Wiyot Tribe
Environmental Department

Wiyot Tribe Water Quality Monitoring Program

WATER QUALITY ASSESSMENT REPORT

Project Period
October 2008 through September 2009

Dylan Gray
Tribal Environmental Specialist
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List of Acronyms

CICORE – Center for Coastal Observation, Research, and Education
CWA – Clean Water Act
DO – Dissolved Oxygen
EPA – United States Environmental Protection Agency
HSU – Humboldt State University
MPN – Most Probable Number
NCRWQCB – North Coast Regional Water Quality Control Board
PCBs – Polychlorinated biphenyls
QA – Quality Assurance
QAPP – Quality Assurance Program Plan
QC – Quality Control
STORET – EPA's Store & Retrieve Database
SVOCs – Semi-Volatile Organic Compounds
TPH – Total Petroleum Hydrocarbons
TSS – Total Suspended Solids
WQI – Water Quality Indicator

Background

Located adjacent to the southern end of Humboldt Bay, the Table Bluff Reservation of the Wiyot Tribe includes 88.5 acres of land situated between the Humboldt Bay watershed and Eel River Estuary. In addition to the present reservation lands of the Wiyot people, the tribe also has interest in protecting the water resources of the "lower reservation", located at the south edge of Table Bluff and adjacent to McNulty Slough of the Eel River Estuary; the tribe's land on Indian Island, located in Humboldt Bay; and Cock Robin Island, located in the Eel River Estuary and acquired by the tribe in 2006.

The Wiyot people have always lived around Humboldt Bay and the lower Eel and Mad Rivers, and have used the waters of the bay, rivers, and coast for many purposes. Fishing, hunting, and gathering food and culturally significant materials are particularly important to Tribal members who have long depended on fish and wildlife for subsistence. Before the damming of wetlands by European settlers, there were over 100 miles of travelable waterway up into sloughs and creeks that empty into Humboldt Bay. Using redwood canoes, these routes were means of reaching important locations, such as ceremonial grounds and fishing sites. Food resources such as shellfish, crabs, seals, otter, fish, and eels were often harvested from the rivers, bay, and mudflats in canoes. Basket and textile materials such as tule and willow root were, and still are, collected from wetland and riparian habitats. Water continues to be essential in use of medicines, soaking basket materials, leaching foods such as acorns, and bathing the sick when in ceremonies, or when used while fasting during ceremonies.

There are many threats to the tribe's various water resources, including industrial contamination from lumber treatment, toxic compound production from illicit methamphetamine production, illegal dumping, inadequate septic systems, erosion, agricultural runoff, and automobile-related pollution, among many. Undoubtedly, the Tribe has many reasons to protect the water that supports the diverse ceremonial, medicinal, practical, and subsistence resources that the people depend on.

Description of Tribal Water Quality Monitoring Programs

The Wiyot Tribe's concern with protecting its water resources has required the establishment of several environmental programs, including a Clean Water Act §106 Water Pollution Control Program (established October 2002) and a CWA §319 Non-Point Source Water Pollution Control Program (established 2003). The overarching aims of the programs are to:

- assess and better understand the tribe's surface water, ground water, and wetland resources,
- to identify on-site and off-site threats and negative stressors to water quality, and
- protect the tribe's water resources and their uses

One tool in meeting these aims is the tribe's Water Quality Monitoring Program (established 2004), the basic elements of which are outlined in the tribe's Quality Assurance Program Plan (approved by US EPA in 2004). The hypothesis formulated for this program is that the waters of the tribe are threatened or impaired by land uses within their respective watersheds. The monitoring program is an investigation to determine the extent and nature of contaminants in groundwater, wetlands, estuaries, and bays affecting the Tribe through traditional analytical techniques. The monitoring objectives are three fold:

- to characterize the extent to which offsite and on-site land uses affect the waters of the Tribe,
- to identify exceedances of water-quality guidelines, and
- to generate data as a basis for future water quality standards, guidelines, and regulatory decisions.

