Table 2-6: PEAS Spill Reports

Wayne County					Macomb County					St. Clair County					Sanilac County				
Year	Number of spills	Types of Spills	Quantity	spill site	Year	Number of spills	Types of Spills	Quantity	spill site	Year	Number of spills	Types of Spills	Quantity	spill site	Year	Number of spills	Types of Spills	Quantity	spill site
2004	4	sheen	unknown	Rouge River	2004	9	oil	unknown	Clinton river	2004	9	treated effluent	15,000 gal	Black River	2004	0			
		oil sheen	unknown	Detroit River			machine oil	5 gal	Clinton river			Ketone	unknown	St. Clair River					
		turbine oil	157 gal	Detroit River			CSO	unknown	Lake St. Clair			Methyl ethyl ketone	100 barrels	St. Clair River					
		truck chemical	45,000 gal	Turkey Creek			unknown chemical drum	unknown	Clinton river			Ethylene oxide	unknown	St. Clair River					
							hazardous waste	3,000 gal	Clinton river			high pH liquid	3,375 gal	St. Clair River					
							Sewage	unknown	Lake St. Clair			Paint	lots	St. Clair River					
							Machine oil	unknown	Clinton river			Petroleum	unknown	Sarnia Bay					
							Nickel sulfate	three 55 gal drums	Clinton river			hydrocarbon	unknown	St. Clair River					
							Dredging	unknown	Clinton river			Hydraulic oil	1 gal	St. Clair river					
2005	2	chlorinated water	42.1 MG	Milk River to Lake St. Clair	2005	3	Fuel oil	unknown	Clinton river	2005	8	Wood/lumber	unknown	St. Clair River	2005	0			
		oil	unknown	Rouge River			printing plate materials	unknown	Clinton river			hydraulic oil	2 liters	St. Clair River					
							cement	unknown	Lake St. Clair			yellow dye	10-15 pounds	St. Clair River					
												sewage	minimal	Black River					
												blacktop chunks	unknown	St. Clair River					
												oil	unknown	St. Clair River & Pine river					
												chlorinated water	180 ppm	St. Clair River					
												gray water	unknown	St. Clair River					

Wayne County				
Year	Number of spills	Types of Spills	Quantity	spill site
2006	3	discolored	unknown	Detroit River
		coal pile water	several thousand gal	Detroit River
		mud, dirt, BOP dust	unknown	Detroit River
2007	2	Wastewater	unknown	Detroit River
		Hydrochloride acid	unknown	Rouge River

Macomb County				
Year	Number of spills	Types of Spills	Quantity	spill site
2006	6	dead fish (100's)	unknown	Lake St. Clair
		PCB & dead fish	unknown	Lake St. Clair
		oil sheen	unknown	Red Run drain
		soil	unknown	Clinton river
		oil	unknown	Lake St. Clair
		coolant	unknown	Lake St. Clair
2007	3	hydraulic fluid	5 gal	Red Run drain
		oil	40 gal	Lake St. Clair
		ethylene glycol	40,000 gal	Bear Creek

St. Clair County				
Year	Number of spills	Types of Spills	Quantity	spill site
2006	11	ortho-xylene	unknown	St. Clair River
		brine	24,000 liters	St. Clair River
		hydrocarbon	unknown	St. Clair River
		hydrocarbon	unknown	St. Clair River
		dead fish (>100)	unknown	St. Clair River
		hydrocarbon	unknown	St. Clair River
		dead fish (1000's)	unknown	St. Clair River
		sheen	unknown	St. Clair River
		sheen	unknown	St. Clair River
		oil	unknown	Belle river
		lawn waste	1/4 mile long	St. Clair River
2007	10	coal dust, mud	small	St. Clair River
		Benzene & Metaxylene	unknown	St. Clair River
		boiler feed water	12 m3	St. Clair River
		steam condensate	10 gal	St. Clair River
		sewage, partial treatment	unknown	St. Clair River
		sewage, chlorinated	unknown	St. Clair River
		heat exchanger at Shell oil	unknown	St. Clair River
		hydrocarbon	unknown	St. Clair River
		diesel (tugboat)	unknown	St. Clair River
		sewage, partial treatment	unknown	St. Clair River

Sanilac County				
Year	Number of spills	Types of Spills	Quantity	spill site
2006	2	black, manure odor, dead fish & frogs	Unknown	Big Creek
		Sewage	Unknown	Lake Huron
2007	2	human & animal waster	unknown	Forester Creek
		yellow residue	unknown	Lake Huron

Wayne County					Macomb County					St. Clair County					Sanilac County				
Year	Number of spills	Types of Spills	Quantity	spill site	Year	Number of spills	Types of Spills	Quantity	spill site	Year	Number of spills	Types of Spills	Quantity	spill site	Year	Number of spills	Types of Spills	Quantity	spill site
2008	3	asphalt	80 gal	Detroit River	2008	8	Sewage	180 yds	Lake St. Clair	2008	10	sewage, partial treatment	unknown	St. Clair River	2008	2	Diesel & milk	100 gal & 17,900 gal	Lake Huron
		Gasoline	unknown	River Rouge			oil	unknown	Lake St. Clair			Acetonitrile	20 kg	St. Clair River			demolition spoil	several truckloads	Lake Huron/Detroit Water Pickup
		Hexicarbitol	5 gal	Detroit River			diesel fuel	unknown	Lake St. Clair			sewage, partial treatment	unknown	St. Clair River					
							hydraulic fluid? (barge)	unknown	Lake Huron to Lake St. Clair			CSO overflow	unknown	St. Clair River					
							hydrocarbon	large vol	Red Run drain			bypass overflow	unknown	St. Clair River					
							diesel fuel	unknown	Clinton river & Lake St. Clair			oil	unknown	St. Clair River					
							pumped from boat	unknown	Lake St. Clair			fuel	unknown	St. Clair River					
							oil based paint	unknown	Lake St. Clair			sheen	unknown	St. Clair River					
												sheen	unknown	St. Clair River					
												mud, other hazards	unknown	Black river					
2009	3	suspended solids	unknown	Detroit River	2009	1	wastewater	unknown	Coon Creek	2009	12	wastewater	unknown	St. Clair river	2009	1	milky unknown	Unknown	Lake Huron
		particulate	unknown	Detroit River								CSO bypass	unknown	St. Clair river					
		gasoline	unknown	Rouge river								CSO bypass	unknown	St. Clair river					
												phenol	2+ kg	St. Clair river					
												Ethyl benzene & xylene	83 ppb & 92.3 ppb	St. Clair river					
												oil & diesel	unknown	Black river					
												VSS	unknown	Telford Creek					
												oil	50 gal	Jordan Creek/Pine river					
												oil	unknown	Jordan Creek/Pine river					
												unknown (2 drums)	unknown	Black river					
												Chlorine	60,000 gal	Black river					
												oil	10 pints	St. Clair river					
2010	1	oil	1 cup	Detroit River	2010	1	human waste	unknown	Lake St. Clair	2010					2010				

The Ontario spill reporting system provides different information than the PEAS in Michigan. The OSAC provides data for the entire province of Ontario. Therefore, it is not possible to interpret how much of the reporting applies to the DWSD intakes. The OSAC data is aggregated and distinguished as to the type of area impacted, water, land, air or some combination of those designations. Spill types are not provided but a probability of spill impact on the location type is predicted. The number of spills in Ontario that are associated with any water body is shown in **Figure 2-18.** The probability that spill will adversely impact receiving water is shown in **Figure 2-19**.

