5.0 RECEIVING WATER CHARACTERIZATION

Executive Summary: A primary objective of the WWP is to improve water quality in rivers and streams impacted by CSO and SSO discharges. Understanding how discharges influence water quality conditions is therefore a fundamental element of the wet weather planning process. To this end, a series of monitoring programs were implemented to assess the quality of receiving waters and the impact of wet weather discharges. These programs included the monitoring of receiving waters, sanitary sewage, CSOs and industrial discharges. Monitoring data were collected and analyzed to:

- Characterize water quality conditions during wet and dry weather and for sensitive areas;
- Evaluate whether and to what extent receiving waters are in attainment with applicable water quality standards;
- Identify constituents of concern;
- Establish existing water quality conditions to serve as a baseline for evaluating the effectiveness of future control measures; and
- Support the development and validation of receiving water quality models.

The receiving water quality monitoring program included sampling at 51 locations on the three main rivers (Allegheny River, Monongahela River, and Ohio River) and select tributaries in and around the service area. Water quality conditions entering the service area were also monitored as a part of characterizing the impact from CSO and SSO discharges. Each location was sampled for three wet and three dry weather events. The monitoring assessment results show that under existing conditions water quality standards established to protect water contact recreation are not being met. Results indicate that fecal coliform is the primary constituent of concern for all ALCOSAN receiving waters. In particular, measured concentrations frequently exceeded the 200 and 400 cfu/100 mL thresholds in the recreational season with CSO discharges causing and contributing to non-attainment of water quality standards.

The receiving water characterization effort also included the development of water quality models used to simulate fecal coliform loadings to receiving waters from wet weather discharges and to predict receiving water quality under existing conditions, and ultimately to predict the water quality benefit of alternative overflow control strategies. The pollutant loading estimates were produced using the hydrologic and hydraulic simulation models along with data available from existing national stormwater quality databases, locally-collected sanitary sewage data, locally-collected industrial discharge data, and a number of locally-collected CSO/stormwater discharge samples. The receiving water quality monitoring results were used to validate the predictive models.

Section 5.1 provides an overview of the physical characteristics of the receiving waters including: watershed characterization (physiography, topography, geology, climate and land use), receiving stream hydrology, habitat and geomorphological characteristics and current uses. Section 5.2 details applicable water quality standards. Section 5.3 provides an overview of

the various water quality monitoring programs with Section 5.4 summarizing the results. Section 5.5 describes the water quality modeling approach and presents an assessment of attainment with fecal coliform water quality standards under existing conditions.

5.1 Physical Characterization

5.1.1 Watershed Characterizations

The 309-square mile ALCOSAN service area is situated at the confluence where the Allegheny and Monongahela Rivers meet to form the Ohio River, a 981-mile long tributary to the Mississippi River. ALCOSAN's wastewater treatment plant is located three miles downstream from the City of Pittsburgh's Point State Park in the headwaters of the Ohio River.

Table 5-1 shows the sizes of the major contributing watersheds and the percent within the ALCOSAN service area. The two rivers that converge at Point State Park drain nearly 19,000 square miles from West Virginia to New York.

Table 5-1: Allegheny, Monongahela, and Ohio River Watershed Descriptions[5-1]

Watersheds	States in Watershed	Total Area (Square Miles)	Area* Within ALCOSAN Service Area (Square Miles)	Percentage (%) in ALCOSAN Service Area
Allegheny River	New York Pennsylvania	11,580	67	0.6
Monongahela River	Maryland Pennsylvania West Virginia	7,340	96	1.4
Ohio River	Illinois Indiana Kentucky Ohio Pennsylvania West Virginia	189,422	146	<0.1

**Area does not include main rivers surface area.*

Physiography: Allegheny County lies in a physiographic province called the Appalachian Plateau Province, more specifically in the Pittsburgh Low Plateau Section, where the uppermost elevation is defined by an expansive upland plateau that has been eroded over geologic time by streams and rivers resulting in many narrow, steep to moderately steep-sided valleys, most of which are densely forested with hardwoods. The drainage pattern is highly branching.

Topography: The topography of the area is valley driven, highly dendritic with clay soils lacking permeability. Figure 5-1 shows USGS topography within the ALCOSAN service area.

[5-1] USGS Pennsylvania Water Science Center, Compressed Digital Spatial Data Available for Downloading at http://pa.water.usgs.gov/pa_digit.v2.html

Examples of elevation changes in the ALCOSAN service area are:

- Chartiers planning basin: One highpoint elevation is 1,358 feet in North Fayette Township, lowpoint: 710. Elevation change, 648 feet.

- Lower Ohio / Girty's Run planning basin: One highpoint elevation is 1,300 feet above Bear Run, lowpoint: 692. Elevation change, 608 feet.

- Upper Monongahela planning basin: One highpoint elevation is 1,210 feet above Herrmann Creek, lowpoint: 710. Elevation change, 500 feet.

The elevations where tributaries discharge into the three rivers is controlled by US ACOE locks and dams and are discussed below in Section 5.1.2 Receiving Stream Hydrology and Flow Characteristics.

Geology and Soils: The land surface of the Pittsburgh region is underlain by sedimentary rocks (sandstone, shale, coal, and limestone) of Pennsylvanian, Mississippian, and Devonian age. They have been fractured, faulted and folded in many areas. Soils in areas of steep slopes are commonly shallow, weakly developed, poorly drained, with low fertility and high erosion potential. Gentler slopes with soils over unconsolidated sediments are commonly deep, well-drained, and fertile. Much of Allegheny County however, has a thin soil cover with areas of low-permeability, with predominantly clay, clay/shale soils underlain by bedrock.

Climate: The climate of the Pittsburgh region is temperate; it lies in the humid continental belt; and lies in Plant Hardiness Zone 6 according to Arbor Days Foundation (previously 1986 USDA Zone 5). Much weather arrives from west / northwest with Lake Erie influencing snow and rain. The region's climate has four defined seasons, featuring cold winters with snow and warm, humid summers with frequent clouds and precipitation. Total average annual precipitation (based on historic record from Pittsburgh International Airport from 1949-2007) is 36.8 inches. Average annual runoff (estimated from 1951- 1980) ranges from 18 to 26 inches. Average annual recharge ranges from 8 to 15 inches. The remaining precipitation is estimated as evapo-transpiration in the region's hardwood forests[5-2].

Land Use: ALCOSAN services many older established communities, including the City of Pittsburgh which is 250 years old and surrounding municipalities such as Carnegie, Millvale, and Homestead that have hosted active industries and residential populations for over 120 years. These areas still have relatively large impervious footprints comprised of developed riverfronts, transportation infrastructure, industrial buildings, parking lots, commercial and residential areas. There are less woodlands in the older parts of Pittsburgh: within ALCOSAN's service area one-third of each acre is wooded; outside ALCOSAN's service area in Allegheny County, half of every acre is wooded. [5-3]
Land use is predominantly urban and suburban development. Older, established communities in close proximity to early sources of transportation and industry—on broad floodplains and moderately steep slopes are common. Forested areas cover some ridge tops, steep to

[5-2] USGS National Water Quality Assessment Program – The Allegheny – Monongahela River Basin

[5-3] Allegheny County GIS, Woodland Layer

moderately steep hillsides, and stream valleys. Table 5-2 shows land use types in the ALCOSAN service area.

Table 5-2: Percent Land Cover Types in the ALCOSAN Service Area[5-4]

Land Use	Total Area (Acres)	Percentage (%) of Total Area
Agriculture	5,800	3
Barren Land	4,400	2
Forest	60,300	30
Rangeland	4,200	2
Urban Built-Up	123,000	61
Water	4,200	2
Total	**201,900**	**100**

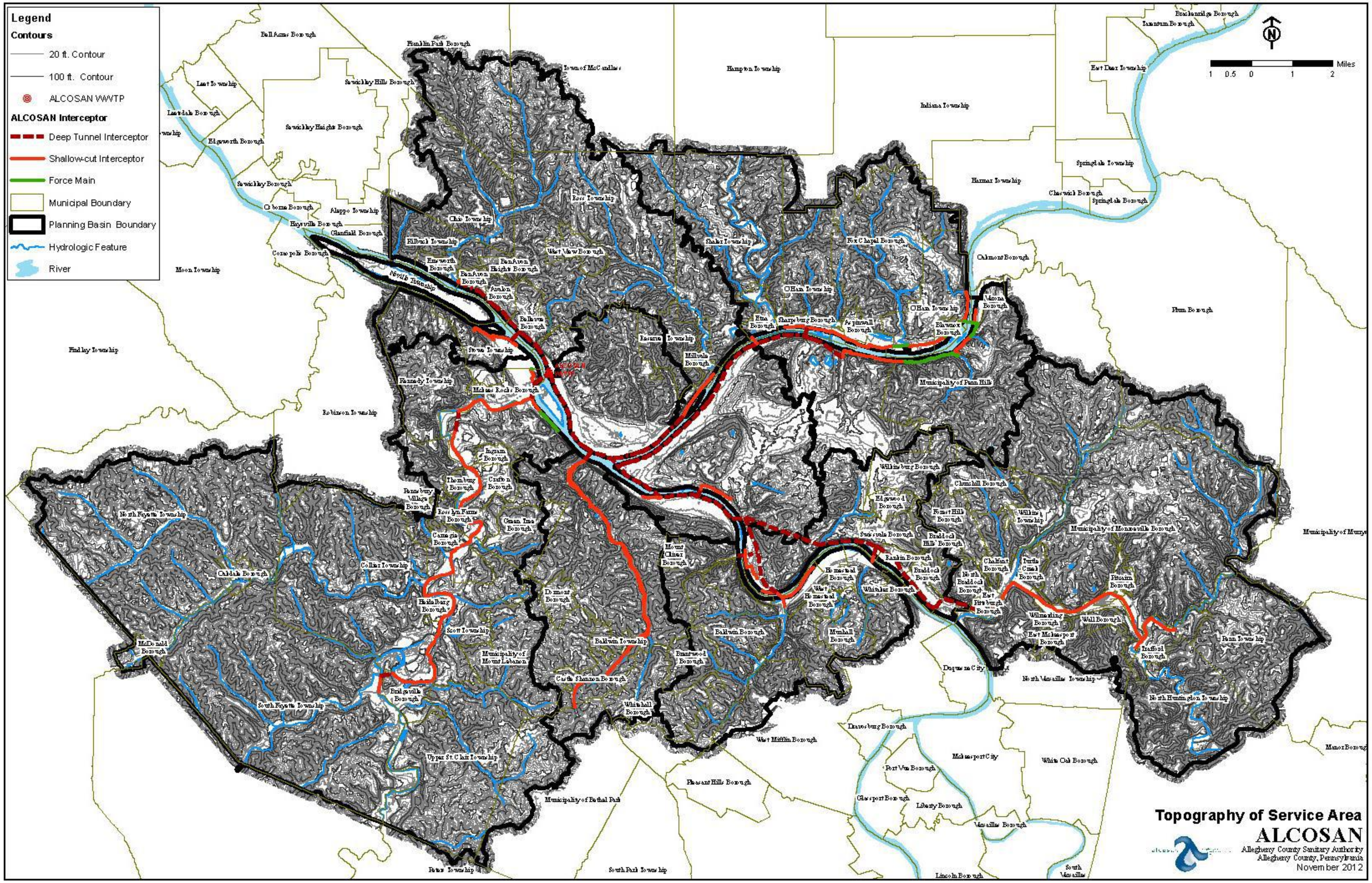
The ALCOSAN service area comprises 309 square miles and provides regional wastewater conveyance and treatment for the City of Pittsburgh and all or a portion of 82 municipalities. Roughly 17 percent of the area is served by combined sewer systems (where wastewater and storm water runoff are conveyed through a single sewer pipe system), 52 percent of the ALCOSAN service area is served by separate sanitary sewer systems (where wastewater and storm water are conveyed through two distinct and parallel piping systems), and 31 percent is non-contributing areas that are either undeveloped or served by individual on-lot systems. A map showing the sewered areas by type (Figure 3-1) and a complete description of the ALCOSAN collection system can be found in ***Section 3, Existing Systems and Conditions.***

5.1.2 Receiving Stream Hydrology

The Allegheny River originates in northern Pennsylvania, flows north into New York, then to the south to flow again through Pennsylvania to Pittsburgh. Major tributaries to the Allegheny River include the Conewango Creek, French Creek, Clarion River, Redbank Creek, Kiskiminetas River and its tributary the Conemaugh River. The Monongahela River originates in West Virginia at the confluence of the West Fork River and Tygart Valley River and flows northward to Pittsburgh. Major tributaries of the Monongahela River generally flow northward and include the Cheat River, Youghiogheny River, Tygart Valley River and West Fork River (McAuley, 1995).

[5-4] Southwestern Pennsylvania Commission – 2006 Land Cover Data

Figure 5-1 Topography of Service Area



This page was intentionally left blank for double sided printing

At the Pittsburgh point, the Allegheny River and Monongahela River converge to create the Ohio River, which flows northwest into the state of Ohio. Major tributaries to the three main rivers in the ALCOSAN service area include Chartiers Creek, Saw Mill Run and Turtle Creek.

Chartiers Creek has a drainage area of 257 square miles. The creek flows north approximately 35 miles from its headwaters near Lagonda, Pennsylvania into the Ohio River (river mile 2.5) (Chen et al., 2001). Major tributaries to Chartiers Creek include Chartiers Run, Millers Run, Robinson Run, Little Chartiers Creek, Brush Run, McLaughlin/ Graesers Run, Painters Run, and Scrubgrass Run (Chen et al., 2001).

Saw Mill Run drains 18 square miles, a much smaller watershed than either Chartiers Creek or Turtle Creek. The stream flows north approximately 9 miles from its headwaters in Bethel Park, Pennsylvania and flows into the Ohio River just downstream of the Allegheny and Monongahela River confluence (river mile 0.7).

Turtle Creek, which drains 147 square miles, has a watershed approximately half the size of Chartiers Creek. The creek flows south and west from its headwaters in Delmont, Westmoreland County, Pennsylvania to its mouth on the Monongahela River (river mile 11.5) in North Versailles, Allegheny County, Pennsylvania. Major tributaries to Turtle Creek include Haymakers Run, Thompson Run, Steels Run, Abers Creek and Brush Creek.

Locks and Dams: The Monongahela, Allegheny, and Ohio Rivers have been modified by a series of locks and dams for navigation purposes, not flood control. The waterbodies between each lock and dam are called pools because of their uniform elevation although these elevations tend to change with the season and river conditions. Most of ALCOSAN's service area lies in the Pittsburgh (Emsworth) Pool with a typical elevation of 710 feet. Upstream on the Allegheny is the Lock and Dam (L/D) 2 pool which is currently operated between 721.5 and 724 feet. On the Monongahela River, the Braddock pool varies from 720.5 to 722 feet. Downstream, the Ohio is at 692 feet elevation below the Emsworth Dam, nearly three miles downstream of ALCOSAN. Planning basins with main tributaries that discharge above or below the Pittsburgh Pool (710 feet) are listed below:

- Turtle Creek / Thompson Run—Turtle Creek discharges 1,600 feet above the Braddock dam into the upper pool.
- Upper Allegheny—Squaw Run discharges 10,000 feet above L/D 2 into the upper pool.
- Lower Ohio / Girty's Run—Lowries and Toms Run all discharge below the Emsworth Dam at 692 feet elevation.

5.1.3 Habitat and Geomorphological Characteristics

Innumerable small headwater streams (typically unnamed) drain into tributaries that contribute flow to larger main tributaries in each planning basin. As streams and rivers increase in volume and width, their characteristics change too.

Headwater streams, when left undeveloped, receive water from groundwater and runoff from the forested plateau or slopes. They have full tree canopy coverage that shade streambeds and keep waters cool. Channels are small, narrow, and sometimes rocky with occasional woody debris. They're found in the steepest part of the valleys, and have the steepest gradients and fastest running waters. Unnamed tributaries to Toms Run in the Lower Ohio / Girty's Run planning basin are examples of these uppermost water channels.

As streams descend, they cut a wider floodplain, elevation changes lessen, waters slow and streams widen. The tree canopy widens too, allowing in more sunlight. Surface waters and streambeds become warmer, allowing algae to grow. These "partial canopy" streams are characterized by some shade, transitional temperatures, gravelly streambed with riffles and pools. Examples of partial canopy streams are Robinson Run and Chartiers Creek in the Chartiers Creek planning basin.

The Allegheny, Monongahela, and Ohio Rivers have daily exposure to full sun, warm surface waters, low gradients, algal growth in warm seasons, gravel and silt riverbeds, and a few sluggish backchannels. With the exception of occasional flooding, river elevations are fairly constant due to the locks and dams. Warm water fish occupy these "full sun" rivers that range from 150 feet in the backchannels to a quarter mile or more in width. Full shade and partial canopy streams dominate the region's other surface waters.

During the summer of 2009, ALCOSAN conducted a habitat survey to assess the aquatic habitat quality and condition of ALCOSAN's six receiving waters within its service area. Results of the study showed that riparian habitat was found to be degraded not only due to development, but also competition for space with invasive species such as Japanese knotweed. Japanese knotweed was found to be a major problem throughout the ALCOSAN service area. This invasive species creates dense thickets and excludes many native plants. Japanese knotweed creates a less stable bank and provides less shade than woody riparian species. Despite disturbances to riparian habitat throughout much of the service area, the habitat field survey documented a diversity of native riparian species. In addition, the habitat field survey found riparian vegetation to be more extensive along the streams (Chartiers Creek, Turtle Creek and Saw Mill Run) than the main rivers, as well as more extensive along Chartiers Creek and Turtle Creek, as compared to Saw Mill Run.

The least disturbed land cover areas occurred in the upstream portion of Turtle Creek within the service area, as well as the upstream portion of Chartiers Creek within the service area. These stream sections also had strong fish habitat scores, confirming land cover can be an indicator for habitat quality. A stronger relationship was observed when fish habitat scores are overlain with stream channel type. As may be expected, channelized sections had consistently lower fish habitat scores, than non-channelized stream sections.