Monitoring Design

Non-Random Data Collection Methodology was used to determine sites for monitoring and sampling based on proximity to potential contamination and where water quality impairment has been deemed most likely to occur (see Appendix 1, Wiyot Tribe Water Quality Monitoring Locations). Thus far, the tribe has established the following sample stations to monitor for site-specific potential contamination:

- At the reservation wetland, two shallow wetland wells have been developed to monitor the groundwater/surface water interface year round. Surrounding land uses that could potentially result in contamination of the wetland include agricultural production of beef cattle and hay, and the adjacent management of the reservation's community septic leach field. The most likely contaminants to be detected in the wetland would include nitrates and phosphates, as well as fecal coliform.
- At McNulty Slough, adjacent to the lower reservation. The water quality at this site is threatened by historical solid waste/hazardous waste accumulation and burn/ash pits, surrounding agricultural land use for dairy and beef cattle, illicit methamphetamine production, failing residential septic systems, and improperly abandoned residential wells. Additionally, it is possible that pollutants carried in McNulty Slough, which passes within 15 yards of the tribe's community drinking water wellhead, could impact the Tribe's groundwater. Likely contaminants at this site include fecal bacteria, nitrates and phosphates, pesticides, metals, and petroleum hydrocarbons. The slough is only sampled during mid- to high-tides, when there is adequate water for monitoring.
- At the mouth of Humboldt Bay. The bay is on the Regional Water Quality Control Board's "watch list" for impairment due to sediments; longshore currents bring sediment from the Eel River watershed into Humboldt Bay; additionally, several of the bay's tributary streams are 303d listed for sediment impairment. This monitoring site is meant to determine water quality coming into the bay from outside the Humboldt Bay

watershed; consequently, the site is monitored only during the last hour of an incoming tide. Likely contaminants include suspended solids.

- Adjacent to the tribe's Indian Island property in Humboldt Bay, just offshore in the Middle Channel. The tribe's land on Indian Island, historically the site of an old dry-dock facility and foundry, is currently undergoing a brownfields cleanup project for metals and dioxin contamination. Samples are collected from this site only at mid-tides, although in-situ monitoring occurs on a continuous basis.
- At the mouth of the Mad River Slough, in northern Humboldt Bay. This site is near operational lumber mills with known historic dioxin and PCB contamination (Humboldt Bay is presently 303d listed for impairment due to dioxin and PCB contamination). This site is monitored only during outgoing tides.

Other sites that the tribe intends to eventually establish include:

- At the periphery of the reservation. The predominant land use surrounding the reservation is agriculture, although other sources of groundwater contamination are possible.
- Cock Robin Island, in the Eel River Estuary. The Eel River lower mainstem and delta is 303(d) listed for sediment impairment and water temperature. Surrounding land uses are dominated by timber production and dairy cattle ranching.

The tribe's landholdings have increased since the water quality monitoring program began in 2003. In summer of 2004, the tribe acquired approximately 60 acres on Indian Island adjacent to the tribe's 1.5 acre landholding that had been acquired in 2000. This land includes some 40 acres of saltmarsh, the water quality of which has not been tested. Because of the expense associated with integrating this new area into the monitoring program, it is unlikely that the tribe will assess the water quality at this site in the near future.

Additionally, in 2006 the tribe acquired approximately 80 acres on Cock Robin Island in the Eel River Estuary. The land includes shifting river frontage and river bed. As stated above, the tribe desires to eventually establish a monitoring site at the island, but this will be dependent on funding. Until funding is acquired, the water quality at the site will go unassessed.

The number of wetland acres and estuary square miles monitored can be reviewed in Table 1: Atlas of Tribal Waters and Assessment, Appendix I. A map of current monitoring sites can be reviewed in Figure 1: Wiyot Tribe Water Quality Monitoring Locations, Appendix II.

Core Water Quality Indicators (WQI)

The tribe samples for a suite of WQIs at all of the present monitoring sites, as well as specific additional WQIs unique to each site based on suspected contamination threats. The WQIs common to all sites are:

- Temperature
- pH
- Dissolved Oxygen (DO)
- Turbidity
- Phosphorus (total phosphate)
- Total Nitrogen (total Kjeldahl, ammonia, nitrate-nitrite)
- Total/fecal Coliform

The tribe also monitors these parameters at all sites:
- Specific Conductivity
- Salinity

The tribe monitors for additional WQIs and constituents at the following sites:
- McNulty Slough – Total Petroleum Hydrocarbons (TPH), metals, total suspended solids (TSS)
- Indian Island – Semi-Volatile Organic Compounds (SVOCs) (including pentachloraphenol), metals, Polychlorinated Biphenyls (PCBs), metals, and TSS
- Bay Entrance – SVOCs, PCBs, and TSS
- Mad River Slough – SVOCs, PCBs, and TSS

Temperature, pH, DO, turbidity, specific conductivity, and salinity monitoring is performed *in situ* with Yellow Springs Instruments 6600 EDS sondes; phosphorus, nitrogen, bacteria, SVOC, PCB, and TSS monitoring are performed using various collection methods described in the tribe's QAPP. All collected samples are analyzed by North Coast Laboratories in Arcata, California.