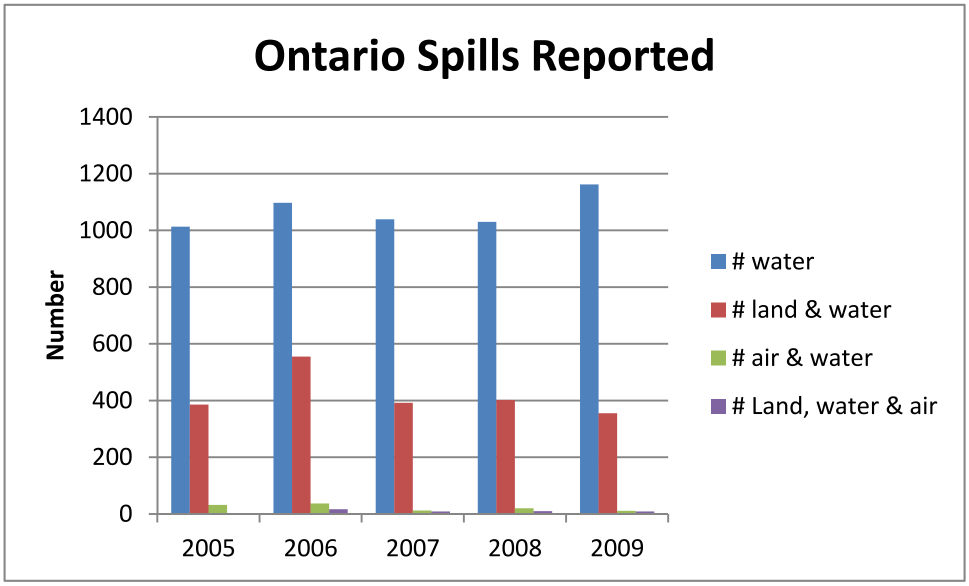

Figure 2-18: Number of Spills Reported by OSAC in Ontario

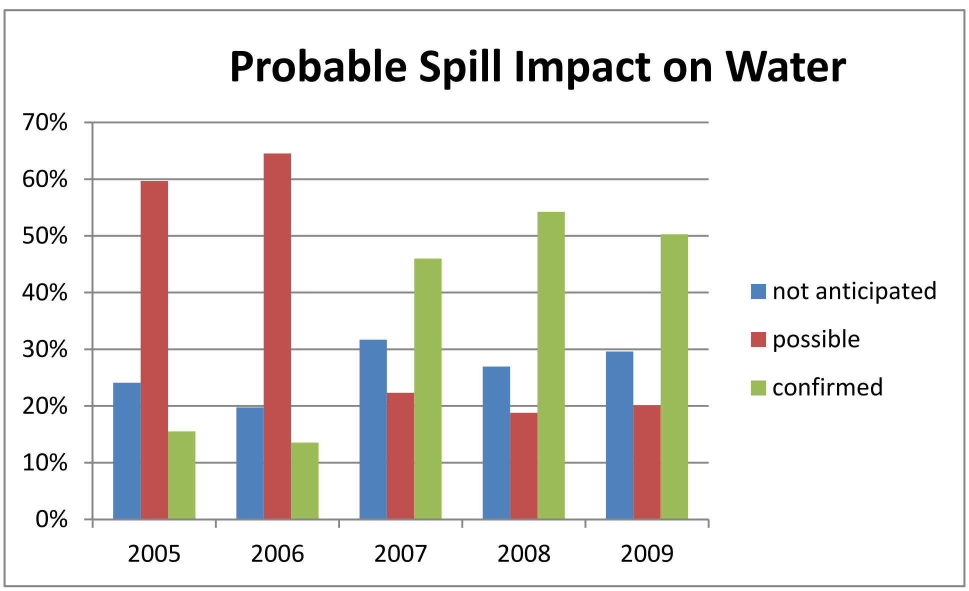

Figure 2-19: Probability that Spills in Ontario Impact Water

2.6 Huron to Erie Water Quality Monitoring System

2.6.1 Background

The St. Clair River System is a major shipping route and manufacturing area that includes a large number of petrochemical plants. This has led to over 700 spills since 1986. Examples of spilled substances include vinyl chloride and methyl ethyl ketone (MEK). Such contamination events are a concern for utilities, such as DWSD, which draw their water from this source. Therefore, a river monitoring network was established in 2007. The network includes water utilities which draw water from Lake Huron to Lake Erie.

2.6.2 Goal

The goal of this project was to establish a monitoring network along the St. Clair River, Lake St. Clair and Detroit River to protect the drinking water supply. This goal contained four objectives

- The installation of monitoring equipment at various Water Treatment Plant (WTP) intakes
- Analysis of water quality every 15 to 30 minutes 24/7
- Sharing of real-time data from the monitoring network with each participating WTP
- Development and use of a water quality alarm system

2.6.3 Historical System

The monitoring equipment originally consisted of:

- YSI sonde for measuring pH, temperature, conductivity, dissolved oxygen, oxidation/reduction potential, turbidity and chlorophyll
- Microtox or Deltatox test unit. This unit is a biosensor that bases potential toxicity on bacterial respiratory response.
- GC/MS (Gas Chromatography/Mass Spectroscopy) for measuring 25 Volatile Organic Chemicals (VOCs).
- TOC analyzer by Hach
- A fluorometer for measuring hydrocarbon with specific calibration performed to measure diesel fuel.

The system originally included 13 utilities. Over time, one new utility was added (Monroe) and 5 dropped from the program. Not all utilities received the same set of monitors. All have the YSI multi-parameter sonde.

Data were collected using data loggers. The data were transferred via cellular network and put into an iChart for review. All data are posted online at:

http://www.rwqims.com/ProjectPage.aspx?project=MCHD – DWPP

Alarms for some parameters are based a pre-established range of results. Some parameters have not set alarm limits. No event detection system is employed.

2.6.4 Current System

The list of currently participating utilities and their monitoring equipment is provided in **Table 2-7**. The locations of the communities are shown in **Figure 2-10**.

Table 2-7: Community Monitoring Locations

Utility	Multi parameter sonde	TOC analyzer	Fluorometer	GC/MS	Microtox
Marysville WTP	X		X		
Marine City WTP	X				
Algonac	X				
Ira WTP	X				
Mt. Clemens WTP	X	X			
Water Works Park II	X	X no data	X		X
Southwest WTP	X	X	X		X
Wyandotte	X no data				
Monroe	X	X	X		

The multi-parameter sonde has the capability to measure pH, temperature, conductivity, dissolved oxygen, ORP, turbidity and chlorophyll. The fluorometer is used to measure total hydrocarbons. The GC/MS units are no longer used but were initially employed to detect 26 VOCs listed in **Table 2-8**.

Microtox is used to test for potential water contamination. It is based on respiration of a strain of bioluminescent bacteria. Changes in bacterial respiration indicate a change in water quality. Deltatox is a similar version that is used for screening only. It is portable and thus provides greater flexibility of use. Both units are reported as capable of detecting over 2,700 chemicals with results available in five minutes. The detection limit for microbials is 100 cfu/mL. The detection limits for toxic chemicals are variable depending on the compound. If Deltatox indicates a potential detection, then DWSD tests the sample using Microtox for confirmation and identification. Deltatox is used at Lake Huron, Northeast and Springwells to test finished water daily. Microtox is used at Water Works Park and Southwest where both raw and finished waters are examined daily. In addition, the Water Quality Group uses Microtox to test one distribution sample from each community weekly.

Figure 2-20: Monitoring Locations

Table 2-8: VOC Compounds formerly Monitored by GC/MS

Compound	Target Concentration (mg/L)
Benzene	0.005
m, o, p-Xylene	3.33
Chloroform	0.08
Carbon tetrachloride	0.005
Tetrachloroethene	0.005
1,1,1-Trichloroethane	0.2
1,1,2-Trichloroethene	0.005
Styrene	0.1
1,2-Dichloropropane	0.005
Methylene chloride	0.005
Chlorobenzene	0.1
Ethylene dibromide	0.00005
Toluene	1
1,2-Dibromo-3-chloropropane	0.0002
MTBE	0.04
Hexane	3
Cyclohexane	3
Trichloroethene	0.005
Acrylonitrile	0.0026
1,1-Dichloroethene	0.007
1,2-Dichloroethane	0.005
Vinyl chloride	0.002
Ethyl benzene	0.07
1,2 & 1,4-Dichlorobenzene	0.6 & 0.075
cis & trans -1,2-Dichloroethene	0.07 & 0.1

A local data logger captures data from the multi-parameter sonde, and these data are periodically uploaded to an off-site project server. Data are shared between the participating utilities using a password protected website. Data are then transferred to a public website with iChart software and data export to Excel ability.

The notification system consists of a phone autodialer which forwards information on events when they are detected by the monitoring system.

SEMCOG provided estimated annual equipment maintenance and replacement costs (**Table 2-9**). Replacement costs are calculated based on a life time of 10 years for all equipment except the sonde which was estimated at 6 years.

Table 2-9: Monitoring Maintenance Costs per Location

	Multiparameter sonde		TOC analyzer		Fluorometer		Data logger
	Routine	Non-routine	Routine	Non routine	Routine	Non routine	
Labor (contractor)	$3.348	$2,130	$1,496	$497	$1,000	$497	
Expenses	$2,356	$2,489	$8,000	$0	$602	$550	
Replacement Cost (annual)	$1,020		$2,300		$2,400		$300
Total annual cost	$11,343		$11,796		$5,049		$300

This equates to an annual cost including replacement of $28,488 per monitoring location. These figures are based on 2007 costs. Therefore, escalating those costs at 3% per year, this becomes $33,025 in 2013. These cost figures are based on communication with SEMCOG and assume that all of these units are in use at a utility.

This cost does not include the GC/MS as those units are no longer in use by any of the utilities. Originally five GC/MS units were employed, one each by Mt. Clemons, Algonac, Water Works Park II, Southwest and St. Clair.

In addition, this cost does not include the TOC analyzer used at Southwest. DWSD does not still operate the TOC analyzer at Water Works Park.

The capital cost for Deltatox is approximately $6,500 (2013 vendor provided). The capital cost for Microtox is approximately $20,000. Consumables are expensive with a single analysis costing between $75 for Microtox and $5 for Deltatox (2013 dollars per vendor). So total annual sample analysis cost for 7,078 samples annually (based on 5,618 Microtox and 1,460 Deltatox samples) is approximately $32,476.50 based on cost estimates provided by DWSD. This budget does not include maintenance, repair and replacement costs. A new online version of Microtox is now available. The Microtox CTM continuously measures the chemical toxicity of water. It provides a 4-week operating cycle that is fully automatic.

2.6.5 Maintenance

Calibration and maintenance are performed once every 60 days. Other online studies have found that more frequent data validation is required. In Ann Arbor, a distribution system online monitoring panel was investigated and calibration checks were found necessary every two weeks for many of the same parameters in the distribution system. It is likely that calibration could be required more frequently as source water may contain more potential foulants.

Data from the system demonstrate significant changes in values that may be due to either calibration activity or sensor degradation. For example, there is an abrupt increase in dissolved oxygen in mid-May 2013 at WWP (Figure 5). DO shifted from 100% saturation to 140% saturation. The pH shows an abrupt increase in mid-April 2013 at WWP (Figure 7). These significant changes should have triggered alarms. It is important that users be made aware of any calibration, maintenance or replacement activities. These should be annotated in the database and on the graph, otherwise incorrect interpretation may result. In addition, any significant change in a set of results should be verified by comparison with a lab analysis or a standard to determine if the value is real or is the sensor requires attention.