Development activities have extensively modified habitat within the receiving waters. Overhanging vegetation, for example, is often reduced or absent in areas with residential, commercial or industrial activity as well as vegetated areas dominated by Japanese knotweed. Bank stabilization, channelization and flood control measures were found to have the most profound impact on all six waterways. Measures such as locks and dams, elevated banks and artificial bank materials (wall-piling, cement, etc.) have severely reduced or eliminated floodplain habitat, overhanging vegetation, aquatic macrophytes, root wads, live tree roots near the water's edge, and undercut banks. These measures have also reduced, and in some sections eliminated, in-stream habitat diversity such as riffles or deep pools that provide critical habitat for fish species.

Table 5-3 shows data about streams in the ALCOSAN service area that receive overflows from ALCOSAN's interceptor system. Stream highpoints and lengths are calculated from the uppermost convergence of two headwater tributaries.

Table 5-3: Characteristics of Streams Receiving Overflows from ALCOSAN Interceptor Systems

Stream Name	Stream Highpoint (in Service Area)	Length in Service Area (feet)	Average Annual Flow (USGS)		Total Drainage Area[5-5] (square miles)	Canopy Cover
			(cfs)	Gage Location		
Chartiers Creek	850	117,600	292.0	Carnegie	257	Partial
Saw Mill Run	1070	43,100	19.3	Duquesne Hts.	18	Partial
Turtle Creek	805	61,700	180.4	Wilmerding	147	Full Shade Partial Sun
Allegheny River	750	58,700	20,640	Natrona	11,580	Full Sun
Monongahela River	735	52,300	8,766	Elizabeth	7,340	Full Sun
Ohio River	720	41,700	34,256	Sewickley	189,400	Full Sun

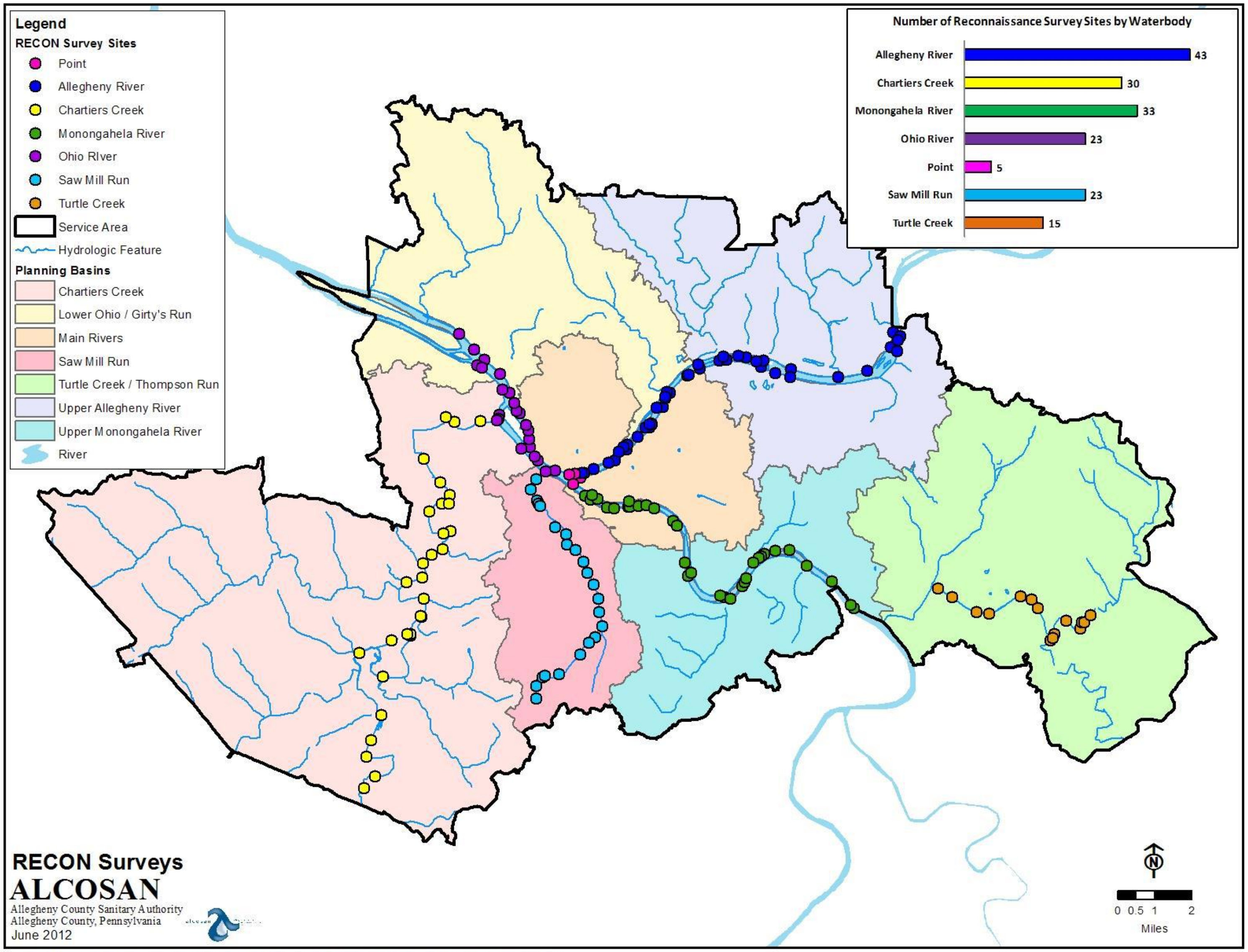
5.1.4 Current Uses

Recreation: A recreational use study was conducted by ALCOSAN in the summer of 2009. The study included field observations, field interviews, and a community mail-in survey. The recreational use survey results presented herein summarizes data collected from field observations. The field survey was divided into two phases; a field reconnaissance and a follow-up or detailed investigation.

The goals of the reconnaissance phase were to assess the likelihood of significant recreational use, identify potential high use areas, and determine sites for follow-up investigation. Surveys were restricted to ALCOSAN receiving waters and conducted within both channelized and non-channelized portions of the waterways. A total of 172 locations were surveyed for the reconnaissance phase and are shown in Figure 5-2.

[5-5] USGS GIS Watershed Data

Figure 5-2: Recreational Use Study Reconnaissance Phase Survey Locations



Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\Section5\FINAL\UpdatesperReviewComments\RECONSites

The goal of the detailed investigation phase was to characterize waterway use practices and was accomplished by conducting multiple recreational use surveys at locations identified in the reconnaissance phase as having likelihood for significant recreational activity. Using the data collected during the field reconnaissance phase, approximately 3-5 sites per waterway[5-6] were selected for further investigation. The selection criteria for sites retained for detailed investigation included:

- The site was identified during GIS analysis as having high recreation potential (a park, known recreation site, etc.);
- The site is easily accessible;
- The site contains recreation-related infrastructure (restrooms, parking lot…etc.); and/or
- The site demonstrated high recreation use or the potential for high-use during reconnaissance surveys.

During the reconnaissance and the investigation phase use categories (recreational activities) were established in terms of primary contact, secondary contact, and non-contact activities. Use categories are listed for each contact type in Table 5-4.

Table 5-4: Contact Type and Use Categories

Contact Type	Use Categories	
Primary (PC)	Swimming	Tubing
	Jet Skiing	Wading
	Rope Swinging	Water Skiing
Secondary (SC)	Canoeing	Power Boating
	Fishing	Sculling
	Kayaking	Rowing
Non-Contact (NC)*	Biking	Jogging
	Walking	Picnicking
	Hiking	
* Non-Contact activities occurring along waterway		

[5-6] Only one site was chosen for follow-up investigation on Saw Mill Run because little evidence of recreation was observed.

The points surveyed during the reconnaissance phase were prioritized as high (defined as any primary contact recreation activity observed plus one or more of the criteria listed above), medium (defined as secondary contract recreation activities observed plus one or more of the criteria listed above) or low (defined as any non-contact recreation activities observed). All recreational based sensitive areas listed in Appendix C of the Consent Decree were selected for detailed investigation. The prioritization results were mapped and reaches selected based on clusters of high and medium ranked sites. 20 reaches were selected for follow-up investigation, where a reach represents the observer's field of view which may include several sites.

Detailed investigation field work targeted a mix of weekdays, weekends and holidays to capture peak recreation use times. Visits were undertaken during dry weather periods and wet weather impacted periods to assess use practices when overflows may be influencing water quality conditions. Water quality was assumed to be wet weather impacted on calendar days with 0.1 inches of rainfall or more, and for the following two calendar days. Table 5-5 summarizes the number of visits and type (dry or post wet weather) for each site/reach. Post wet weather periods were designated using the number of calendar days since rainfall occurred: 0-24 hours (PW1), 24-48 hours (PW2), and 48-72 hours (PW3).

Table 5-5: Follow-Up Site Investigation Summary Including Reconnaissance Data Point(s)

Receiving Waters And Site/Reach Follow-Up Descriptions		No of Visits					
		Total	Dry Weather Total	Wet Weather Total	Post Wet Weather		
					PW1	PW2	PW3
Allegheny River							
ALL_1	PNC Kayak Pittsburgh	10	6*	4	3	0	1
ALL_2	31st Street Bridge	8	5	3	2	0	1
ALL_3	Millvale Bait & Tackle Shops	11	7*	4	3	0	1
ALL_4	Highland Dam – Lock & Dam No. 2	12	8**	4	3	0	1
ALL_5	Steel City Rowing Club	11	6*	5	3	0	2
Monongahela River							
MON_1	Southside Park Public Boat Launch	10	7*	3	2	0	1
MON_2	Sandcastle Park	10	7*	3	1	0	2
MON_3	Costco Gas Station at the Waterfront	8	5	3	2*	0	1
MON_4	Nine Mile Run Park	10	6	4	3*	0	1

Table 5-5: Follow-Up Site Investigation Summary Including Reconnaissance Data Point(s)

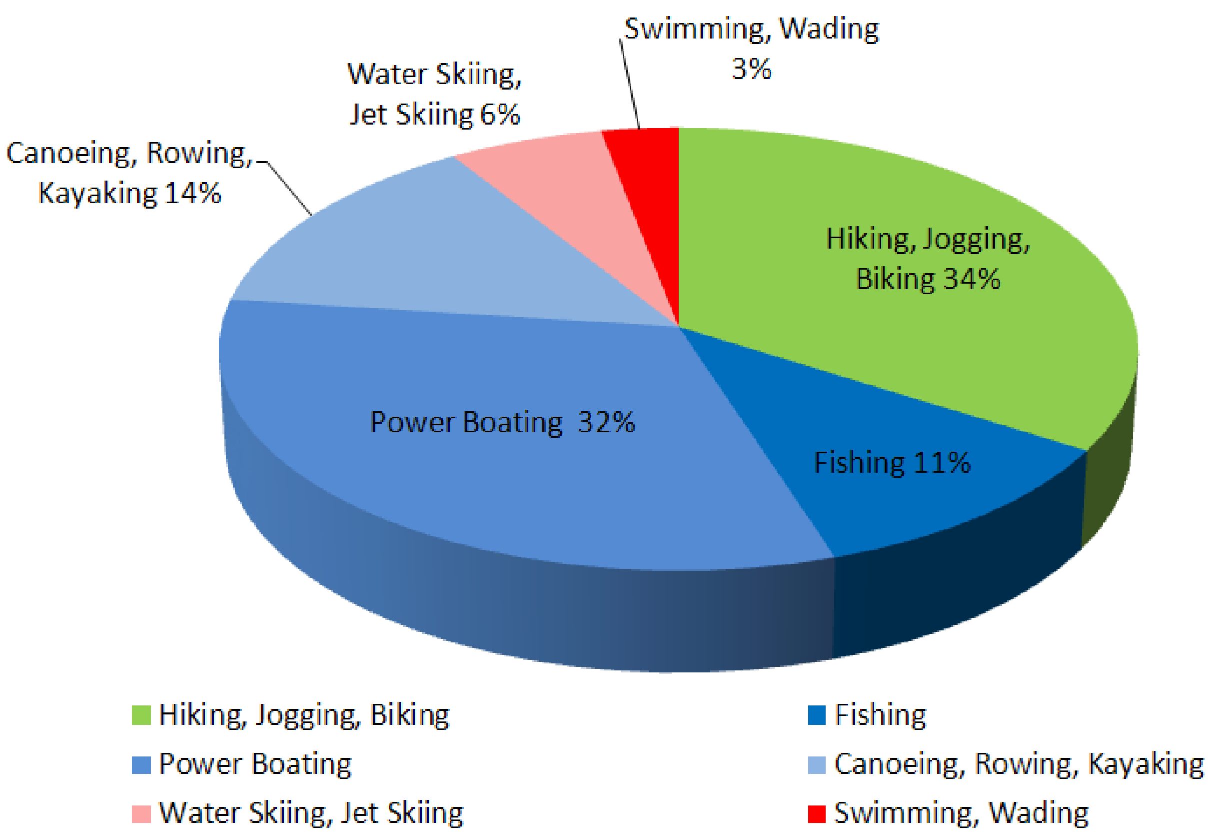
Receiving Waters And Site/Reach Follow-Up Descriptions		No of Visits					
		Total	Dry Weather Total	Wet Weather Total	Post Wet Weather		
					PW1	PW2	PW3
Ohio River							
OH_1	Beginning of Riverfront	10	4	6	2*	2	2
OH_2	Bob O'Conner Memorial Dock	10	4	6	2*	2	2
All Rivers							
Point	Point State Park	10	7**	3	2	0	1
Chartiers Creek							
CC_1***	Mouth of Chartiers	12	5*	7	3*	2	2
CC_2	Thornburg Bridge	11	8*	3	0	1	2
CC_3	DeSota Street	11	8*	3	0	1	2
CC_4	Campbell's Run	11	8*	3	0	1	2
CC_5	Wingfield Pines AMD Treatment Site	11	7*	4	2	0	2
Turtle Creek							
TT_1	Dirt Bike Trails Intersection SR 48 & SR 130	12	7	5	4	0	1*
TT_2	Waterfall and Trafford Soccer Fields	13	8	5	4	0	1*
Saw Mill Run							
SMR_1	Seldom Seen	11	5	6	2	2*	2

* Includes one (1) reconnaissance survey point.
** Includes two (2) reconnaissance survey points.
*** Any calculations performed for the Ohio River includes all data documented for CC_1. Chartiers calculations do not include data documented from CC_1. Thus, total number of site visits for the Ohio River equals 32.

For the ALCOSAN receiving waters studied, secondary contact and non-contact recreation activities were much more prevalent than primary contact activities (Figure 5-3). Primary contact activities were evident, however, and were split into two categories: 1) swimming and wading; and 2) water skiing and jet skiing. Secondary contact activities were divided into three categories: 1) power boating; 2) fishing; and 3) canoeing, rowing, and kayaking. Non-contact activities were summed up in one category as hiking, jogging, and biking.

The most common use category was power boating (32% of all observed recreationists). Combining all secondary contact use categories shows that nearly 60% of all recreationists were either in a boat or fishing. Less than 10% of all recreationists observed were participating in primary contact activities.

Figure 5-3: ALCOSAN Recreational Use Categories Summary



The main rivers, including Point State Park, were more popular destinations for recreation than the tributary streams (Figure 5-4). There were more than 1500 recreationists observed on the main rivers and less than 50 counted on the tributaries. The Allegheny and the Monongahela Rivers, down to and including the Point, represented the highest use areas with over 90% of all recreation observed in these areas.

Table 5-6 shows the percentage of field visits where recreation was observed for primary, secondary and non-contact recreation activities on each waterway. No primary contact activities were observed on any of the field visits to Turtle Creek and Saw Mill Run.

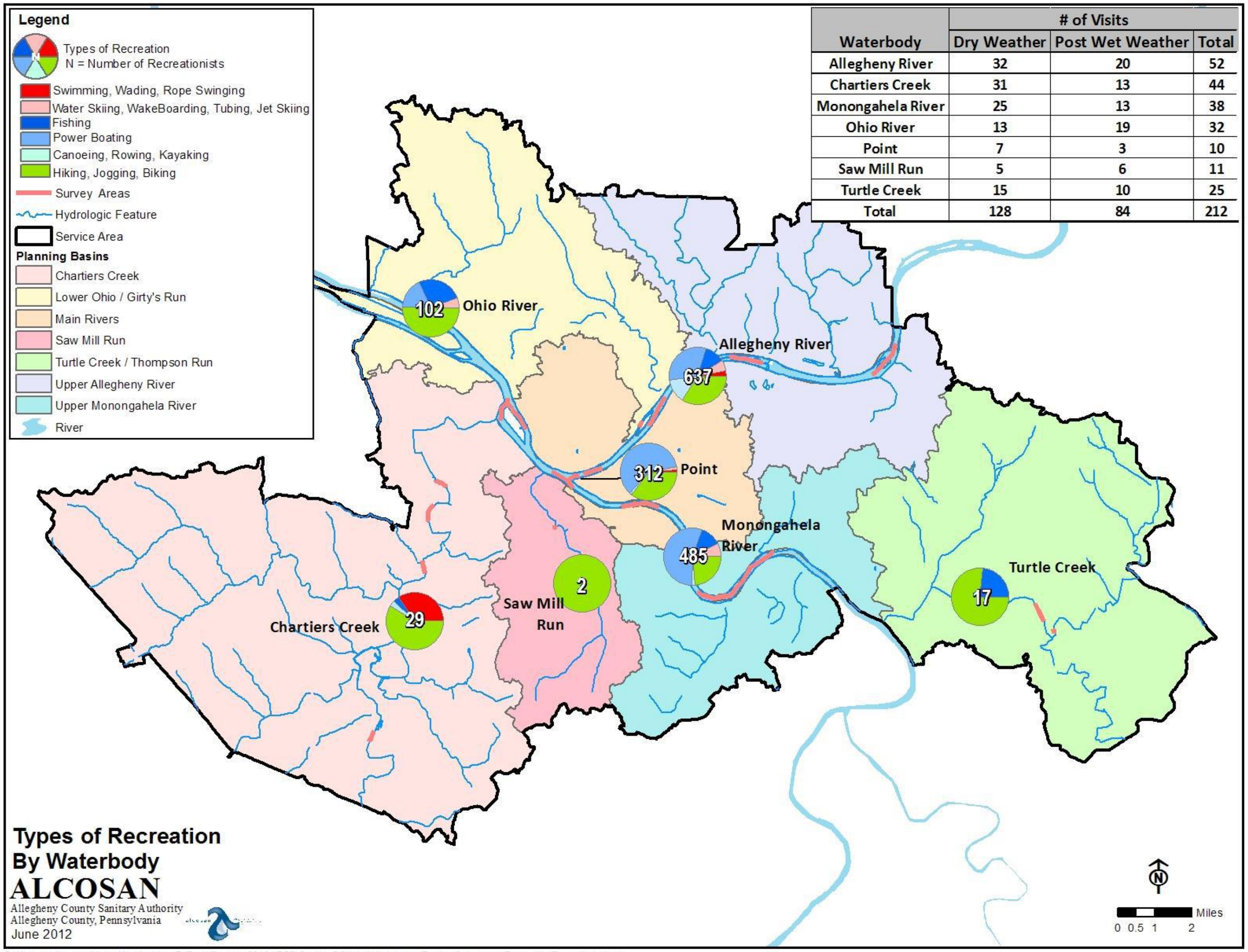
Table 5-6: Percentage of Field Visits Where Recreational Activities Were Observed by Waterway

Waterway	Total Visits	Primary	Secondary	Non-Contact	Any Recreation
Allegheny River	52	33%	79%	33%	89%
Monongahela River	38	40%	79%	34%	82%
Ohio River	32	13%	28%	53%	72%
Point State Park*	10	30%	80%	80%	100%
Chartiers Creek	44	14%	5%	20%	34%
Turtle Creek	25	0%	12%	20%	32%
Saw Mill Run	11	0%	0%	9%	9%

* Point State Park is not a waterway but a point where the Allegheny and Monongahela Rivers meet.

