Plant discharge	Waubedonia Park (43° 28' 0.14", -87° 58' 0.89")	Major tributary confluence
6	M.R. downstream of Fredonia Wastewater Plant discharge	Waubedonia Park (43° 28' 0.14", -87° 58' 0.89")	Wastewater plant discharge
7	Hawthorne Drive Creek near terminus	Hawthorne Drive (43° 26' 26.28", -87° 58' 16.72")	Major tributary
8	M.R. downstream of Hawthorne Drive Creek	Hawthorne Drive (43° 26' 26.28", -87° 58' 16.72")	Major tributary confluence
9	Riverside Drive Creek near terminus	Evergreen Lane (43° 25' 11.22", -87° 56' 28.79")	Major tributary
10	M.R. downstream of Riverside Drive Creek	Evergreen Lane (43° 25' 11.22", -87° 56' 28.79")	Major tributary confluence
11	M.R. upstream of Saukville Wastewater Plant discharge	West Riverside Park (43° 22' 33.78", -87° 56' 31.58")	Upstream of wastewater plant discharge
12	M.R. downstream of Saukville Wastewater Plant discharge	West Riverside Park (43° 22' 33.78", -87° 56' 31.58")	Wastewater plant discharge
13	Mole Creek	Pleasant Valley Road (43° 21' 7.18", -87° 52' 16.16")	Major tributary
14	Mole Creek near terminus	N. Green Bay Road (43° 20' 12.10", -87° 56' 57.39")	Major tributary
15	M.R. downstream of Mole Creek	N. Green Bay Road (43° 20' 12.10", -87° 56' 57.39")	Major tributary confluence
16	M.R. at downstream extent of Bridge Street impoundment	Riverwalk Platform (43° 19' 7.78", -87° 56' 57.79")	Impoundment effects
17	M.R. at Bridge Street Dam tailwater	14th Avenue (43° 19' 6.21", -87° 56' 56.39")	Dam effects

18	M.R. downstream of Grafton Wastewater Plant discharge	Falls Road (43° 18' 33.15", -87° 57' 6.12")	Wastewater plant discharge
19	M.R. upstream of Cedar Creek	Lakefield Road (43° 17' 40.25", -87° 56' 39.84")	Upstream of confluence of tributary with known contamination
20	Cedar Creek	Grafton Lions Park (43° 19' 15.71", -87° 58' 40.05")	Major tributary with known contamination
21	Cedar Creek near terminus	City of Cedarburg property (43° 17' 24.41", -87° 57' 3.39")	Major tributary with known contamination
22	M.R. downstream of Cedar Creek	City of Cedarburg property (43° 17' 24.41", -87° 57' 3.39")	Downstream of confluence of tributary with known contamination
23	Ulao Creek near terminus	Bonniwell Road (43° 15' 55.89", -87° 56' 2.95")	Major tributary
24	M.R. downstream of Ulao Creek	Highland Road (43° 15' 3.75", -87° 56' 29.08)	Downstream of major tributary
25	M.R. at downstream extent of Mequon-Thiensville impoundment	Village Park (43° 13' 51.11", -87° 58' 42.70")	Impoundment effects
26	M.R. at Mequon-Thiensville Dam tailwater	Village Park (43° 13' 50.10", -87° 58' 46.66")	Dam effects
27	Pigeon Creek near terminus	Green Bay Road (43° 13' 50.08", -87° 59' 0.53")	Major tributary
28	M.R. downstream of Pigeon Creek	Donges Bay Road (43° 12' 25.35", -87° 58' 12.23")	Downstream of major tributary
29	Trinity Creek near terminus	Highway 57 (43° 12' 1.31", -87° 58' 4.90")	Major tributary
30	M.R. downstream of Trinity Creek	River Barn Park (43° 11' 51.02", -87° 57' 49.92")	Downstream of major tributary

1 – Site location coordinates measured using the Ozaukee County GIS
2 – M.R. = Milwaukee River

Table 5. Water Quality Parameters and Laboratory Limits

Test	Detection Limit	Reporting Limit	Total Samples[1]
Total Phosphorus	0.005 mg/L	0.016 mg/L	150
Total Kjeldahl Nitrogen (TKN)	0.18 mg/L	0.68 mg/L	150
Ammonia	0.07 mg/L	0.23 mg/L	150
Nitrites/Nitrates	0.025 mg/L	0.061 mg/L	150
Fecal Coliform	10 CFU/100mL	Does Not Apply	150
E. coli	1 CFU/100mL	Does Not Apply	TBD[2]
Total Suspended Solids (TSS)	2 mg/L	7 mg/L	150
Orthophosphate	0.007 mg/L	0.010 mg/L	150
Chlorophyll a	0.26 µg/L	0.87 µg/L	150

1 – Sample size is largely dependent on the number of high flow events during the sampling period

2 – E. coli sample size is dependent on fecal coliform "hotspots" identified that require further quantification

Continual monitoring of basic water quality parameters will occur at three distinct locations in the mainstem Milwaukee River (Figure 2). These include:

1. Immediately upstream of the Riveredge Creek terminal confluence in the Village of Newburg, approximately river mile (RM) 55
2. Downstream of the Bridge Street Dam in the Village of Grafton, approximately RM 31
3. Immediately downstream of the Trinity Creek terminal confluence in the City of Mequon, approximately RM 17

These three locations were largely chosen to provide full spatial distribution across the major sections of the Milwaukee River in Ozaukee County. Program staff will apply professional judgment to determine specific locations for each monitoring station, based on accessibility, safety, low likelihood of tampering, and capability with equipment logistics (e.g., cable lengths, etc.).

Each monitoring station will record water temperature (accurate within 0.1°C), water depth (accurate within 0.015 ft), dissolved oxygen concentration (accurate within 0.5% saturation), pH (accurate within 2% of full scale), and conductivity (accurate within 20 µs) several times per hour. Program staff will visit each station monthly for data downloading, battery replacement, general maintenance and cleaning, and requisite calibration. All monitoring equipment will be maintained in accordance with manufacturer recommendations (Attachments 1 and 2).

Monitoring these parameters continuously will allow Program staff to establish baseline data and trends related to various flow conditions. The data collected from continuous monitoring will also be cross referenced to the larger, discrete water quality sampling data set, allowing inference of water quality changes as they relate to specific events or time periods. Water quality data collected throughout the Project will also be consistent with those entered into WDNR's Surface Water Integrated Monitoring Systems (SWIMS), making for efficient data management and comparability (WDNR 2010).

Sampling Method Requirements

All water samples will be collected in containers, field preserved, labeled, and submitted for analysis in accordance with approved SOPs provided by the certified but not yet selected laboratory. General sampling requirements are as follows:

- Samples will be collected in containers approved by the WDNR laboratory certification program.

- Sampling must be performed with an emphasis on avoiding contamination throughout the process (e.g., do not touch the inside of the container, do not put caps on the ground during sampling, fully rinse sampling equipment between sites, etc.).
- To provide accurate and reliable results, sample preservation and holding times must be strictly adhered to throughout the process (e.g., labeling and preserving/icing samples immediately following collection, promptly delivering samples to the laboratory to ensure analysis within a given hold time, etc.).
- Complete sampling information must be obtained and documented for each sample including location, date, time, air and water temperature, average flow velocity, and other relevant field conditions at each sampling site. Together with cross section measurements performed by laboratory staff at each sampling site, average flow velocity will provide an estimation of discharge during sampling periods. Flow velocity measurement methods may be consistent with those outlined in Bain and Stevenson (1999). Other means of estimating discharge may be acceptable but must be governed by approved protocols and SOPs.
- The Program Manager and QA/QC Manager/Officer (Planning and Parks Specialist) are jointly responsible for all sampling corrective actions. Program Coordinator (Planning and Parks Director) approval and all sampling corrective actions is required.

The equipment used for continuous water quality monitoring will be calibrated by Program staff prior to initial deployment to confirm proper function. The stations will be located at sites providing safe access and a low likelihood of tampering. The monitoring probes and cords will be weighted to ensure submersion throughout the duration of sampling. Semimonthly checks at each station will include battery replacement, general maintenance, data download, and recalibration as necessary. The monitoring stations and probes will be maintained and calibrated as needed in accordance with manufacturer recommendations as cited in operating manuals and other supporting documents.

Sample Handling and Custody Requirements

All water quality samples must be sealed, preserved/iced, and transported to the laboratory in a prompt timeframe to ensure analysis occurs within necessary hold times per the Certified Laboratory SOPs. The Certified Laboratory chosen to perform Project sampling and analysis will conform to industry-standard Level 2 requirements, including analytical reports, QA/QC reports, and chain of custody documentation. The laboratory will assume custody of each sample it receives and is responsible for forwarding all sample analysis results to the Project Coordinator (or designee) following the completion of analysis.

Data from the continuous monitoring stations will be downloaded every month by Program staff onto external memory and immediately transported to the County offices and uploaded to the Ozaukee County network server.

Analytical Requirements

All Project water quality parameters will be assessed by a laboratory certified by WDNR for the analyses in question. Each method of analysis must also match those published by USEPA (http://water.epa.gov/scitech/methods/cwa/methods_index.cfm) or be consistent with the QA/QC requirements of those not published by USEPA (USEPA 2009). Final determination of analytic methods will be largely dependent on SOPs from the certified laboratory (not yet selected), though generally accepted methods are listed in Table 6.

Table 6. Water Quality Parameters and Analytical Methods

Water Quality Sample Parameter	Analytical Method
Total Phosphorus	EPA 365
Total Kjeldahl Nitrogen (TKN)	EPA 351
Ammonia	EPA 350
Nitrites/Nitrates	EPA 353
Fecal Coliform	SM9222(D)
E. coli	SM9223(B)
Total Suspended Solids (TSS)	EPA 160
Orthophosphate	SM4500-PE
Chlorophyll a	EPA 445

Quality Control Requirements

The Certified Laboratory will adhere to current industry-accepted practices for handling and testing samples, QA/QC, and chain of custody methods and will be held to industry-standard Level 2 reporting requirements (Ohio EPA 2006). Specific details, including requisite procedures for calculating QC statistics, will be included in the SOPs of the laboratory chosen to perform the work. Those SOPs will be included in a future revision of this QAPP. In general, field precision will be confirmed by collection and analysis of one field blank and one field duplicate sample for each sampling event (i.e., each of the five proposed collections). Criteria for acceptance for each type of quality control sample will be based on the SOPs provided by the Certified Laboratory chosen to perform the sampling and analysis. Accuracy will be maintained by strict adherence to sampling protocol and handling time for the tests listed in Table 5. Laboratory staff involved in field sampling will also take care to consistently sample at specified GPS coordinates and with methods described above and in laboratory SOPs. Laboratory staff involved in field sampling will also take care to consistently sample flowing portions of the river cross-section to represent the quality of water discharging through the Project Area.

Program staff involved in the deployment of the continuous monitoring stations will strictly adhere to manufacturer guidelines for equipment operation. During initial deployment and monthly site visits to each monitoring station, Program staff will ensure that each sampling probe is sufficiently secured within the river channel at each site. After each 6 months of deployment, each system's pH and DO probes will be replaced and recalibrated. Pre- and post-field calibration instrument checks will be completed during each 6-month calibration to assess instrument measurement drift. If one or more instruments drift outside of the manufacture specified accuracy range, data measured by the instrument in question will be adjusted to compensate for the drift. The data range subject to correction will be determined by comparison to accurate data collected by one or more of the non-drifting instruments.

Instrument/Equipment Testing, Inspection, and Maintenance Requirements

All laboratory equipment used for water quality sample analysis will be installed, operated, and maintained in accordance with the approved SOPs of the as not yet selected certified laboratory. Relevant SOPs will be included in a future QAPP revision.

All continuous water quality monitoring systems will be inspected, tested, and calibrated annually by the manufacturer. Program staff will inspect each system monthly for any signs of damage. All necessary repairs and recalibrations will be completed prior to the redeployment of a previously damaged system. A limited quantity of parts and accessories (exact number will be consistent with funding constraints) necessary for routine maintenance, including calibration solutions and replacement probes, will be kept at the Ozaukee County Planning and Parks Department. Any other parts or accessories will be obtained through the system manufacturer.

Data Management

All data management will be directed and overseen by the Program Manager (or designee). This includes but is not limited to field data form entries, data entered into spreadsheets and/or databases, and data reported from the Certified Laboratory. Relevant data will also be converted into a format usable for entry into the WDNR SWIMS database. All data will be stored at the Ozaukee County Planning and Parks Department where it is readily accessible to Program staff. No data will be stored off site.

Relevant standardized forms and checklists used by the as yet unchosen Certified Laboratory will be included in a future QAPP revision.

Relevant requisite computer hardware and software used by the as yet unchosen Certified Laboratory will be included in a future QAPP revision. Program personnel operate PC computers loaded with Microsoft Windows XP or Microsoft Windows 7, as well as the Microsoft Office 2007 suite of programs.

C. Assessment/Oversight

Assessments and Response Actions

The Project includes quarterly, semi-annual, and final reporting requirements built around the schedule outlined in the Project grant narrative. The Project is considered "on schedule" if pertinent milestones are reached.

The 30 sites are expected to be sampled at least five times during 2011 and 2012, with efforts concentrated to the degree practicable on baseline, autumn flow conditions or high flow rain events. Flood events, resource limitations, field equipment issues, and other uncontrollable factors may affect the sampling schedule. To the degree practicable, Program staff will try to avoid or mitigate any negative affects to the proposed schedule. If the sampling plan requires revision, modification, or alteration, approvals from the Project Coordinator, Program Manager, and QA/QC Manager/Officer are required.

The Program Assistants and Program Interns will be involved in field operations used to generate Project data. All field operation problems detected by Program staff or the Certified Laboratory will be reported directly to the Project Coordinator and Program Manager. Internal field operation assessments will be completed by the Program Manager and QA/QC Manager/Officer during the initial field calibration event (i.e., 6 months after deployment) for continuous water quality monitoring and during the first and third water discrete quality sampling event. Assigning approximate dates for these assessments is not practicable. These assessments will include a field readiness review and full analysis of all operation procedures. The Program Manager and QA/QC Manager/Officer will provide immediate verbal feedback and a subsequent written analysis to the Program Assistants and/or contracted Certified Laboratory staff prior to the next sample event. The Program Assistants and/or the Certified Laboratory staff are responsible for determining actions suitable for addressing detected problems and proposing them to the Project Coordinator and Program Manager for approval. Any changes to sampling protocol, methods, sites, or frequencies approved by the Project Coordinator and Program Manager will be reported to the QA/QC Manager/Officer for inclusion in a revised QAPP. Pursuant to Section 2.3.1 of EPA QA/G-5, no independent assessments will be completed as this is not a long-term project (USEPA 2002).