2.6.6 Data Handling and Interpretation

The data collection software includes a graphical data display as well as the option to export data to Excel. The public website is available at

http://www.rwqims.com

Utility specific websites, where data are uploaded and reviewed, are password protected and were not available for review.

Only a limited amount of data can be graphically displayed with the software on the website. Typically one parameter for a six month interval can be presented. This limitation restricts comparison between parameters and variation over time. The ability to graphically display a larger data set would be valuable. Data can be exported and then managed in Excel, but this adds additional steps to what should be a rapid response system.

Data are recorded every 15 minutes. This data frequency is fairly low based on current Event Detection System (EDS) protocols. But this may be necessary and acceptable given the data graphic handling limitations.

Acceptable data ranges are not provided for all parameters. Parameters with established ranges are

- DO >5.0 mg/L
- pH 6.5 to 9.0
- Turbidity <25 NTU

Given the wide range of acceptable values and the general lack of parameter ranges, this system is unlikely to indicate an alarm condition should a contamination event occur. Further, while pH has an acceptable range, some utilities report that it is common to exceed this range during algal blooms.

Conductivity is displayed in **Figure 2-21** for Water Works Park (WWP) WTP from April 1, 2013 to September 30, 2013. Conductivity for Southwest (SW) WTP is shown in **Figure 2-22** for October 1, 2013 through December 31, 2013. The monitoring system had been offline at SW and was restored beginning in late September 2013. The conductivity can be observed to vary daily and with significant magnitude at WWP. At times, the values double suddenly and at other times they drop to near zero. At Southwest, conductivity is relatively stable and values are reasonable during October. Later, conductivity begins to vary widely and drops to zero in December. Laboratory data are available for comparison to the online conductivity analyzer. Analysis of monthly data for WWP reports an average of 212 uS with a range of 201 to 223. These data are consistent with the lower values observed with the online sensor. Analysis of monthly data for SW reports an average of 226 uS with a range of 219 to 232 uS. These values are similar to the online data in October but do not match that observed at later dates.

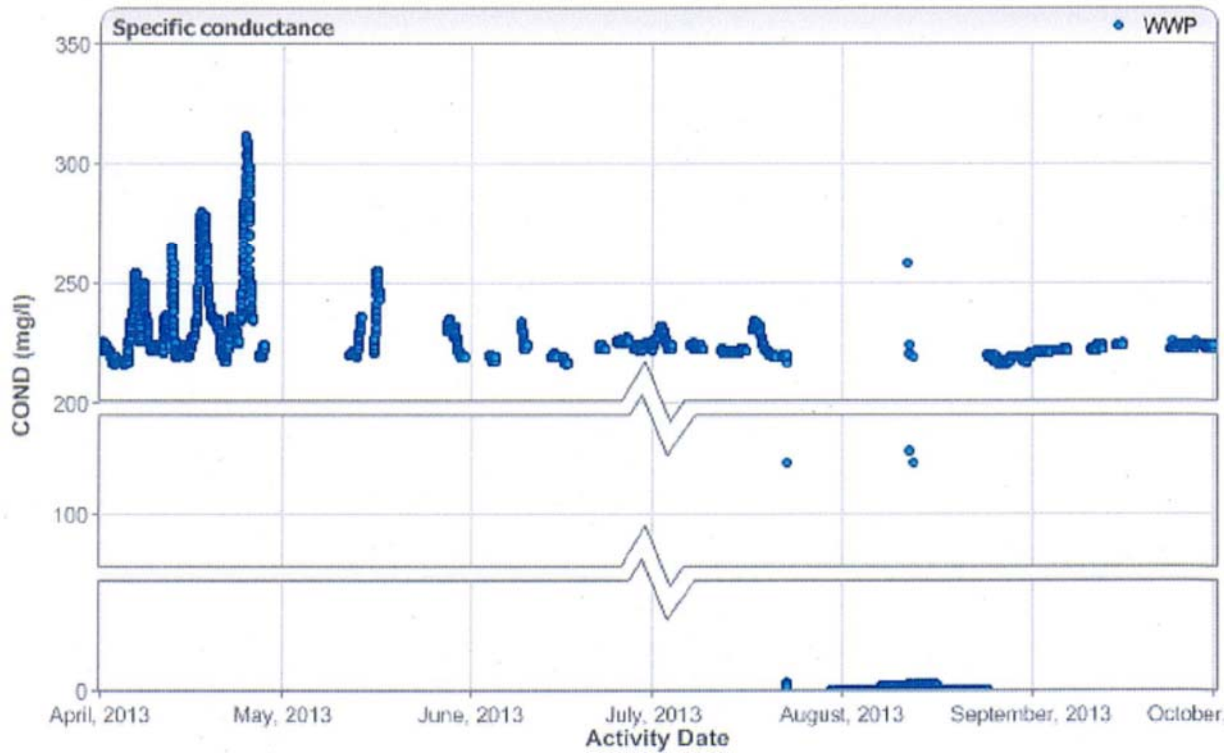

Figure 2-21: WWP Conductivity

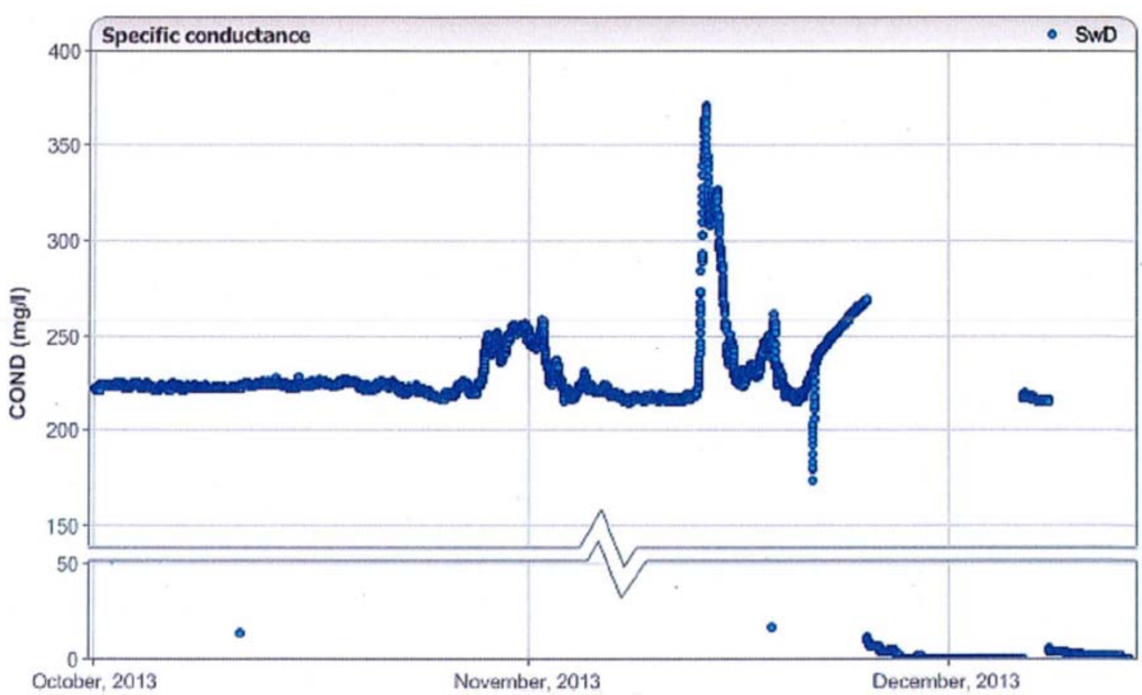

Figure 2-22: Southwest WTP Conductivity

The pH is displayed in **Figure 2-23** for the WWP for April 1, 2013 to September 30, 2013 and in **Figure 2-24** for SW for October 1, 2013 to December 31, 2013. The pH ranges from about 6.0 to 9.0 at both locations, but with different patterns. This is inconsistent with data reported by the WTPs. WWP reports a pH average of 7.64 and a range of 6.52 to 7.96 in 2012 and SW an average of 7.72 and a range of 7.67 to 7.81 based on monthly results. Daily data were also available from April through July for WWP with an average of 8.3 and range of 7.4 to 8.8. Daily data were not available for SW. While these values indicate that shifts in pH occur, the wide variation reported by the online monitor would make it difficult to distinguish a contamination event. High variability in the data makes interpretation difficult and limits the ability to detect contamination events. In addition, there is a significant gap followed by an increase in the data values in mid-April. Day to day variability is also significant. While seasonal or long term changes might be predicted, as for example with an algae bloom, day to day variation should be relatively minimal. The high variability in the data suggests that the probe performance is not satisfactory.