The table shows that primary and secondary activities are taking place significantly more on the Allegheny and Monongahela Rivers (Point State Park includes points on both rivers). This is also evident by the number of recreationists participating in primary and secondary contact activities by survey area as shown in Figures 5-4 and 5-5.

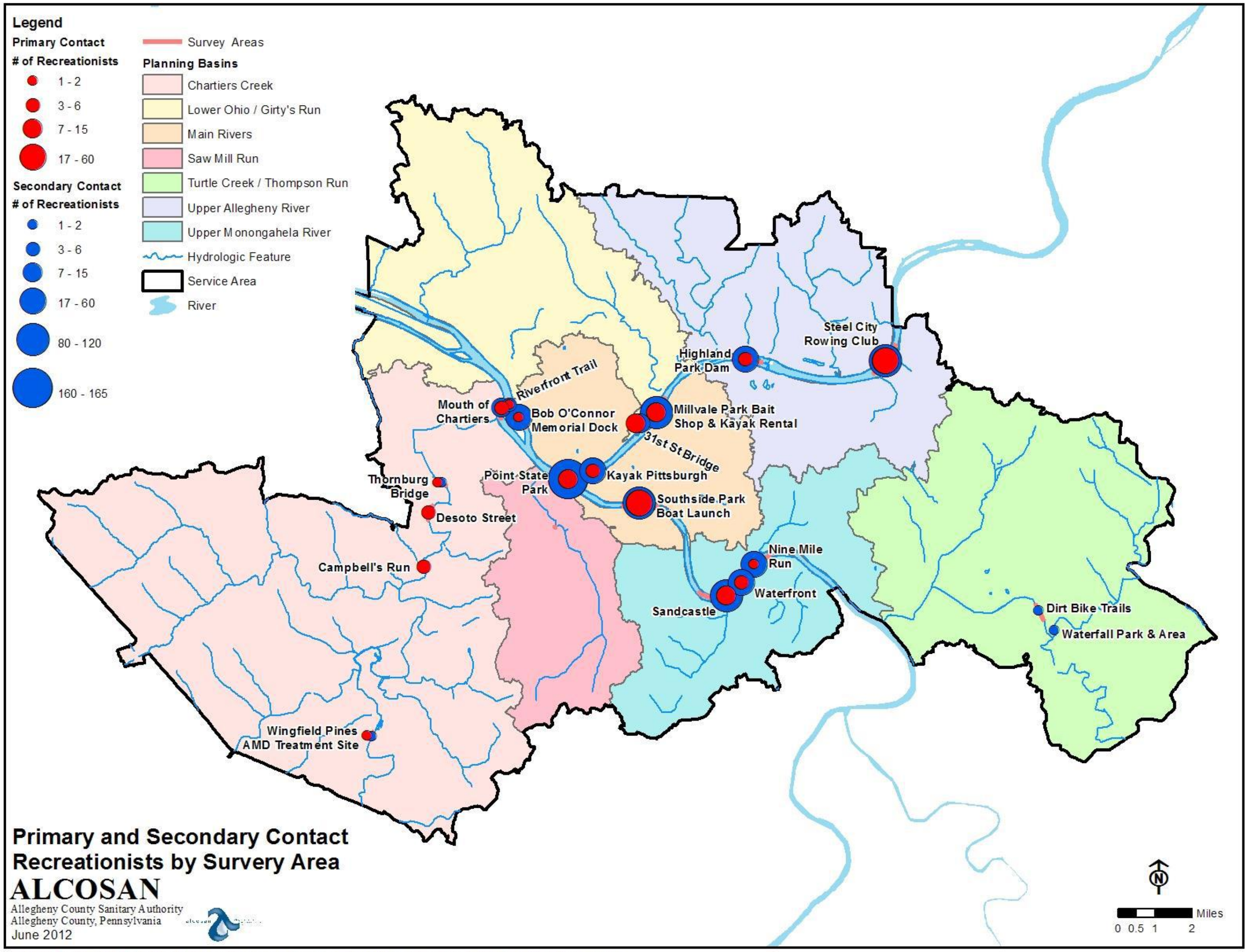
Figure 5-4: Types of Recreation by Waterbody



Waterbody	# of Visits		
	Dry Weather	Post Wet Weather	Total
Allegheny River	32	20	52
Chartiers Creek	31	13	44
Monongahela River	25	13	38
Ohio River	13	19	32
Point	7	3	10
Saw Mill Run	5	6	11
Turtle Creek	15	10	25
Total	128	84	212

Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\Section5\FINAL\UpdatesperReviewComments\RecreationTypesWaterbody

Figure 5-5: Primary and Secondary Contact Recreationists by Survey Area



Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\Section5\FINAL\UpdatesperReviewComments\ContactTypebySurveyArea

Aquatic Life: As set forth in §93.4 of Title 25 of the Pennsylvania Code, "except when otherwise specified in law or regulation" all surface waters within the state have a designated use for aquatic life of warm water fishery. Additionally, a number of surface water bodies in and around the ALCOSAN service area have additional designated uses as shown in Table 5-7.

Table 5-7: Designated Uses for Aquatic Life in and Around the ALCOSAN Service Area.

Symbol	Designated Use for Aquatic Life	Stream Names
CWF	Cold Water Fishery	Deer Creek, Unnamed
TSF	Trout Stocking Fishery	Thoms Run, Nine Mile Run, Pine Creek, Lowries Run, Little Deer Creek, Peters Creek, Long Run, Turtle Creek, Brush Creek, Montour Run, Big Sewickley Creek
HQ-WWF	High Quality - Warm Water Fishery	Squaw Run, Guyasuta Run
HQ-CWF	High Quality - Cold Water Fishery	Haymakers Run
HQ-TSF	High Quality - Trout Stocking Fishery	Little Sewickley Creek, Long Run, Jacks Run

Incidental observations of fish and conversations with recreational fishermen during the recreational use survey provided limited information regarding fish species composition and abundance. Along the Ohio, Allegheny and Monongahela Rivers survey teams reported that fishing is common, particularly from ALCOSAN outfall structures. Fishing was also observed and reported to occur from a variety of parks, docks and boat launches along the river banks, as well as from boats. During the field surveys, bass fishing boats were frequently observed, particularly leading up to the 2009 Forrest Wood Cup Pittsburgh Steelers Quay bass fishing championship. Fish species reported to be commonly caught include blue gill, carp, catfish, bass, and sauger.

Recreational fishing is less popular along Chartiers Creek and Saw Mill Run, but still occurs. Interviews with recreationists observed during the Turtle Creek surveys, meanwhile, identified five of the sites as popular fishing sites. Fish reported to be commonly caught include catfish, bass, trout, chubs, and carp. Fish, including minnow and creek chub were observed in the water at five sites along Saw Mill Run, while carp were observed at one site on Chartiers Creek and one site on Turtle Creek.

Water Supply: Drinking water intakes for five major water suppliers serving over 500,000 customers occur within the ALCOSAN service area. These suppliers are summarized in Table 5-8 and locations are shown in Figure 5-6.

Table 5-8 Water Suppliers with Surface Water Intakes within the ALCOSAN Service Area

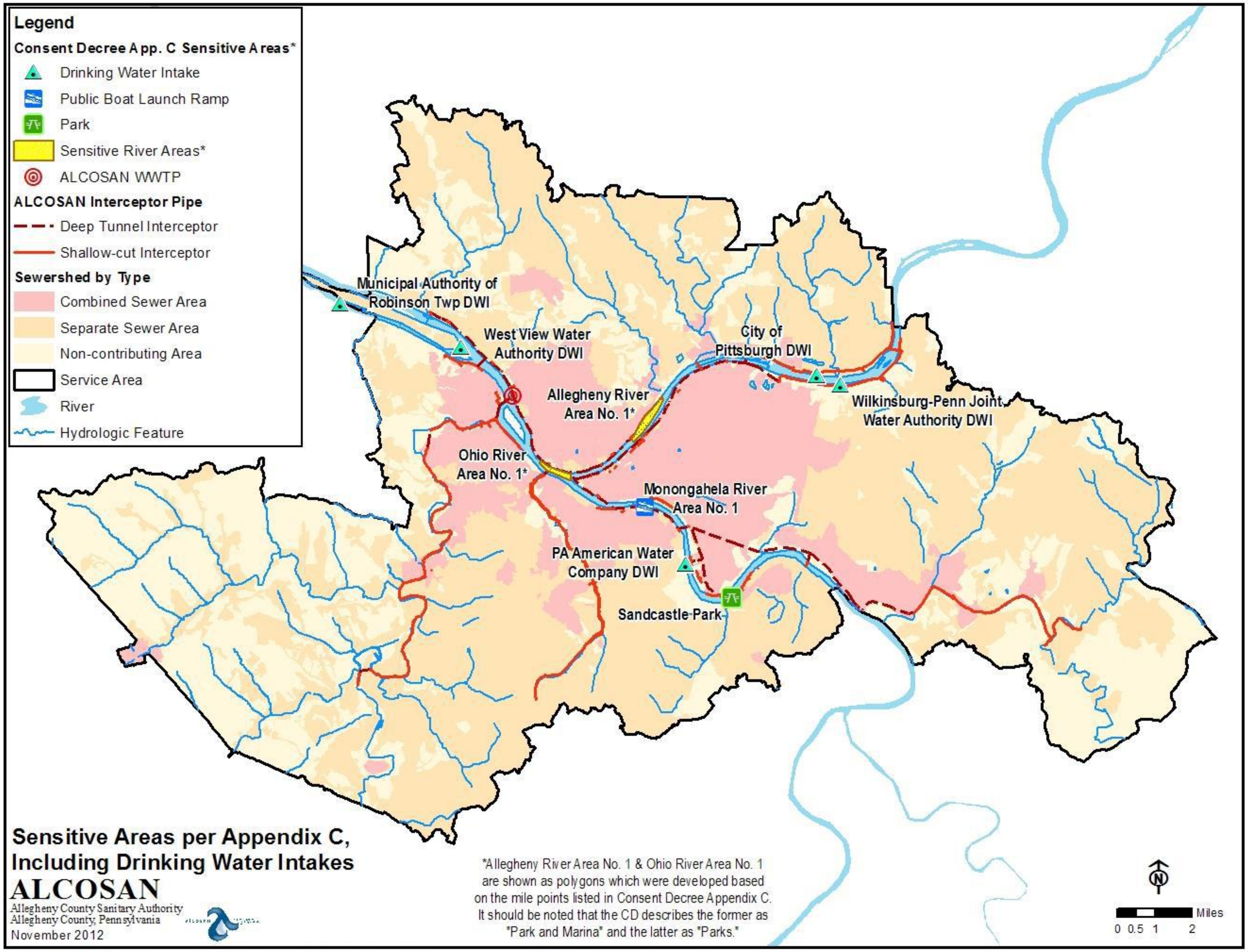
Water Supplier	Customers Served*	Primary Source	Municipalities Served (Direct Sales)
Pennsylvania American Water	200,000	Monongahela River	Boroughs of: Baldwin, Bethel Park, Brentwood, Bridgeville, Carnegie, Castle Shannon, Crafton, Dormont, Dravosburg, Elizabeth, Glassport, Greentree, Heidelberg, Ingram, Jefferson, Liberty, Lincoln, McDonald, Mt Oliver, Munhall, Pleasant Hills, Rosslyn Farms, Thornburg, West Elizabeth, West Homestead, West Mifflin, Whitaker, Whitehall; Townships of: Baldwin, Collier, Elizabeth, Forward, Scott, South Fayette, Upper St. Clair Municipality of Mt. Lebanon; Cities of: Clairton, Pittsburgh; and 27 Washington County municipalities.
Pittsburgh Water and Sewer Authority	85,000	Allegheny River	City of Pittsburgh
Robinson Township Municipal Authority	4,700	Ohio River	Robinson Township
Borough of West View Municipal Authority	200,000	Ohio River	Avalon Borough, Bellevue Borough, Ben Avon, Ben Avon Heights, Bradford Woods, Emsworth Borough, Franklin Park, Kennedy Township, Kilbuck Township, Marshall Township, McCandless Township, McKees Rocks Borough, Ohio Township, Pine Township, Ross Township, Sewickley Hills Borough, Stowe Township, West View Borough, 28th Ward of the City of Pittsburgh. Sections of the following communities: Adams Township, Cranberry Township, Economy Borough, Reserve Township, Robinson Township, Sewickley Heights Borough, Sewickley Hills Borough, Shaler Township.
Wilkinsburg-Penn Joint Water Authority	40,000	Allegheny River	Braddock Hills, Chalfant, Churchill, East McKeesport, East Pittsburgh, Edgewood, Forest Hills, North Braddock, Pitcairn, Rankin, Swissvale, Trafford, Turtle Creek, Wilkinsburg, Wilkins Township, Wilmerding Sections of: Braddock (4th Ward), Monroeville, Municipality of Penn Hills, North Huntingdon, North Versailles, Pittsburgh (13th Ward)

*Approximate values

Navigation: Commercial navigation is extremely important to the region providing a cost-effective means to move large quantities of raw materials, especially coal, and bulk goods. As noted in §93.9 of Title 25 of the Pennsylvania Code, the Ohio, Allegheny and Monongahela rivers have been assigned a protected use of navigation. As such, the waters are "protected for the commercial transfer and transport of persons, animals and goods".

The ALCOSAN service area lies within the Port of Pittsburgh, the 2nd busiest inland port and the 17th busiest port of any kind in the nation. The service area is bounded by the Emsworth L/D on the Ohio River, L/D 2 on the Allegheny River and L/D 2 on the Monongahela River. While not all boats, especially recreational, make use of the locks, a sense of boat activity on the rivers can be gained by examining the number of lock transits for those locks within or near the ALCOSAN service area as shown in Table 5-9.

Figure 5-6: Sensitive Areas, Including Drinking Water Intake Locations



Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 5

Table 5-9: Average Yearly Vessel Traffic 2005 to 2010*

River	Lock	Commercial		Recreational	
		Upbound	Downbound	Upbound	Downbound
Allegheny	Lock 2	489	484	2,618	2,665
Monongahela	Lock 2	1,540	1,516	815	811
Ohio	Emsworth	1,839	1,813	1,220	1,283

*Source: ACOE, Navigation Information Connection for The Upper Mississippi River System (http://www2.mvr.usace.army.mil/omni/webrpts/omni_gr/omni_criteria.cfm)

5.1.5 Sensitive Areas

Sensitive areas are identified in Appendix C of the consent decree and are summarized in Table 5 -10 with locations shown previously in Figure 5-6.

Table 5-10: Sensitive Areas per Consent Decree (Appendix C)

Area name	Mile Point	Descending Bank	Description
Allegheny River			
Wilkinsburg-Penn Joint Water Authority	9.0	Left	Drinking Water Intake (DWI)
City of Pittsburgh	8.0	Right	DWI
Allegheny River Area No. 1	3.4 to 2.0	Right	Park and Marina
Monongahela River			
PA American Water Company	4.5	Left	DWI
Monongahela River Area No. 1	2.3	Left	Boat Ramp
Monongahela River Area No. 2	6.2	Left	Park
Ohio River			
West View Water Authority	5.0	Upstream End of Neville Island	DWI
Municipal Authority of Robinson Township	8.6	Left; back channel of Emsworth Dam	DWI
Ohio River Area No. 1	0.0 to 1.0	Right	Parks
*Descending bank is referenced as moving downstream			

This page was intentionally left blank to facilitate double-sided printing.

5.2 Applicable Water Quality Standards

5.2.1 Protected Uses

According to § 93.3 in Title 25 of the Pennsylvania Code, there are 14 types of protected water uses in Pennsylvania. Table 5-11 lists the official water uses, which are grouped into 4 categories: Aquatic Life, Water Supply, Recreation and Fish Consumption, and Other. By default, the designated uses for all surface water bodies in Pennsylvania are those marked as "Statewide Use" in Table 5-11 (§ 93.4). Exceptions to these statewide uses are listed in §§ 93.9a – 93.9z and are primarily for uses protecting aquatic life. In addition, water bodies can be classified as High Quality (HQ) or Exceptional Value (EV) where chemical and/or biological drivers indicate that these water bodies need to be preserved (§ 93.4b). There are some water bodies with HQ classification in the Allegheny County area, but none with EV classification.