An internal data quality assessment will be completed by the Program Manager and QA/QC Manager/Officer annually. The Program Manager and QA/QC Manager/Officer will provide immediate verbal feedback and a subsequent written analysis to the Program Assistants and/or contracted Certified Laboratory staff prior to the next sample event.

The not yet selected Certified Laboratory will complete and report data quality assessments in accordance with their approved SOPs (to be included in a future QAPP revision). No assessments by groups independent of the Project will occur.

Any significant quality assurance problems will be reported by the Program Manager and QA/QC Manager/Officer to the Program Coordinator, who, with input from the Program Manger and QA/QC Manager/Officer, will determine and implement suitable corrective actions.

Reports to Management

The Project includes mandatory quarterly, semi-annual, and final reports to USEPA. The Project Coordinator and Program Manager, with assistance from the Program Assistants and Program Interns, are responsible for preparing and submitting all management reports to the Project Officer. Quarterly reporting is conducted through the Great Lakes Accountability System (GLAS) and quantitatively tracks progress toward established Project milestones. Semi-annual reporting is also submitted digitally to the Project Officer. Semi-annual reports are due April 30 and October 30 of each Project year and include summary information regarding:

1. Work accomplished during the reporting period
2. Object class category changes
3. Corrective actions
4. Projected new work
5. Percent completion of scheduled work
6. Percent budget spent
7. Changes to principal investigator
8. Needed changes to Project period
9. Date and amount of latest drawdown request
10. Delays and/or adverse conditions that materially impair meeting Project outputs/outcomes specified in the assistance agreement work plan
11. Results of performance evaluations and audits
12. Results of periodic data quality assessments
13. Any significant QA problems

Project Officer consideration of, and potential approval for, necessary revisions and modifications to Project timelines and outputs/outcomes would be management actions directly driven by semi-annual reporting.

The final Project report will include summary information pertaining to Project nature and extent, as well as information regarding Project outputs/outcomes. Applied methodologies, significant events and/or experiences, data compilation (i.e., a spreadsheet or database) and analysis, sample custody documentation, conclusions and recommendations, and pertinent photos, figures, and maps will be included. The draft final report will be submitted by the Project Coordinator and Program Manager to the Project Officer electronically no more than 45 days after the Project period. Hardcopy and digital copies of the final report will be submitted by the Project Coordinator and Program Manager to the Project Officer electronically no more than 90 days after the Project period.

D. Data Validation and Usability

Data Review, Validation, or Verification

The chosen Certified Laboratory will adhere to current industry-accepted practices for safe handling, testing of samples, QA/QC, and chain–of-custody methods. Specific details will be included in the SOPs of the laboratory chosen to perform the work, which will be provided as an attachment in a future revision of this QAPP. In general, field precision will be confirmed by the use of at least one field duplicate and one field blank each of the five sampling events. The laboratory will confirm precision by analyzing both samples for the full suite of parameters. Accuracy will be maintained by strict adherence to sampling protocol and handling time for the tests listed in Table 7, as well as the usage of field blanks and/or known positive samples. Laboratory staff involved in field sampling will also take care to consistently sample from within the thalweg (or representative areas when sampling in impoundments) to obtain samples representative of the flowing portions of the river at each sampling site.

Pre- and post-field calibration of continuous water quality monitoring system instruments will be completed during each 6-month calibration to assess instrument drift. If one or more instruments drift outside of the manufacture specified accuracy range, data measured by the instrument in question will be adjusted to compensate for the drift. The data range subject to correction will be determined by comparison to accurate data collected by one or more of the non-drifting instruments.

Verification and Validation Methods

Water quality sampling results will be verified through review of sample submittal and results documentation to ensure the sample were:

1. Preserved (if required) in accordance with certified laboratory SOPs
2. Documented in accordance with certified laboratory SOPs
3. Analyzed in accordance with certified laboratory SOPs

Internal quality control and quality assurance review methods and criteria will be completed by the as not yet selected Certified Laboratory in accordance with their approved SOPs (included in a future QAPP revision). Levels of analytical accuracy are detailed in Table 5. Requisite levels of precision will be also be detailed in the Certified Laboratory SOPs.

If data generated from samples is found to be outside of the SOP-specified accuracy and/or precision level, that data will be excluded from the project.

Continuous water quality monitoring will be reviewed to ensure the deployed monitoring systems:

1. Have been factory calibrated within the past year
2. Are field calibrated no more than 6 months after deployment (pre- and post-field calibration checks will be completed to assess instrument drift during deployment)
3. Are repaired and recalibrated in cases of damage

Internal reviews by the Program Manager and QA/QC Manager/Officer will accomplish the above verifications. The Program Manager and QA/QC Manager/Officer are responsible for determining steps to resolve data verification issues and submitting them to the Project Coordinator (Planning and Parks Department Director) for approval. Verification issue root-cause analyses may include chain of custody verification, sample collector or Certified Laboratory representative interviews, instrument calibration verification, data entry accuracy evaluation, and other tactics. Verification issues identified and the resultant resolutions will be conveyed to the Project Manager by the Project Coordinator (Planning and Parks Department Director).

Reconciliation with Data Quality Objectives

Data generated by the Project will provide baseline and trend-related water quality data for portions of the Milwaukee River Watershed and Milwaukee Estuary AOC within Ozaukee County. When finalized, Project parameters and methods will have been reviewed and edited by requisite WDNR and USEPA staff. As such, all Project data is expected to be useful and usable for management agencies related to the AOC and the Milwaukee River Watershed. Specifically, water quality sampling and monitoring in the Project Area will address the following objectives:

- Collecting baseline data for select chemical or physical water quality parameters and pathogens at strategic points within the mainstem Milwaukee River and select tributary streams in Ozaukee County
- Monitoring basic water quality parameters continuously in the mainstem Milwaukee River

Data collected will facilitate characterization and estimation of baseline water quality conditions and changes throughout the County, as well as any trend-related water quality concerns related to contemporary sources of nutrient or pathogen loading in the system. Future management, restoration, or regulatory actions within the Milwaukee River Watershed can possibly then be assessed for measurable effect on the tested parameters.

Water quality sample results generated by the Project will be considered reconciled with data quality objectives if the sample were:

1. Collected in accordance with certified laboratory SOPs
2. Preserved (if required) in accordance with certified laboratory SOPs
3. Documented in accordance with certified laboratory SOPs
4. Analyzed in accordance with certified laboratory SOPs

Anomalous results resolved in accordance with Certified Laboratory SOPs will also affirm DQOs have been met.

Continuous water quality monitoring results will be considered reconciled with data quality objectives if the deployed systems:

1. Have been factory calibrated within the past year
2. Are field calibrated no more than 6 months after deployment (pre- and post-field calibration checks will be completed to assess instrument drift during deployment)
3. Are repaired and recalibrated in cases of damage

Correction to data impacted by instrument drift will also affirm DQOs have been met.

The Program Manager and QA/QC Manager/Officer are responsible for resolving all issues regarding failure to meet data quality objectives.

Sample records, field logs, and chain of custody documentation will be reviewed to verify that all the samples collected were analyzed so the dataset can be considered complete. Data entries and analyses will also be verified. The input of large quantities of continuous monitoring data will be spot-checked to detect potential data entry errors. Once the data have been confirmed to meet standards, a final report detailing a summary of sample results and a summary of QA/QC and chain of custody will be prepared.

E. References Cited

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Attachment 1

Global Water

Instrumentation, Inc.

11390 Amalgam Way
Gold River, CA 95670
T: 800-876-1172
Int'l: (916) 638-3429, F: (916) 638-3270

Temperature Sensor: WQ101
pH Sensor: WQ201
Conductivity Sensor: WQ301
Dissolved Oxygen Sensor: WQ401
ORP/Redox: WQ600

00-758
11/30/09

Congratulations on your purchase of Global Water's Water Quality Sensors. This instrument has been quality tested and approved for providing accurate and reliable measurements. We are confident that you will find the sensor to be a valuable asset for your application. Should you require assistance, our technical staff will be happy to help.

Table of Contents

I. Sensor Checklist

a. Water Quality Sensor

b. Water Quality Sensor Manual

II. Inspection

a. Your water quality sensor was carefully inspected and certified by our Quality Assurance Team before shipping. If any damage has occurred during shipping, please notify Global Water Instrumentation, Inc. and file a claim with the carrier involved.

   Use the checklist to ensure that you have received everything needed to operate the water quality sensor.

III. Sensor Installation

General

a. Water quality sensors have many applications and therefore many installation options. All the sensors are fully submersible and may be suspended by their waterproof cables in the water to be monitored.

b. Do not install the water quality sensor in applications that contain solvents. Over time, many solvents can deteriorate the cable and the sensing element.

c. Install your water quality sensor so that it is easily accessible for calibration purposes. You may need to remove and reinstall it in the future, so plan ahead!

d. The sensors will not function correctly if mud, silt, leaves, or garbage buries them. The pH, Dissolved Oxygen, and ORP/Redox sensors will fail if they are left out of the water for extended periods of time. Install the sensor in a way that will avoid these conditions.

e. All Global Water water quality sensors produce a 4-19 mA output signal. 4-19 mA is an industrial standard signal for process control monitoring. Most PLCs (Programmable Logic Controller), RTUs (Remote Telemetry Unit), and data acquisition systems accept this signal directly. If the system only accepts voltage signals, the sensor output must be converted to a voltage signal by reading the voltage across a precision resistor in series with the signal wire. Since Ohms Law states that V = IR, if the 4-19 mA signal is dropped across a 250 ohm resistor, the output will be 1 to 4.75 volts DC. If the 4-19 mA signal is dropped across a 125 ohm resistor, the output will be halved to 0.5 to 2.375 VDC. The 4-19 Ma signal wire is connected to the datalogger voltage input terminal. The resistor is placed between this input and the ground terminal of the datalogger's battery. The power (or voltage to the sensor) must be connected to positive battery terminal of the datalogger.

f. The sensors may be pulsed on or turned on by the logging system prior to taking a reading. Use a warm up time appropriate to the water quality sensor you are using to assure that the sensor is fully on. The sensors can run continuously for real time applications. Each sensor draws between 4 and 19mA depending on whether the sensor is reading at the minimum or maximum of its range.

Groundwater

g. Sensors may be suspended in 2” monitoring wells near the well screen. Several sensors may be suspended in the same well by staggering the sensors one foot apart.

Surface Water

h. Sensors may be submerged at the monitoring point and hung from their cables. It is recommended to protect the sensors inside a 4” PVC drainpipe that will act as a protective stilling well. Put a cap on the bottom end of the pipe to allow easy water flow past the sensors. Drop the sensor until it touches the bottom of the stilling well and then pull it up slightly and secure the cable.

IV. Temperature Sensor

a. Temperature sensor specifications.

Output:	4-19mA
Range:	-50° C to + 50° C
Accuracy:	±0.2° F or ±0.1° C
Operating Voltage:	10-36VDC
Current Draw:	Same as sensor output.
Warm Up Time:	5 seconds minimum
Operating Temperature:	-50°C to +100°C
Size of Probe:	3/4" diameter x 4 1/2" long
Weight:	1/2 lb.

b. The sensor is a two-wire sensor using the red wire for power and the black wire for the output signal. Warning: Always connect the sensor with the power turned off.

c. The temperature sensor may be stored without any special provisions. Place the sensor inside a bag to keep the sensor clean and store on a shelf or hang it on a wall.

d. To check the temperature sensor calibration you will need:

1 thermometer
3 containers of water
1 power supply
1 current meter
Connecting wires as necessary

Connect the sensor to the power supply and current meter in the following way. Attach the black wire to the positive input of the current meter. Connect the ground terminal of the power supply to the ground of the current meter. Attach the red wire to the positive terminal of the power supply. See Appendix B. Warning: Always connect the sensor with the power turned off.

See Appendix A for the temperature calibration worksheet.

V. pH Sensor

a. pH sensor specifications.

Output:	4-19mA
Range:	0-14 pH
Accuracy:	2% of full scale
Operating Voltage:	10-36VDC
Current Draw:	16.6 mA plus sensor output
Warm Up Time:	3 seconds minimum
Operating Temperature:	-5° to +55°C
Pressure Rating:	0-100 psi
Size of Probe:	1 1/4" diameter x 10" long
Weight:	1 lb.

b. The sensing element is covered with a protective cap while at the Global Water facility to prevent the sensor from becoming damaged. This cap must be removed prior to sensor installation or the readings will be in error. To remove the cap, remove the protective shield and remove the rubber cap covering the sensing element. Replace the protective shield. Note: Save the cap for future use.

c. This sensor has a removable sensing electrode. If the sensor is reading incorrectly, after following the basic maintenance steps, the electrode should be removed and the metal contacts cleaned. If this does not improve the sensor's results the electrode should be replaced. To remove the sensing electrode loosen the set screw holding the sensor shield and remove the shield from the sensor. Unscrew the sensing electrode from the sensor housing. Clean the metal contacts of the electrode with a clean cloth. If the electrode is replaced with a new electrode the sensor must be recalibrated to work correctly.

d. The pH sensor is a three-wire sensor. Three wire sensors use the red wire for positive voltage, the white wire for the output signal, and the black wire for ground. Warning: Always connect the sensor with the power turned off.

e. The pH sensor must be stored where the sensing element remains wet or the sensing element will be damaged. It can be stored in a container of clean water or a wet sponge can be placed inside the protective cap shipped with the sensor. Place the cap over the sensing element to keep it wet. The sensor can then be stored on a shelf or hung on a wall.

f. The pH value of a substance is directly related to the ratio of hydrogen ion (H+) and Hydroxyl ion (OH-) concentrations. If H+ is greater than OH-, the solution is acidic, i.e., the pH value falls in the 0 to 7 range. If the OH- is greater than the H+, the material is basic with a pH value in the 7 to 14 range. If equal amounts of H+ and OH- ions are present, the material is neutral with a pH value of 7.

The pH electrode can be thought of as a battery whose voltage changes as the pH of the solution in which it is inserted changes. It consists of two basic parts: 1) a Hydrogen ion-sensitive glass bulb, and 2) a reference electrode. The special glass of the sensitive bulb has the ability to pass H+ i.e., it is said to be H+ sensitive. This ability allows the H+ inside the bulb to be compared to the H+ outside of the bulb, and a voltage to be developed that is related to the difference. The bulb then is a half-cell that needs a reference voltage in order to function.

The voltage produced by the complete probe is a linear function of pH, generally about 60 mV per pH unit. For example, at 7.00 pH the probe produces zero volts while at 6.00 pH it produces +60 mV. If the voltage had been negative it would indicate that the solution had a value of 8.00 pH.