Presently, the tribe is discrete monitoring for pH, DO, turbidity, specific conductivity, and salinity on a bi-weekly schedule at all sites except for Indian Island, which is monitored on an ongoing basis – the sonde is deployed in a permanently fixed protective housing where it logs water quality data unattended. Discrete sampling consists of deploying a sonde for about 15 minutes; long-term sampling consists of deploying a sonde for two-week periods during which the sonde logs sample data every 15 minutes. The tribe is monitoring for all other WQIs annually.

See Table 2: Designated Uses for Water Bodies & Making Assessment Decisions, Appendix I.

Collaboration with Other Organizations

The tribe views collaboration with other organizations as a powerful tool for maximizing results by pooling resources and expertise. The tribe has worked extensively with other organizations in its efforts to monitor water quality in and around Humboldt Bay. These include Humboldt

Baykeeper; the Center for Integrated Coastal Observation, Research, and Education (CICORE); and Humboldt State University.

Collaboration with Humboldt Baykeeper (a non-profit organization formed in 2004 with the purpose of safeguarding coastal resources for the health, enjoyment, and economic strength of Humboldt Bay) has included mutual assistance in accessing sampling sites. Coordination with CICORE (a California State University organization formed in 2002 with the purpose of bolstering coastal observation) has included data sharing and sampling site coordination, as well as standardization of sampling equipment. The Tribe has worked with several professors at Humboldt State University (HSU) to share and interpret data. In 2007 and 2008 the tribe collaborated with Dr. Matthew Hurst of HSU in an exhaustive trace dissolved metals study of the bay; this study was performed at all of the tribe's sampling sites in Humboldt Bay, and the data collected is of higher detail, resolution, and thoroughness than could be achieved if each organization worked without collaboration. In 2008 and 2009, the Tribe again collaborated with Dr. Hurst on a detailed nutrient study on Bay. The results are not ready for release yet, but will be available in 2010.

Quality Assurance

In September 2004, US EPA approved a Quality Assurance Program Plan (QAPP) for Water Quality Assessment and Monitoring for the Wiyot Tribe. The QAPP ensures that the quality assurance (QA) and quality control (QC) procedures used to document technical data generated during projects is accurate, precise, complete, and representative of actual field conditions. QA is defined as an integrated program designed to assure reliability and repeatability of monitoring and measurement data. QC is defined as the routine application of procedures to obtain prescribed standards of performance in the monitoring and measurement process. The QAPP is consistent with guidelines set forth in the U.S. Environmental Protection Agency (US EPA)'s *Requirements for Quality Assurance Project Plans for Environmental Data Operations, EPA QA/R-5* (US EPA, 1998) and *Guidance for Quality Assurance Project Plans, EPA QA/G-5* (US EPA, 1998).

Data Management

Historically, all data collected for sonde parameters (temperature, dissolved oxygen, turbidity, specific conductivity, pH, salinity) have been generated in electronic format and managed using Microsoft Excel. Data generated from laboratory-analyzed samples have been converted from paper to electronic format using Microsoft Excel. Metadata generated from field notes and sample collection log sheets generated in the field are also converted to Microsoft Excel.

Additionally, the tribe formats all data to be compatible with EPA's STORET data base; data are regularly uploaded to the database via the WebSIM online interface. To facilitate public availability of collected information, data from the Tribe's sampling of physical parameters of water quality are posted and available for download in graph or table format at the website for the Center for Integrative Coastal Observation, Research, and Education (CICORE). All the Tribe's data – physical, chemical, and biological – are available for review on the Tribe's website.

The tribe oversees all aspects of data recording, validation, transformation, transmittal, reduction, analysis, and tracking as prescribed in the tribe's EPA-approved QAPP.