Table 5-11: Protected Water Uses in Pennsylvania

Symbol	Name	Description	Statewide Use
Aquatic Life			
CWF	Cold Water Fishes	Maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna which are indigenous to a cold-water habitat.	
WWF	Warm Water Fishes	Maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.	✓
MF	Migratory Fishes	Passage, maintenance and propagation of anadromous and catadromous fishes and other fishes which ascend to flowing waters to complete their life cycle.	
TSF	Trout Stocking	Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.	
Water Supply			
PWS	Potable Water Supply	Used by the public as defined by the Federal Safe Drinking Water Act, 42 U.S.C.A. § 300F, or by other water users that require a permit from the Department under the Pennsylvania Safe Drinking Water Act (35 P. S. §§ 721.1—721.18), or the act of June 24, 1939 (P. L. 842, No. 365) (32 P. S. §§ 631—641), after conventional treatment, for drinking, culinary and other domestic purposes, such as inclusion into foods, either directly or indirectly.	✓
IWS	Industrial Water Supply	Use by industry for inclusion into nonfood products, processing and cooling.	✓
LWS	Livestock Water Supply	Use by livestock and poultry for drinking and cleansing.	✓

Table 5-11: Protected Water Uses in Pennsylvania

Symbol	Name	Description	Statewide Use
AWS	Wildlife Water Supply	Use for waterfowl habitat and for drinking and cleansing by wildlife.	✓
IRS	Irrigation	Used to supplement precipitation for crop production, maintenance of golf courses and athletic fields and other commercial horticultural activities	✓
Recreation and Fish Consumption			
B	Boating	Use of the water for power boating, sail boating, canoeing and rowing for recreational purposes when surface water flow or impoundment conditions allow.	✓
F	Fishing	Use of the water for the legal taking of fish. For recreation or consumption.	✓
WC	Water Contact Sports	Use of the water for swimming and related activities.	✓
E	Esthetics	Use of the water as an esthetic setting to recreational pursuits.	✓
Other			
N	Navigation	Use of the water for the commercial transfer and transport of persons, animals and goods.	

Designated and Existing Uses: Pennsylvania has two types of protected water uses: Designated Uses and Existing Uses. Designated uses are defined for each water body whether or not they have been attained. The uses marked as statewide uses in Table 5-11, with the exceptions listed by water body in § 93.9a—93.9z, are the designated uses that apply throughout the state.

Existing uses are defined as "Those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards" (§ 93.1). Existing uses are based on technical information and data that have been reviewed by PaDEP, while designated uses represent the regulatory goal of the Environmental Quality Board (EQB) regardless of whether the water body is attaining or has ever attained that use. Only water bodies with an existing use that is more restrictive than the designated use are included on the Existing Use List[5-7] maintained by PaDEP. There are currently no water bodies in the Allegheny County area on the Existing Use List. Therefore, the designated uses listed in §§ 93.4 and 93.9a – 93.9z define the most restrictive uses for each water body.

[5-7] http://www.depweb.state.pa.us/watersupply/lib/watersupply/existing_use_/eu_table_list.pdf [Accessed March 28, 2018]

The statewide designated uses marked in Table 5-11 apply to most surface water bodies in Allegheny County and the surrounding area, with the exceptions listed in Table 5-11 according to Drainage Lists (§93.9u, §93.9v, and §93.9w). These exceptions apply to the aquatic life category only. Rivers not listed in Table 5-12 are assigned the statewide designated use for aquatic life, which is warm water fishery. The designated use for aquatic life for each surface water body in and around the ALCOSAN service area is shown in Figure 5-7. In addition, navigation is a designated use for the Allegheny, Monongahela, and Ohio Rivers.

Table 5-12: Designated Uses for Aquatic Life in and Around the ALCOSAN Service Area

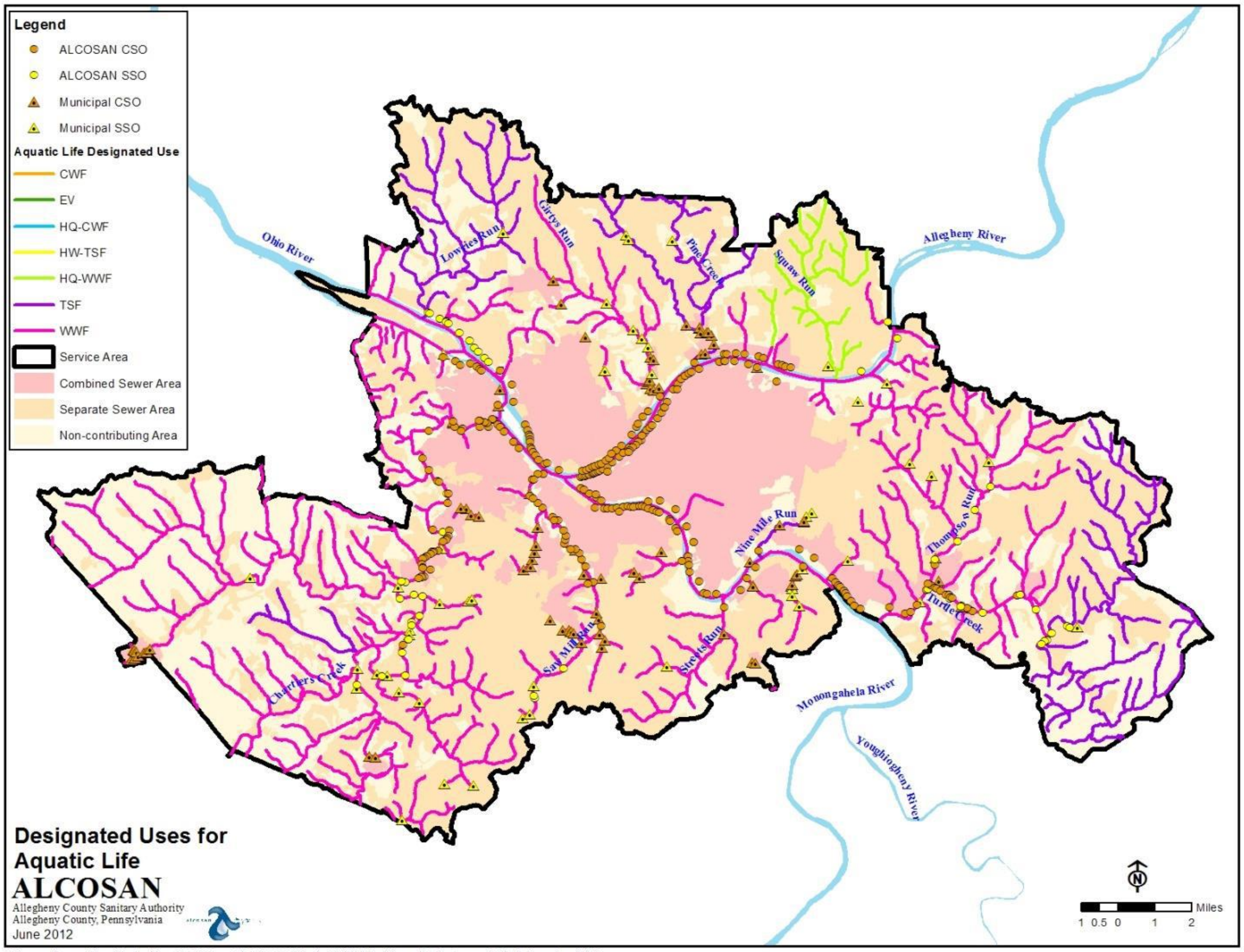
Symbol	Designated Use for Aquatic Life	Stream Names
CWF	Cold Water Fishery	Deer Creek, Kilbuck Run, Pine Creek
TSF	Trout Stocking Fishery	Thoms Run, Nine Mile Run, Pine Creek, Lowries Run, Little Deer Creek, Peters Creek, Long Run, Turtle Creek, Brush Creek, Montour Run, Big Sewickley Creek, Abers Creek, Bull Creek, Pucketa Creek, Simpson Run
HQ-WWF	High Quality - Warm Water Fishery	Squaw Run, Guyasuta Run
HQ-CWF	High Quality - Cold Water Fishery	Haymakers Run
HQ-TSF	High Quality - Trout Stocking Fishery	Little Sewickley Creek, Long Run, Jacks Run

5.2.2 Numeric Criteria

The state's water quality standards provide a quantitative basis for determining whether a water body is attaining its designated uses. Some of these standards apply to all designated uses, while others are for specific uses. The critical use is the designated use for which the standard is primarily meant to protect. There are two groups of water quality standards, defined in separate chapters of the Pennsylvania Code:

- Standard Water Quality Criteria (§ 93) –nutrients, dissolved oxygen, temperature, pH, iron, and bacteria
- Toxic Substances (§ 16) – heavy metals, PCBs
- In addition to the state water quality standards, the Ohio River Valley Water Sanitation Commission (ORSANCO) applies its own set of standards to the Ohio River, which are similar though not identical to the state standards, as discussed below.

Figure 5-7: Designated Uses for Aquatic Life Protection



Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\Section5\FINAL\UpdatesperReviewComments\DesigUses_AquaticLife

State Standard Water Quality Criteria: The water quality criteria for standard constituents are listed in § 93.7. These standards are listed in Table 5-13 below for all parameters that are included in the ALCOSAN receiving water quality sampling program. The minimum temperatures required to support each of the three types of aquatic life uses for various periods throughout the year are listed in Table 5-14. The DO and temperature criteria that apply to each aquatic life use are listed in Table 5-15.

Table 5-13: Standard Water Quality Criteria

Parameter	Symbol	Criteria	Critical Uses
Alkalinity	Alk	Minimum 20 mg/l as $CaCO_3$, except where natural conditions are less. Where discharges are to waters with 20 mg/l or less alkalinity, the discharge should not further reduce the alkalinity of the receiving waters.	CWF, WWF, TSF, MF
Ammonia Nitrogen	Am	The maximum total ammonia nitrogen concentration at all times shall be the numerical value given by: [NH3-N] × (log-1[pK_T-pH] + 1) where: [NH3-N] = un-ionized ammonia nitrogen = 0.12 × f(T)/f(pH) f(pH) = 1 + 101.03(7.32-pH) f(T) = 1, for T ≥ 10°C f(T) =[1+10(9.73-pH)]/[1+10(pKT-pH)], for T < 10°C pK_T = 0.090 + [2730/(T+273.2)] The average total ammonia nitrogen concentration over any 30 consecutive days shall be less than or equal to the numerical value given by: [NH3-N] ×(log-1[pKT-pH] + 1) where: [NH3-N] = un-ionized ammonia nitrogen = 0.025 × f(T)/f(pH) f(pH) = 1, for pH ≥ 7.7 f(pH) = 100.74(7.7-pH), for pH < 7.7 f(T) = 1, for T ≥ 10°C f(T) = [1+10(9.73-pH)]/[1+10(pK_T-pH)], for T < 10°C The pH and temperature used to derive the appropriate ammonia criteria shall be determined by one of the following methods: 1) Instream measurements, representative of median pH and temperature—July through September. 2) Estimates of median pH and temperature—July through September—based upon available data or values determined by the Department. For purposes of calculating effluent limitations based on this value the accepted design stream flow shall be the actual or estimated lowest 30-consecutive-day average flow that occurs once in 10 years.	CWF, WWF, TSF, MF

Table 5-13: Standard Water Quality Criteria

Parameter	Symbol	Criteria	Critical Uses
Fecal Coliform	Bac_1	(Fecal Coliforms/100 ml) – During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period.	WC
Total Coliform	Bac_2	(Coliforms/100 ml) – Maximum of 5,000/100 ml as a monthly average value, no more than this number in more than 20 of the samples collected during a month, nor more than 20,000/100 ml in more than 5% of the samples.	PWS
Dissolved Oxygen		The following specific dissolved oxygen criteria recognize the natural process of stratification in lakes, ponds and impoundments. These criteria apply to flowing waters and to the epilimnion of a naturally stratified lake, pond or impoundment. The hypolimnion in a naturally stratified lake, pond or impoundment is protected by the narrative water quality criteria in § 93.6 (relating to general water quality criteria). For nonstratified lakes, ponds or impoundments, the dissolved oxygen criteria apply throughout the lake, pond or impoundment to protect the critical uses.	
	DO_1	For flowing waters, 7-day average 6.0 mg/l; minimum 5.0 mg/l. For naturally reproducing salmonid early life stages, applied in accordance with subsection (b), 7-day average 9.0 mg/l; minimum 8.0 mg/l. For lakes, ponds and impoundments, minimum 5.0 mg/l.	CWF
	DO_2	7-day average 5.5 mg/l; minimum 5.0 mg/l.	WWF
	DO_3	For the period February 15 to July 31 of any year, 7-day average 6.0 mg/l; minimum 5.0 mg/l. For the remainder of the year, 7-day average 5.5 mg/l; minimum 5.0 mg/l.	TSF
pH	pH	From 6.0 to 9.0 inclusive.	CWF, WWF, TSF, MF
Iron	Fe_1	30-day average 1.5 mg/l as total recoverable.	CWF, WWF, TSF, MF
	Fe_2	Maximum 0.3 mg/l as dissolved.	PWS

Table 5-13: Standard Water Quality Criteria

Parameter	Symbol	Criteria	Critical Uses
Temperature	Temp	Maximum temperatures in the receiving water body resulting from heated waste sources regulated under Chapters 92, 96 and other sources where temperature limits are necessary to protect designated and existing uses.	See Table 5-12
Nitrite + Nitrate	N	Maximum 10 mg/l as nitrogen.	PWS

Table 5-14: Temperature Standards by Aquatic Life Use

Period	***Temperate (˚F)***		
Symbol:	***$Temp_1$***	***$Temp_2$***	***$Temp_3$***
Critical Use:	***CWF***	***WWF***	***TSF***
January 1-31	38	40	40
February 1-29	38	40	40
March 1-31	42	46	46
April 1-15	48	52	52
April 16-30	52	58	58
May 1-15	54	64	64
May 16-31	58	72	68
June 1-15	60	80	70
June 16-30	64	84	72
July 1-31	66	87	74
August 1-15	66	87	80
August 16-30	66	87	87
September 1-15	64	84	84
September 16-30	60	78	78
October 1-15	54	72	72
October 16-31	50	66	66
November 1-15	46	58	58
November 16-30	42	50	50
December 1-31	40	42	42

Table 5-15: DO and Temperature Criteria for each Aquatic Life Use

Symbol	Water Uses Protected	DO Criteria	Temp Criteria
WWF	Statewide list	DO2	Temp2
CWF	Statewide list plus Cold Water Fish	DO1	Temp1
TSF	Statewide list plus Trout Stocking	DO3	Temp3
HQ-WWF	Statewide list plus High Quality Waters	DO1	Temp2
HQ-CWF	Statewide list plus High Quality Waters and Cold Water Fish	DO4	Temp1
HQ-TSF	Statewide list plus High Quality Waters and Trout Stocking	DO1	Temp3
EV	Statewide list plus Exception Value Waters	Existing	Existing

Toxic Substance Criteria: In addition to the standard water quality constituents listed above, there are a series of water quality standards for toxic substances as listed in § 93.8c of Title 25 of the Pennsylvania Code. For each of these toxic substances there are three criteria:

- The Criteria Continuous Concentration (CCC) represents the maximum concentration allowable for chronic (i.e. long-term) exposure.
- The Criteria Maximum Concentration (CMC) represents the maximum concentration allowable for acute (i.e. short-term) exposure.
- The Human Health Criteria represents the maximum allowable concentration allowable for exposure to humans.

The criteria for each of the toxic substances sampled as part of the ALCOSAN Wet Weather Program are listed in Table 5-16. The criteria apply to the dissolved forms of the heavy metals. Except for Chromium (VI), the CCC and CMC for each heavy metal depend on the water hardness (H) in mg/L as CaCO3.

Table 5-16: Toxic Substances Water Quality Criteria

Chemical Name	Criteria Continuous Concentrations (CCC) (µg/L)	Criteria Maximum Concentration (CMC) (µg/L)	Human Health Criteria (µg/L)
Silver	N/A	0.850xExp(1.72xln[H]-6.520)	N/A
Cadmium	{1.101672-(ln[H]x0.041838)}x Exp(0.7409xln[H]-4.719)	{1.136672-(ln[H]x0.041838)}x Exp(1.0166xln[H]-3.924)	N/A
Chromium (III)	0.860xExp(0.819xln[H]+0.6848)	0.316xExp(0.819xln[H]+3.7256)	N/A
Chromium (VI)	10	16	N/A
Copper	0.960xExp(0.8545xln[H]-1.702)	0.960xExp(0.9422xln[H]-1.700)	N/A

Table 5-16: Toxic Substances Water Quality Criteria

Chemical Name	Criteria Continuous Concentrations (CCC) (µg/L)	Criteria Maximum Concentration (CMC) (µg/L)	Human Health Criteria (µg/L)
Nickel	0.997xExp(0.846xln[H]+0.0584)	0.998xExp(0.846xln[H]+2.255)	610
Lead	{1.46203-(ln[H]x0.145712)}x Exp(1.273xln[H]-4.705)	{1.46203-(ln[H]x0.145712)}x Exp(1.273xln[H]-1.460)	N/A
Zinc	0.986xExp(0.8473xln[H]+0.884)	0.978xExp(0.8473xln[H]+0.884)	N/A
PCB	0.014	N/A	0.000064

ORSANCO Water Quality Standards: In addition to the state regulations, the Ohio River is subject to another set of water quality standards defined by the Ohio River Valley Water Sanitation Commission (ORSANCO), which is an interstate commission including 8 states that comprise the Ohio River Basin and the federal government. The ORSANCO standards[5-8] apply to the entire length of the Ohio River beginning at the confluence of the Allegheny and Monongahela Rivers at Pittsburgh Point and extending 981 miles to the confluence of the Ohio and Mississippi Rivers at Cairo Point, Illinois. The latest revision to these standards was passed in 2015.

The Ohio River Valley Water Sanitation Compact specifies the designated uses of the Ohio River such that it must be "for safe and satisfactory use as public and industrial water supplies after reasonable treatment, suitable for recreational usage, capable of maintaining fish and other aquatic life, and adaptable to such other uses as may be legitimate."

The ORSANCO water quality standards are similar to the state water quality standards with a few exceptions. Differences between the two sets of standards for only the constituents included in the ALCOSAN receiving water quality program are:

- Dissolved Oxygen: Daily average DO must be at least 5 mg/L with a minimum of 4 mg/L at any time of the day. During the spawning season between April 15 through June 15, the minimum concentration is 5 mg/L at all times.