A buffer solution is a solution with a well-defined pH value and has the ability to resist changes in pH. These characteristics are well suited to the standardization of pH measuring systems. Buffers are available in a wide range of pH values and come either in pre-mixed liquid form or as convenient dry powder capsules. When selecting buffers for use with your particular system, a value should be chosen nearest to that of the sample being measured.

g. Calibration should be checked monthly using the following procedure.
   You will need the following equipment:

   3 small containers

   1 bottle of 10pH buffer

   1 bottle of 4pH buffer

   1 power supply
   1 current meter
   Connecting wires as necessary

Connect the sensor to the power supply and current meter in the following way. Attach the black wire to the ground terminal of the power supply. Attach the white wire to the positive input of the current meter. Connect the ground terminal of the power supply to the ground of the current meter. Attach the red wire to the positive terminal of the power supply. See Appendix C. Warning: Always connect the sensor with the power turned off.

See Appendix A for the pH calibration worksheet.

VI. Conductivity Sensor

a. Conductivity sensor specifications.

Output:	4-19mA
Range:	0-5000 uS
Accuracy:	1% of full scale
Operating Voltage:	12VDC (± 5%)
Current Draw:	6.5 mA plus sensor output
Warm Up Time:	3 seconds minimum
Operating Temperature:	-40°C to +55°C
Size of Probe:	1" diameter x 12" long
Weight:	1 lb.
Temperature compensation:	2% per °C
Electrodes:	316 Stainless Steel

b. The Conductivity sensor is a three-wire sensor. Three wire sensors use the red wire for positive voltage, the white wire for the output signal, and the black wire for ground. Warning: Always connect the sensor with the power turned off.

c. The Conductivity sensor may be stored without any special provisions. Place the sensor inside a bag to keep the sensor clean and store on a shelf or hang it on a wall.

d. The Conductivity sensor has two stainless steel electrodes. The outside electrode is a ring and the inside electrode is a wire. The Conductivity sensor measures the ability of a solution to conduct an electric current between the two electrodes. The sensor can be used to measure either solution conductivity or total ion concentration of aqueous samples.

e. The Conductivity sensor is automatically temperature compensated using an internal thermister. Therefore the sensor will give the same conductivity in a solution that is at 15 °C as it would if the same solution were warmed to 25°C. This means that one calibration can be used for measurements in water samples of different temperatures. Without temperature compensated the conductivity readings would change as the temperature changed, even though the actual ion concentration did not change. CAUTION: When using the sensor in solutions with different temperatures the sensor must be left in the new solution for a minimum of 20 minutes prior to taking a valid reading.

f. To check the Conductivity sensor calibration you will need the following equipment:

3 small containers

1 bottle of distilled water

1 bottle of 5000 uS solution

1 power supply
1 current meter
Connecting wires as necessary

Connect the sensor to the power supply and current meter in the following way. Attach the black wire to the ground terminal of the power supply. Attach the white wire to the positive input of the current meter. Connect the ground terminal of the power supply to the ground of the current meter. Attach the red wire to the positive terminal of the power supply. See Appendix C. **Warning: Always connect the sensor with the power turned off.**

See Appendix A for the conductivity calibration worksheet.

VII. Dissolved Oxygen Sensor

a. Dissolved Oxygen sensor specifications.

Output:	4-19mA
Range:	0-100% Dissolved Oxygen
Accuracy:	+/- 0.5% FS
Operating Voltage:	10-36VDC
Current Draw:	11.8 mA plus sensor output
Warm Up Time:	10 seconds minimum
Operating Temp:	-40° to +55°C
Size of Probe:	1 ¼" diameter x 11" long
Weight:	1 lb.
Membrane:	0.001 FEP Teflon (standard)
Combined Error:	2% FS

b. The sensing element is covered with a protective cap while at the Global Water facility to prevent the sensor from becoming damaged. This cap must be removed prior to sensor installation or the readings will be in error. To remove the cap, remove the protective shield and remove the rubber cap covering the sensing element. Replace the protective shield. Note: Save the cap for future use.

c. This sensor has a removable sensing electrode. If the sensor is reading incorrectly, after following the basic maintenance steps, the electrode should be removed and the metal contacts cleaned. If this does not improve the sensor's results the electrode should be replaced. To remove the sensing electrode loosen the set screw holding the sensor shield and remove the shield from the sensor. Unscrew the sensing electrode from the sensor housing. Clean the metal contacts of the electrode with a clean cloth. If the electrode is replaced with a new electrode the sensor must be recalibrated to work correctly.

d. The Dissolved Oxygen sensor is a three-wire sensor. Three wire sensors use the red wire for positive voltage, the white wire for the output signal, and the black wire for ground. Warning: Always connect the sensor with the power turned off.

e. The dissolved oxygen sensor must be stored where the sensing element remains wet or the sensing element will be damaged. It can be stored in a container of clean water or a wet sponge can be placed inside the protective cap shipped with the sensor. Place the cap over the sensing element to keep it wet. The sensor can then be stored on a shelf or hung on a wall.

f. Dissolved oxygen (DO) refers to the volume of oxygen that the water contains. The quantity of oxygen that the water can hold depends on the temperature, salinity, and pressure of the water. Gas solubility increases with decreasing temperature (colder water holds more oxygen). Gas solubility increases with decreasing salinity (freshwater holds more oxygen than does saltwater). Finally, gas solubility decreases as pressure decreases. Thus, the amount of oxygen absorbed in water decreases as altitude increases because of the decrease in relative pressure.

g. Calibration should be checked monthly using the following procedure.

   You will need the following equipment:

   2 small containers

   1 one-gallon container

   1 package of zero oxygen solution

   1 power supply
   1 current meter
   Connecting wires as necessary

   Connect the sensor to the power supply and current meter in the following way. Attach the black wire to the ground terminal of the power supply. Attach the white wire to the positive input of the current meter. Connect the ground terminal of the power supply to the ground of the current meter. Attach the red wire to the positive terminal of the power supply. See Appendix C. Warning: Always connect the sensor with the power turned off.

   See Appendix A for the dissolved oxygen calibration worksheet.

VIII. ORP/Redox Sensor

a. ORP/Redox sensor specifications.

Output:	4-19 mA
Range:	-500mV to +500mV
Accuracy:	2% of full scale
Operating Voltage:	10-36VDC
Current Draw:	13.5 mA plus sensor output
Warm Up Time:	3 seconds minimum
Operating Temp:	0° to +55°C
Size:	1” diameter x 10 ½” long
Weight:	1 lb.

b. The sensing element is covered with a protective cap while at the Global Water facility to prevent the sensor from becoming damaged. This cap must be removed prior to sensor installation or the readings will be in error. To remove the cap, gently pull the rubber tab on the end of the cap and the cap should come off. Replace the protective shield. Note: Save the cap for future use.

c. The ORP/Redox sensor is a three-wire sensor. Three wire sensors use the red wire for positive voltage, the white wire for the output signal, and the black wire for ground. Warning: Always connect the sensor with the power turned off.

d. The ORP/Redox sensor must be stored where the sensing element remains wet or the sensing element will be damaged. It can be stored in a container of clean water or a wet sponge can be placed inside the protective cap shipped with the sensor. Place the cap over the sensing element to keep it wet. The sensor can then be stored on a shelf or hung on a wall.

e. ORP (Oxidation Reduction Potential) is a measure of the oxidation activity of the water. If the oxidation activity is high it will rust a piece of iron quickly. ORP is also used as an alternative way to measure chlorine concentration, since water high in chlorine (a strong oxidizer) has a high ORP. ORP is measured as a voltage between a platinum wire and a reference electrode. As this voltage goes up, the ORP goes up. The sensor amplifies this voltage and converts it to the 4-20 mA output signal.

f. To check the conductivity sensor calibration you will need the following equipment:

3 small containers

1 package of 100mV solution

1 package of 465mV solution

1 power supply
1 current meter
Connecting wires as necessary

Connect the sensor to the power supply and current meter in the following way. Attach the black wire to the ground terminal of the power supply. Attach the white wire to the positive input of the current meter. Connect the ground terminal of the power supply to the ground of the current meter. Attach the red wire to the positive terminal of the power supply. See Appendix C. Warning: Always connect the sensor with the power turned off.

See Appendix A for the dissolved oxygen calibration worksheet.

IX. Maintenance

a. Global Water recommends verifying the calibration every 6 months unless specified otherwise.

b. The sensors must be cleaned periodically. The suggested cleaning rate depends on the installation area. In dirty areas the sensor should be cleaned weekly. In a clean area they can be cleaned yearly. Begin by checking them after the first week, then wait one month if appropriate and so on. All sensors can be cleaned using water and liquid dish soap. A small amount of bleach can be added if there appears to be algae growth. Clean glass membranes with a Q-tip, soap, water, and bleach. Electrodes should be cleaned with a bristle brush, soap, and water.

X. Trouble Shooting

Issue: Sensor reading incorrectly

a. Verify power source is supplying correct voltage.

b. Clean the sensor following the maintenance instructions.

c. Check the sensor's calibration.

Other issues

d. Call Global Water for tech support: 800-876-1172 or 916-638-3429 (many problems can be solved over the phone). Fax: 916-638-3270 or Email: globalw@globalw.com.

   When calling for tech support, please have the following information ready;

   1. Model #.
   2. Unit serial number.
   3. P.O.# the equipment was purchased on.
   4. Our sales number or the invoice number.
   5. Repair instructions and/or specific problems relating to the product.

   Be prepared to describe the problem you are experiencing including specific details of the application, installation, and any additional pertinent information.

e. In the event that the equipment needs to be returned to the factory for any reason, please call to obtain an RMA# (Return Material Authorization). Do not return items without an RMA# displayed on the outside of the package.

   Clean and decontaminate the sensor if necessary.
   Include a written statement describing the problems.
   Send the package with shipping prepaid to our factory address. Insure your shipment, Global Water's warranty does not cover damage incurred during transit.

XI. Warranty

a. Global Water Instrumentation, Inc. warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from factory. Global Water's obligations under this warranty are limited to, at Global Water's option: (I) replacing or (II) repairing; any products determined to be defective. In no case shall Global Water's liability exceed the products original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by Global Water Instrumentation, Inc., or which has been subject to misuse, negligence or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

b. The warranty begins on the date of your invoice.

c. Replaceable electrodes for the pH and Dissolved Oxygen sensors are not covered under this warrantee.

XII. Appendix A: Calibration Procedures

Temperature Calibration check

Step 1) Fill a container of water with enough ice that it will not melt quickly.

Step 2) Place the temperature sensor and thermometer into the container. Turn on the power supply and the current meter. Let the sensor stabilize for 30 minutes before taking any measurements.

Step 3) Record the ice bath temperature, I_T = _______, and record the output current of the sensor, I_C = _______.

Step 4) Fill a container with enough warm water that it will not cool down quickly.

Step 5) Place the temperature sensor and thermometer into the container. Turn on the power supply and the current meter. Let the sensor stabilize for 30 minutes before taking any measurements.

Step 6) Record the warm water temperature, W_T = _______, and record the output current of the sensor, W_C = _______.

Step 7) Subtract I_C from W_C, $W_C - I_C$ = _______ = C.

Step 8) Subtract I_T from W_T, $W_T - I_T$ = _______ = T.

Step 9) Calculate B. $W_C - (C/T)(W_T)$= _______ = B.

Step 10) Find the low current value for the sensor. $-(C/T)(50)+B$= _____ = L_C. This current is the output current the sensor would produce if the temperature were -50°C.

Step 11) Find the high current value for the sensor. $(C/T)(50)+B$= _____ = H_C. This current is the output current the sensor would produce if the temperature were 50°C.

Step 12) Use these new current values to recalibrate the system that is monitoring the sensor output.

pH Calibration check

Step 1) Fill one container with tap water and another with 4 pH buffer solution.

Step 2) Place the pH sensor into the container with 4 pH buffer. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements.

Step 3) Record the output current of the sensor, W = _______. Remove the sensor and rinse it off in the tap water.

Step 4) Fill a container with 10 pH buffer solution.

Step 5) Place the pH sensor into the container. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements.

Step 6) Record the output current of the sensor, X = _______. Remove the sensor and rinse it off in the tap water.

Step 7) Subtract 4 pH current output from the 10 pH current output, X - W = _______ = C.

Step 8) Calculate B. X – (C/6)(10)= _______ = B.

Step 9) Find the low current value for the sensor. B= _____ = L_C. This current is the output current the sensor would produce if the pH were 0.

Step 10) Find the high current value for the sensor. (C/6)(14)+ B= _____ = H_C. This current is the output current the sensor would produce if the pH were 14.

Step 11) Use these new current values to recalibrate the system that is monitoring the sensor output.

Conductivity Calibration check

Step 1) Fill one container with tap water and another with 5000 uS solution. Ensure that the solution covers the bottom 2" of the sensor.

Step 2) Place the conductivity sensor into the container with 5000 uS solution. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements. (20 minutes if the sensor's temperature is different from the solutions.)

Step 3) Record the output current of the sensor, X = _______. Remove the sensor and rinse it off in the tap water.

Step 4) Fill a container with distilled water.

Step 5) Place the conductivity sensor into the container. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements. (20 minutes if the sensor's temperature is different from the water.)

Step 6) Record the output current of the sensor, W = _____.

Step 7) The low current value for the sensor is equal to W. This current is the output current the sensor would produce if the conductivity were 0.

Step 8) The high current value for the sensor is equal to X. This current is the output current the sensor would produce if the conductivity were 5000 uS.

Step 9) Use these new current values to recalibrate the system that is monitoring the sensor output.

Dissolved Oxygen Calibration check

Step 1) Fill one container with tap water and another with Zero Oxygen solution.

Step 2) Place the dissolved oxygen sensor into the container with the Zero Oxygen solution. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements.

Step 3) Record the output current of the sensor, W = _______. Remove the sensor and rinse it off in the tap water.

Step 4) Fill the one-gallon container half full of tap water and shake vigorously for several minutes to mix the water with oxygen

Step 5) Place the dissolved oxygen sensor into the container. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements.

Step 6) Record the output current of the sensor, X = _____.

Step 7) The low current value for the sensor is equal to W. This current is the output current the sensor would produce if the dissolved oxygen value were 0%.

Step 8) The high current value for the sensor is equal to X. This current is the output current the sensor would produce if the dissolved oxygen value were 100%.

Step 9) Use these new current values to recalibrate the system that is monitoring the sensor output.

ORP/Redox Calibration check

Step 1) Fill one container with tap water and another with the 100 mV solution.

Step 2) Place the ORP/Redox sensor into the container with 100 mV solution. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements.

Step 3) Record the output current of the sensor, W = _______. Remove the sensor and rinse it off in the tap water.