Data Analysis and Assessment

TBR has not yet developed or implemented Tribal water quality standards. Interim standards to be implemented while Tribal standards are under development generally duplicate federal and State of California standards. Jurisdiction and enforcement of these standards is the responsibility of the Wiyot Tribal Council.

The tribe compares collected data to applicable water quality standards and criteria set forth by US EPA and State of California, including the North Coast Regional Water Quality Control Board Basin Plan and Amendments, the National Recommended (Ambient) Water Quality Criteria, the California Ocean Plan, California Toxics Rule, and National Primary Drinking Water Standards. These comparisons indicate whether water quality is meeting established water quality criteria, and the tribe's water quality assessments are based on the results of these comparisons. Whether or not designated uses of tribal waters are being supported is a dominant consideration in the assessment process (see Table 2: Designated Uses for Water Bodies & Making Assessment Decisions, Appendix I).

Assessment Narrative

There is substantial variation in the quality of the tribe's water resources. While the reservation wetland has relatively good water quality, McNulty Slough has problems with regard to a couple of monitoring parameters, and Humboldt Bay has additional issues detected via monitoring by other organizations. The following assessments are based on data collected since the tribe's water quality monitoring program began in 2003 through September 2009, with specific comparisons between data collected prior to October 2008 and data collected from October 2008 through September 2009.

Reservation Wetland: Monitoring at the two shallow wetland wells on the reservation has not shown any exceedances of water quality criteria. Sampling for nitrite showed no detections

since sampling began in 2005. The greatest concentration of nitrate detected was only 2.1 mg/L (in October 2008), well under even the National Recommended Ambient Water Quality Criterion of 10.0 mg/L for sources of drinking water (which the wetland is not). In October of 2008 sampling showed concentrations of ammonia nitrogen in the two wetland wells of .61 and .11 mg/L, far below the US EPA Recommended Water Quality Criteria for Freshwater Aquatic Life after taking into account temperature and pH of the sample.

Bacteriological results have been more variable. While most sampling events have shown coliform concentrations of less than 30 MPN/100ml, four events have yielded higher results: one surface water sample collected in 2005 showed concentrations of 240 MPN/100ml; a sample collected from one of the monitoring wells soon after its development resulted in >1600 MPN/100ml; another sample collected from the same well 6 months later showed coliform concentrations exceeding 1600 MPN/100ml; and another sample collected from the same well in February 2009 showed concentrations of 1600 MPN/100ml. The other well has not shown a concentration exceeding 30 MPN/100ml. Fecal coliform has not been detected in the wetland during any of the sampling events. While there is no criterion for fecal coliform concentrations that applies directly to shallow wetland groundwater, the North Coast Regional Water Quality Control Board's (NCRWQCB) objective for inland surface waters is a 30-day median of 50 MPN/100ml. Because a minimum of 5 samples must be collected to determine the 30-day median, the available data are not comparable; however, since no fecal coliform have ever been detected in the wetlands it is assumed that the wetland water quality in regards to bacteria meets related, if inapplicable, water quality criteria.

Total phosphate phosphorus concentrations have been variable, with samples yielding results ranging from non-detections to a maximum of 0.93 mg/L. There is no criterion for phosphate that applies directly to shallow wetland groundwater; however, the National Recommended Ambient Water Quality Criterion for streams is .05 mg/L. It is unsurprising that the phosphate levels in the wetland occasionally exceed the stream-related criterion – wetlands often act as a sink for nutrients.

From 1990 until 2005, the uplands surrounding the wetland were used as grazing land for beef cattle production. With too many head of cattle for the available area, the land was significantly over-grazed; additionally, the cattle had unfettered access to the wetland itself. Evidence of their impact included denuding of wetland vegetation, deep tracks through the wet areas, complete destruction of low terrestrial and semi-aquatic vegetation, and fecal deposition. In 2005, the tribe installed exclusionary fencing around the wetland and a surrounding buffer area; in 2006, the tribe implemented a range management plan to improve the environmental conditions of the upland and wetland. While the wetland habitat has improved dramatically, water quality monitoring has not resulted in observations of improvement due to cattle management. This is in part because water quality prior to implementation of wetland protective measures was not particularly poor. However, the

protective measure implementation is still viewed as a success because it protects good water quality in the wetland, rather than improving poor water quality.