- Ammonia Nitrogen – The one-hour average concentration shall not exceed more than once every three years on average an Acute Criterion Concentration (ACC), and the 30-day average concentration shall not exceed more than once every three years the Chronic Criterion Concentration (CCC). The four-day average concentration over a 30-day period shall not exceed 2.5 times the CCC. The ACC and CCC are both dependent on water temperature and pH according to the following equations where T is the water temperature in Celsius.

[5-8] http://www.orsanco.org/index.php/standards

Acute Criterion Concentration (ACC) in mg/L is calculated by:

$$ACC = \frac{0.411}{1 + 10^{7.204-\mathrm{pH}}} + \frac{58.4}{1 + 10^{\mathrm{pH}-7.204}}$$

Chronic Criterion Concentration (CCC) in mg/L when fish early life stages are present (March 1 to October 31) is calculated by:

$$CCC = \left(\frac{0.0577}{1 + 10^{7.688-\mathrm{pH}}} + \frac{2.487}{1+10^{\mathrm{pH}-7.688}}\right) \times MIN\left[2.85\ or\ 1.45 \times 10^{0.028\times(25-T)}\right]$$

Chronic Criterion Concentration (CCC) in mg/L when fish early life stages are not present (November 1 to the end of February) is calculated by:

$$CCC = \left(\frac{0.0577}{1+10^{7.688-\mathrm{pH}}} + \frac{2.487}{1+10^{\mathrm{pH}-7.688}}\right) \times \left(1.45 \times 10^{0.028\times[25-MAX(T\ or\ 7\ ℃)]}\right)$$

Temperature (T): Allowable daily maximum stream temperatures are based on equations in the standards which vary by calendar day. Monthly averages of the daily maximum allowable water temperatures are defined in Table 5-17.

- Chromium (VI) – the chronic criterion for dissolved Cr(VI) is 11 µg/L and the acute criterion is 16 µg/L.

- Cadmium – the acute and chronic criteria are calculated according to the following equations where H is hardness in mg/L as $CaCO_3$:

    - $ACC = (1.136672 - 0.041838 \cdot \ln H) \times \mathrm{e}^{1.0166\ (\ln \mathrm{H})-3.924}$

    - $CCC = (1.101672 - 0.041838 \cdot \ln H) \times \mathrm{e}^{0.7409\ (\ln \mathrm{H})-4.719}$

- *E. coli* – During the contact recreation season (recently revised to April 1 through October 31), *E. coli* concentrations must not exceed 130 cfu/100 mL as a 90-day geometric mean based on at least 5 samples per month, nor exceed 240 cfu/100 mL in more than 25 percent of the samples.

- Nitrite Nitrogen – must not exceed 1.0 mg/L at any time.

- Total Silver – must not exceed 50 µg/L at any time.

- PCBs – total PCBs (defined as the sum of all congener or all isomer or homolog or Aroclor analyses) must not exceed 0.000064 µg/L.

Table 5-17: ORSANCO Temperature Standards for Aquatic Life Use

Period	Period Average Daily Maximum Temp (˚C)
January	7.6
February	6.6
March	10.7
April	16.2
May	21.8
June 1-15	26
June 16-30	30.6
July	31.7
August	31.7
September 1-15	30.6
September 16-30	27.2
October	23.4
November	18.3
December	13.2

5.2.3 Narrative Criteria

General or narrative criteria applicable to all waters are designed to control those substances not identified by specific criteria but which may be harmful to protected water uses or to human, animal, plant or aquatic life if present in excessive amounts. Section 93.6 of Title 25 of the Pennsylvania Code sets forth two such criteria:

(a) Water may not contain substances attributable to point or nonpoint source discharges in concentration or amounts sufficient to be inimical or harmful to the water uses to be protected or to human, animal, plant or aquatic life.

(b) In addition to other substances listed within or addressed by this chapter, specific substances to be controlled include, but are not limited to, floating materials, oil, grease, scum and substances that produce color, tastes, odors, turbidity or settle to form deposits.

This page was intentionally left blank to facilitate double-sided printing.

5.3 Water Quality Monitoring Programs

5.3.1 Receiving Water Quality

The ALCOSAN Receiving Water Quality Monitoring Program (RWQMP) was designed to meet the requirements of ALCOSAN's CD, including the following objectives.

- Evaluate whether and to what extent receiving waters are in attainment with applicable water quality standards
- Characterize water quality conditions during wet and dry weather and for sensitive areas
- Support the development and validation of a receiving water quality model
- Support the development of the wet weather plan
- Characterize existing water quality conditions to serve as a baseline for evaluating the effectiveness of future control measures

The RWQMP included sampling at 51 stations on the three main rivers (Allegheny River, Monongahela River, and Ohio River) and select tributaries in and around the service area. The stations are shown in Figure 5-8. The monitoring stations were grouped into three categories that define the types of samples that were collected during each event:

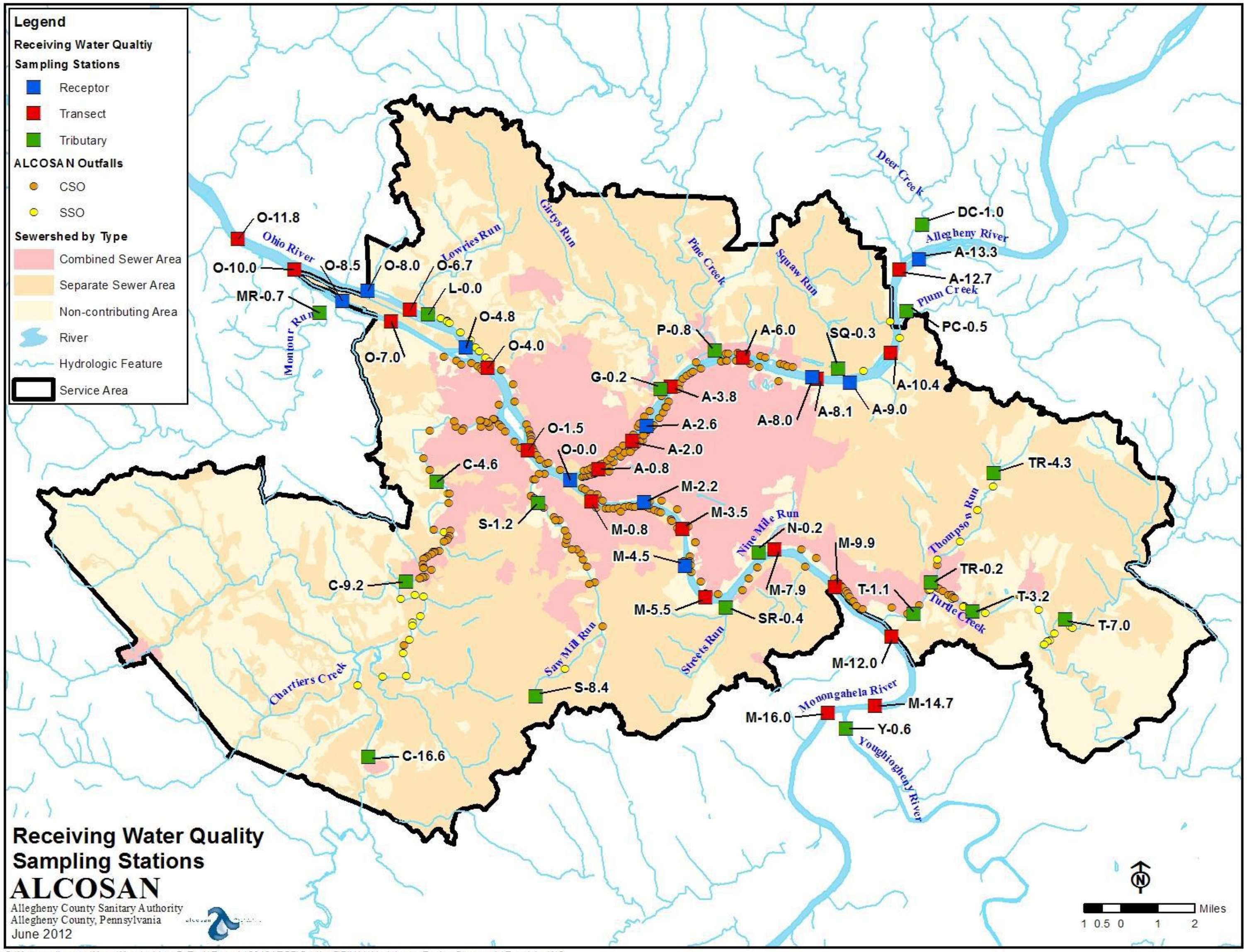
- River Transect Sites - one, depth-integrated, isokinetic, equal-discharge increment (EDI) sample; one grab sample approximately 20 feet from the left water's edge (LWE); and one grab sample approximately 20 feet from the right water's edge (RWE) were collected.
- Tributary Sites - one, depth integrated, equal-width increment (EWI) sample was collected.
- Receptor Sites - a single vertical (SV), depth-integrated, isokinetic sample was collected by a boat team immediately upstream of the selected receptor.

A description of sampling types is shown in Figure 5-9.

Monitoring was conducted in the Three Rivers and selected tributaries during wet and dry weather conditions beginning in 2006 and extending through the fall of 2011. Receptors, transects and tributaries were sampled from April 1 through October 31 in any given year. The sampling and monitoring season is based on the recreational period as defined by the State of Pennsylvania and ORSANCO as well as the professional judgment of the project team staff. The recreational season was extended to include April and October to permit more opportunity for sampling.

A total of three dry and three wet weather events were targeted for each station. The conditions under which each sample was collected are identified in the water quality database according to the Hydraulic Conditions Purpose ID (HCPID). Table 5-18 lists the HCPIDs and their descriptions.

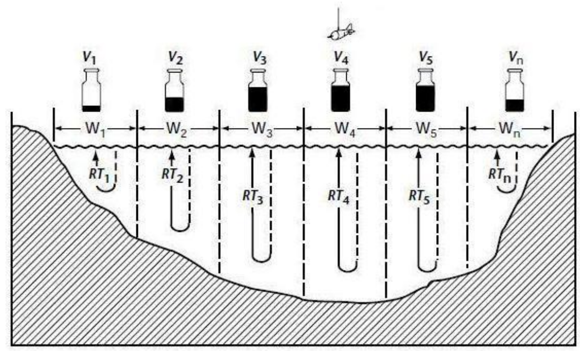
Figure 5-8: Receiving Water Quality Stations



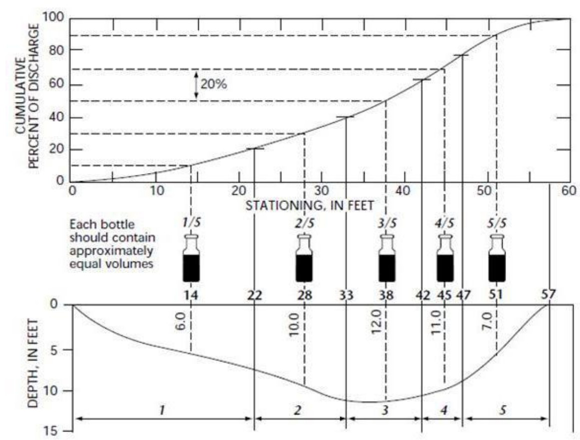
Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\Section5\FINAL\UpdatesperReviewComments\ReceivingWQ

Figure 5-9: Description of Water Sampling Types*

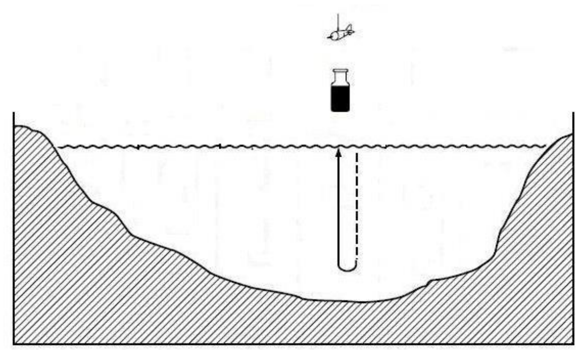
For the depth integrated, equal-width increment (EWI) sampling method, the stream cross section is divided into a number of equal-width increments. Samples are collected by lowering and raising a sampler through the water column at the center of each increment. The combination of the same constant transit rate used to sample at each vertical and the isokinetic property of the sampler results in a discharge-weighted sample that is proportional to total streamflow.



The objective of the depth-integrated, isokinetic, equal-discharge increment (EDI) method is to collect a discharge-weighted sample that represents the entire flow passing through the cross section by obtaining a series of samples, each representing equal volumes of stream discharge. The EDI method requires that flow in the cross section be divided into increments of equal discharge. Equal-volume, depth-integrated samples are collected at the centroid of each of the equal-discharge increments along the cross section. Centroid is defined as that point in the increment at which discharge is equal on both sides of the point.



A single vertical (SV), depth-integrated, isokinetic sample involves lowering the sampler at a predetermined constant transit rate until slight contact is made with the streambed. Upon contacting the streambed, the sampler is immediately raised at the same constant transit rate until the sampler completes the vertical traverse.



*Information excerpted from *U.S. Geological Survey, 2006, Collection of water samples, version 2: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 9, Chapter A4.*

Table 5-18: Description of Hydraulic Condition Purpose IDs

HCPID	Description
DW	Dry Weather
PW1	Wet Weather, 1 Day Prior
PW3	Wet Weather, 3 Days Prior
PW4	Wet Weather, 4 Days Prior
PW5	Wet Weather, 5 Days Prior

Samples were analyzed for a number of water quality parameters including the Sewage Parameters, as defined in Appendix O of the Consent Decree, as well as other parameters indicative of water quality. Table 5-19 lists the parameters analyzed at each location.

Table 5-19: Receiving Water Quality Sampling Parameters

Parameter ID	Description	Units	Sewage Parameter*
BOD_5	Biochemical Oxygen Demand, 5 Day	mg/L	X
COD	Chemical Oxygen Demand	mg/L	
DO	Dissolved Oxygen	mg/L	X
ECOLI	Escherichia coli	cfu/100mL	X
FCOLI	Fecal Coliform	cfu/100mL	X
HARD	Total Hardness	mg $CaCO_3$/L	
NH3	Ammonia Nitrogen	mg/L	X
NO32	Nitrate-Nitrite Nitrogen	mg/L	X
OP	Ortho-Phosphate	mg/L	
PH	pH	su	
SC	Specific Conductance	µS/cm	
TEMP	Temperature	˚C	
TKN	Total Kjeldahl Nitrogen	mg/L	
TP	Total Phosphorus	mg/L	
TSS	Total Suspended Solids	mg/L	X
TURB	Turbidity	NTU	

Table 5-19: Receiving Water Quality Sampling Parameters

Parameter ID	Description	Units	Sewage Parameter*
PCBs	Polychlorinated Biphenyls	ug/L	
AG_D	Silver Dissolved	mg/L	
AG_T	Silver Total	mg/L	
CA_T	Calcium Total	mg/L	
CD_D	Cadmium Dissolved	mg/L	
CD_T	Cadmium Total	mg/L	
CR_D	Chromium Dissolved	mg/L	
CR_T	Chromium Total	mg/L	
CU_D	Copper Dissolved	mg/L	
CU_T	Copper Total	mg/L	
FE_D	Iron Dissolved	mg/L	
FE_T	Iron Total	mg/L	
MG_T	Magnesium Total	mg/L	
NI_D	Nickel Dissolved	mg/L	
NI_T	Nickel Total	mg/L	
PB_D	Lead Dissolved	mg/L	
PB_T	Lead Total	mg/L	
ZN_D	Zinc Dissolved	mg/L	
ZN_T	Zinc Total	mg/L	

* - Sewage Parameters as defined in Consent Decree

Description of Sampling Events

Dry-Weather Sampling Event Criteria: The criteria used to define dry weather monitoring and sampling events on the Allegheny, Monongahela and Ohio Rivers and tributaries followed that of ORSANCO (Ohio River Water Sanitation Commission, 2006) and is summarized below.

- ALCOSAN WWTP wet well was operating under normal conditions.

- No precipitation greater than 0.1 inches in the local watershed 72 hours before a sampling event.

- Dry weather conditions needed to prevail throughout the monitoring and sampling event. If it began to rain after the collection of some dry weather samples, the Field Program Manager would decide whether the samples collected that meet the dry weather criteria should be discarded or analyzed.

Wet Weather Sampling Event Criteria: Two types of wet weather event criteria are defined below; Type A and Type B.

Wet-Weather Sampling Event Criteria Type A:
The criteria used to target a Type A wet weather sampling event was as follows:

- No precipitation greater than 0.1 inches in the local watershed for 48 hours followed by a minimum of approximately 0.30 inches of rainfall (spatially averaged) over a 24-hour period along the Allegheny, Monongahela or Ohio rivers. (Attempts were be made to capture a range of precipitation greater than 0.3 inches over a 24-hour event period.)
- Sources discharging into the Allegheny, Monongahela or Ohio rivers were generally active.
- Sources discharging into tributary streams were generally active.
- A dry period following the precipitation to allow sampling following the precipitation. (Sampling occurred on dry-days one, three and five following the precipitation, but sampling was terminated if additional precipitation occurred. If excessive weekend recreational boat traffic was anticipated to interfere with the boat transect sampling, then other alternative sampling days may have been selected including for example, day four or day six sampling.)

Wet Weather Sampling Event Criteria Type B:
Type B criteria included sampling and monitoring during extended wet weather events. The criteria used were consistent with guidance for initiating monitoring of wet weather events in the U.S. EPA Combined Sewer Overflows Guidance for Monitoring and Modeling (U.S. EPA, 1999). The criteria that were used to define an extended wet-weather sampling event were similar to that of a wet-weather sampling event, with the exception that the 0.3 inches of rainfall may occur over a 72-hour period instead of only a 24-hour period. The specific criteria are as follows:

- No precipitation greater than 0.1 inches in the local watershed for 48 hours followed by a minimum of approximately 0.30 inches of rainfall (spatially averaged) over a 24 to 72-hour period along the corridor of the Allegheny, Monongahela or Ohio rivers. (Attempts were made to capture a range of precipitation greater than 0.3 inches over a 24 to 72-hour event period.)
- Sources discharging into the Allegheny, Monongahela or Ohio rivers were generally active during one or more of the periods of precipitation.