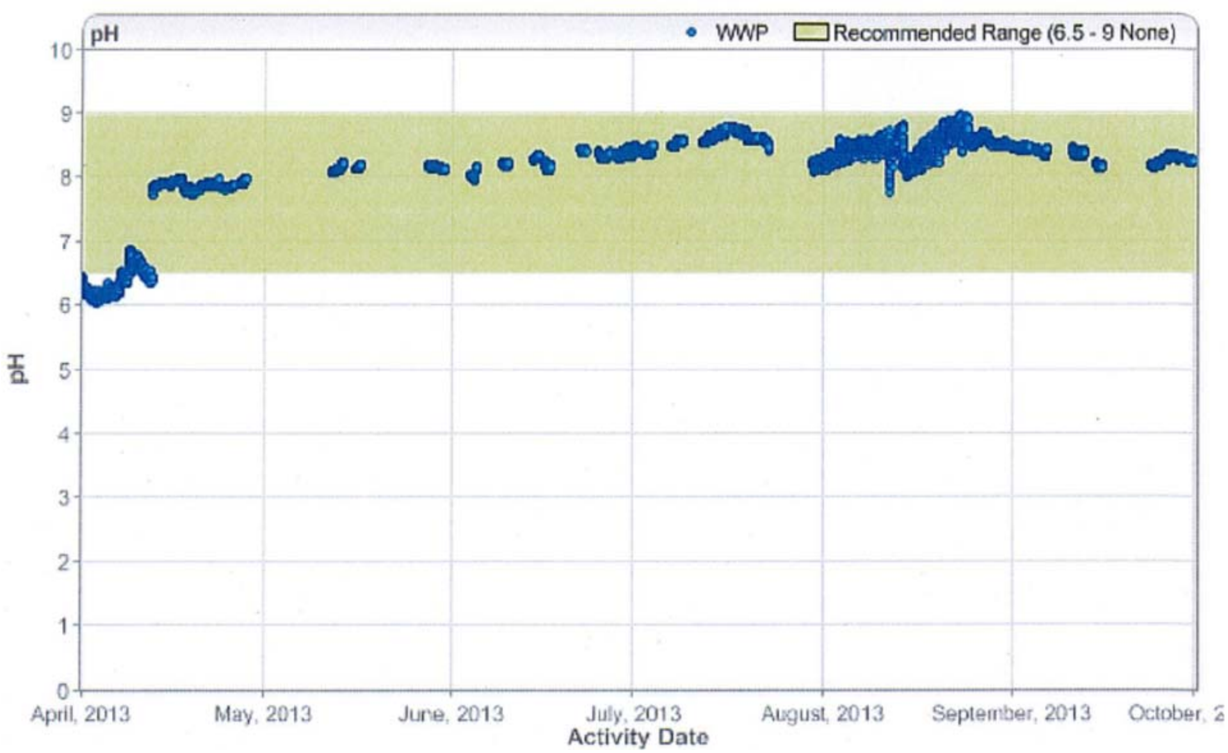

Figure 2-23: WWP pH

Figure 2-24: Southwest WTP pH

Similar sudden shifts in data are observed for a number of parameters, but not necessarily on the same dates. For example dissolved oxygen at WWP is shown in **Figure 2-25** and for SW in **Figure 2-26**. A sudden shift in data values is observed in mid-May at WWP. Such shifts might be expected from calibration activities or sensor failure. At SW, the dissolved oxygen initially increases over time, which is consistent with declining temperature. However, in mid-November, the dissolved oxygen becomes erratic. Laboratory data are available for comparison to the online dissolved oxygen analyzer. Analysis of monthly data for WWP reports an average of 8.6 mg/L with a range of 6.6 to 10.7 mg/L. These data are lower than the values observed with the online sensor. Analysis of monthly data for SW reports an average of 10.6 mg/L with a range of 8.8 to 11.8 mg/L. These values are similar to the online data in October and early November but do not match that observed at later dates. SW dissolved oxygen is higher than at WWP.

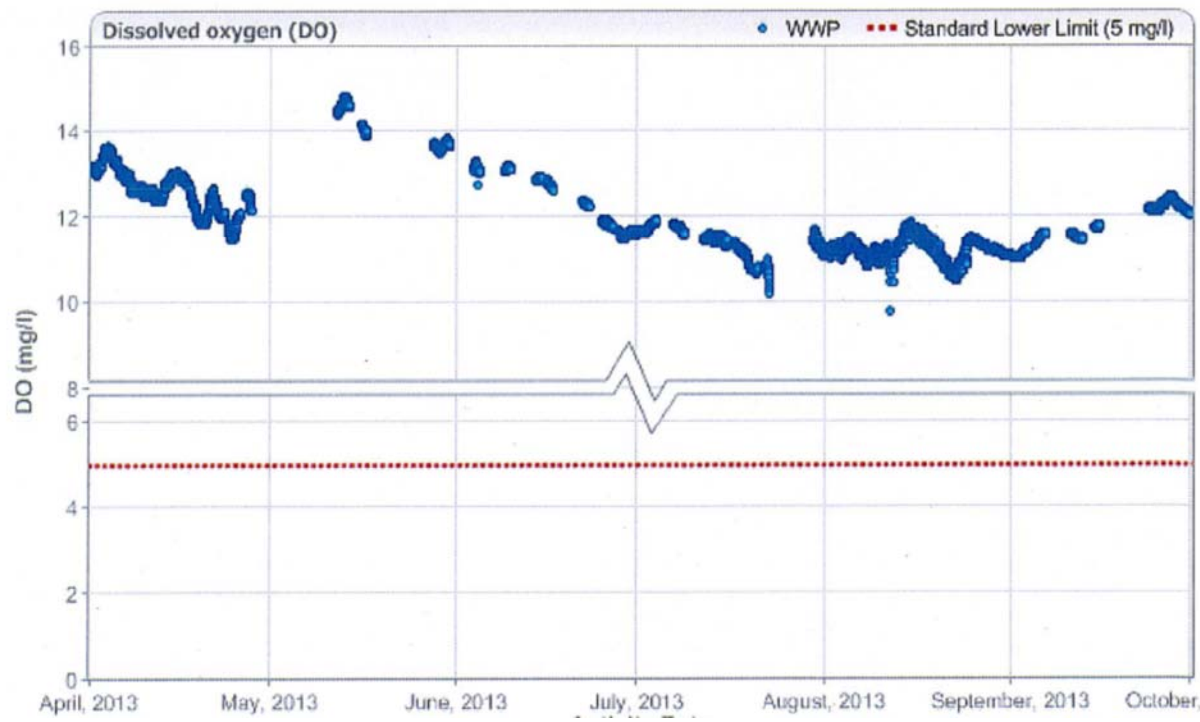

Figure 2-25: WWP Dissolved Oxygen

Figure 2-26: Southwest WTP Dissolved Oxygen

Chlorophyll is displayed in **Figure 2-27** for the WWP for April 1, 2013 to September 30, 2013 and in **Figure 2-28** for SW for October 1, 2013 through December 31, 2013. At WWP, chlorophyll ranges erratically from zero to 400µg/L. A diurnal pattern may be observed, but no seasonal pattern is present as would be predicted. At SW, the chlorophyll is highly variable until mid-November when it drops near zero. The accuracy of the chlorophyll sensor cannot be determined since chlorophyll analyses are measured by a laboratory. Laboratory analysis of chlorophyll is not performed and therefore was not available for comparison. However, based on reported algae counts, the chlorophyll at both WWP and SW are higher than would be predicted.