Step 4) Fill a container with the 465 mV solution.

Step 5) Place the ORP/Redox sensor into the container. Turn on the power supply and the current meter. Let the sensor stabilize for 5 minutes before taking any measurements.

Step 6) Record the output current of the sensor, X = _______. Remove the sensor and rinse it off in the tap water.

Step 7) Subtract 100 mV current output from the 465 mV current output, X - W = _______ = C.

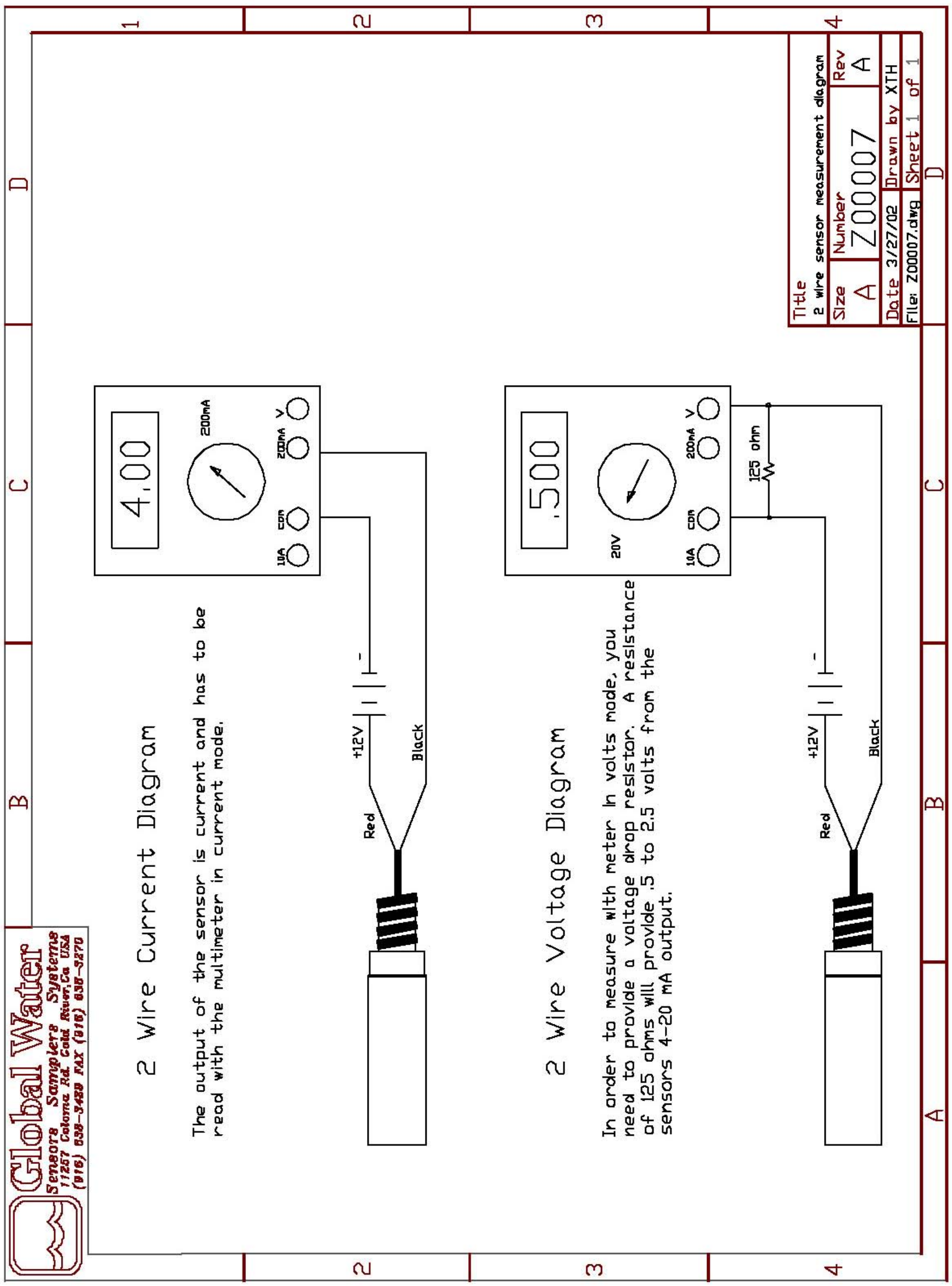
Step 8) Calculate B. X – (C/365)(465)= _______ = B.

Step 9) Find the low current value for the sensor. –(C/365)(500)+B= _____ = L_C. This current is the output current the sensor would produce if the temperature were –500 mV.

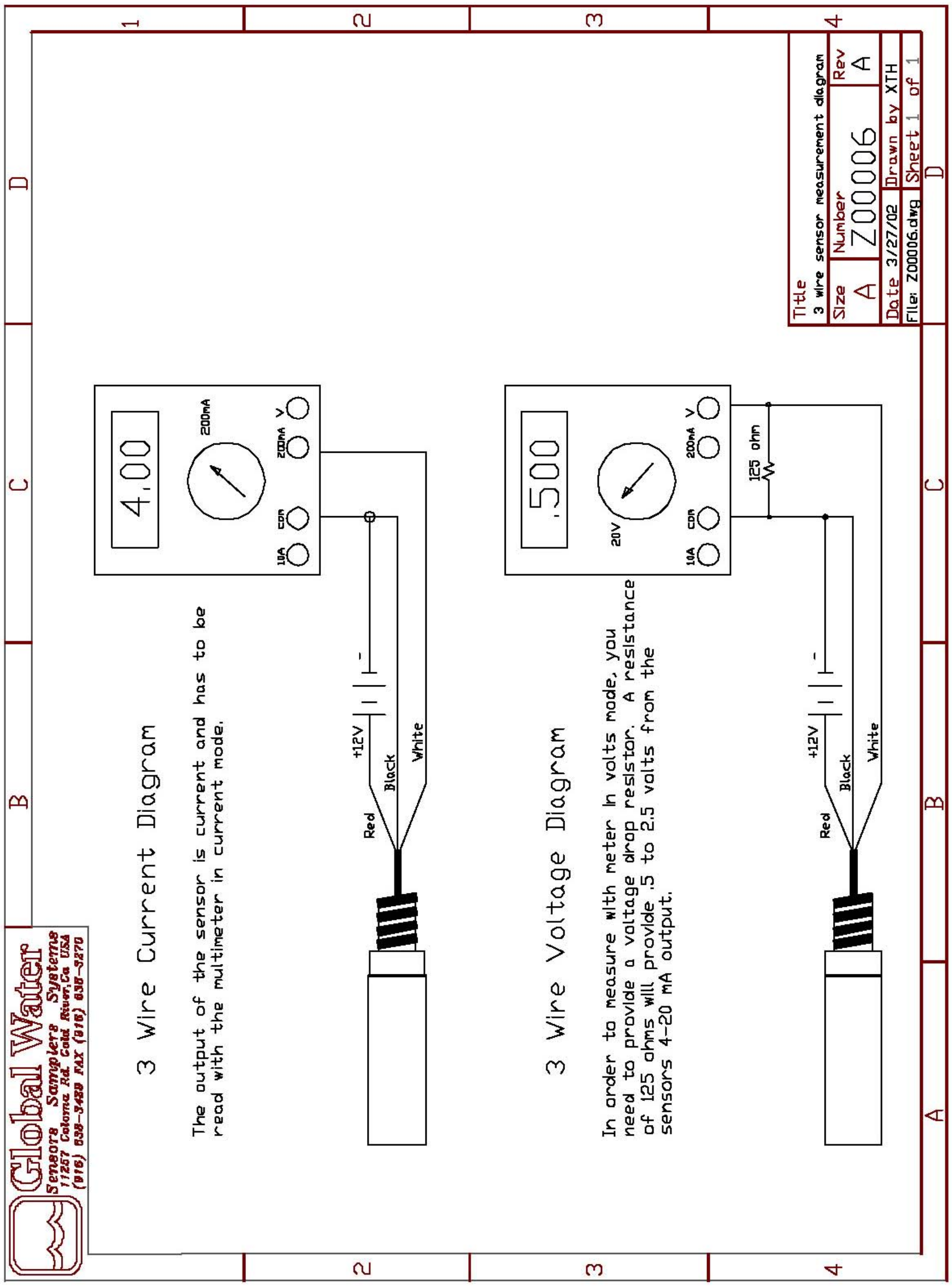
Step 10) Find the high current value for the sensor. (C/365)(500)+B= _____ = H_C. This current is the output current the sensor would produce if the temperature were 500 mV.

Step 11) Use these new current values to recalibrate the system that is monitoring the sensor output.

XIII. Appendix B: 2 Wire Sensor Measurement Diagram



XIV. Appendix C: 3 Wire Sensor Measurement Diagram



Declaration of CE Conformity

Global Water Instrumentation, Inc.
11390 Amalgam Way
Gold River, CA 95670 USA
FAX: 00 1 916 638 3270
Phone: 00 1 916 638 3429

declares that the Products:

Product Name: Water Quality Sensors; Temperature, Conductivity, ORP/Redox

Model Number: WQ101, WQ301, WQ600

conforms to the following European Council directives:

Low Voltage Directives: 2006/95/EC; Requirements covering all health and safety risks of electrical equipment operating within certain voltage ranges.
According to the following standards:
EN61010-1: 2001

Electro-Magnetic Directives: 2004/108/EC; Requirements to prevent electrical and electronic equipment from generating or being affected by electromagnetic disturbances.
According to the following standard:
EN 61326-1: 2006

Global Water hereby certifies that the product stated above conforms to all directives and standards required for it to bear the CE mark.

Dale Daniel
Engineering Manager
Global Water Instrumentation, Inc.

Attachment 2

Global Water

Instrumentation, Inc.

11390 Amalgam Way
Gold River, CA 95670
T: 800-876-1172
Int'l: (916) 638-3429, F: (916) 638-3270

Water Level Sensor: WL400

00-997
10/25/06

Global Water
800-876-1172 • globalw.com

Congratulations on your purchase of the Global Water WL400 Water Level Sensor. This instrument has been quality tested and approved for providing accurate and reliable measurements. We are confident that you will find the sensor to be a valuable asset for your application. Should you require assistance, our technical staff will be happy to help.

Table of Contents

I. Sensor Checklist

a. Water Level Sensor

b. Water Level Sensor Manual

II. Inspection

a. The water Level sensor was carefully inspected and certified by Global Water's Quality Assurance Team before shipping. If any damage has occurred during shipping, please notify Global Water Instrumentation, Inc. and file a claim with the carrier involved.

   Use the checklist to ensure that everything needed to operate the water Level sensor was received.

III. Sensor Installation

General

a. Water Level sensors have many applications and therefore many installation options. All the sensors are fully submersible and may be suspended by their waterproof cables in the water to be monitored.

b. Do not install the water Level sensor in applications that contain solvents. Over time, many solvents can deteriorate the cable and the sensing element.

c. Install the water Level sensor so that it is easily accessible for calibration purposes. Take care not to kink the cable. This will close the vent tube that the sensor uses to compensate for barometric changes. Also be aware that the sensor may need to removed and reinstalled in the future, so plan ahead!

d. The sensor will not function correctly if mud, silt, leaves, or other debris buries it. Install the sensor in a way that will avoid these conditions.

e. All Global Water water level sensors produce a 4-20 mA output signal. 4-20 mA is an industrial standard signal for process control monitoring. Most PLCs (Programmable Logic Controller), RTUs (Remote Telemetry Unit), and data acquisition systems accept this signal directly.

f. The power wire (red wire) must be connected to positive supply terminal of the data logger or of the battery. The 4-20mA signal wire (black wire) is connected to the data logger’s input terminal. If the sensor is equipped with the optional temperature output circuit, connect the output wire (white wire) to a second input terminal on the logger in the same way as the level output.

g. If the system only accepts voltage signals, the sensor output must be converted to a voltage signal by reading the voltage across a precision resistor in series with the signal wire. Since Ohms Law states that V = IR, if the 4-20 mA signal is dropped across a 250 ohm resistor, the output will be 1 to 5.00volts DC. If the 4-20 mA signal is dropped across a 125 ohm resistor, the output will be halved to 0.5 to 2.50 VDC. The resistor is placed between this input and the ground terminal of the data logger's battery. The optional temperature output produces a 0-10mA output current, generating either 0-2.50 volts or 0-1.25 volts depending on the resistor selected.

h. The sensors may be manually pulsed on or turned on by the logging system prior to taking a reading. Use a warm up time appropriate to the water Level sensor being used to assure that the sensor is fully on. The sensors can run continuously for real time applications. Each sensor draws between 4 and 20mA depending on whether the sensor is reading at the minimum or maximum of its range. The optional temperature output will draw additional current up to the maximum 10mA.

Groundwater

i. The sensor may be suspended in a 2" monitoring well near the well screen.

Surface Water

j. The sensor may be submerged at the monitoring point and hung from its cable. It is recommended to protect the sensor inside a 4" PVC drainpipe that will act as a protective stilling well. Put a cap on the bottom end of the pipe to allow easy water flow past the sensors. Drop the sensor until it touches the bottom of the stilling well and then pull it up slightly and secure the cable.

Sewer Flow Option

k. The WL400 Sewer Pipe Flow Option includes a level sensor built into a protective "mouse" housing and attached to a 12" stainless steel strap. The sensor/straps can be installed at the invert of a sewer or in a pipe, the cable can be attached to a sewer's stair rungs and run to the data monitoring device.

l. When installed in a pipe that is under 12" diameter, the steel straps spring into the pipe, holding the sensor in place. Additional fasteners are usually not required for this type of installation.
m. For a sewer pipe over 12" diameter, the sensor's steel straps must be mounted into the pipe. The straps can be secured with molly or concrete bolts, or with marine-grade epoxy.