As stated above, water quality monitoring in the wetland has not resulted in observation of exceedances of applicable criteria. It is concluded that the wetland is serving all of its designated uses, including wildlife habitat and cultural uses (see Table 2: Designated Uses for Water Bodies & Making Assessment Decisions, Appendix I and Table 3a: Use Support in Tribal Freshwater Wetlands, Appendix I). Water quality during the period of October 2008 through September 2009 was consistent with water quality prior to October 2008; therefore water quality appears maintained at the site.

McNulty Slough: Since the beginning of the monitoring program, monitoring at McNulty Slough has shown recurrent water quality issues where bacteriology and dissolved oxygen (DO) are concerned, and this phenomenon continued during the period of October 2008 through September 2009. Fecal coliform concentrations have generally been very high, with a range of 17 to over 1600 MPN/100ml and an average of over 550 MPN/100ml. The NCWQCB objective for fecal coliform in estuaries is a 30-day median of 50 MPN/100ml, based on a minimum of 5 samples. While monitoring efforts have not meet the minimum of 5 samples in a 30-day period, it is safe to say that water quality in the slough is impaired due to fecal contamination – only one sample collected in a period of over 3 years yielded a concentration of less than 50 MPN/100ml.

The cause of the fecal contamination is almost certainly bovine excrement; the Eel River estuary is home to many dairy and beef cattle operations. Cattle and their excrement have been observed on the upland shores around the sloughs, as well as below the high-tide elevation during low tides; there are few, if any, cattle exclusions to prevent cattle access to the sloughs and their tributaries.

McNulty Slough has also consistently shown significant issues as regards low DO concentrations, and this continued into the period of August 2008 through September 2009. The NCRWQCB dissolved oxygen objective for estuaries is 6.0 mg/L. Since monitoring began at the site in December 2004, 33% of sampling events have shown DO concentrations below that objective, with the lowest detection at 0.67 mg/L (recorded August 2007), the lowest concentration the tribe has detected at any location at any time. The average DO concentration detected from the period of August 15th through October 24th 2008 was 4.11 mg/L, well below the NCRWQCB objective; the average DO concentration detected during the period of August 7th through September 16th 2009 was 4.06. While DO saturation during the period of late July to early September 2007 ranged from 8.95% to approximately 34%, DO saturation was not observed below 30% in the period of October 2008 through September 2009. Sustained saturation levels below 30% are generally considered hypoxic and sufficiently low to kill most fish. A low DO concentration of 3.34mg/L coincided with an observed bait fish kill in the slough on July 20, 2006.

The low DO concentrations in McNulty Slough are likely due to eutrophication, which is not uncommon in coastal estuaries. While monitoring has not resulted in regular observations of excess nutrient (i.e. - nitrogen and phosphorus) loading, it has already been stated that the slough is impaired by excess fecal coliform concentrations.

As detailed above, according to the observations made by the tribe's water quality monitoring program, McNulty Slough is impaired for fecal contamination and depressed DO levels. These impact the designated uses of coldwater wildlife habitat, shellfish and fish consumption, and contact recreation, including swimming and cultural uses; tribal members are discouraged from swimming, fishing, or shell-fishing in the slough (see Table 2: Designated Uses for Water Bodies & Making Assessment Decisions, Appendix I; Table 3b: Use Support in McNulty Slough, Appendix I; and Table 4a: Causes & Sources of Impairment in McNulty Slough, Appendix I). Water quality during the period of October 2008 through September 2009 was consistent with water quality prior to October 2008, therefore water quality appears maintained at the site.

Indian Island: As regards the water column itself, water quality at Indian Island appears generally to serve the designated uses for that water body, with one exception – prior to October 2008, monitoring at the site had shown levels of DO in violation of regional criteria. The NCRWQCB objective for DO concentration in estuaries is a minimum of 6.0 mg/L. While there have been observations of isolated, ephemeral dips in DO concentration below 6 mg/L since monitoring at the site began in 2005, more significant concern arises from extended periods of low DO concentrations, of which none were detected during 2009. The period from May through early August 2007 exhibited frequent sustained depressions of DO concentrations below 6.0 mg/L in the water column off Indian Island; during a two-week monitoring period in June 2007, the mean DO concentration was 5.65 mg/L. In contrast, the period of October 2008 through September 2009 did not indicate any sustained depressed DO concentrations, just abbreviated dips below 6.0 mg/L.