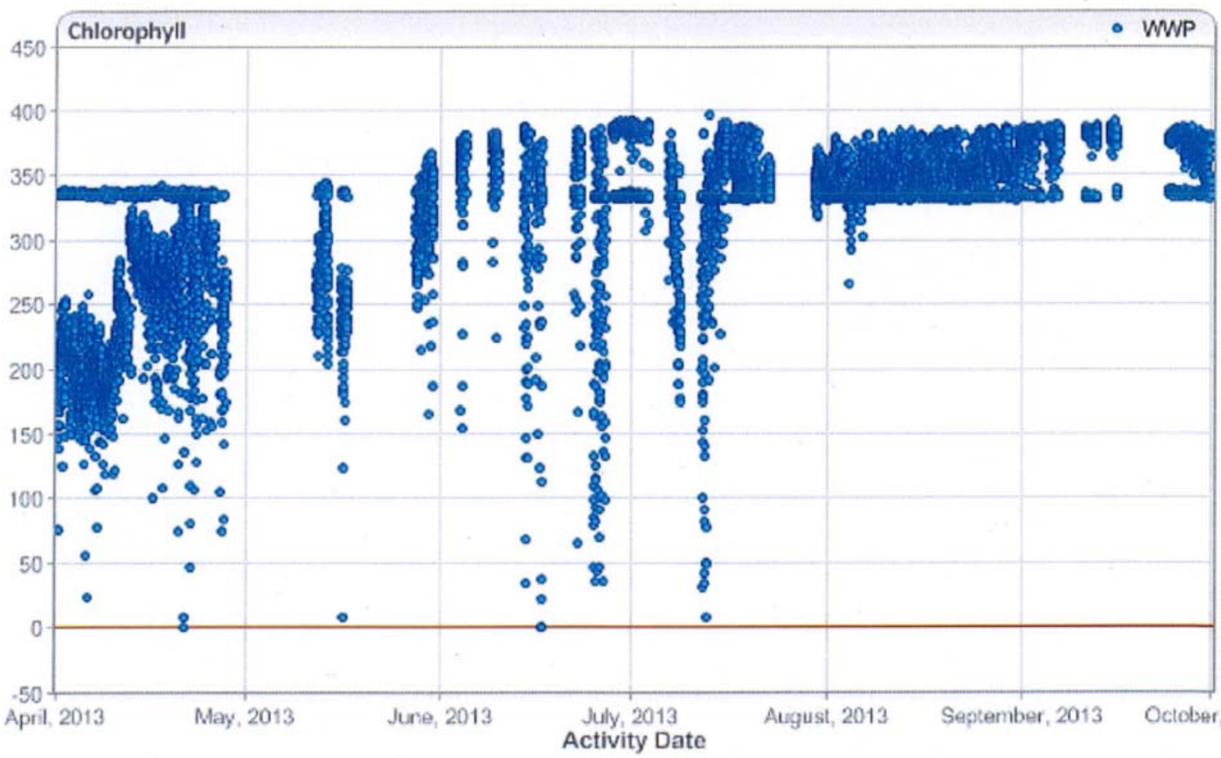

Figure 2-27: WWP Chlorophyll

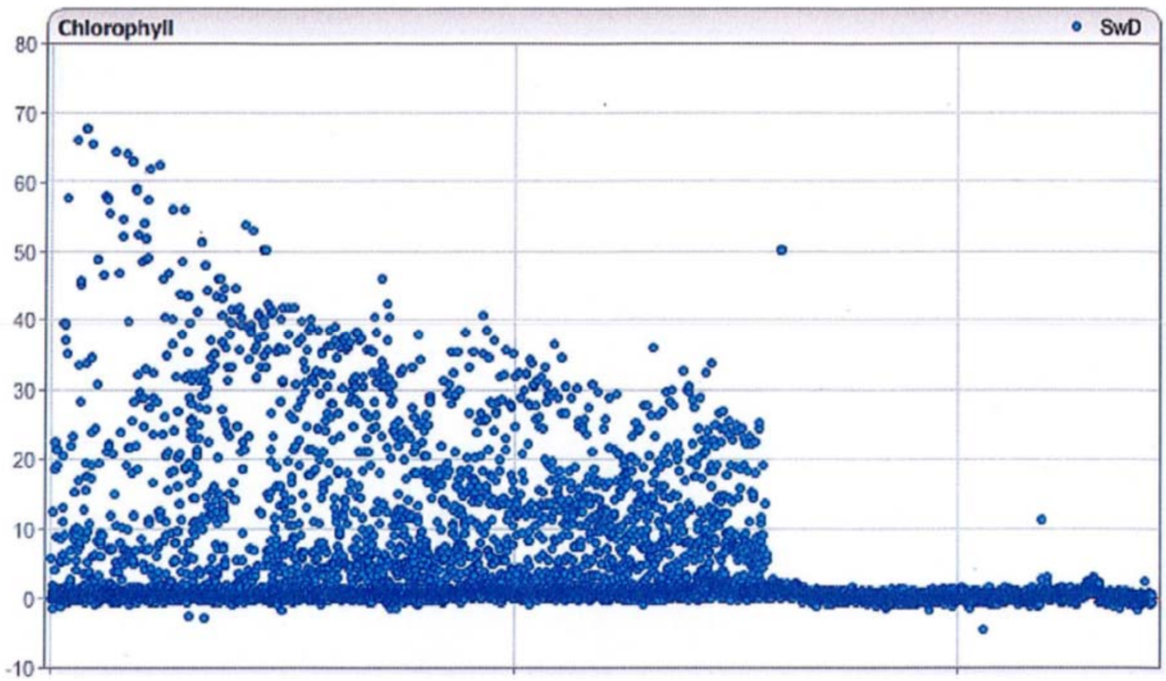

Figure2-28: Southwest WTP Chlorophyll

Oxidation Reduction Potential (ORP) is displayed in **Figure 2-29** for the WWP for April 1, 2013 to September 30, 2013 and in **Figure 2-30** for SW for October 1, 2013 through December 31, 2013. At WWP, ORP ranges erratically from 400 units down to below zero. ORP at SW is fairly stable until late November when it suddenly drops and becomes erratic. The accuracy of the ORP sensor cannot be determined since laboratory analyses are not performed.

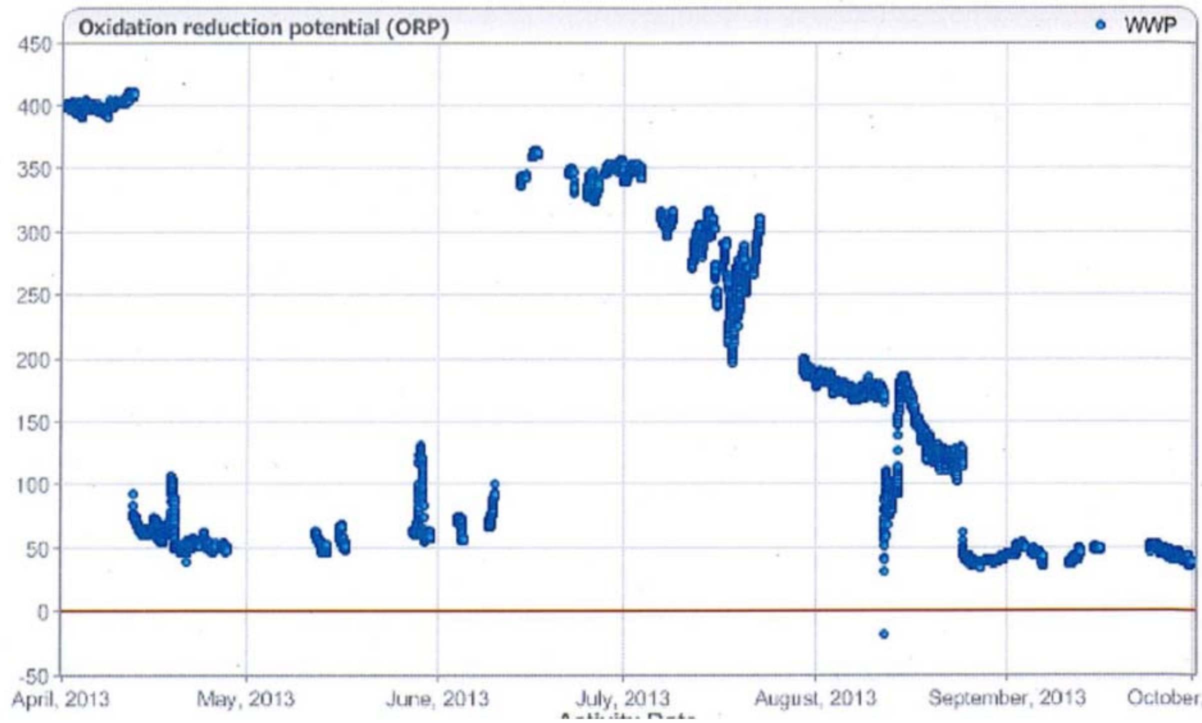

Figure 2-29: WWP ORP

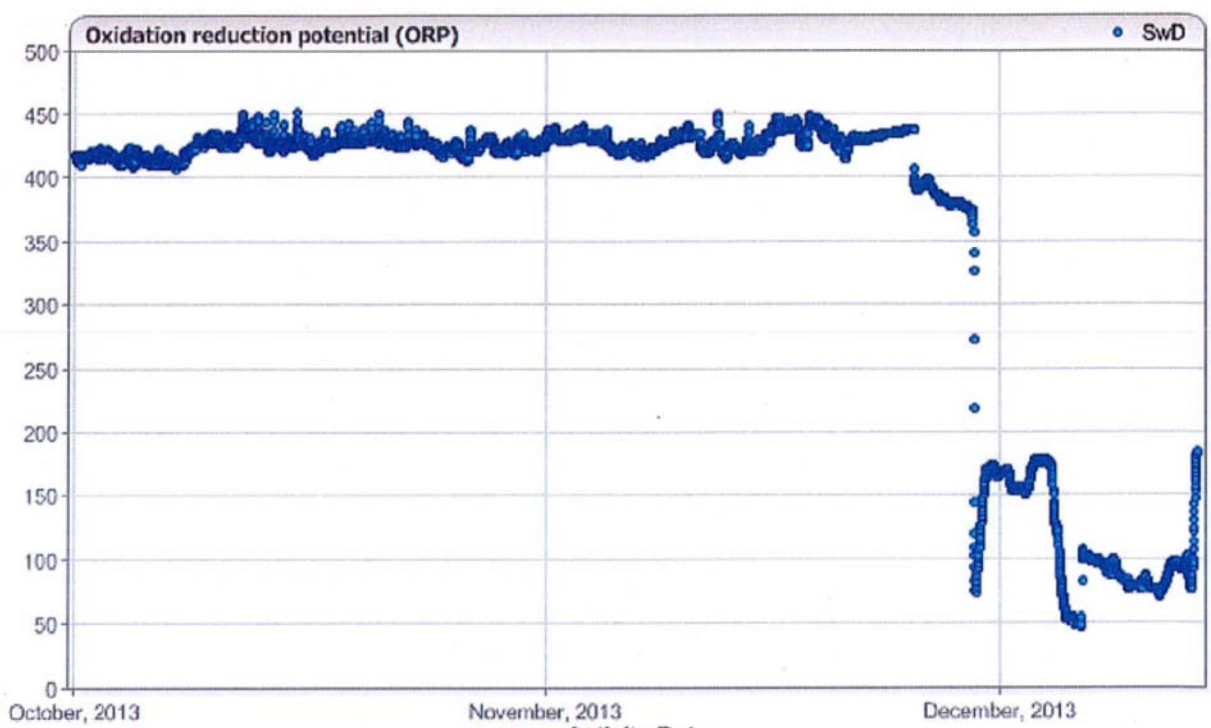

Figure 2-30: Southwest WTP ORP

Temperature is displayed in **Figure 2-31** for the WWP for April 1, 2013 to September 30, 2013 and in **Figure 2-32** for SW for October 1, 2013 through December 31, 2013. While data gaps are present, temperature may demonstrate a diurnal pattern at WWP and SW. At WWP, the temperature increases and decreases with the seasons as expected. At SW, temperature drops during October and into November. Then it rapidly increases to 26 degrees C and fluctuates from 6 to 27 degrees C. It is likely that the temperature probe is malfunctioning at SW. Based on monthly analyses for the timer periods analyzed, the temperature range at WWP is 9.2 to 23.4 degrees C and at SW is 6.9 to 14.5 degrees C. Since most sensors perform temperature compensation as part of their analytical process, an inaccurate temperature may negatively impact multiple parameters.