IV. WL400 Specifications

Sensing element:

Sensor Element:	Silicone Diaphragm, Wet/Wet Transducer
Range:	0-3', 0-15', 0-30', 0-60', 0-120', 0-250' Optional Temp: 32°-122°F (0°-50°C)
Linearity and Hysteresis:	±0.1% FS
Accuracy:	Level: ±0.1% FS at constant temperature ±0.2% over 32° to 70°F range Temp: Smaller of 0.5°F or ±1% of reading
Overpressure:	2 x full scale range
Resolution:	Infinite (Analog)
Outputs:	4-20mA ±1mA at full scale Optional Temperature: 0-10mA ±1mA FS
Supply Voltage:	10-36VDC
Current Draw:	Sum of sensor outputs.
Warm Up Time:	10mS Min, 3 sec. recommended
Operating Temperature:	0° (Not Frozen) to +185°F
Compensated Range:	32° to 70°F submerged, automatic barometric compensation

Housing:

Material:	WL400: 304L Stainless Steel WL400-S: 316 SS
Size:	WL400: 7.5" long x 0.82" diameter WL400-S: 9" long x 1.0" diameter
Weight:	WL400: 110g (4 oz) WL400-S: 250g (9oz)

Cable:

Conductors:	4 each 22 AWG
Jacket Material:	87A shore hardness Polyurethane
Optional jacket:	Fluorinated Ethylene Propylene (FEP) Teflon
Cable O.D.:	7.8mm (0.307")
Vent tube:	HD Polyethylene
Shield:	Aluminum Mylar
Temperature range:	-30 to 85°C (-22 to 185°F)
Weight:	~65g/m (0.7 oz/ft)

a. The sensor is a two-wire sensor using the red wire for power and the black wire for the output signal. **Warning: Always connect the sensor with the power turned off.**

b. The water level sensor may be stored without any special provisions. Place the sensor inside a bag to keep the sensor clean and store on a shelf or hang it on a wall.

c. To check the water level sensor calibration the following supplies are needed:

   1 column of water (the closer the depth is to the maximum range of the sensor the better the calibration will be)
   1 power supply
   1 current meter
   Connecting wires as necessary

   Connect the sensor to the power supply and current meter in the following way. Attach the black wire to the positive input of the current meter. Connect the ground terminal of the power supply to the ground of the current meter. Attach the red wire to the positive terminal of the power supply. See Appendix B. **Warning: Always connect the sensor with the power turned off.**

   See Appendix A for the water level calibration worksheet.

V. Maintenance

a. Global Water recommends verifying the sensor's calibration with a sounder or other measuring device once every 6 months.

b. The screen on the end of the sensor must be periodically checked for clogging from mud, sludge, and other debris. Wash the screen with clean water and/or scrub it gently with a toothbrush. Do not insert objects through the screen, as this may cause damage to the sensor.

VI. Trouble Shooting

Issue: Sensor reading incorrectly

a. Verify power source is supplying the correct voltage.
b. Verify that the vent tube has not been kinked or sealed. The sensor uses this tube to compensate for barometric pressure changes.
c. Clean the sensor following the maintenance instructions.
d. Verify the sensor's calibration.

Issue: Water in the vent tube

a. If water gets into the vent tube of the cable place it next to a heater for 24 hours to dry the inside of the cable.

Other issues

a. Call Global Water for tech support: 800-876-1172 or 916-638-3429 (many problems can be solved over the phone). Fax: 916-638-3270 or Email: globalw@globalw.com.

   When calling for tech support, please have the following information ready;

   1. Model #.
   2. Unit serial number.
   3. P.O.# the equipment was purchased on.
   4. Global Water's sales number or the invoice number.

5. Repair instructions and/or specific problems relating to the product.

Be prepared to describe the problem being experienced including specific details of the application, installation, and any additional pertinent information.

b. In the event that the equipment needs to be returned to the factory for any reason, please call to obtain a RMA # (Return Material Authorization). Do not return items without a RMA # displayed on the outside of the package.

Clean and decontaminate the WL400 if necessary.

Include a written statement describing the problems.

Send the package with shipping prepaid to our factory address. Insure the shipment, Global Water's warranty does not cover damage incurred during transit.

X. Warranty

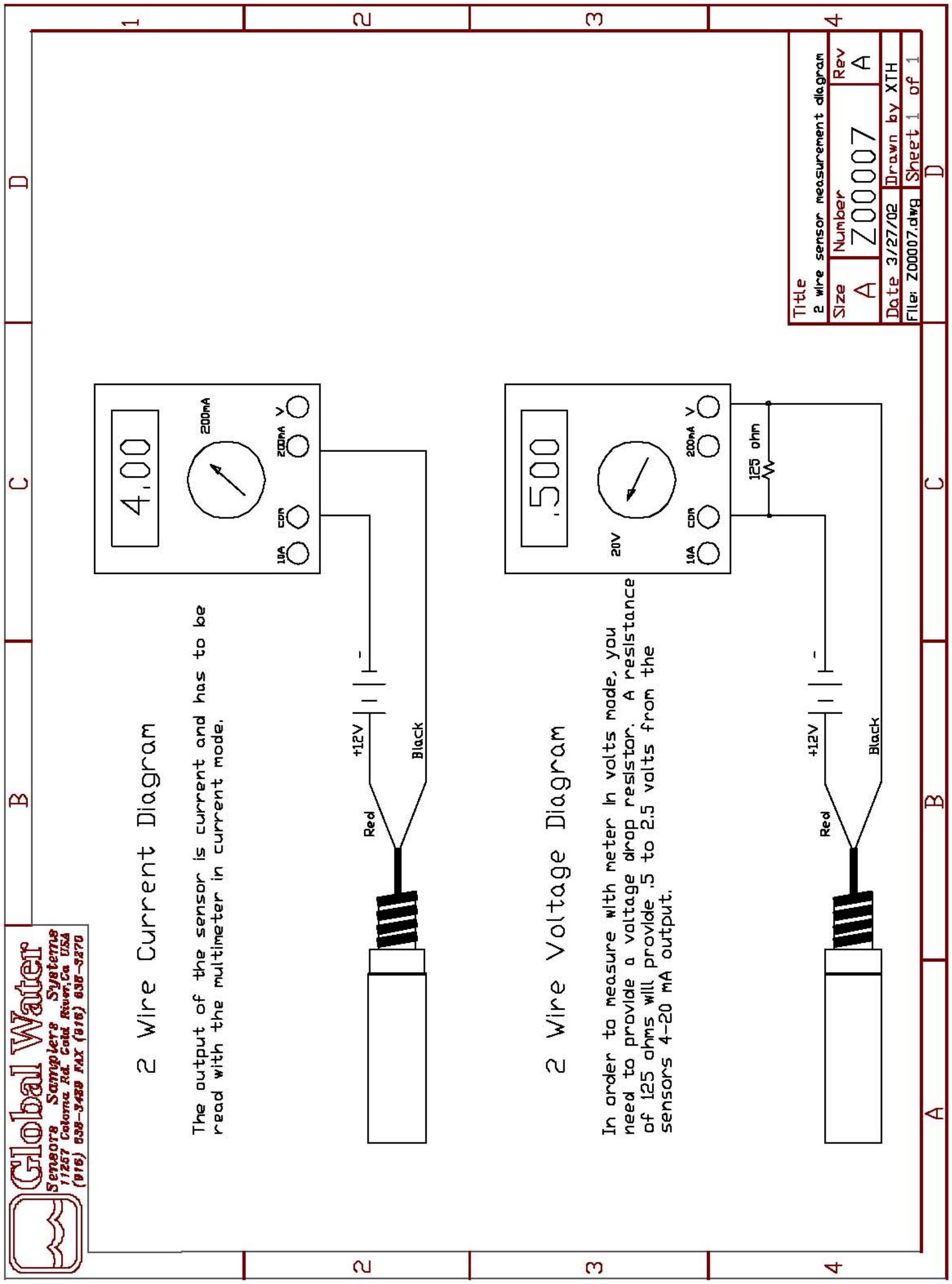
a. Global Water Instrumentation, Inc. warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from date of shipment from factory. Global Water's obligations under this warranty are limited to, at Global Water's option: (I) replacing or (II) repairing; any products determined to be defective. In no case shall Global Water's liability exceed the products original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by Global Water Instrumentation, Inc., or which has been subject to misuse, negligence or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

b. The warranty begins on the date of the product's invoice.

XI. Appendix A: Calibration Procedures

Step 1) Turn on the power supply and the current meter.
Step 2) Record the output current of the sensor, I_L = _______.
Step 3) Place the water level sensor into the column of water.
Step 4) Record the depth of the sensor (the distance from the tip of the sensor to the top of the column of water, W = _______, and record the output current of the sensor, I_H = _______.
Step 5) Subtract I_L from I_H, $I_H - I_L$ = _______ = C.
Step 6) Find the maximum current output for the sensor. (C/W)(Max Range of sensor)+ I_L= _____ = Output current.
Step 7) Use these new current values to recalibrate the system that is monitoring the sensor output.

XII. Appendix B: 2 Wire Sensor Measurement Diagram



Monitoring to Address 7 of 11 BUI's – Milwaukee Estuary AOC

Task 3: Sediment Contamination Sampling

Quality Assurance Project Plan

EPA Grant Funding Source: Great Lakes Restoration Initiative
Grant #: GL-00E00607-0

Project Coordinator:
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121 W. Main Street
Port Washington, WI 53074

Principal Investigators:
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121 W. Main Street
Port Washington, WI 53074

Prepared: April 1, 2011
Revision #: 1

Approvals: **Date:**

Andrew Struck, Director, Ozaukee County Planning & Parks Department
Project Coordinator — 5-25-11

Rajen Patel, U.S. Environmental Protection Agency
Project Officer — 5-24-11

Louis Blume, U.S. Environmental Protection Agency
Great Lakes National Program Office QA Manager — 5-24-11

Matt Aho, Program Manager, Ozaukee County Planning & Parks Department
Fish Passage Program
QA/QC Manager/Officer — 5-25-11

Thomas Dueppen, Specialist, Ozaukee County Planning & Parks Department — 5/26/11

TABLE OF CONTENTS

Distribution List

Personnel listed on the approval sheet and listed under Project/Task Organization will receive a copy of this Quality Assurance Project Plan (QAPP). Individuals taking part in the project may request additional copies of the QAPP from personnel listed under Project/Task Organization.

Executive Summary

The Milwaukee River Watershed Fish Passage Program (Program), a component of the Ozaukee County (County) Planning and Parks Department (Department) Ecological Division, and its project partners will begin sediment contamination sampling and analysis during 2011-2012 (Project) to provide data useful for addressing three of the Milwaukee Estuary Area of Concern (AOC) Beneficial Use Impairments (BUI) and to provide information relevant to multiple proposed BUI delisting targets. These activities are federally funded through the Great Lakes Restoration Initiative (GLRI) and administered by the United States Environmental Protection Agency (USEPA) under grant # GL-00E00607-0, entitled "Monitoring to Address 7 of 11 BUI's – Milwaukee Estuary AOC." The Project will focus on portions of the AOC within Ozaukee County and other relevant reaches of the Milwaukee River Watershed in Ozaukee County. This QAPP documents the work plan and quality control procedures for Task 3, Sediment Contamination Sampling, under the aforementioned grant.

The Project directly pertains to three BUIs for the Milwaukee Estuary AOC:

- Restrictions on Fish and Wildlife Consumption
- Degradation of Benthos
- Restrictions on Dredging Activities

Information pertinent to specific BUI delisting targets and actions will be garnered through analysis of historic orthophotographs and extensive sediment sampling in four specific reaches of the Milwaukee River to "implement sediment monitoring…to locate historic sites of PCB… contamination impacting the AOC," identify "contaminated sediment hot spots within and upstream of the AOC," and potentially identify "known contaminant sources contributing to sediment contamination and degraded benthos" (SEH and ECT 2008).

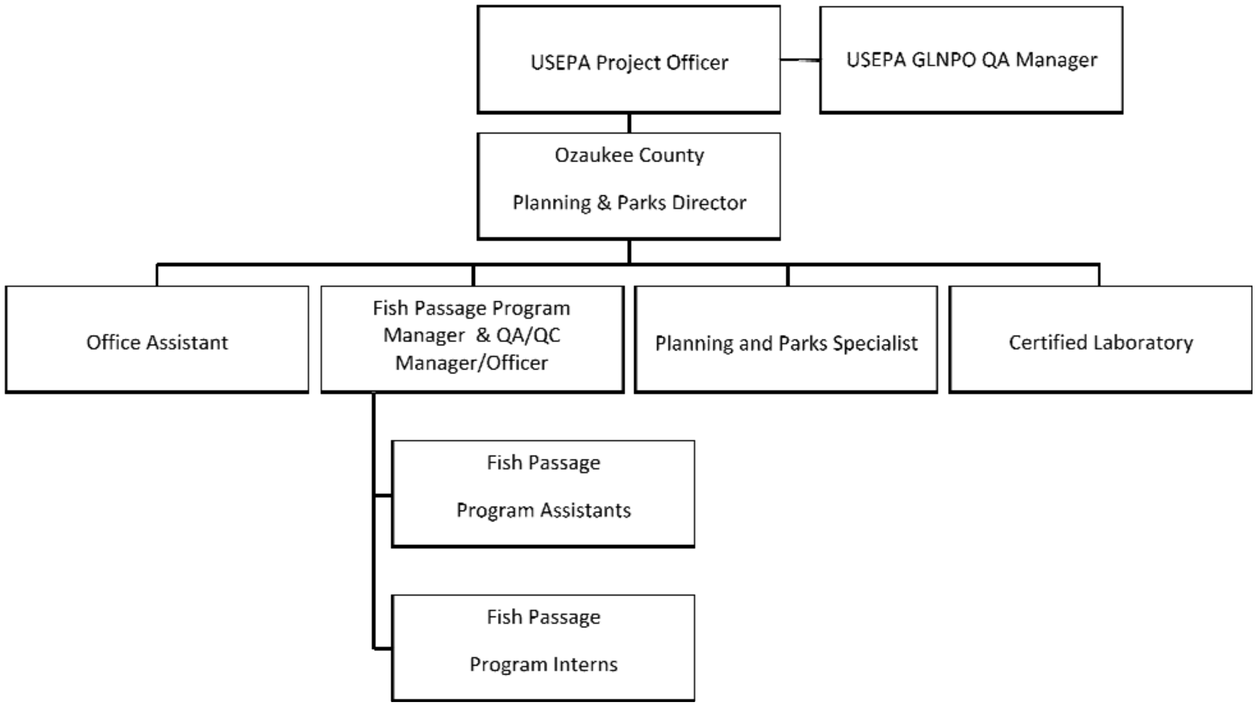
A. Project Organization

Personnel involved in project implementation are listed below (Table 1 and Figure 1).