- Sources discharging into tributary streams were generally active during one or more of the periods of precipitation.
- A dry period following the precipitation to allow sampling following the precipitation. (Sampling occurred on dry-days one, three and five following the precipitation, but sampling was terminated if additional precipitation occurred. If excessive weekend recreational boat traffic was anticipated to interfere with the boat transect sampling, then other alternative sampling days may have been selected including for example, day four or day six sampling.)

An example of an extended wet weather event that does not meet the ORSANCO wet or dry weather criteria, but would meet the extended wet weather criteria, would be rain occurring in duration of two or three days in a row after a 48-hour antecedent dry period. Intermittent precipitation of several days in duration is common during the recreational season in western Pennsylvania. Useful information obtained during sampling of an extended wet weather event included the evaluation of the cumulative impacts of several days of precipitation. Sampling after several days of precipitation allowed for the evaluation of areal and temporal exceedances of water quality criteria in tributaries and the Three Rivers. Knowledge of the effects of extended wet weather precipitation on receiving waters provided a more comprehensive examination of the time necessary for the receiving waters to return to compliance with respect to water quality criteria.

The *Receiving Water Quality Monitoring Plan (April 2009)* provides additional details on the water quality monitoring that was performed to support the development of the Wet Weather Plan.

5.3.2 CSO Discharges

The CSO Pollutant Monitoring Plan (PMP) consisted of monitoring and sampling wet weather combined sewer flow within diversion structures that periodically discharge into the receiving waters within the ALCOSAN service area. Dry weather flow in the combined system was also sampled and monitored.

CSO monitoring and sampling locations were selected to represent the combined sewer area in the ALCOSAN service area. A review of the ALCOSAN service area historical CSO data was conducted and sites were selected that were expected to actively discharge combined sewage into the Ohio, Allegheny, and Monongahela Rivers and three tributaries (Chartiers Creek, Saw Mill Run, and Turtle Creek). CSO monitoring and sampling sites were selected based on location, sewershed characteristics, average annual overflow volume, frequency and duration of overflow, configuration, upstream land use, accessibility and safety. Sampling locations are shown in Figure 5-10 and summarized in Table 5-20. Shown on the table are the CSO outfalls that were sampled, a description of their location, the tributary service area and population, and whether or not an industrial user discharges to them.

The CSO monitoring and sampling program began late in 2007 and was originally planned to continue through 2009 and was targeted for the recreational season (May 1 through October 15). However, weather conditions were a significant factor in this sampling program and resulted in the program extending into 2010 and then 2011. A goal of the program was to sample as many events as possible during the recreational season but sampling was not limited to the recreational season. ALCOSAN evaluated weather conditions on a year-round basis and conducted sampling events when conditions were appropriate and feasible. Sampling events were collected during the spring, summer, fall, and winter seasons in an effort to capture the seasonality influences on overflows. Additionally, some of the sites originally selected were removed and replaced with alternate sites due to logistics or the inadequacy of the site to perform as expected in regards to volume and frequency of overflow. Operational improvements were made to the ALCOSAN Waste Water Treatment Plant which resulted in decreased frequency and duration of overflow throughout the system.

A total of three dry and three wet weather events were targeted for each site. Samples were analyzed for the same water quality parameters as the receiving water samples (provided in Table 5-19).

Description of Sampling Events

Dry-Weather Sampling Event Criteria: The criteria that were used to define a suitable dry weather sampling event were as follows:

- ALCOSAN Waste Water Treatment Plant wet well is operating under normal conditions.
- No precipitation greater than 0.1 inches over the entire ALCOSAN service area for 72 hours before a sampling event.
- Dry-weather conditions must prevail throughout the sampling event.

Wet Weather Sampling Event Criteria: The criteria used to target a wet weather sampling event are as follows:

- No precipitation greater than 0.1 inches over the entire ALCOSAN service area for 48 hours before a sampling event.
- A minimum of approximately 0.30 inches of rainfall over a six-hour (this duration may have varied based on event conditions) period over the basin(s) of study. Attempts were made to capture a range of rainfall events (total rainfall, duration, peak intensity) when CSOs were discharging into the receiving water.

The *Combined Sewer Overflow Pollutant Monitoring Plan (July 2009)* provides additional details on the sampling and analytical procedures used to assess the concentrations of various chemical constituents of CSOs from the ALCOSAN regional collection and conveyance systems.

Figure 5-10: CSO Sampling Locations

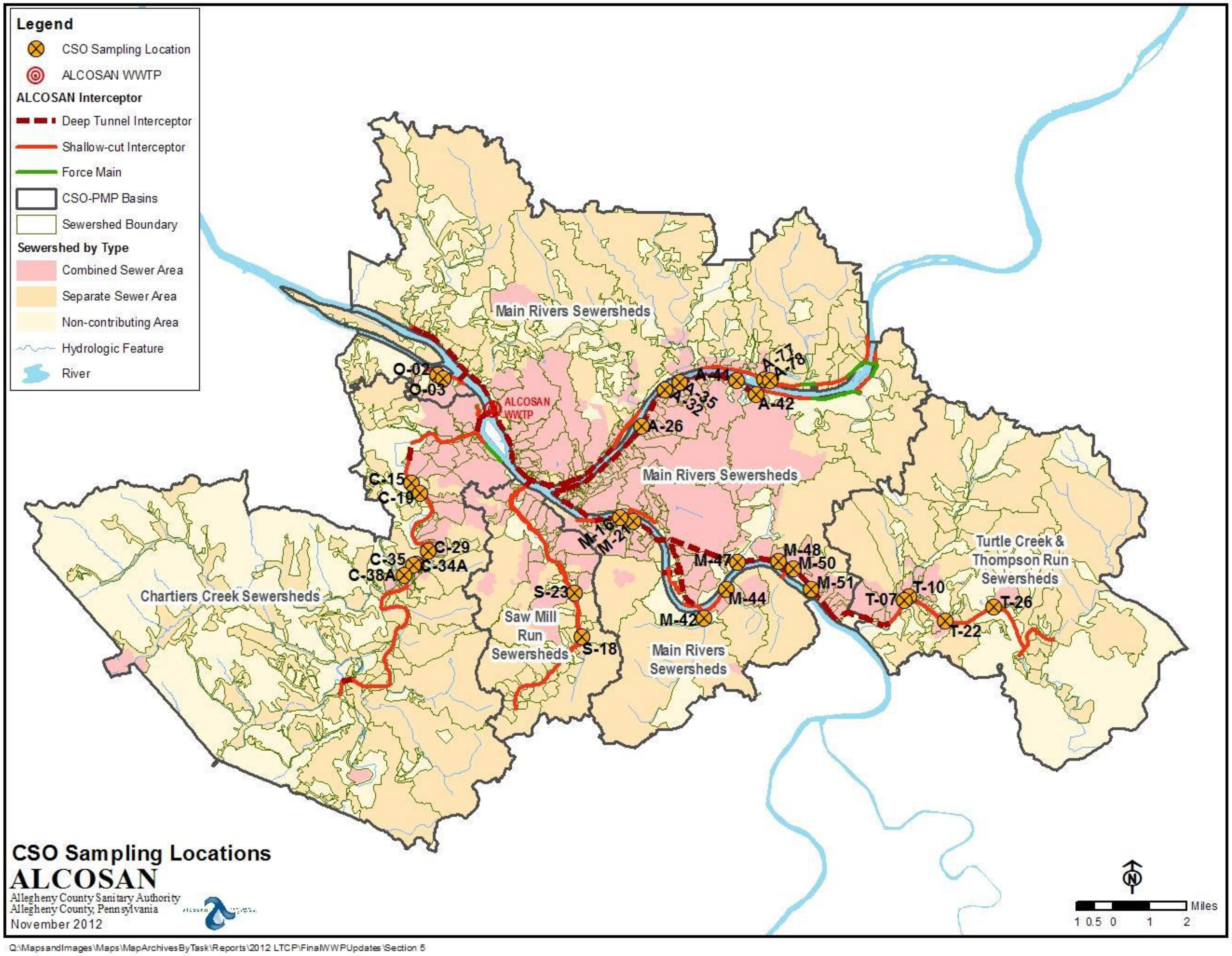


Table 5-20: CSO Sampling Stations

CSO ID	Description	Sewershed Area (Acres)	Sewershed Population	Industrial Users (Y/N)
Chartiers Creek Sewersheds				
C-15	Broadhead Fording Road (COP)	229	1,569	N
C-19	State Hwy Bridge (COP)	329	4,035	N
C-29	Woodkirk Street (COP)	290	685	Y
C-34A	Carnegie CSO (Carnegie)	32	131	N
C-35	Chestnut St. Bridge (Carnegie)	80	892	N
Saw Mill Run Sewersheds				
S-18	Maytide Street (COP)	249	3,079	N
S-23	Edgebrook Avenue East (COP)	134	1,615	N
Turtle Creek / Thompson Run Sewersheds				
T-07	R. B. D/S Thompson Run (Turtle Creek)	1,258	5,501	Y
T-10	Grant Street and Turtle Creek (Turtle Creek)	869	5,257	N
T-22	L. B. Turtle Creek D/S Miller St. (Wilmerding)	226	1,153	N
T-26	D/S Bridge to Pitcairn RR Yards (Pitcairn)	465	3,667	N
Three Rivers Sewersheds				
A-26	38th Street (COP)	46	460	N
A-28	A-28 43rd. Street (COP)	120	2,854	Y
A-32	McCandless Street (COP)	62	1,274	N
A-35	57th Street at River Crossing	128	992	N
A-41	Heths Run (COP)	854	12,219	N
A-42	Negley Run (COP)	2,687	27,203	Y
A-77	Eastern Avenue (Aspinwall)	40	470	N
A-78	Brilliant Avenue (COP)	193	1,476	Y
M-16	S. 20th Street (COP)	285	3,385	Y
M-21	S. 24th Street (COP)	70	1,034	Y
M-42	Streets Run (COP)	6,487	28,872	Y
M-47	Nine Mile Run (COP)	3,812	36,643	Y
M-48	Swissvale (Swissvale Borough)	96	1,615	N
M-50	Rankin-Swissvale (Rankin)	339	4,788	Y
M-51	Rankin-Braddock (Braddock)	516	3,509	N

5.3.3 Industrial Discharges

ALCOSAN evaluated the potential environmental impacts of Industrial User discharges from the outfalls listed in Appendices A and B of the CD by evaluating estimated concentrations of the pollutants listed in CD Paragraph 1(c)(iii) of Appendix F and in Paragraph 9 of Appendix O (Table 5-21) that would occur at the point of discharge from the sewer outfalls through which the industrial wastewater flows to the point of connection to the ALCOSAN Regional Conveyance System. This was accomplished by pollutant concentration sampling performed at the individual Industrial User's facilities.

Table 5-21: Pollutants to be Evaluated under CD Appendices F and O

Parameters	
(Appendix F Paragraph C III)	**Appendix O Paragraph 9**
Toxicity	Chemical Oxygen Demand
pH	Cadmium
Chemical Oxygen Demand	Chromium
Color	Copper
Suspended Solids	Iron
Polychlorinated Biphenyls (PCBs)	Lead
Dissolved Oxygen Content	Polychlorinated Biphenyls (PCBs)
	Nickel
	Silver
	pH
	Zinc

The initial sampling and analysis conducted, and included in the initial July 2008 Industrial User Assessment report, provided an initial screening to identify the need for further analysis. Based upon the initial data collection and analysis, ALCOSAN executed a second round of sampling of the Industrial Users' to better understand potential pollutant loadings to receiving streams attributable to Industrial Users. The second round of sampling utilized composite sampling where feasible to obtain data representative of discharge characteristics throughout the day for each Industrial User. If composite sampling could not be performed (batch and intermediate dischargers, and unsecured locations that could not be taken by an automatic sampler), four grab samples were taken every ½ hour during the time of discharge. These results were included as part of the July 2009 Industrial User Assessment Annual Update.

During 2010, Industrial User sampling conducted by ALCOSAN continued. Users that were previously found to potentially discharge pollutants in concentrations that could negatively impact water quality were re-sampled. In addition, Industrial Users that recently

commenced to discharge to the ALCOSAN system were also sampled for inclusion in ALCOSAN's continuing evaluation.
The rounds of sampling occurred at the regular sampling locations used by ALCOSAN in its industrial pretreatment program and was directed at process waste streams. These locations were selected to reflect point(s) of discharge of waste streams subject to the industrial pretreatment program. The selected assessment methodology was based on a simplified random stratified sampling approach in which the Industrial Users were visited for sampling purposes during the normal course of the ALCOSAN Industrial Waste staff's work week. Wet weather and groundwater impacts were accounted for in the hydrologic and hydraulic modeling that was utilized to generate the overflow volume estimates.

The concentrations of the water quality parameters at the respective overflows were estimated based on each Industrial User's highest Relative Contribution Factor (RCF). The highest RCF was defined by the day in which an overflow lasting more than one hour occurred and during which the Industrial Users' percentage of total flow was greatest. This conservative approach was utilized to provide for a worst case (highest) estimate of the concentrations reaching the outfall, or stated conversely, the overflow day in which the Industrial User's discharge would be least diluted by runoff, groundwater, and other wastewater. In cases where an Industrial User discharges to more than one sewershed, RCF computations assumed that the entire Industrial User's permitted flow could discharge to either sewershed.

5.3.3.1 Computational Methodology

Industrial Flow Volumes: Daily Industrial User flows to their respective municipal collection systems were used in the computation of discharge concentrations. The industrial flow data are based on user supplied flow rates or, as may be applicable for large volume Industrial Users, from validated sewage flow meters at the points of connection to the municipal sewerage.

Calculation of Relative Contribution Factors: The Relative Contribution Factor (RCF) for an industry was defined as a fraction or a ratio of Industrial Users discharge to the total flow from the sewershed in which the industry is located. The RCF is a dilution factor.

RCF = Industrial Users' Discharge / Total Flow

The RCFs were computed for each current regulated industry within the ALCOSAN service area. The Industrial Users' discharge was a conservative estimate that was calculated by multiplying the permitted maximum daily flow volumes by 365 days. The total flows used in the computations were obtained from the results of a model simulation using the ALCOSAN regional system-wide hydrologic and hydraulic model. The total flow generated from a given sewershed consisted of base wastewater flow (BWWF), groundwater infiltration (GWI), stormwater runoff, and the total discharge from all industries and other contributors to the municipal collection system in the sewershed.

5.3.3.2 Total Flow Estimation

The quality-reviewed flow monitoring data available for the 2005 year was utilized to estimate the GWI and BWWF component of the total flow. There are permanent flow meters in the shallow-cut interceptor systems as well as temporary meters monitoring flow from the individual sewersheds. Therefore, at a given point in time, the flow monitoring status of a sewershed was either monitored or unmonitored. Depending on the monitoring status of a sewershed where the given industry is located, and for which the dilution factor was being computed, the total flows were handled differently. These differences are discussed below.

Industry Located in a Monitored Sewershed:
If a sewershed was monitored during the 2005 simulation period, the GWI and BWWF components were derived by deconstructing the hydrographs using a flow monitoring data analysis software program called SHAPE. In this case, the groundwater inflow time series component would have included the industrial discharge component.

Industry Located in an Unmonitored Sewershed:
If a sewershed was unmonitored during the period of simulation, the GWI and BWWF time series were extrapolated from the downstream shallow-cut meter flow based on service area and population information.

Industry Located in a Partially Unmonitored Sewershed:
The flow monitored data were used for estimating the GWI and BWWF even if the sewershed was not monitored for the entire year. Instead of seasonally varying groundwater inflow, a constant groundwater inflow was used which included the industrial discharge component.

5.3.3.3 RCF Dilution Factors

A Statistical Analysis Software (SAS) program was developed to compute the dilution factors for each industry. Program inputs included the following:

- Industrial Users' daily average discharge (gallons)
- Sewershed in which industry is located
- Model-estimated total flow time series for each sewershed
- Model-simulated time series of overflows for the interceptor outfalls for the corresponding sewersheds

For each sewershed, the program was designed to identify the days in which an outfall was active for more than an hour. For example, the C-39 outfall was active on 37 calendar days during the entire 2005 year. For each industry present in this sewershed, for all the 37 days in which the outfall was active for more than an hour, dilution factors were computed. For each industry, the minimum, maximum, and average dilution factors were reported along with cumulative distribution frequency plots.

5.3.4 PCB CTS Sampling

In accordance with Appendix F Paragraph 6 of the ALCOSAN Consent Decree (CD), ALCOSAN was required to investigate and, if found, eliminate PCB discharges. To this end, a program was designed to identify the presence or absence of legacy PCBs in or entering the Conveyance and Treatment System (CTS). If PCBs were detected then further action would be taken to attempt to identify the source of the PCBs within the CTS or the Collection System. The sampling locations and frequency of sampling were selected to address these goals. This program was not intended to investigate or characterize pollutant delivery processes, or as in the case for the CSO sampling plan, to provide data to be used in the characterization of pollutant concentrations and loadings. The plan for investigating PCBs included the following provisions:

- Collect samples of wastewater within interceptors and wastewater influent at the Sewage Treatment Plant.
- Analyze the samples collected during one dry and one wet weather event to determine the concentration of PCBs in each sample.
- Analyze the samples collected during wet weather events to determine the concentration of total suspended solids (TSS) in each sample.
- Identify, to the extent feasible, which portions of the CTS, if any, convey discharges of PCBs to the Sewage Treatment Plant.
- Identify, to the extent feasible, which Customer Municipalities and Industrial Users, if any, route flow containing PCBs to the CTS.
- Identify, to the extent feasible, which trunk lines and/or Customer Municipality service areas, if any, convey discharges of PCBs to the CTS.