Another significant measure of dissolved oxygen as a water quality and aquatic wildlife habitat indicator is DO saturation. While DO concentrations below the regional criterion were observed prior to October 2008, DO saturation (dissolved oxygen relative to water salinity and temperature) levels have generally remained supportive of coldwater aquatic life. All but two monitoring periods since monitoring began have shown average DO saturation levels above 80%, indicating a healthy aquatic environment; since October 2008, no monitoring periods have shown average DO saturation levels below 80%. The monitoring period with the lowest DO saturation average, 69%, was from June 1-15 2007; this period included the lowest instantaneous DO saturation observation of 27.6%. For nearly 2 hours on June 6 2007, DO saturation at the Indian Island monitoring site dropped below 30%, a level below which many fish species cannot survive. However, this phenomenon was not observed elsewhere in the bay during the same time period, making the water quality problem not only short in duration but very local in extent.

As with McNulty Slough, the low DO concentration and DO saturation during this hypoxic event were likely due to some degree of eutrophication. While there are no data to support it, this may have been due to excess nutrients in the water column, the result coastal upwelling and re-suspension of bay sediments which occur during the windy summer months. Hypothetically, the increased nutrient load coupled with unusually sunny weather would have resulted in excessive algal growth and decomposition, in turn depleting DO. Incidentally, many observations of heavy algal growth on the mud flats of Indian Island were made during the period of depressed DO concentrations in early summer 2007.

Fecal coliform has not been an issue for the site, as the highest detected levels at Indian Island and Mad River Slough (both in the north-bay and near oyster production mudflats) have been instantaneous values of 30 and 40 MPN/100ml, respectively. The NCRWQCB objective for fecal coliform in aquaculture areas (the most stringent objective that applies to the monitoring area) is an instantaneous maximum of 49 MPN/100ml.

Despite soil contamination on shore at Indian Island, the bay water column has shown no water quality criteria exceedances for PCBs, SVOCs, or toxic metals. Because there has never been detection of PCBs or SVOCs in the water column, the tribe will likely decrease the monitoring frequency for these constituents. Presently, Humboldt Bay is CWA 303d listed as impaired due to PCB and dioxin contamination. However, the medium of detection for these contaminants has been sediment, which both of these contaminants bind with. Presumably, the affinity of dioxin for fine sediments effectively removes the vast majority it from the water column except during periods when the sediments are re-suspended; however, more study must be done to determine what traces of dioxin may exist in the bay water column.

Even without unbound dioxin in the water column, there may still be a threat posed by the sediment-bound dioxin, particularly for bi-valves, mollusks, and bottom-feeding fish that spend significant amounts of time in the benthic substrates. Filter feeders such as mussels and oysters (an economically important aquaculture product in Humboldt Bay) take in bay water as well as suspended sediments while feeding, ingesting some of the sediments. Any accumulation of dioxin in these organisms is then passed on to the tissues of animals that prey on these filter feeders; the accumulations continue at every increased trophic level onto which the contaminant is passed, resulting in what is called bio-accumulation. Thus, it is quite possible for a human to eat a fish with toxic levels of dioxin from the bay, while the bay water column itself is largely free of dioxin. However, whether or not this is occurring will remain unknown until the tissues of resident fish and filter feeders are analyzed for dioxin. Unfortunately, monitoring for dioxin is a very expensive proposition due to the high costs of sample analysis; presently, no one has funding to perform adequate dioxin sampling in the bay to answer the questions regarding its distribution and extent.

Exhaustive monitoring for trace metals in the bay water column has shown that Humboldt Bay has relatively low dissolved nutrient and contaminant trace metal concentrations when compared to other well-studied estuaries such as San Francisco Bay, San Diego Bay, Galveston Bay, and Narragansett Bay. No dissolved metals concentrations from samples collected in the bay have approached or exceeded any applicable criteria. For this reason, the tribe will likely decrease the monitoring frequency for dissolved toxic metals.