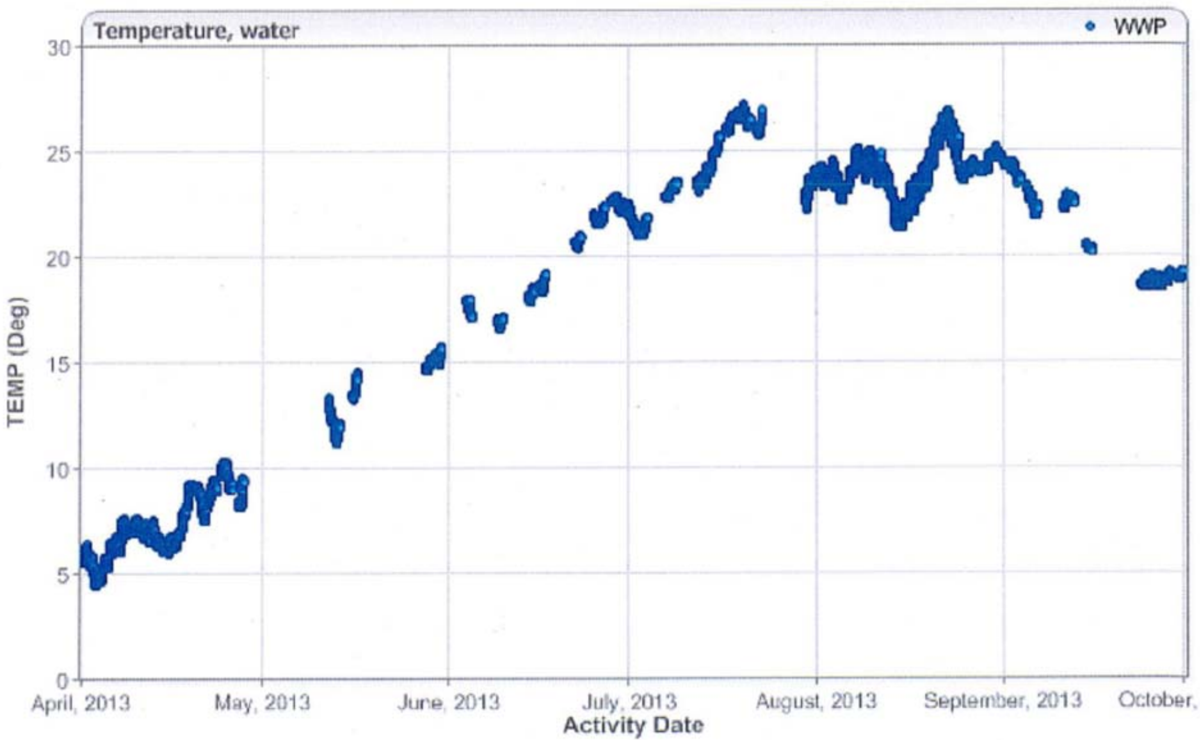

Figure 2-31: WWP Temperature

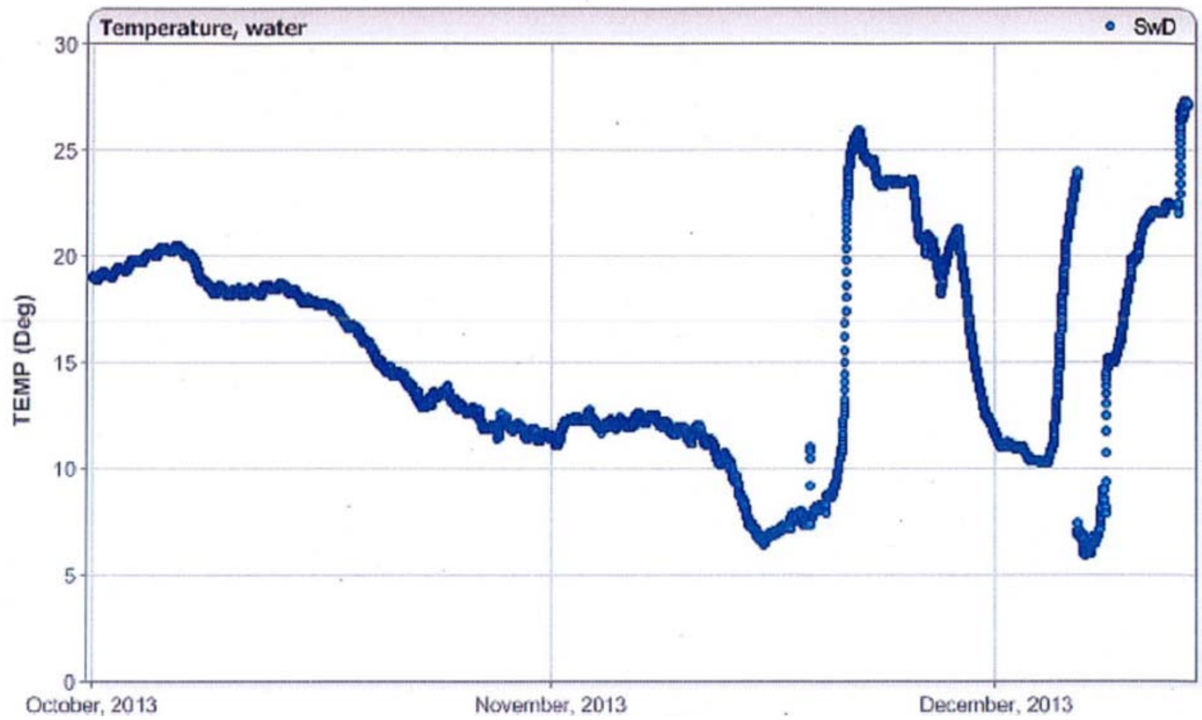

Figure 2-32: Southwest WTP Temperature

Turbidity is displayed in **Figure 2-33** for the WWP for April 1, 2013 to September 30, 2013 and in **Figure 2-34** for SW for October 1, 2013 through December 31, 2013. Wide variability is observed at WWP. The data do not match that obtained by grab samples. Values range from negative to over 1,500 NTU. The monthly average for this time period was 2.7 NTU with a range of 1.0 to 3.7 NTU based on lab results. The daily maximum lab value reported was 80 NTU. This online instrument does not appear to be performing correctly. Values can never be negative. The instrument should be in almost constant alarm condition at WWP for the six months of data examined. At SW, turbidity is typically below the alarm limit of 25 NTU, but does have excursions to over 300 NTU in December. The lab data for this period were not available for comparison.