Table 1: Project Implementation Personnel

Individual	Role in Project	Organizational Affiliation
Rajen Patel	Project Officer	U.S. Environmental Protection Agency
Louis Blume	GLNPO QA Manager	U.S. Environmental Protection Agency
Andrew Struck	Department Director and Project Coordinator	Ozaukee County Planning and Parks Department
Thomas Dueppen	Planning and Parks Specialist	Ozaukee County Planning and Parks Department
Matt Aho	Fish Passage Program Manager and QA/QC Manager/Officer	Ozaukee County Planning and Parks Department
Ryan McCone	Fish Passage Program Assistant	Ozaukee County Planning and Parks Department
Luke Roffler	Fish Passage Program Assistant	Ozaukee County Planning and Parks Department
Kevin Hensiak	Fish Passage Program Intern	Ozaukee County Planning and Parks Department
Steven Kunst	Fish Passage Program Intern	Ozaukee County Planning and Parks Department
Cynthia DeGroot	Office Assistant	Ozaukee County Planning and Parks Department
Certified Laboratory	Sediment Sampling and Laboratory Analysis	To Be Determined

Figure 1: Project Organizational Chart



The USEPA Project Officer will be responsible for the following activities:

- Review and approval of initial QAPP and subsequent versions
- Review and approval of all quarterly, semi-annual, and financial reporting

The USEPA Great Lakes National Program Officer (GLNPO) QA Manager will be responsible for the following activities:

- Review and approval of initial QAPP and subsequent versions

The Ozaukee County Planning and Parks Director (Project Coordinator) will be responsible for the following activities:

- Coordinate QAPP development and implementation with primary stakeholders
- Issue quarterly, semi-annual and annual reports to USEPA
- Maintain official, approved QAPP

The Ozaukee County Planning and Parks Specialist will be responsible for the following activities:

- GIS analysis of historic orthophotographs
- Field team leader for sediment poling surveys
- Coordinate geo-spatial data collection and transfer to partners
- Maintain Ozaukee County GIS software

The Ozaukee County Fish Passage Program Manager and QA/QC Manager/ Officer will be responsible for the following activities:

- Develop amended QAPP
- Coordinate all field activities
- Assist the Project Coordinator with coordination of all QAPP development, coordination of stakeholder input
- Administer QAPP quality control

The Ozaukee County Fish Passage Program Assistants will be responsible for the following activities:

- Assist the Planning and Parks Specialist with field data collection
- Data processing, review, analysis, evaluation, and reporting

The Ozaukee County Fish Passage Program Interns will be responsible for the following activities:

- Assist Program staff with field data collection
- Data processing, review, analysis, evaluation, and reporting

The Ozaukee County Office Assistant will be responsible for the following activities:

- General administrative assistance
- Materials and supplies purchasing
- General reporting assistance to the Project Coordinator and Program Manager

The Certified Laboratory will be responsible for the following activities:

- Collection and laboratory analysis of sediment samples
    - The Certified Laboratory will be chosen as part of a qualification-based selection process and must be certified to perform or subcontract all requisite analyses

Problem Definition/Background

The Milwaukee Estuary was designated an AOC during the 1980s due to historical dredging and other modifications, as well as heavy pollutant loads from local industry and agriculture. The Milwaukee Estuary Remedial Action Plan (RAP) was subsequently released and updated and documents 11 BUIs affecting the AOC as well as proposed delisting targets and actions for each BUI (WNDR 1991; WDNR 1994; SEH and ECT 2008). The AOC includes the Milwaukee harbor and estuary, nearshore areas of Lake Michigan, the Kinnickinnic and Menomonee Rivers, and portions of the Milwaukee River Watershed in Milwaukee and Ozaukee Counties.

Most Milwaukee Estuary AOC BUI's are closely tied to sediment contamination from compounds including PCBs (SEH and ECT 2008). While sediment contamination is known as a problem of great significance within the AOC, the extent of the contamination at specific locations is largely unknown (WDNR 1994). Without initial characterization of the location and extent of those deposits that continue to operate as a source of contaminants to the AOC, successful and cost-effective remediation of the AOC in the future may not be possible (WNDR 1994).

Initial PCB sampling and analysis was performed at various sites throughout the AOC from October 1993 through December 1995 (Westenbroek 1997). However, the large majority of the sampling during this study occurred outside the area proposed for this Project. Also, in 1996, the Hamilton Dam in Cedarburg collapsed and was removed. Given that Cedar Creek and the Hamilton Pond were identified by Westenbroek (1997) as a source of PCBs to the Milwaukee River, assessing sediment contamination at locations downstream of Cedar Creek in Ozaukee County will fill a critical knowledge gap regarding the current characterization of contaminated sediments within the Milwaukee Estuary AOC.

Project Objectives

The Project, through a measured and science-based approach, will begin locating and evaluating sediment contamination in Ozaukee County portions of the Milwaukee River Watershed. The Project will provide initial characterization of the current location and extent of sediment contamination within certain portions of the AOC in Ozaukee County. Specifically, the Project aims to address the following objectives:

- Delineating approximate areas of sediment accretion in specific sampling reaches through historic orthophotography analysis
- Determining the thickness and general composition (e.g., sand, silt, etc.) of targeted sediment accretions through poling surveys

- Determining general locations and extent of contaminated sediment deposits through core sampling and laboratory analysis

Quality Objectives and Criteria for Measurement Data

The Project is constituted of a monitoring design, not an experimental design, for providing initial characterization of the location and extent of contaminated sediment deposits in Ozaukee County portions of the mainstem Milwaukee River. As such, the measurement and data quality objectives are largely based on the precision and accuracy limits specified in the SOPs of the Certified Laboratory chosen for this project. Generated data will be shared with local WDNR AOC staff for consideration while developing BUI delisting criteria. However, applying robust statistical inferences to the entire Project Area or AOC is not a Project objective. Thus, the data quality objectives are that data collected in the field, generated in the field, or generated in a laboratory conforms to the items below to ensure it provides accurate representation of sediment quality at the time of sampling/measurement.

Results from discrete sediment quality samples will be considered data of acceptable quality if the samples were:

1. Collected in accordance with certified laboratory SOPs
2. Preserved (if required) in accordance with certified laboratory SOPs
3. Documented in accordance with certified laboratory SOPs
4. Analyzed in accordance with certified laboratory SOPs

The as yet unselected Certified Laboratory will be required to submit full SOPs detailing sampling and analysis procedures for inclusion in a subsequent QAPP revision. Precision will be evaluated by the Certified Laboratory through comparison of sample results to field and lab duplicate sample results for each sample site. Quantitative measures of accuracy will be estimated using laboratory QC approaches (e.g.., laboratory blanks, laboratory duplicates, etc) specified in the SOPs of the Certified Laboratory chosen for the project. However, given the intended usage of the baseline monitoring data generated by this project and the highly variable nature of sediment contamination sampling, precision and accuracy limits are expected to range widely, as they have for similar studies in the past (WDNR 2001; USEPA 2002; S. Westenbroek, United States Geological Survey, personal communication). The sampling locations specified below were selected to represent either free-flowing reaches of the Milwaukee River (Sites 1 and 3) or impoundments (Sites 2 and 4) with soft sediment accretions (i.e., likely areas with contaminated sediment accumulations). Comparability of data and results will be maintained by use of accepted protocols and strict documentation of methods, sampling sites and dates, analyses, chains of custody, etc. The Project will follow the sampling methods established by the pre-remediation monitoring of the Estabrook impoundment in Milwaukee (WDNR 2001), as well as the Milwaukee River PCB Mass Balance Study (Westenbroek 1997), to maintain comparability to previous sediment monitoring within the AOC and repeatability for future studies. The Certified Laboratory chosen to perform sediment sampling and analysis for the Project will be required to conform to these procedures, as well as those established by the Wisconsin Department of Natural Resources (WDNR) in *General Sediment Sampling Equipment and Procedures* (WDNR 2008).

The County has full confidence in the value of the proposed work to all agencies involved with AOC management and restoration. Project staff will routinely communicate output, outcome, and results progress with EPA project managers through scheduled progress reports and regular correspondence.

Project/Task Description and Schedule

Tasks

A comprehensive sediment sampling program will be implemented for portions of the Milwaukee River in Ozaukee County to begin establishing the general location and extent of contaminated sediment deposits in impounded and free-flowing river reaches. The Project includes the following tasks:

1. Sediment poling, sampling and analysis for suspected contaminants
2. QAPP preparation, reporting, and outreach

Task 1 - Sediment Sampling: Sediment quality monitoring activities along four sections of the Milwaukee River within the County, including:

1. The reach extending from the Milwaukee-Ozaukee county line, approximately River Mile (RM) 17, to the base of the Mequon-Thiensville (M-T) Dam (RM 20)
2. The M-T Dam impoundment (extending approximately from RM 20 to RM 21)
3. The reach extending from RM 21 to a point approximately 100 to 200 yards upstream of the confluence with Cedar Creek (RM 28)
4. The Newburg Dam impoundment (approximately RM 57)

Prior to sediment sampling, Project Staff will analyze orthophotographs of each of the above reaches taken during the estimated period of earliest PCBs release (approximately 1950) to present. This analysis will be used to document any changes in the position of the river channel, areas subject to deposition, and slack water areas during flood events where deposits of PCB contaminated sediment may be present outside of the river channel. Subsequently, Project Staff will perform a preliminary sediment poling survey to document the thickness and general composition (e.g., sand, silt, etc.) of sediment in different portions of the targeted River segment. All sampling locations will be documented using precision global positioning satellite (GPS) survey equipment and latitude/longitude coordinates. Sediment composition, thickness, and distribution will likely dictate the most effective sampling methods to achieve Project objectives within the allotted budget for this task. Sampling and sediment characterization/analysis for PCBs will be performed by Certified Laboratory staff from late-spring of 2011 through summer of 2012.

Task 2 - QAPP Preparation, Project Reporting and Outreach: Project staff has undertaken all project planning and QAPP preparation to date. Milestones are defined in Table 2 below.

Table 2. Project Progress Indicators

Task Category	Activity Description	Indicator or Status	Explanation
Sediment Sampling	Submittal/Approval of Sampling and Analysis Plan		
	Historic data review and sediment poling survey		
	Start Sampling Process		
	Substantial Completion		
	Submittal of Final Report		
QAPP Preparation, Reporting, and Outreach	Submittal / Approval of QAPP		
	BUI Progress Measures		
	Quarterly and Annual Financial / Progress Reports		
	Project Outreach Activities		

Quarterly, semi-annual and annual progress and/or financial reporting will be performed by County staff in accordance with USEPA requirements as specified in the Cooperative Agreement. Outreach and educational activities will be performed by Program staff with assistance from partner groups and/or engineering/environmental consulting firms. Outreach/educational activities include public meetings and presentations, posting of information on the Ozaukee County website, presentations at conferences, and other activities performed with various project partners as indicated in the grant workplan.

All Project work will be completed in Ozaukee County, USA. For reference, a relatively central point of reference for the project is: HUC code: 04040003 (Milwaukee River), Latitude and Longitude: 43.230007 and -87.9800889 (these are the coordinates for the Mequon-Thiensville Dam), State: Wisconsin, County: Ozaukee, City: Thiensville, ZIP Code: 53092.

Schedule

Table 3 describes the steps to be taken and the significant milestones to be achieved to complete the proposed project as well as the estimated schedule of these achievements, including the submittal of the final report, with anticipated target dates. The table is organized into two technical areas representing each task as described above.

Table 3. Project Milestones and Target Dates

Task #	Task Category	Milestone Description	Target Date
1	**Sediment Sampling**	Sampling and Analysis Plan: *Initiate Plan/QAPP coordination with WDNR/EPA*	2/15/2011
		Sampling and Analysis Plan: *Submittal of final plan within QAPP for WDNR/EPA approval*	4/15/2011
		Sampling and Analysis Plan: *Historic orthophotograph review and sediment poling survey*	5/1/2011
		Start of initial sampling	6/1/2011
		Completion of final sampling	9/15/2012
		Reports: *Submittal of final sediment report to WDNR/EPA*	12/31/2012
2	**QAPP Preparation, Reporting, and Outreach**	Award: *Formal announcement by EPA*	9/20/2010
		Cooperative Agreement: *Execution of final agreement by County*	11/15/2010
		Staff Initiation or Consultant Procurement: *Issue requests for proposals (per 40 CFR 31.36)*	12/17/2010
		Consultant Procurement (as needed): *Execution of consulting agreement*	3/10/2011
		QAPP: *Submittal of initial draft to WDNR*	2/15/2011
		Quarterly Financial/Progress Reports: *Submittal of initial GLAS report to EPA*	1/15/2011
		QAPP: *Submittal of final plan to WDNR/EPA for approval*	4/15/2011
		Outreach: *Completion of final project outreach activities*	12/31/2012
		Annual Financial/Progress Reports: *Submittal of final report to EPA*	12/31/2012
Final Report			12/31/2012

Personnel, Special Equipment or Supplies

The analysis of historic orthophotographs will be performed using Department computers equipped with ArcGIS 9.3.1 (Environmental Services Research Institute, Inc.). This initial analysis is expected to indicate potential areas of sediment deposition within the specified sampling reaches. Given the historic nature and lack of orthorectification of many of the photographs in question, this analysis will be undertaken strictly as a general guide for directing Project staff toward the most likely depositional areas during upcoming sediment poling surveys.

Project staff will perform sediment poling surveys under the direction of the Planning and Parks Specialist (Professional Geologist) in those areas identified as having a high likelihood of historical sediment deposition. These surveys will determine sediment thickness and approximate extent of depositional areas within specified sampling reaches. Program staff may also be able to determine specific sampling "hotspots" based on areas of highest sediment deposition in each sample reach. Special equipment necessary to conduct sediment poling surveys includes:

- Jon Boat

- Motor
- Gasoline
- Anchor
- Oars
- Life jackets
- GPS - Topcon GRS-1 with subfoot mapping accuracy (http://www.topconpositioning.com/products/gps/geodetic-receivers/integrated/grs-1.html)
- Tile probe with depth markings
- All weather field books

The Program maintains a hard copy and digital file of the Topcon GRS-1 and TopSurv software user manual. The online version is located at http://www.top-survey.com/top-survey/downloads/TpSrv_rm.pdf.

The Wisconsin Certified Laboratory chosen for sediment sampling and contaminant analysis will provide and utilize all necessary sampling equipment based on their standard operating procedures (SOPs) and the guidance established for similar sediment contamination studies (Westenbroek 1997; WDNR 2001; WDNR 2008). All SOPs will be included as attachments in a future revision of this document.

Special Training Requirements or Certifications

The Certified Laboratory chosen for the sediment sampling and analysis will be required to submit full SOPs detailing sampling procedures and methodology consistent with the guidelines established by Westenbroek (1997) and WDNR (2001; 2008). These SOPs must adequately address quality issues related to sample collection, contamination, data management, etc. The lab must also possess current certification from WDNR to perform all of the required analyses or have the ability to subcontract with another certified lab as necessary. SOPs and certification documents will be included in future versions of this document, following the selection of the Certified Laboratory.

The Planning and Parks Specialist has a current Professional Geologist License from the State of Wisconsin and several years of relevant professional experience with GIS software and analysis and will direct and oversee all historic orthophotograph analysis.