In summary, the tribe's water quality monitoring program has shown that the bay is generally serving its designated uses. One exception is due to the observed occasional depressed DO levels at the Middle Channel next to Indian Island, which indicate decreased habitat quality for aquatic life. However, because the DO saturation values are only depressed for short, infrequent periods and limited in spatial extent, the waters generally meet the necessities of aquatic life. Therefore, it is concluded that the bay is not impaired by depressed DO levels, rather only threatened by impairment. Water quality monitoring by other organizations (including the NCRWQCB and Humboldt BayKeeper) has led to the CWA 303d listing of the bay as impaired by dioxin and PCBs found in the bay sediments, although much more study is needed to understand the extent and distribution of these contaminants (see Table 2: Designated Uses for Water Bodies & Making Assessment Decisions, Appendix I; Table 3c: Use Support in Humboldt Bay, Appendix I; and Table 4c: Causes & Sources of Impairment and Threatening Impairment in Humboldt Bay, Appendix I). While some mild improvement in DO concentrations were observed during since October 2008, general water quality during the period of October 2008 through September 2009 was consistent with water quality prior to October 2008, therefore water quality appears maintained at the site.

Appendix I: Tables

Table 1: Atlas of Tribal Waters and Assessment

Water Body Type and Measurement	Value (Tribal Ownership)	Value (Assessed)
Total number of stream miles	0.5	0
Total number of saltwater wetland acres	40	0
Total number of freshwater wetland acres	0.5	0.5
Total number of estuary acres	7.5	7.5

Table 2: Designated Uses for Water Bodies & Making Assessment Decisions

Water Body	Designated Uses	Parameter(s) Measured to Determine Support of Use of Goal
Humboldt Bay	Aquatic life and wildlife Shellfish/fish consumption Contact recreation/swimming/cultural uses	*E. coli* or enterococci DO, temperature, pH, turbidity nitrogen, phosphorus Dissolved metals SVOCs PCBs
McNulty Slough	Aquatic life and wildlife Shellfish/fish consumption Contact recreation/swimming/cultural uses	*E. coli* or enterococci DO, temperature, pH, turbidity nitrogen, phosphorus
Reservation Wetland	Aquatic life and wildlife Cultural/secondary contact	*E. coli* or enterococci DO, temperature, pH, turbidity nitrogen, phosphorus

Table 3a: Use Support in Tribal Freshwater Wetlands

Designated Use of Tribal Goal	Number of Acres Monitored/ Assessed	Number of Acres Fully Supporting Use of Goal	Number of Acres Supporting Use but Threatened	Number of Acres Not Supporting Use or Goal
Aquatic life and wildlife	0.5	0.5	0	0
Shellfish/ fish consumption	0.5	0.5	0	0
Contact recreation/ swimming/ cultural uses	0.5	0.5	0	0

Table 3b: Use Support in McNulty Slough

Designated Use of Tribal Goal	Number of Slough Miles Monitored/ Assessed	Number of Slough Miles Fully Supporting Use of Goal	Number of Slough Miles Supporting Use but Threatened	Number of Slough Miles Not Supporting Use or Goal
Aquatic life and wildlife	0.25	0	0	0.25
Shellfish/ fish consumption	0.25	0	0	0.25
Contact recreation/ swimming/ cultural uses	0.25	0	0	0.25

Table 3c: Use Support in Humboldt Bay

Designated Use of Tribal Goal	Number of Acres Monitored/ Assessed	Number of Acres Fully Supporting Use of Goal	Number of Acres Supporting Use but Threatened	Number of Acres Not Supporting Use or Goal
Aquatic life and wildlife	7.5	0	0	7.5
Shellfish/ fish consumption	7.5	0	0	7.5
Contact recreation/ swimming/ cultural uses	7.5	0	7.5	0

Table 4a: Causes & Sources of Impairment in McNulty Slough

Parameter	Number of Slough Miles Not Supporting Use	Source of Impairment or Threat of Impairment
E. coli	0.25	Agriculture (livestock grazing)
Dissolved Oxygen	0.25	Agriculture (livestock grazing)

Table 4c: Causes & Sources of Impairment and Threatening Impairment in Humboldt Bay

Parameter	Number of Estuary Acres Supporting Use But Threatened	Number of Estuary Acres Not Supporting Use	Source of Impairment of Threat of Impairment
Dissolved Oxygen	7.5	0	Eutrophication, source unknown
Dioxin	0	7.5	Historic lumber treatment, boat maintenance
PCBs	0	7.5	Historic use of hydraulic fluids, pesticides, etc; precise source unknown

Appendix III: Figures

Figure 1: Wiyot Tribe Water Quality Monitoring Locations