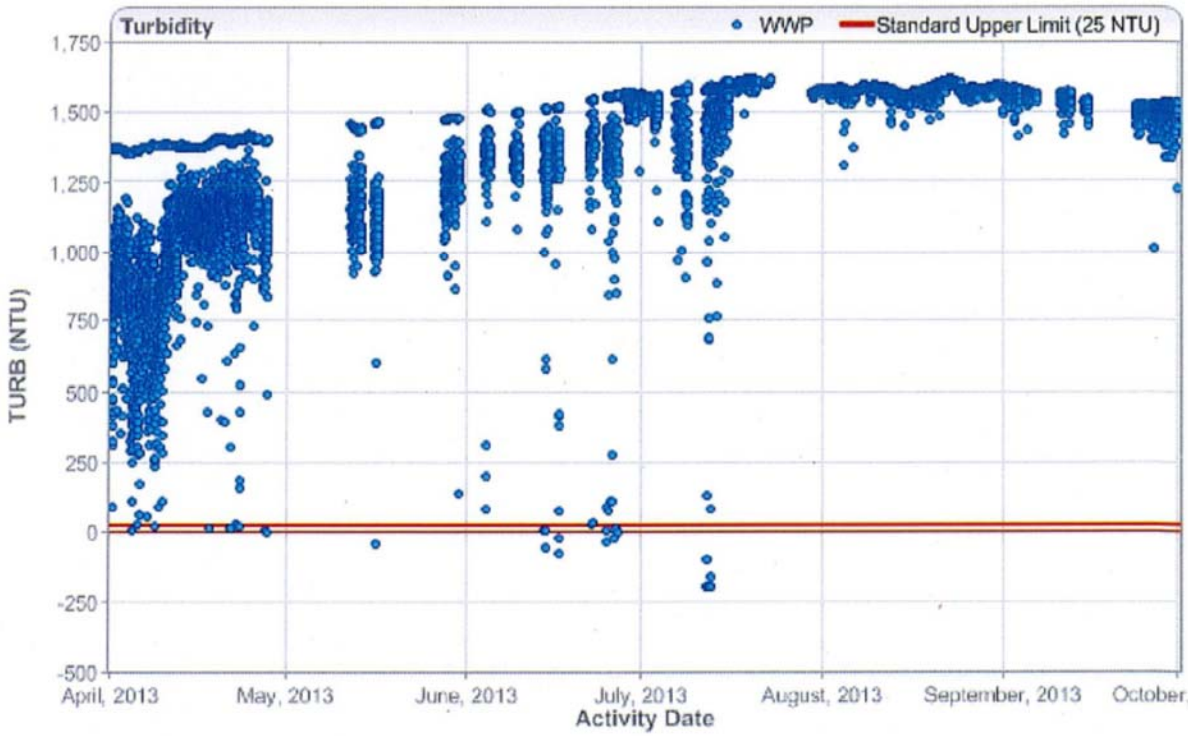

Figure 2-33: WWP Turbidity

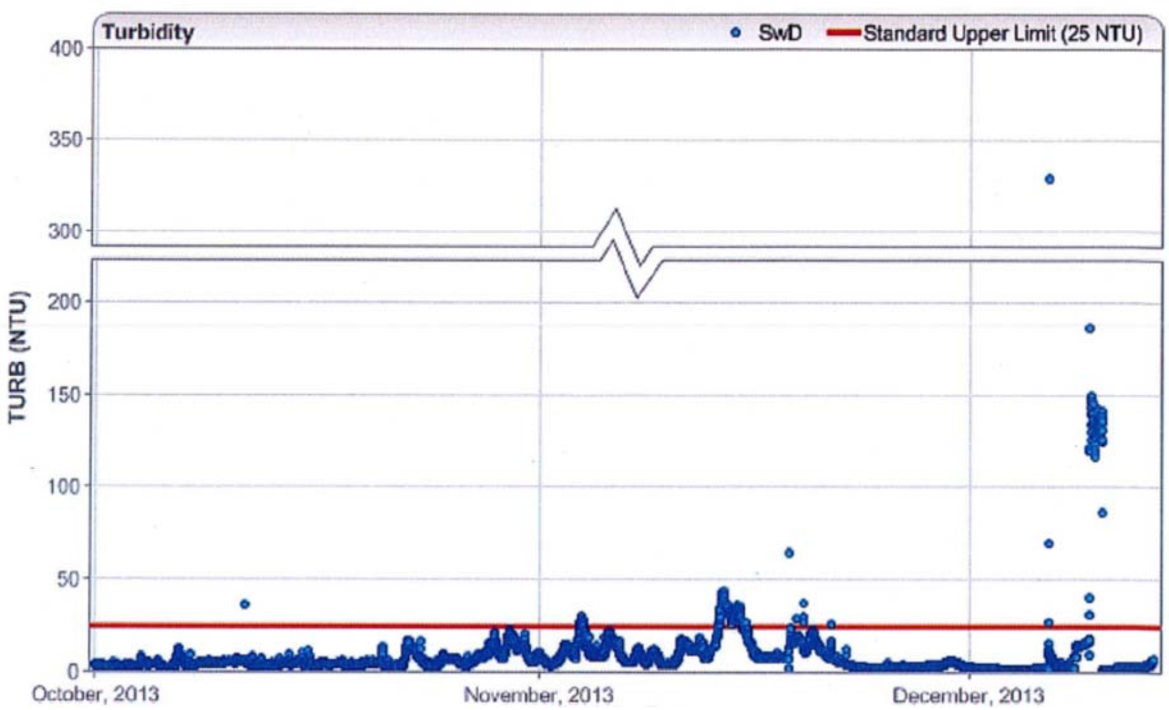

Figure 2-34: Southwest Turbidity

SW also has a hydrocarbon sensor (**Figure 2-35**). Hydrocarbon is usually zero for the time from October 1, 2013 through December 31, 2013, with the exception of a peak in mid-November. It is not known if this peak is real. However, readings up to 0.12 mg/L are observed briefly. No lab data were available for comparison.

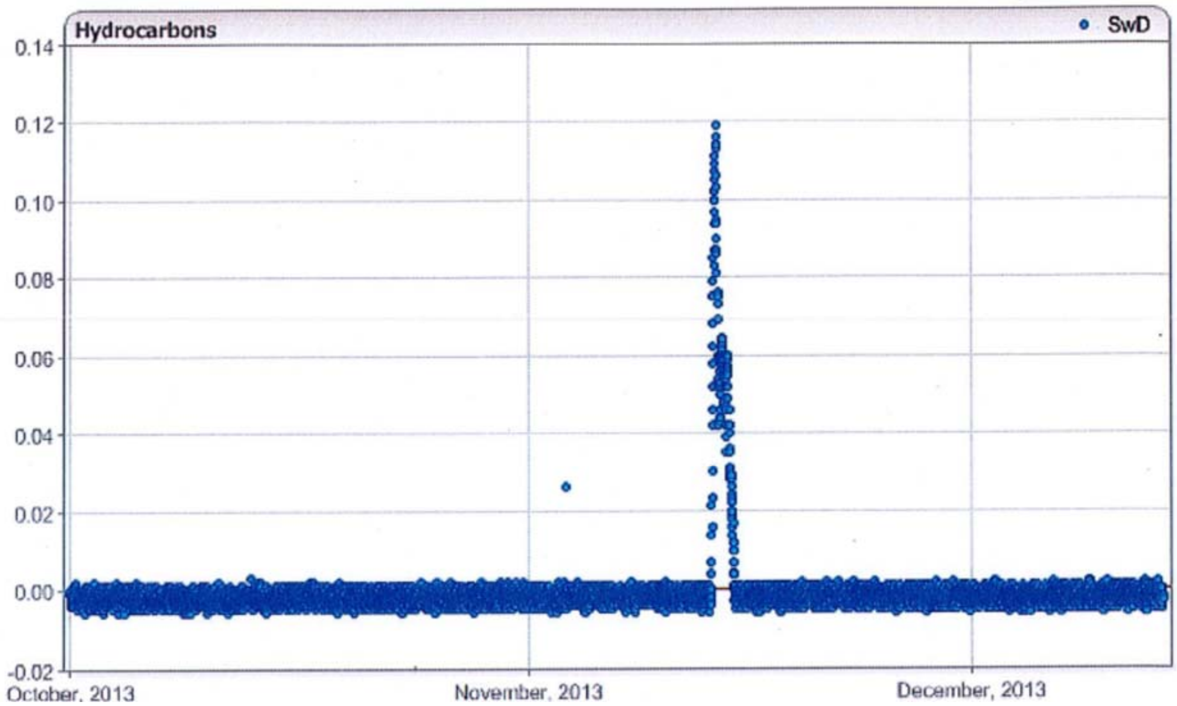

Figure 2-35: Southwest Hydrocarbons

SW also has a TOC online monitor. The results of the TOC monitor for October 1, 2013 through December 31, 2013 indicate results close to zero with a few intermittent high values up to 37 mg/L (**Figure 2-35**). These maximum values are much higher than observed through routine monitoring and are therefore suspect. Values of near zero are also suspect. Monthly TOC data were not available for this time period. However, data from 2012 through the first half of 2013 report a range of 1.55 to 3.20 mg/L for TOC.

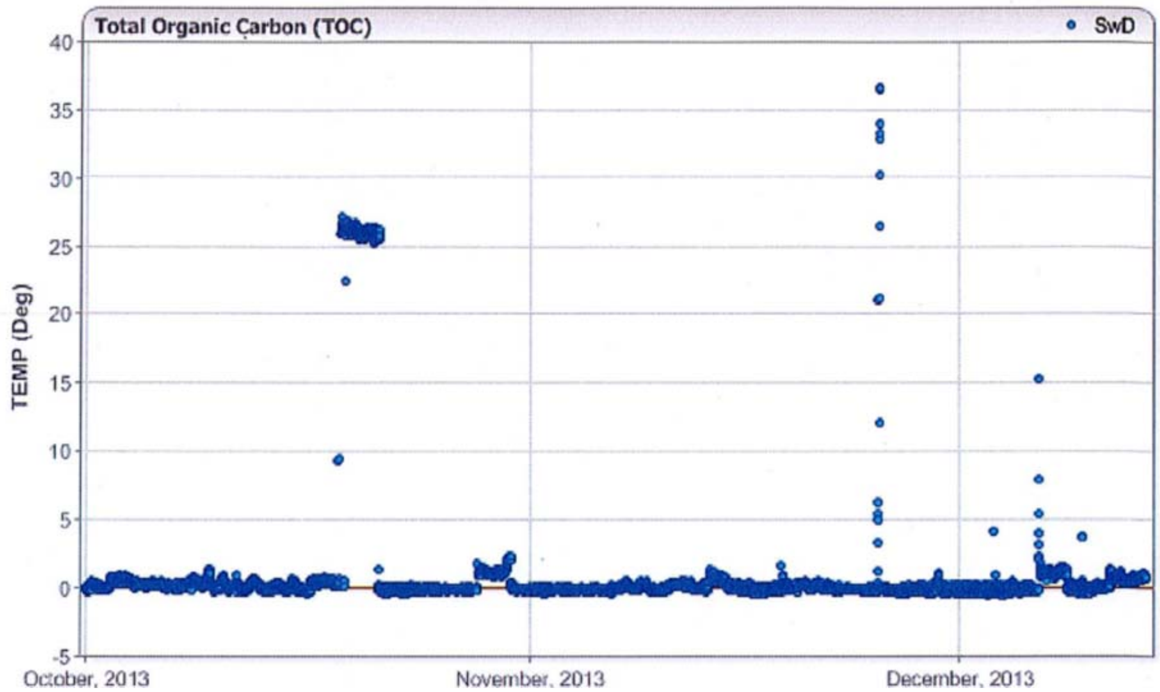

Figure 2-36: Southwest TOC

The variability in the data for all parameters should be investigated. The frequency of calibration and maintenance combined with appropriate selection of sensors (manufacturer based selection based on pilot studies) was demonstrated to improve consistency of results in a study at the Ann Arbor WTP. It is recommended that routine attention be paid to these instruments by plant staff with routine sample or standard checks performed until reliability can be established.

Understanding seasonal variations is an important component of any analysis. It is recommended that approaches to provide more flexibility in graphics, including time frame and number of parameters, be investigated.