Program staff will fully review operating manuals and other supporting documentation pertaining to relevant field equipment, The Program staff, including the Program Manager and Program Assistants, have received GPS unit operation training from the QA/QC Manager/Officer and are experienced operators of the Program GPS unit. Post processing of GPS data will include 'joining' data in ESRI ArcMap 9.3.1 by the Planning and Parks Specialist.

Documentation and Records

Field Records and Laboratory Records

The Planning and Parks Specialist and Program staff will maintain detailed field records during each poling survey. These will include the date, time, weather conditions, staff initials, GPS coordinates, depth of the sediment-water interface, depth of refusal, and other relevant field conditions at each poling site (e.g., suspected sediment composition). Poling data will be saved to the GPS unit in the field and backed up on the County network drive daily. Information from the poling survey will be digitally plotted on orthorectified (NAD 1927) photographs using ArcMap 9.3.1 to assist with the planning and execution of the sediment sampling phase of the Project. NAD 1927 is the standard projection for the County, as well as local agencies such as the Southeast Wisconsin Regional Planning Commission. The NAD 1927 project will be used during this project to maintain compatibility with all other County GIS files, though, if necessary, interested agencies can easily transform all files to a projection that better suits their needs (e.g., NAD 1983). All GIS data generated by this project will be compiled in a geospatial database and stored in perpetuity on the Ozaukee County network server, which is backed up daily.

The Certified Laboratory chosen to perform the sediment sampling and analysis will be required to maintain detailed field logs and/or collection sheets. These will document date, time, GPS coordinates, depth of sediment-water interface, depth of sample, and other relevant field conditions at each sampling site. The lab will be required to conform to industry-standard Level 2 reporting requirements, including analytical results, QA/QC reports, and chain-of-custody documentation (Ohio EPA 2006).

Project Records

Anticipated Project records include this QAPP, field records from Certified Laboratory and Project staff, QA/QC documentation, laboratory analysis results, and orthophotographs containing information from the poling survey. The Project Coordinator and QA/QC Manager/Officer will be responsible for maintaining this QAPP and all individuals on the Distribution List will receive and file a copy. The revision number is located in the header bar of this document. Subsequent QAPP revisions (if necessary) will be forwarded to all project partners in hard copy and digital PDF format. Field records and other hard copy documents will be scanned to PDF file format and stored in perpetuity along with any digital data on the Ozaukee County network server, which is backed up daily. All hard copy and digital files will be shared upon request with the WDNR and USEPA.

Final Report

The Project final report will be saved in electronic MSWord and PDF file format on the Ozaukee County network server and in hardcopy in the Ozaukee County Planning and Parks Department. The final report will be shared with all project partners in digital and hardcopy format.

Project File Final Disposition and Record Retention

All Project hardcopy files will be retained in perpetuity at the Ozaukee County Planning and Parks Department and/or digitally on the Ozaukee County network server and will be made available upon request.

B. Measurement/Data Acquisition

Sample Process Design (Monitoring Design)

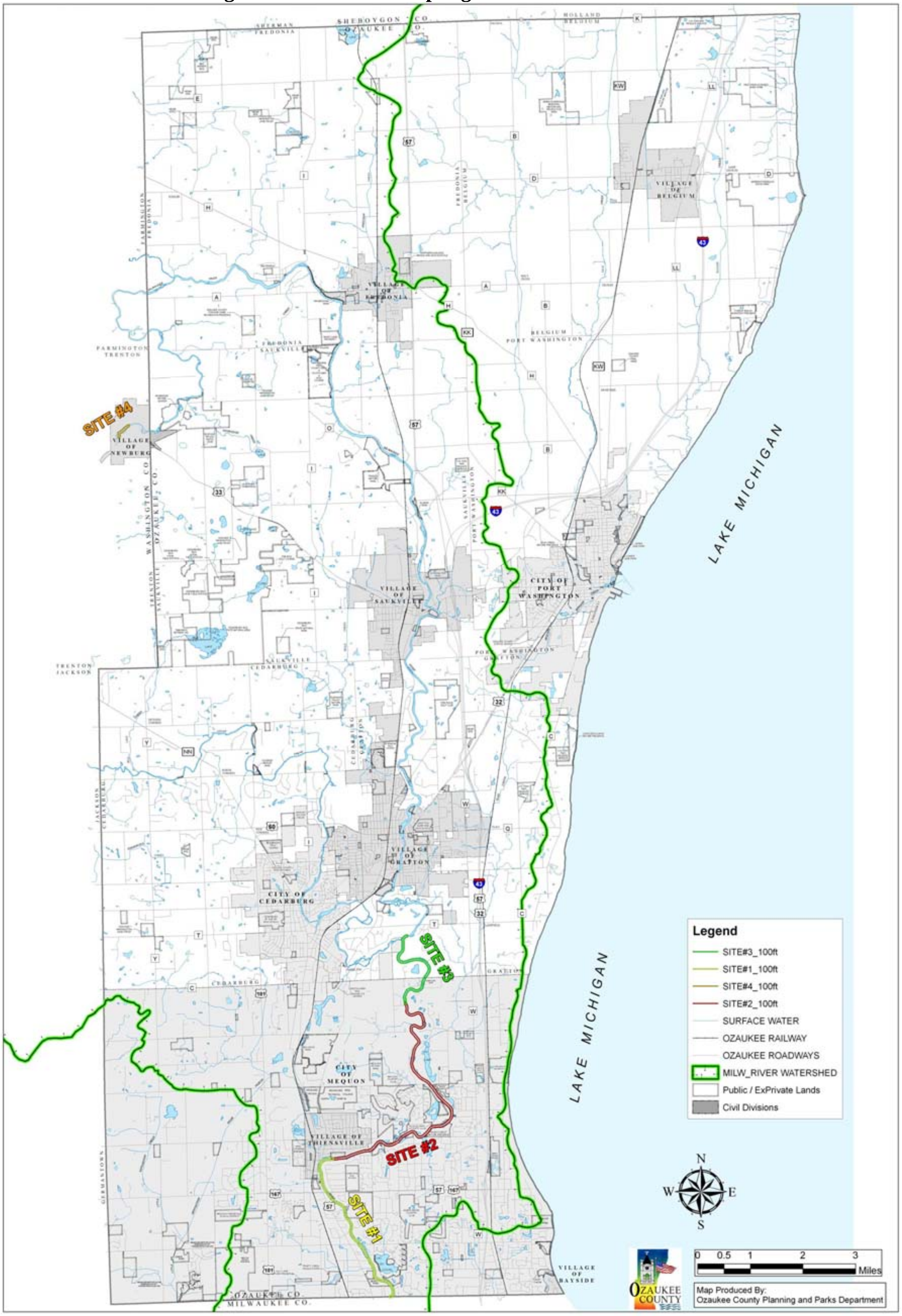
The Project, through a measured and science-based approach, will begin locating and evaluating sediment contamination in Ozaukee County portions of the Milwaukee River Watershed. The sediment sampling will provide initial characterization of the current location and extent of sediment contamination within certain portions of the AOC in Ozaukee County. Specifically, the Project aims to address the following objectives:

- Delineating approximate areas of sediment accretion in specific sampling reaches through historic orthophotography analysis
- Determining the thickness and general composition (e.g., sand, silt, etc.) of targeted sediment accretions through poling surveys
- Determining general locations and extent of contaminated sediment deposits through core sampling and laboratory analysis

Sediments in portions of the Milwaukee Estuary AOC have been previously sampled for PCB contamination (Westenbroek 1997). However, the majority of the sampling during this study occurred outside the area proposed for this Project. Further, in 1996, the Hamilton Dam on Cedar Creek near Cedarburg failed and was removed, presumably bolstering sediment transport loading in Cedar Creek. Given that Cedar Creek and the Hamilton Pond were identified by Westenbroek (1997) as a source of PCBs to the Milwaukee River, assessing sediment contamination at locations downstream of Cedar Creek in Ozaukee County will fill a critical knowledge gap regarding the current characterization of contaminated sediments within the Milwaukee Estuary AOC. The sampling reaches for this project are located on the mainstem Milwaukee River (Figure 2) and are listed as follows:

1. The reach extending from the Milwaukee-Ozaukee county line, approximately River Mile (RM) 17, to the base of the Mequon-Thiensville (M-T) Dam (RM 20)
2. The M-T Dam impoundment (extending approximately from RM 20 to RM 21)
3. The reach extending from RM 21 to a point approximately 100 to 200 yards upstream of the confluence with Cedar Creek (RM 28)
4. The Newburg Dam impoundment (approximately RM 57)

Figure 2. Sediment Sampling Reaches on the Milwaukee River



Characterizing the general location and extent of any PCB contamination at the Newburg Dam impoundment (Site 4), which lies immediately west of the Ozaukee-Washington County line, will provide Project staff with a known contaminant level as the Milwaukee River enters the County, as well as the extent of sediment contamination in an impoundment uninfluenced by the known PCB contamination of Cedar Creek. Sampling at Site 3 will provide information on the influence of Cedar Creek PCB contamination on the mainstem Milwaukee River, as well "control" sampling immediately upstream of the Cedar Creek confluence. Site 2 is located at the M-T Dam impoundment, which is the first major depositional area downstream of the Cedar Creek confluence. Since this impoundment was sampled by Westenbroek (1997) prior to the failure of the Hamilton Dam, Project sampling locations within the impoundment will closely mirror those used in the previous survey (WDNR 2001). Sampling of sediments in the free-flowing stretch below the M-T Dam to the Ozaukee County line (Site 1) will provide Project staff with general knowledge of contamination levels as the Milwaukee River leaves the County.

GIS analysis of historic orthophotographs will provide Project staff with likely areas of sediment accretion in the sample reaches specified above. Analysis will be lead by the Planning and Parks Specialist and will utilize 8 orthophotographs for each site, dated 1941, 1950, 1963, 1970, 1980, 1990, 2000, and 2010. This coincides with the period dating from the estimated earliest date for release of PCBs (approximately 1950) to present. Comparison of multiple images of a sampling reach will be facilitated by the use of conspicuous landmarks common to all images (e.g., large manmade structures). Given the historic nature of many of these orthophotographs and their usage as simply a general guide for field crews, orthorectification will be unnecessary. The Planning and Parks Specialist will create maps depicting the geographic extent of each suspected sediment deposition area, and upload coordinates to the GPS unit for staff field location of each sampling reach.

The Planning and Parks Specialist will lead Project staff in conducting sediment poling surveys in identified areas of likely sediment deposition following orthophotography analysis. The poling surveys will further delineate general areas of sediment deposition within each sampling reach. Given that PCB accumulation is most likely in areas of soft sediment deposition (WDNR 2001), the poling surveys will also identify potential "hotspots" of deepest sediment deposition for upcoming sediment sampling by the Certified Laboratory. Some suspected depositional areas within the two free flowing sample reaches may benefit from visual field verification prior to scheduling formal sediment poling.

The initial poling surveys will be conform to a gridded sampling pattern composed of transects arranged perpendicular to the main channel flow direction. Poling locations will originate at the shoreline and traverse perpendicular across the channel and toward the opposite shoreline. The spacing between each poling location along a given transect will be 10 feet. Transects of the grid will be 50 to 100 feet apart. Each poling location will be GPS located and measures of water depth to soft bottom and total depth to hard bottom will be recorded.

Sediment core sampling undertaken by this project specifically targets sampling those areas most likely to contain contaminated sediment to confirm or refute their contamination status. No additional statistical extrapolation or estimation of total contaminated sediment volume is intended, therefore no random sampling design is proposed. Areas with the thickest soft sediment will be prioritized for core sampling activities, though a range of soft sediment depths with be sampled at each site (e.g., less than 1 foot, 1-5 feet, 5-10 feet, over 10 feet). Program staff will provide the Certified Laboratory with maps and geographic coordinates depicting the geographical extent of prioritized core sampling locations (based on poling survey findings). Core sample locations will be distributed in a grid pattern of size and spacing determined by the extent of the depositional area and each core sample will include GPS coordinates. Up to 100 core samples (including replicates) will be selected from the grid at each site.

The Certified Laboratory performing sediment core sampling in the depositional areas identified by Project staff will do so with the intent of retrieving a fully intact vertical core of sediment at each site (sample thickness dependent on depth of refusal). Each 6-inch increment of collected core samples will be analyzed. The purpose of all analyses is the gathering of initial information at the sites specified, not direct guidance for a future reclamation project. The assessed parameters are based on WDNR (2001) and conversations with WDNR Water Resources and Office of the Great Lakes staff (D. Dinsmore, M. Burzynski, and M. O'Shea, personal communication, March 15, 2011). Final detection and reporting limits for each parameter will depend largely on the Certified Laboratory chosen for the Project, as well as future feedback from USEPA and WDNR personnel. Limits within the capabilities of several local prospective laboratories are listed below (Table 4).

Table 4. Sediment Contamination Parameters and Laboratory Limits

Test	Detection Limit	Reporting Limit	Total Samples[1]
Total PCBs	4.33 ppb	14.43 ppb	400
Total Organic Carbon	95 ppm	1,000 ppm	150
Sediment Particle Grain Size Analysis	N/A	N/A	150

1 – Sample size includes field replicates and background samples and is largely dependent on the extent of soft sediment deposition delineated during poling surveys and the final price quote for each analysis

Any alternations to the detection and/or reporting limits above will be included in a future revision of this QAPP.

Sampling Method Requirements

Project staff will use the following procedure to estimate and record sediment thickness at each individual poling location following the methods established by WDNR (2001):

1. Initialize GPS position tracking
   a. Ensure GPS unit is as close as possible to the actual point of poling
   b. Begin logging points when in position for poling (multiple points will cancel out any error associated with a single position point)
2. Determine water depth and record in GPS and/or field log book
   a. Insert tile probe vertically into the water column
   b. Note tile probe depth mark at the water surface when the probe contacts the sediment-water interface
   c. Note any observations regarding suspected sediment composition based on sound (no sound suggests silt)
3. Determine depth of refusal and record in GPS and/or field log book
   a. Insert tile probe past the sediment-water interface using "reasonable human force" until refusal
   b. Note tile probe depth mark at the water surface
4. Stop GPS position tracking after collection of at least 10 points and record all latitude/longitude coordinates in GPS and/or field log book prior to moving to the next poling location

Sampling locations will be determined based on the results of sediment poling surveys and assigned GPS coordinates for ease of location and quality control. Specific core sampling procedures will likely differ somewhat depending on the Certified Laboratory chosen to perform the sampling and analysis of sediment for the Project. Relevant SOPs detailing industry-accepted sediment sampling equipment and methods will be provided as an attachment to this document in a future revision, but general sampling guidelines from WDNR (2001) are as follows:

1. Gently lower core sampler to the sediment-water interface and push into the sediment to the point of refusal
2. Extract the sampler from the sediment, taking care to preserve the sample in its entirety
3. Remove and cap the core liner and minimize handling to prevent sediment mixing
4. Label the core with the name of the sampling reach and unique core number
   a. Record GPS coordinates, water depth, depth of refusal, unique core number, and other relevant field observations in field book
5. Extrude 6 inch segments of each core sample into clean sample bottles
6. Label each sample bottle with the name of the sampling reach, unique core number, and depth of segment below the sediment-water interface (e.g., 0-6 inches, 6-12 inches, etc.)