5.3.4.1 Event Criteria

Dry Weather Event Criteria: The criteria used to define a suitable dry weather sampling event were as follows:

- ALCOSAN Waste Water Treatment Plant wet well was operating under normal conditions.
- No precipitation greater than 0.1 inches over the entire ALCOSAN service area for 72 hours before a sampling event (data obtained from 3 Rivers Wet Weather (3RWW) rain gauge network.
- Dry weather conditions must prevail throughout the sampling event.

Wet Weather Event Criteria: The criteria used to target a wet weather sampling event were as follows:

- No precipitation greater than 0.1 inches over the entire ALCOSAN service area for 48 to 72 hours before a sampling event.
- An event of approximately 0.30 – 0.50 inches of rainfall over a six-hour (this duration varied based on event conditions) period over the area of study. However, events up to 1.00 inches of rainfall over 6 hours may have been sampled. The event size was determined by calculating the amount of rainfall it takes to cause the ALCOSAN system to flow vigorously and cause overflows.

5.3.4.2 PCB CTS Sampling Sites

PCB CTS sampling locations were selected to represent the deep-tunnel (DTI) and shallow-cut (SCI) interceptors in the ALCOSAN service area. Sampling sites were selected based on location, sewershed characteristics, configuration, upstream land use, accessibility and safety. The sampling sites for PCB investigation are summarized in Table 5-22 and shown in Figure 5-11. The diameter of the interceptor conduits at the points where samples were collected is shown. The locations were selected in downstream reaches of the interceptor subsystems to provide maximum drainage basin and pipe network coverage.

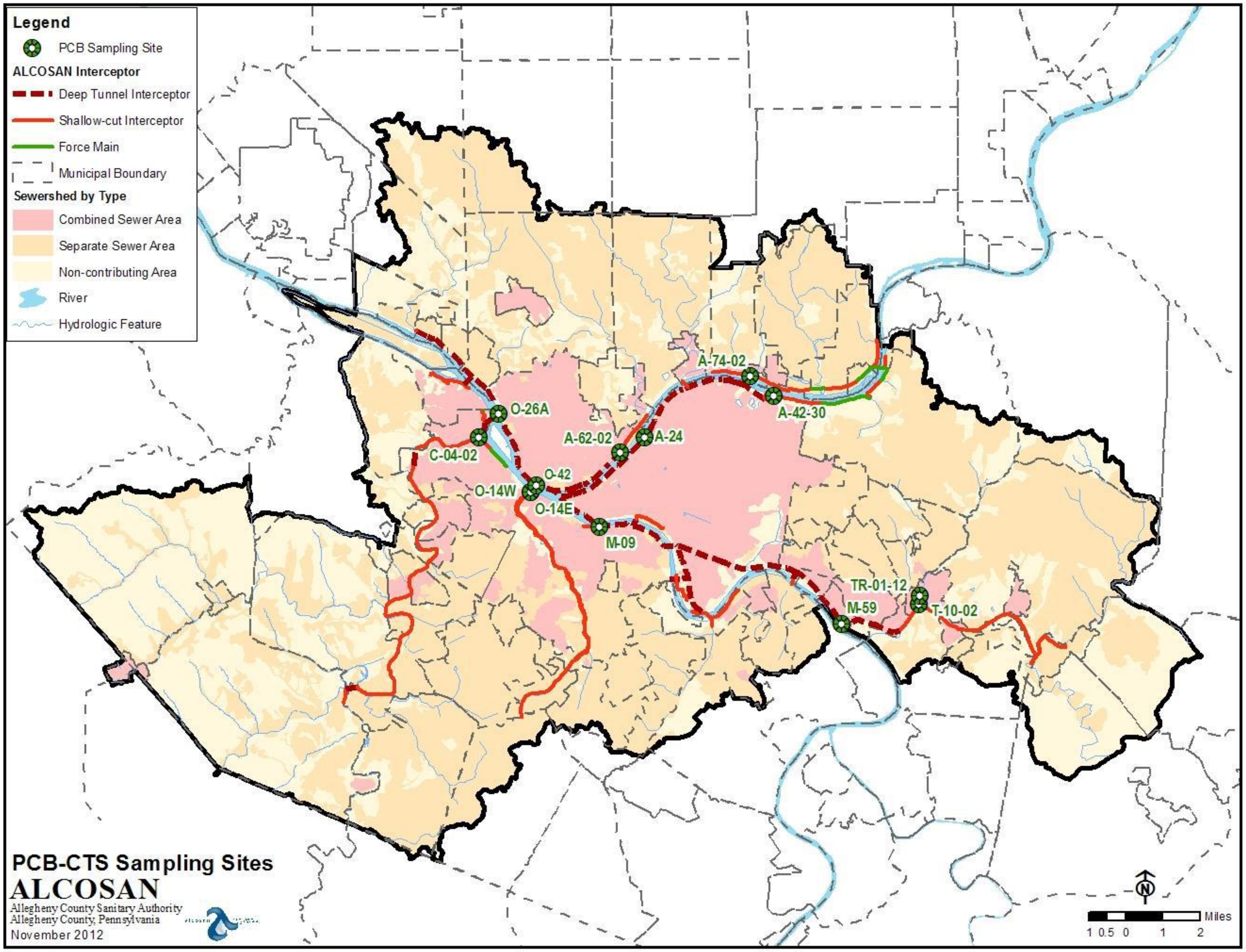
A total of 13 sites were selected:

- Four deep-tunnel interceptor sites
- Eight shallow-cut interceptor sites
- One site in the influent flow to the sewage treatment plant at Main Pump Station 3, where the influent flow to the plant is commingled

Table 5-22: PCB CTS Sites

Location ID	Description	Diameter (in)	DTI/SCI/STP
C-04-02	Chartiers Creek Interceptor at Crivelli Chevrolet	45”	SCI
O-14E-00	42” Saw Mill Run Interceptor	42”	SCI
O-14W-00	48” Saw Mill Run Interceptor	48”	SCI
O-42-00	Belmont Street Access Shaft	120”	DTI
A-62-02	Lower Northern Allegheny Interceptor along River Avenue	36”	SCI
A-24-00	36th. Street Access Shaft	60”	DTI
A-42-30	Allegheny River Interceptor	42”	SCI
M-09-00	South 8th. Street Access Shaft	84”	DTI
M-59-00	11th. Street – Braddock- Access Shaft	54”	DTI
TR-01-12	Thompson Run Interceptor along Church Street	21”	SCI
T-10-02	Turtle Creek Interceptor Along Main Street	39”	SCI
A-74-02	Allegheny River Interceptor at Silkys Crows Nest	30”	SCI
O-26A-00	Main Pump Station 3. Wastewater influent at the Sewage	N/A	STP

Figure 5-11: PCB-CTS Sampling Sites



Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 5

The *Polychlorinated Biphenyls (PCB) Conveyance and Treatment System Quality Assurance Project Plan (January 2009)* provides additional details on the sampling and analytical procedures used to investigate and eliminate PCB discharges to the regional collection and conveyance system.

5.3.5 Data Quality Assurance Review

The above water quality monitoring and sampling programs employed data quality assurance review procedures to ensure that program objectives were met. Internal quality control checks were performed on field and laboratory generated measurements as summarized herein.

Field Measurements: Field quality control checks consisted of quality assurance (QA)/quality control (QC) samples that were collected or prepared by the field crews and were submitted for laboratory analysis. These samples consisted of duplicates, field blanks, and equipment blanks. Acceptable control limits were established, the data were reviewed, and an assessment was made of the adequacy of the quality control checks. When problems were identified; corrective actions were discussed and implemented, as appropriate. In addition, quality control checks were conducted in advance of, and following, the use of multi-parameter meters.

Laboratory Measurements: The laboratory performed quality control checks on all samples analyzed, which included sample duplicates, matrix spikes, matrix spike duplicates, control samples, and method blanks as appropriate. The laboratory conducted quality control procedures for analytical services in accordance with their standard operating procedures and the individual method requirements referenced by U.S. EPA methods or Standard Methods (18th, 19th and 20th Editions) with acceptable control limits. Quality control check issues were identified and corrective actions were implemented.

All of the data collected were subject to review, verification and validation processes as described in the *Receiving Water Quality Monitoring Plan*, *CSO Pollutant Monitoring Plan* and *PCB Conveyance and Treatment System Quality Assurance Project Plan*. Final qualifiers were assigned regarding data usability. This process is discussed in the next section.

Data Review, Verification, Validation and Usability: All environmental measurement data and samples collected were subjected to quality control. This was a multi-step process where the Program Managers were responsible for verifying the data and the Quality Assurance Manager conducted the data validation. The data generated from the sampling program were subjected to a multi-tiered review process which included:

- Review of the data at the bench (laboratory) and field levels
- Secondary review of field records by the Field Program Manager and analytical results from laboratory by the Quality Assurance Manager to verify the data against method and SOP requirements
- Screening level review of the verified data by the appropriate Program Managers for reasonableness and to identify obvious data anomalies
- Validation and data usability by the Quality Assurance Manager

If data did not meet QA/QC criteria, additional review of the quality control checks and any relevant laboratory bench sheets were conducted. Upon completion of QA/QC review, the data were flagged appropriately, identifying the limitations of the data.

Data Verification: The data quality assurance review process included a series of data verification activities that were conducted during field activities and in the laboratory.

Field Activities Data Verification:

The Field Program Managers were responsible for ensuring that the samples were collected and handled according to the procedures specified in the FMSP and SOPs. Sample collection verification included confirming that the samples were collected with the proper equipment at the appropriate locations with the appropriate frequency using proper labeling protocol. Sample handling verification included confirmation by the laboratory that the samples were stored in the appropriate containers with the correct preservative, that the samples were stored at the proper temperature during transport from the field to the laboratory, and that all of the appropriate information was logged on the chain-of-custody records.

Laboratory Activities Data Verification:

The Laboratory QA/QC Managers were responsible for verifying laboratory generated data. Laboratory verification included assessing that the procedures used to generate the data were consistent with the method requirements as specified in the laboratory's SOPs and that the QA/QC requirements for each method were met. Examples of method requirements include verifying the calibration and data reduction procedures. Method QA/QC requirements vary by analyte. A laboratory report was released to the Quality Assurance Manager after the data were verified and approved.

Data Validation Requirements: The Quality Assurance Manager − who is not directly involved with the field program, sample collection, or analysis − performed data validation for this program which included the following.

- Inspect the data verification and review records to ensure that no oversights were made during that process.
- Evaluate the data against the project's Data Quality Objectives.
- Evaluate the data in the context of the project's overall objectives, which include using the data collected to support the development, calibration and application of numerical assessment tools.
- Communicate the data validation results to the rest of the project team.

Field measurements data collection, field sample collection, sample custody, laboratory analytical results and case narrative, laboratory data reviews, and laboratory quality control data were all checked as part of the measurement data and analytical data validation activities. After a review of the laboratory data for compliance with the established quality control criteria based on duplicates, spiked, control, and blank data qualifiers were assigned to the data.

Reconciliation with User Requirements: Once all field measurements and analytical data loaded into the database were reviewed, quality control measures assessed and addressed any problems, the measurement and analytical data were assigned final status in the database. Table 5-23 lists the data qualifiers used in the database along with a description of each qualifier.

Table 5-23: Data Validation Qualifiers

Qualifier	Definition
A	Accepted final data, which have undergone final verification and validation and no data qualifiers were applied.
AF	Accepted field data - Accepted by provider.
E	Estimated value where accuracy of measurement is uncertain
J	Questionable. Problem but not severe enough to reject.
P	Provisional data loaded into the database that have not undergone final verification and validation
L	Logical check failed.
NDJ	Analysis for analyte performed, but analyte was not detected. The reported quantization limit is approximate and may be inaccurate or imprecise.
R	The data are unusable (note: analyte may or may not be present).
RF	Rejected field data - Rejected by provider.

This page was intentionally left blank for double sided printing

5.4 Water Quality Monitoring Results

5.4.1 Receiving Water Quality

The receiving water quality monitoring program was designed to evaluate water quality conditions throughout the ALCOSAN service area in both dry and wet weather. Samples were collected between 2006 and 2011 in the major tributaries, the three main rivers, and at sensitive areas (e.g. marinas, drinking water intakes, recreational areas, etc.) as defined in Appendix C of the CD. The data were analyzed to identify water quality constituents that exceed either Pennsylvania instream water quality standards (summarized in section 5.2) or other reference concentration thresholds in cases where numeric criteria do not exist. This information was then used to identify water quality constituents of concern. For this analysis, all data reported as non-detects by the laboratory were set to the minimum reporting limit. For example, if the concentration of BOD_5 in a sample was reported as < 2.0 mg/L, then the measured concentration was set at 2.0 mg/L. Data flagged as rejected were excluded from this analysis; data flagged as estimated or questionable were included, and weighted equally as accepted data.

Assessment of Attainment with Water Quality Standards (or Other Reference Thresholds) by Parameter

Fecal Coliform

Attainment with fecal coliform criteria (shown in Table 5-13) was assessed by comparing each sample result collected during the recreational season to 200 cfu/100mL and 400 cfu/100mL concentration thresholds, and each sample collected during the non-recreational season compared to 2,000 cfu/100mL. Although this assessment methodology does not strictly conform to the criteria requiring at least five samples in 30 days, it does provide for a conservative assessment of attainment. Figures 5-12 and 5-13 show the measured concentrations of fecal coliform collected during the recreational season and non-recreational season, respectively, compared to applicable thresholds. Figures 5-14 and 5-15 show the percent of samples in each waterbody exceeding each of the three thresholds during the respective seasons.

Figure 5-12: Measured Concentrations of Fecal Coliform during Recreational Season

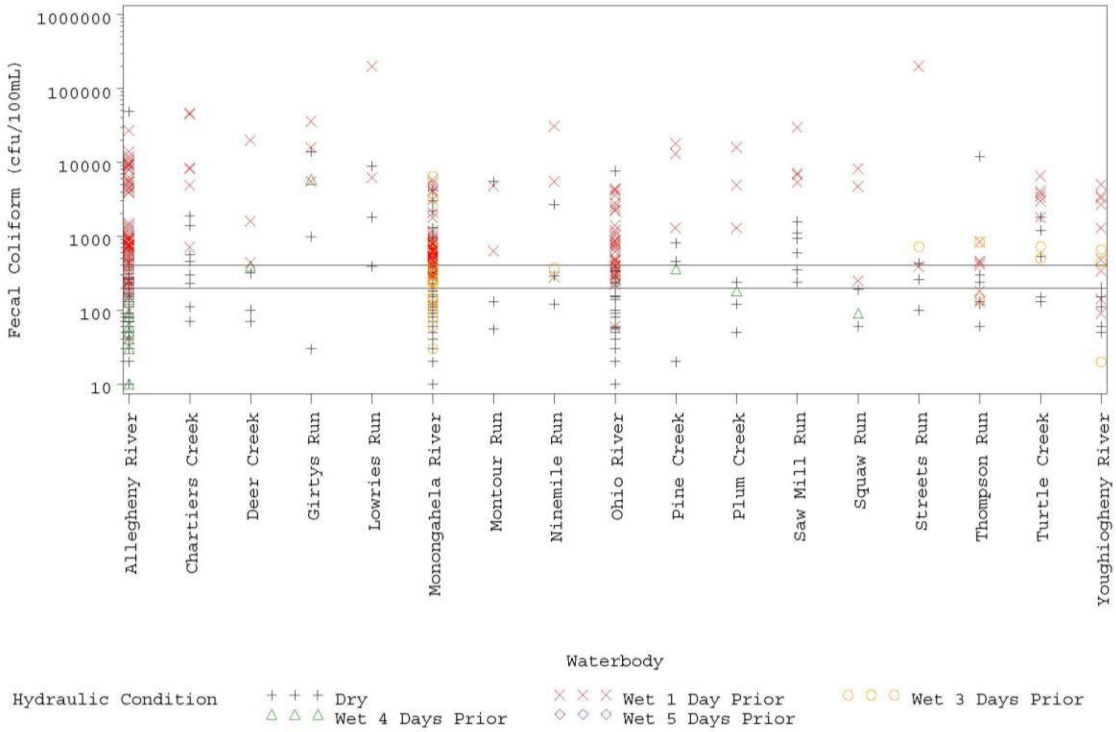


Figure 5-13: Measured Concentrations of Fecal Coliform during Non-Recreational Season

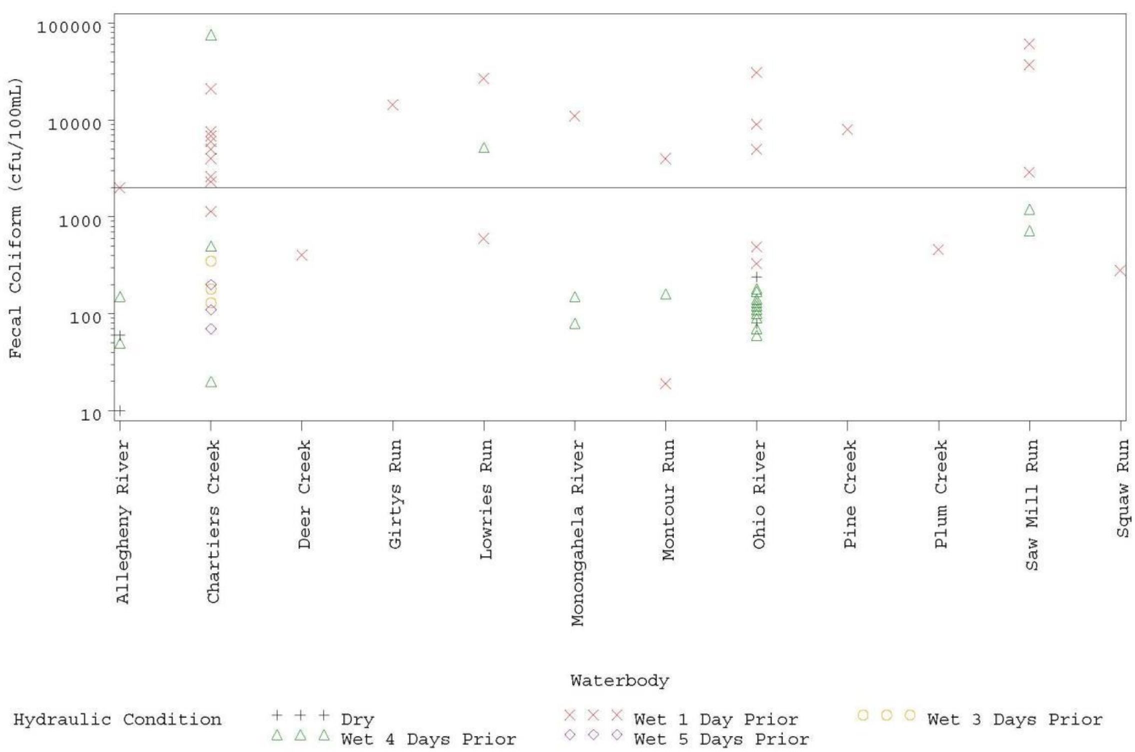


Figure 5-14: Percent of Fecal Coliform Samples > 200 cfu/100mL during Recreational Season