Quality Assurance/Quality Control (QA/QC) levels are included in the database and graphics. However, it is not clear that these levels are routinely being assessed and input into the program. Four levels are offered, but are all based upon documentation such as having a sample plan and standard operating procedure. More conventionally, QA/QC refers to the review of QA/QC data and the ability to meet standard QA/QC method specific requirements, such as percent recovery based on spike analysis and similar factors. Further, the data do not appear to have been assigned a QA/QC designation. Differences in the results based on QA/QC level selected were not apparent. The QA/QC feature of the website would be valuable if implemented

2.6.7 Event Detection

A simple "out-of-range" approach is used to indicate that data points are not within expected values. Only three of the measured parameters have such a range, the remainders of the monitored parameters lack even this. The ranges are set very high. Given the variability in the data, this approach will seldom trigger alarms. Acceptable ranges for the monitored parameters are shown in **Table 2-10**.

Table 2-10: Existing Acceptable Ranges for Parameters

Parameter	Acceptable Data Range (no alarm)
Algae, blue-green	none
Hydrocarbon	none
Chlorophyll	none
Temperature	none
Dissolved oxygen	>5.0 mg/L
pH	6.5 to 9.0
ORP	none
Conductivity	none
Turbidity	<25 NTU max
TOC	none

No event detection software (EDS) programs are used to analyze the data and trigger alarms. The purpose of these software programs is the detection of contamination events due to either intentional or inadvertent causes. An EDS is also useful in providing and enhanced understanding of factors that affect water quality and provides for more timely operational responses to water quality changes. The EDS can be fine-tuned to adjust to seasonal factors and other naturally changing parameters. Through use of an EDS, alarms can detect even small changes in values while still accounting for natural variability.

There are several software programs that can "learn" the data patterns and then apply an algorithm to aid in interpreting when a significant change has occurred in the value of a monitored parameter. USEPA's CANARY program is free and open-source. However, this program is complex and requires significant staff time to understand and program. The output is easy to comprehend. Other EDS systems are also emerging, including systems by Hach, S::can, and Whitewater, which are discussed below. The Clarion Sensing Systems Sentinel and the Frontier Technology H20 Sentinel™ are other possible options, but little information is publicly available on these systems.

Although each system uses a different approach, there are some underlying similarities and differences. Some key concepts and features are compared in Table 2-11. The Hach Guardian Blue system contains an EDS integrated with Hach Monitoring equipment. The other three systems can stand alone and function with varied equipment inputs. It is recommended that DWSD consider implementing one of these EDS to enhance the value of the monitoring network.

Table 2-11: Features Available in an EDS

Item	S::can - ana::tool, vali::tool, and moni::tool	Hach - Event Monitor (Guardian Blue)	Whitewater Security - Bluebox	EPA - CANARY, EDDIES
Integrates with other monitors	Yes	No	Yes	Yes
Data validation	Yes	Unknown	Yes	No
Detects variation within set point range	Yes	Unknown	Yes	Yes
Manages background noise	Yes	Unknown	Yes	Difficult or poor performance

Table 2-11: Features Available in an EDS

Item	S::can - ana::tool, vali::tool, and moni::tool	Hach - Event Monitor (Guardian Blue)	Whitewater Security - Bluebox	EPA - CANARY, EDDIES
Additional single-parameter static thresholds option	Yes	Unknown	Unknown	Yes
Handles baseline changes	Yes	Unknown	Yes	Yes
Updates internal algorithms according to incoming water quality data	Yes	Yes	Yes	Yes
Previous event library	Unknown	Yes	Yes	Difficult or poor performance
Graphical User Interface	Yes	Yes	Yes	Difficult or poor performance
Web based interface	Yes	Unknown	Unknown	No
Includes default configuration	Yes	Unknown	Unknown	No
Can recommend calibration	Unknown	Unknown	Yes	No

2.6.8 Response Plan

No formal response plan exists as part of the river monitoring network. This portion of the monitoring is left to the individual utilities. DWSD's Emergency Response Plan is reviewed in a separate technical memorandum (TM No. 12 Emergency Response Plan).

2.7 Recommendations and Potential Projects

The following are recommendations for DWSD regarding source water assessment and protection (**Table 2-612**.

- SWAPs: Routinely review and update the SWAPs at least every 5 years. Updates should be more frequent if new threats and changing land use occurs.
- Update the contaminant source inventories for all intakes
- SWIPP: Develop a program that meets the MDEQ guidance
- Great Lakes Charter and Annex: Continue awareness and involvement in Great Lakes Charter and Annex through participation in the Huron to Erie Drinking Water Monitoring Network and other programs such as conferences offered by the Michigan Section AWWA (American Water Works Association)
- Fighting Island Intake and Belle Isle intake

  - Develop and maintain a relationship with the Ontario Ministry of the Environment. Refine SWAP for Fighting Island intake and the Belle Isle intake to include information on Ontario involvement and source water regulations and information.
  - Obtain ability to routinely inspect the Fighting Island intake and address issues as necessary, including zebra and quagga mussel control

- Climate Change: Track water quality impacts and precipitation patterns. Plan for potential modifications to treatment processes to address taste and odor and cyanobacteria occurrence (microcystin production), particularly at Southwest WTP.

- Pathogen assessment: Consider additional pathogen assessment of source waters as new emerging pathogens are identified

- Mussel evaluation & control: Evaluate zebra and quagga mussels occurrence in all intakes. Perform a historical water quality data review to determine if mussels have altered source water quality (algae types and concentrations, taste and odor, raw water pumping costs, phytoplankton and macrophyte compositions and numbers, etc.). Establish chlorine feed system and apply chlorine to intakes at Belle Isle and Lake Huron for zebra mussel control

In addition, the following recommendations are specific to the online water quality monitoring network (**Table 2-13**).

- Review and Revise the Huron to Erie Water Quality Monitoring

  Based on review of the current system, it is clear that in order to obtain value from this system more staff time and attention need to be committed to the project. Attention to data, sensor performance, comparison to plant data, and data trending all should be routinely reviewed. This may require staff training on data interpretation and equipment troubleshooting. Involvement of the Water Quality group staff would be beneficial.

  The project should also be expanded to assess and implement a robust calibration and maintenance schedule to ensure accurate – and therefore useful – data collection. At other utilities, weekly to monthly calibration checks and adjustments have been necessary. It is recommended that DWSD start with alternating weeks for checking the functions of these sensors by comparing to a known standard or to a lab test.

  Commensurate with these tasks, the budget for this project should be revised and should include more frequent attention to equipment, full replacement costs and an escalation factor. Life times of the equipment should be verified and adjusted based on experience. It is likely that the life times of some of the equipment are lower than initially predicted.

  DWSD should review the value of the parameters that are being monitored and consider modifications. For example, DWSD might consider UV254 absorbance instead of TOC. While experience has shown that even UV254 can have issues with calibration, it is a much easier means to assess organic content than TOC. The GC/MS is not recommended for use due to expected complexity of operation and maintenance combined with cost. However, this leaves the main driver for the establishment of the river monitoring system, i.e. detection of volatile organic chemicals that have been implicated in past spills, not monitored. A surrogate such as TOC or UV254 will need to be used in its place.

Data reporting is acceptable in the current system. However, DWSD should periodically export larger data ranges in order to assess for seasonal variations or unexpected changes in data.

DWSD should evaluate the benefits of the program and determine if it can commit the necessary resources to achieve collection of adequate data. This assessment must include QA/QC procedures and evaluation. Currently QA/QC is based solely on documentation of procedures, rather than true QA/QC which requires acceptable blanks, duplicate, spikes and other similar actions. A QA/QC plan should be developed and implemented. Staff review of data and QA/QC can than assign a QA/QC "ranking" to the actual data.

If DWSD continues to participate in the river monitoring network, then participation should be expanded to include the Lake Huron. Such expansion should not be undertaken until the existing system and data handling are improved. While Lake Huron is a lower risk source, detection at Lake Huron provides additional warning and response time to downstream communities.

- Invest in an Event Detection System

  Investment in an EDS is recommended. Since this requires time to become fully functional, DWSD should set interim alarm limits for all parameters while investigating the state of the industry on EDS. An emergency response plan is essential for any monitoring system designed for contaminant detection. DWSD should expand its current ERP to include this monitoring system.

- Review the use of Microtox for Risk Assessment:

  The cost of the Microtox and Deltatox system is reported by DWSD to be approximately $33,000 annually. Evaluation of the value of this system and potential alternatives, including the online Microtox system should be performed to determine if there are newer technologies that would be valuable in terms of detection ability, time, cost and other factors. This area of technology is demonstrating continued advancement and newer options may be beneficial. Examples of alternatives might include ATP analysis or other biomonitors.

Table 2-12: Source Water Potential Projects for DWSD Intakes and Protection Areas

Project	Study Cost	Capital Cost	FTEs	Schedule Short or Long Term
Update SWAPs	$75,000	$0		Short
Development SWIPP	$75,000	$0	0.25	Short
Evaluate mussel occurrence	$75,000	$0		Short
Add zebra mussel control to all WTPs	$10,000	TBD based on study $0 to $100,000		Short

Table 2-13: Potential Projects for Huron to Eric Online Water Quality Monitoring Network

Project	Study Cost	Capital Cost	FTEs or Annual Costs	Schedule Short or Long Term
Revise and update online water quality monitoring system	$250,000	TDB based on study $0 to $100,000	0.5 FTE	Short
Implement an Event Detection System for the online monitoring system	$200,000	TDB based on study $0 to $100,000	0.5 FTE	Long
Evaluate Microtox and alternatives	$10,000	TBD based on study $0 to $500,000		Long

2.8 References

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