Worth noting is that the analysis of core samples for this Project will occur at 6 inch intervals, as opposed to the 10 cm (~4 inch) intervals used by WDNR (2001). Segmenting core samples every 6 inches not only allows for general characterization of the location and extent of sediment contamination in specified sampling reaches, but also addresses issues related to total sample size and allocated budget for laboratory analyses. Future sediment sampling efforts in these reaches (e.g., pre-remediation studies) may wish to further refine specific depths of contamination, though 6 inches is expected to be at the lower limit of dredging precision.

Any necessary corrective changes to sampling protocol, methods, sites, or frequencies approved by the Project Coordinator will be reported to the QA/QC Manager/ Officer by the Program Manager for inclusion in a revised QAPP.

Sample Handling and Custody Requirements

All sediment samples must be sealed, labeled, and transported to the laboratory in a prompt timeframe to ensure analysis occurs within necessary hold times per the Certified Laboratory SOPs. The Certified Laboratory chosen to perform Project sampling and analysis will conform to industry-standard Level 2 requirements, including analytical reports, QA/QC reports, and chain-of-custody documentation. The laboratory will assume custody of each sample it receives and is responsible for forwarding all sample analysis results to the Project Coordinator (or designee) following the completion of analysis.

Analytical Requirements

All Project sediment analysis parameters will be assessed by a WDNR Certified Laboratory. Final determination of analytic methods will be largely dependent on SOPs from the certified laboratory (not yet selected), though generally accepted methods are listed in Table 5.

Table 5. Sediment Contamination Parameters and Methods

Test	Method
Total PCBs	EPA SW-846 8082
Total Organic Carbon	Walkley Black
Grain Size Analysis	TBD

Quality Control Requirements

Data quality control and assurance is required for data collected, processed, analyzed, evaluated, and reported for this project. Sampling site boundaries will be documented using a GPS unit with sub-foot accuracy that is checked for accuracy and precision by collecting location data for known points (benchmarks) before and after poling and sampling site boundary locations are documented. U.S. Public Land Survey System (USPLSS) control stations containing information about the monumented corners of the USPLSS in the Southeastern Wisconsin Region will be used to establish benchmarks near each sample site. Benchmarks will consist of a buried 3/8" metal rod, driven railroad spike into the base of a large, mature tree, or sawcut "x" into a concrete curb, sidewalk, or bridge or culvert abutment. Each benchmark will be fully documented with witness corners identified. In addition, a marked staff gauge will be driven into the river bed near the riverbank to at each sample location to document daily water level elevations and ensure comparability of sediment depth measurements from the various poling surveys. The QA/QC officer has over five years of hands-on experience with the establishment of benchmarks and other relevant survey methods. A staff gauge with a known elevation will be established at the following locations:

1. Site #1 – M-T Dam (downstream side)
2. Site #2 – M-T Dam (upstream side)
3. Site #3 – USGS Stream Station (04086600) at CTY C and Milwaukee River
4. Site #4 – Newburg Dam

Water surface elevation readings will be obtained at each reference point, prior to and after each pole survey. The average staff gage reading from each reference point will be used to calculate the river bed elevations for both depth to soft bottom and depth to hard bottom.

Monumented corner and/or benchmark location information are available at:

1. http://maps.sewrpc.org/regionallandinfo/survey.shtm
2. http://www.co.ozaukee.wi.us/Highway/Survey_Monuments_Main.htm

The Certified Laboratory staff will adhere to current industry-accepted practices for safe handling, testing of samples, QA/QC, and chain-of-custody methods. Specific details will be included in the SOPs of the laboratory chosen to perform the work, which will be included in a future revision of this QAPP. Field precision will be confirmed by the use of one field duplicate sample (taken as close as possible to another sample) each sampling day. The laboratory will confirm precision by analyzing both samples for the full suite of parameters. Westenbroek (2001) also employed background samples to provide the laboratory with "clean" samples and a determination of natural soil composition and/or bias in the sampling or analysis process. Background samples are typically collected off-site from an area of likely contamination. As such, approximately five samples will be taken from Milwaukee River tributaries upstream of Cedar Creek with no known PCB contamination and analyzed for the full suite of parameters. Criterion for acceptance for each type of quality control sample will be based on the SOPs provided by the Certified Laboratory chosen to perform the sampling and analysis. The creation of duplicate samples for analysis of sediment contamination is known to be a highly variable process, often with precision limits up to 50% (WDNR 2001; S. Westenbroek, personal communication). Accuracy will be maintained by strict adherence to sampling protocol and handling time for the tests listed in Table 5. Laboratory staff involved in field sampling will also take care to consistently sample at specified GPS coordinates and with methods consistent with those described above and in laboratory SOPs.

Requisite procedures for calculating QC statistics will be included in Certified Laboratory SOPs in a future QAPP revision.

Data Acquisition Requirements for Non-Direct Measurements

The original source for most of the digital orthophotographs and attendant map files (e.g., those for the years 1963, 1970, 1980, 1990, 2000, 2010) is the Orthophotography Program conducted by the Southeastern Wisconsin Regional Planning Commission. The digital aerial photos were placed into a photo mosaic, ortho-rectified using a Digital Terrain Model (DTM), and stored in a Multi-Resolution Seamless Image Database (MrSID). The original projection is in Wisconsin Transverse Mercator (WTM), with a horizontal datum of NAD 1983, 1991 Adjustment (HARN). Since the ground resolution for these aerial photos ranges from 2 to 1 foot pixels and/or the scale of source photography is approximately 1:20,000, only large scale depositional features (point bars, deltas, meanders, large riffles) can be discerned. Small scale alterations in the shoreline (e.g., degradation or accumulation) are not possible to determine, when comparing photos from one time period to the next. As such, the orthophotographs will be used simply as an initial guide for future sediment poling surveys and contamination sampling.

As needed, use of Ozaukee County's orthorectified aerial photos will be supplemented with color aerial photographs taken annually by the U.S. Department of Agriculture Farm Service Agency (FSA). Though not orthorectified, the FSA aerial photographs are taken during a different season than Ozaukee County's aerial photographs and can be useful as supporting and/or illustrative resources.

Several non-direct measurement data sources may be referenced or used for guidance by the Project. The acceptance criteria for each of these information sources is that they come from published scientific literature or were generated by the WDNR or another agency (county, state, federal, or Tribal) using methods congruent with this Project.

Data Management

All data management will be directed and overseen by the Project Coordinator (or designee). This includes but is not limited to field data entries, data entry into spreadsheets and/or databases, mapping, and Certified Laboratory data reporting. A future revision of this QAPP will include standard data entry forms and/or checklists from the Certified Laboratory chosen for this project. Hard copies and electronic copies of all project files will be maintained in perpetuity by the Planning and Parks Department. Interested agencies or personnel may request copies by contacting the Project Coordinator or the Department.

Relevant requisite computer hardware and software used by the as yet unchosen Certified Laboratory will be included in a future QAPP revision.

Program personnel operate PC computers loaded with Microsoft Windows XP or Microsoft Windows 7, as well as the Microsoft Office 2007 suite of programs. Project personnel will employ the Topcon GRS-1 and TopSurv software for the plotting poling locations and the entry of some field data. The Planning and Parks Specialist will also utilize ESRI ArcMap v9.3.1 software for orthophotograph analysis and development of maps and other project files.

C. Assessment/Oversight

Assessments and Response Actions

The Project includes quarterly, semi-annual, and final reporting requirements built around the schedule outlined in the Project grant narrative. The Project is considered "on schedule" if pertinent milestones are reached. The QA/QC Manager/Officer will ensure the timing of the quality control samples in such a way that the samples will be spread out over the length of the project. The QA/QC Manager/Officer will also conduct a field operation assessment, or readiness review, prior to and during the initial poling event and will include a full analysis of all operation procedures to ensure consistency with procedures detailed in this QAPP. The QA/QC Manager/Officer will provide immediate verbal feedback and a subsequent written analysis to staff involved in the poling surveys prior to the next survey.

Analysis of historic orthophotographs and sediment poling surveys are expected to begin in late-spring or summer of 2011. Flood events, resource limitations, field equipment issues, and other uncontrollable factors may affect the overall schedule. To the degree practicable, Project staff will try to avoid or mitigate any negative affects to the proposed schedule. If the sampling plan requires revision, modification, or alteration, approvals from the Project Coordinator and QA/QC Manager/Officer are required.

The Planning and Parks Specialist, Program Assistants, and Program Interns will be involved in field operations used to generate Project data. All field operation problems detected by Project staff or the Certified Laboratory will be reported directly to the Project Coordinator and QA/QC Manager/Officer. The Program Assistants are responsible for determining actions suitable for addressing detected problems and proposing them to the Project Coordinator and QA/QC Manager/Officer for approval. Any changes to sampling protocol, methods, sites, or frequencies approved by the Project Coordinator will be reported to the QA/QC Manager/Officer for inclusion in a revised QAPP. Pursuant to Section 2.3.1 of EPA QA/G-5, no independent assessments will be completed as this is not a long-term project (USEPA 2002).

Reports to Management

The Project includes mandatory quarterly, semi-annual, and final reports to USEPA. The Project Coordinator (or designee), with assistance from the Program Assistants and Program Interns, is responsible for preparing and submitting all management reports to the Project Officer. Quarterly reporting is conducted through the Great Lakes Accountability System (GLAS) and quantitatively tracks progress toward established Project milestones. Semi-annual reporting is also submitted digitally to the Project Officer. Semi-annual reports are due April 30 and October 30 of each Project year and will include summary information regarding:

1. Work accomplished during the reporting period
2. Object class category changes
3. Corrective actions
4. Projected new work
5. Percent completion of scheduled work
6. Percent budget spent

7. Changes to principal investigator
8. Needed changes to Project period
9. Date and amount of latest drawdown request
10. Delays and/or adverse conditions that materially impair meeting Project outputs/outcomes specified in the assistance agreement work plan
11. Results of readiness reviews
12. Laboratory results of data quality assessments
13. Any significant QA problems

Project Officer consideration of, and potential approval for, necessary revisions and modifications to Project timelines and outputs/outcomes would be management actions directly driven by semi-annual reporting.

The final Project report will include summary information pertaining to Project nature and extent, as well as information regarding Project outputs/outcomes. Applied methodologies, significant events and/or experiences, data compilation (i.e., a spreadsheet or database) and analysis, sample custody documentation, conclusions and recommendations, and pertinent photos, figures, and maps will be included. The draft final report will be submitted by the Project Coordinator to the Project Officer electronically no more than 45 days after the Project period. Hardcopy and digital copies of the final report will be submitted by the Project Coordinator to the Project Officer electronically no more than 90 days after the Project period.

D. Data Validation and Usability

Data Review, Validation, or Verification

The staff of the Certified Laboratory will adhere to current industry-accepted practices for safe handling, testing of samples, QA/QC, and chain-of-custody methods. Specific details will be included in the SOPs of the laboratory chosen to perform the work, which will be included in a future revision of this QAPP. Following completion of sampling and analysis, the QA/QC Manager/Officer will perform an internal data examination and review of all laboratory SOPs including data entry, transcription, calculation, reduction, and/or transformation errors. The QA/QC Manager/Officer will also ensure all sample information and quality control items are accounted for and properly documented (e.g., duplicate samples, background samples, chain-of-custody, etc.) per the SOPs. Once the data have been confirmed to comply with the SOPs, a final report including a summary of sample results, as well as QA/QC and chain–of-custody documentation, will be prepared by Project and laboratory staff and submitted to the USEPA.

Reconciliation with Data Quality Objectives

Data generated by the Project will provide general characterization of the location and extent of contaminated sediment deposits in portions of the Milwaukee River Watershed and Milwaukee Estuary AOC within Ozaukee County. When finalized, Project parameters and methods will have been reviewed and edited by requisite WDNR and USEPA staff. As such, all Project data is expected to be useful and usable for management agencies related to the AOC and the Milwaukee River Watershed. Specifically, sediment contamination sampling and monitoring in the Project Area will address the following objectives:

- Delineating likely areas of sediment accretion through historic orthophotography analysis
- Determining the thickness and general composition (e.g., sand, silt, etc.) of targeted sediment accretions through poling surveys
- Determining general locations and extent of contaminated sediment deposits through core sampling and laboratory analysis

Data collected will facilitate the identification of sediment contamination location and extent in Ozaukee County portions of the Milwaukee River Watershed and Milwaukee Estuary AOC. The results of poling surveys and sediment analysis may assist future management efforts including pre-remediation studies and/or removal of contaminated sediments.

Sample records and chain-of-custody documentation will be reviewed to verify that all the samples collected were analyzed so the dataset can be considered complete. The staff of the Certified Laboratory will adhere to current industry-accepted practices for safe handling, testing of samples, QA/QC, and chain-of-custody methods. Specific details will be included in the SOPs of the laboratory chosen to perform the work, which will be included in a future QAPP revision . Precision will be confirmed by the use of one field duplicate sample (taken as close as possible to another sample) in each sampling reach. The laboratory will confirm precision by analyzing both samples for the full suite of parameters, along with lab duplicate samples. Background samples from Milwaukee River tributaries upstream of Cedar Creek will also be obtained to detect natural sediment composition and/or bias. Accuracy will be maintained by strict adherence to sampling protocol and handling time for the tests listed in Table 5. Laboratory staff involved in field sampling will also take care to consistently sample at specified GPS coordinates and in methods consistent with those described above and in laboratory SOPs. The SOPs for the Certified Laboratory chosen for this project will be included in a future revision of this document and will specifically indicate precision and accuracy limits for each analysis. However, given the intended usage of the baseline monitoring data generated by this project and the highly variable nature of sediment contamination sampling, precision and accuracy limits are expected to range widely, as they have for similar studies in the past (WDNR 2001; USEPA 2002; S. Westenbroek, United States Geological Survey, personal communication).

As specified in the language above, the data generated by this project is intended to provide a general indication of the location and extent of contaminated sediment deposits. Analyses and reports generated from this data will function as baseline monitoring to provide initial characterization of current sediment contamination in the mainstem Milwaukee River following significant changes to upstream depositional areas. Local agencies and other interested parties are likely to reference these data for a wide variety of uses, though will undoubtedly schedule much more long-term, intensive, high-profile sampling prior to any remediation projects.

E. References Cited

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