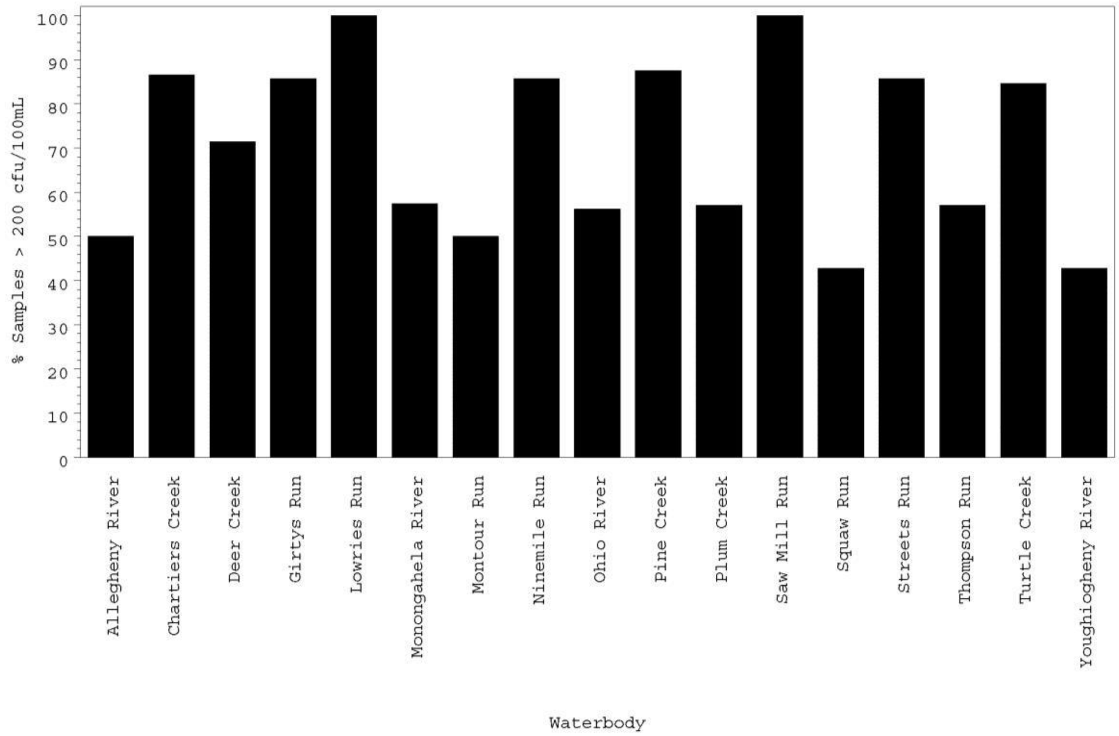
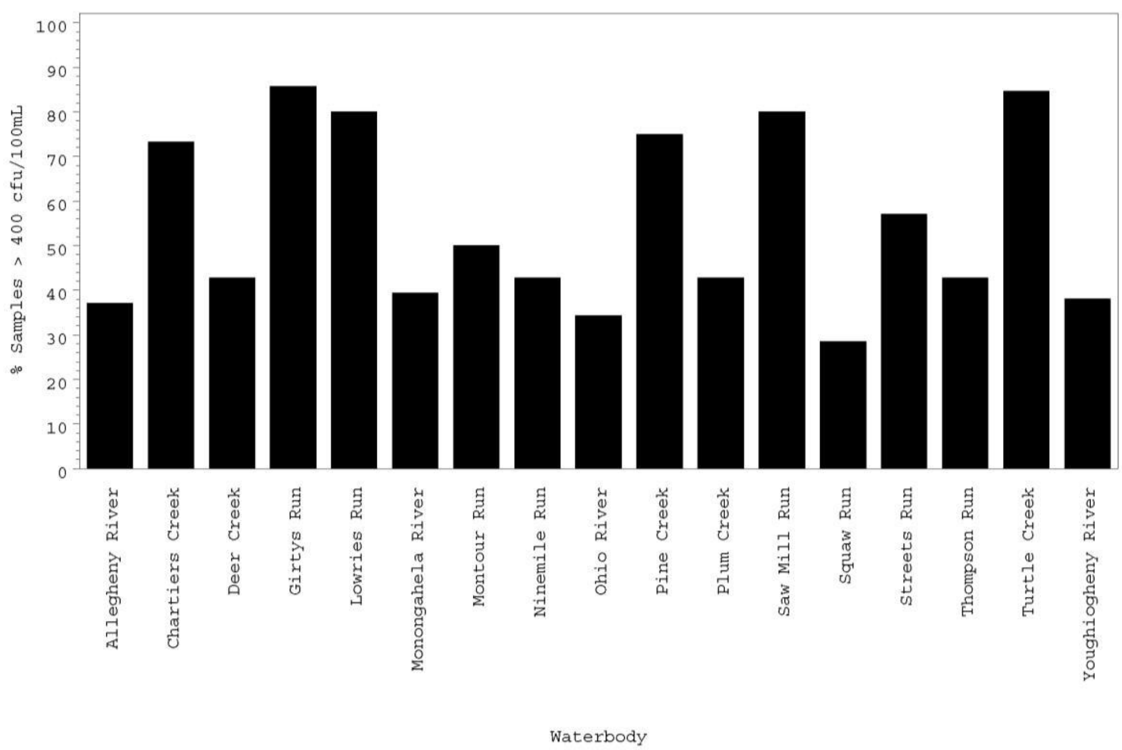


Figure 5-15: Percent of Fecal Coliform Samples > 400 cfu/100mL during Recreational Season



Biochemical Oxygen Demand

Although there is not a numeric water quality standard for 5-day biochemical oxygen demand (BOD_5), observations were compared to a reference threshold of 10 mg/L, which is representative of concentrations typically measured in urban stormwater runoff. The majority (83%) of BOD_5 observations were below the minimum reporting limit of 2 mg/L. Note that two samples were measured to lower minimum reporting limits. Figure 5-16 shows the measured BOD_5 concentrations by waterbody compared to the 10 mg/L threshold. Two wet weather samples on Lowries Run and one wet weather sample on Streets Run exceeded the threshold (Table 5-24). According to USGS field notes, the 9/28/2009 sample from Lowries Run was collected near an active sanitary sewer overflow (SSO) discharge which supports the high BOD_5 concentration. This sample also has high concentrations of phosphorus and nitrogen and a low DO concentration, as discussed below.

Figure 5-16: Measured Concentrations of BOD_5

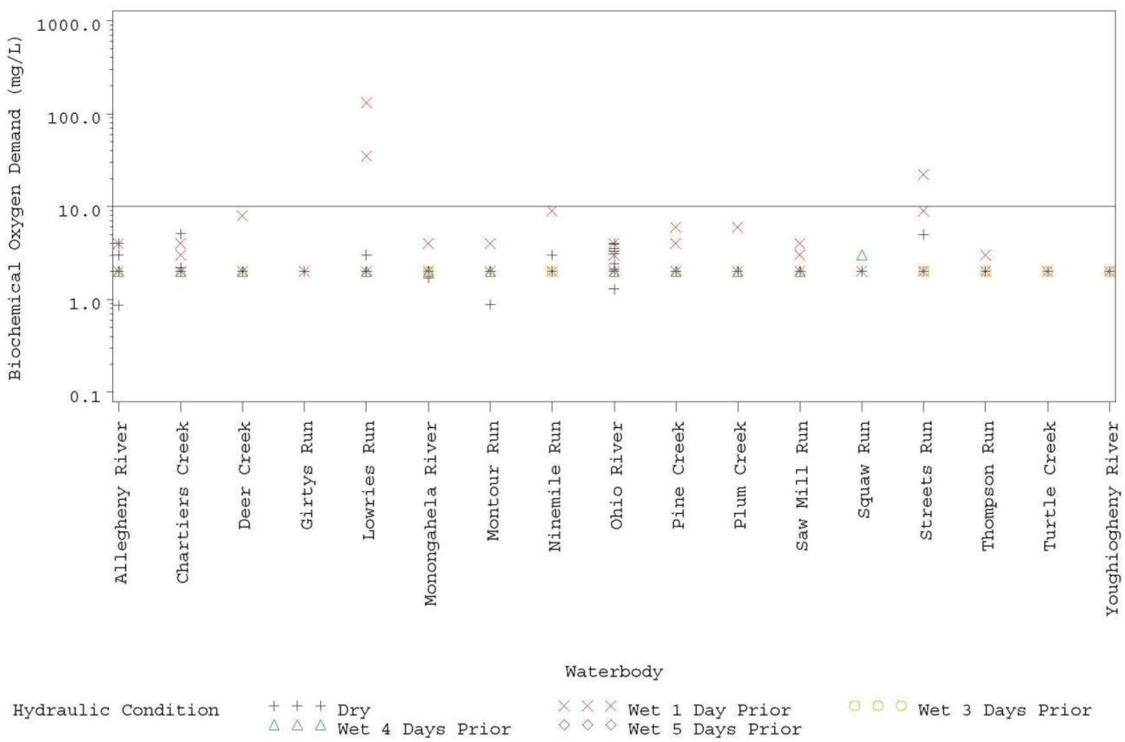


Table 5-24: BOD_5 Observations Exceeding 10 mg/L Reference Threshold

Waterbody	River Mile ID	USGS Station	Sample Date/Time	Qualifier	Value	Units	QA/QC Flag	Hydraulic Condition
Lowries Run	L-00.0	030859501	10/18/06 2:45 PM	=	35	mg/L	A	PW1
Lowries Run	L-00.0	030859501	9/28/09 9:15 AM	=	131	mg/L	A	PW1
Streets Run	SR-00.4	03085113	6/4/08 9:35 AM	=	22	mg/L	A	PW1

Dissolved Oxygen

The Pennsylvania instream dissolved oxygen (DO) standards include a minimum instantaneous concentration and a minimum daily average concentration, both of which vary by designated use and season (Table 5-13). The measured DO concentrations were compared to the most restrictive minimum DO standard for each station over the year. Figure 5-17 shows the measured DO concentrations by waterbody. Table 5-25 lists the only sample, collected on Lowries Run on 9/28/2009, which had a value below either the instantaneous or daily average DO standard. This sample was collected near an active SSO discharge and also had extreme values of BOD_5, nitrogen and phosphorus.

Figure 5-17: Measured DO Concentrations

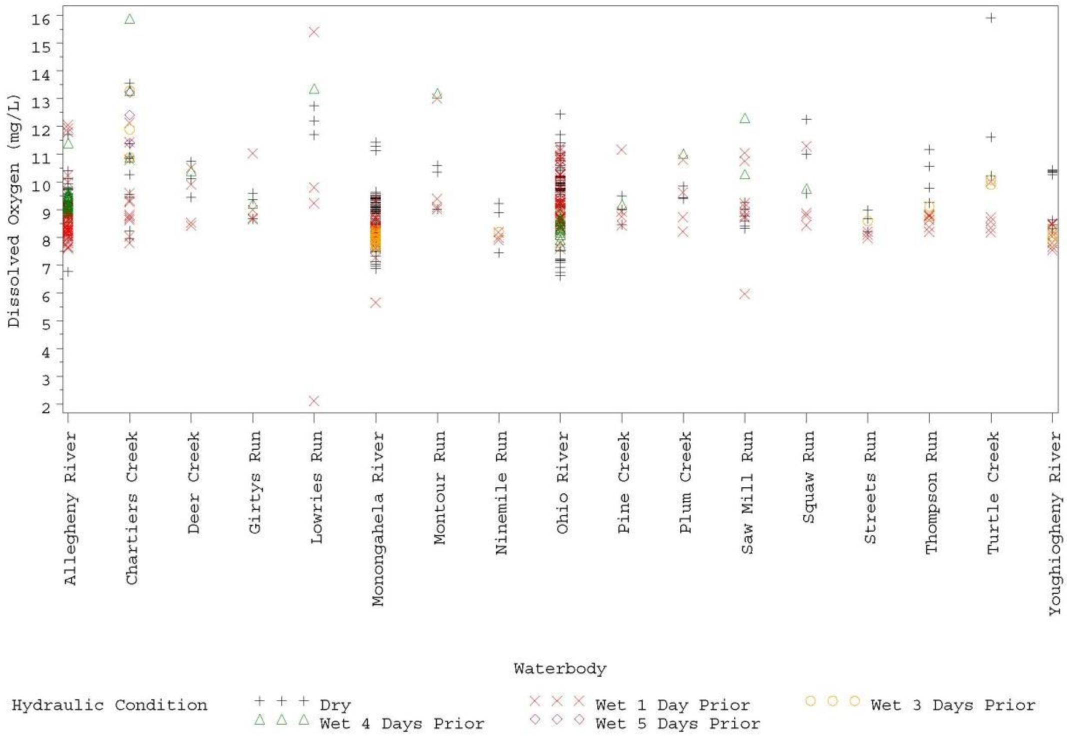


Table 5-25: Samples with Measured DO Less Than DO Standard

Waterbody	River Mile ID	USGS Station	Sample Date/Time	Qualifier	Value	Units	QA/QC Flag	Hydraulic Condition	Designated Use	Instant DO Standard (mg/L)	Average DO Standard (mg/L)
Lowries Run	L-00.0	030859501	9/28/09 9:15 AM	=	2.1	mg/L	AF	PW1	TSF	4	5

Total Ammonia Nitrogen

Observations of total ammonia nitrogen were compared to the total ammonia nitrogen standards (Table 5-13), which are calculated for each individual result as a function of pH and temperature. The standards include a criterion maximum concentration (CMC) and a criterion chronic concentration (CCC). The CMC defines the maximum instantaneous ammonia concentration; the CCC is the maximum 30-day average ammonia concentration and is less than the CMC. Figure 5-18 shows the range of measured concentrations by waterbody. Figures 5-19 and 5-20 show the difference between the measured concentration and associated CMC and CCC, respectively. Any values above zero indicate an exceedance of the applicable standard.

Two samples exceeded the CMC, one of which was the Lowries Run sample on 9/28/2009, and the other was reported as a non-detect where the minimum reporting limit exceeded the CMC. Six samples exceeded the CCC, four of which were non-detects with a minimum reporting limit exceeding the standard. In addition to the Lowries Run sample, there was one sample on Turtle Creek that also exceeded the CCC by 0.05 mg/L in dry weather. Note that the non-detect samples listed in Tables 5-26 and 5-27 were analyzed by the ALCOSAN laboratory, which had a minimum reporting limit of 1.0 mg/L, which is greater than the minimum reporting limit of 0.02 mg/L from the Microbac laboratory.

Figure 5-18: Measured Total Ammonia Nitrogen Concentrations

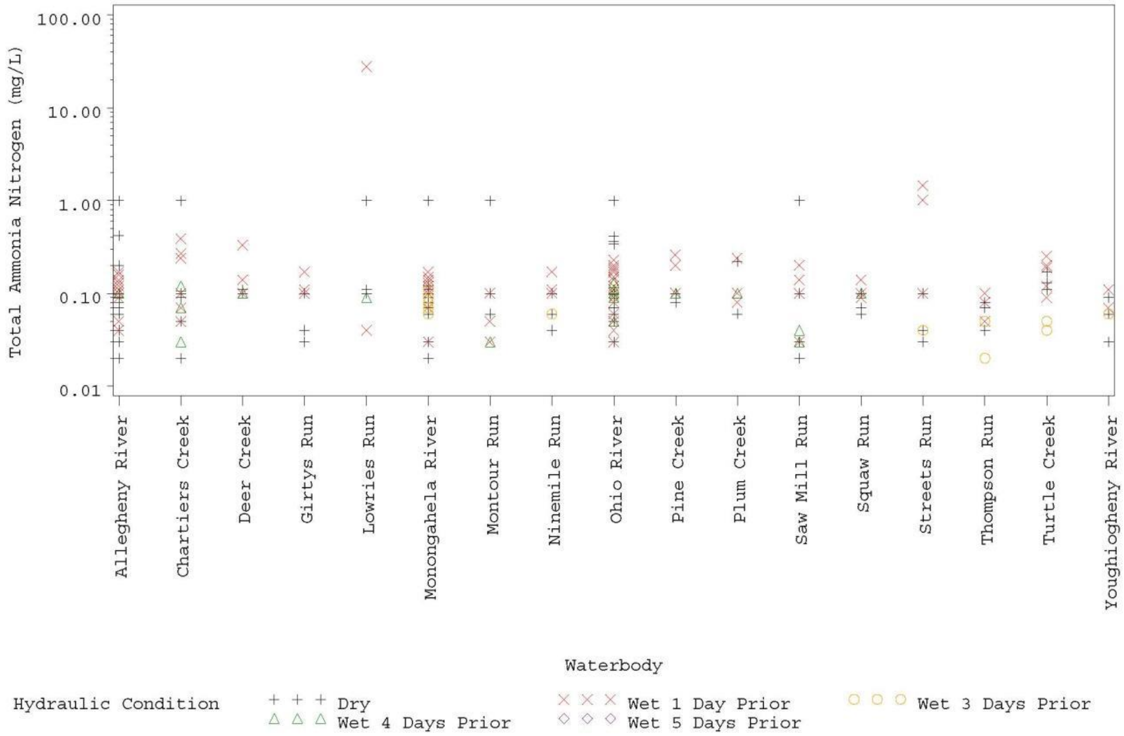


Figure 5-19: Difference between Measured Concentration and CMC for Total Ammonia Nitrogen

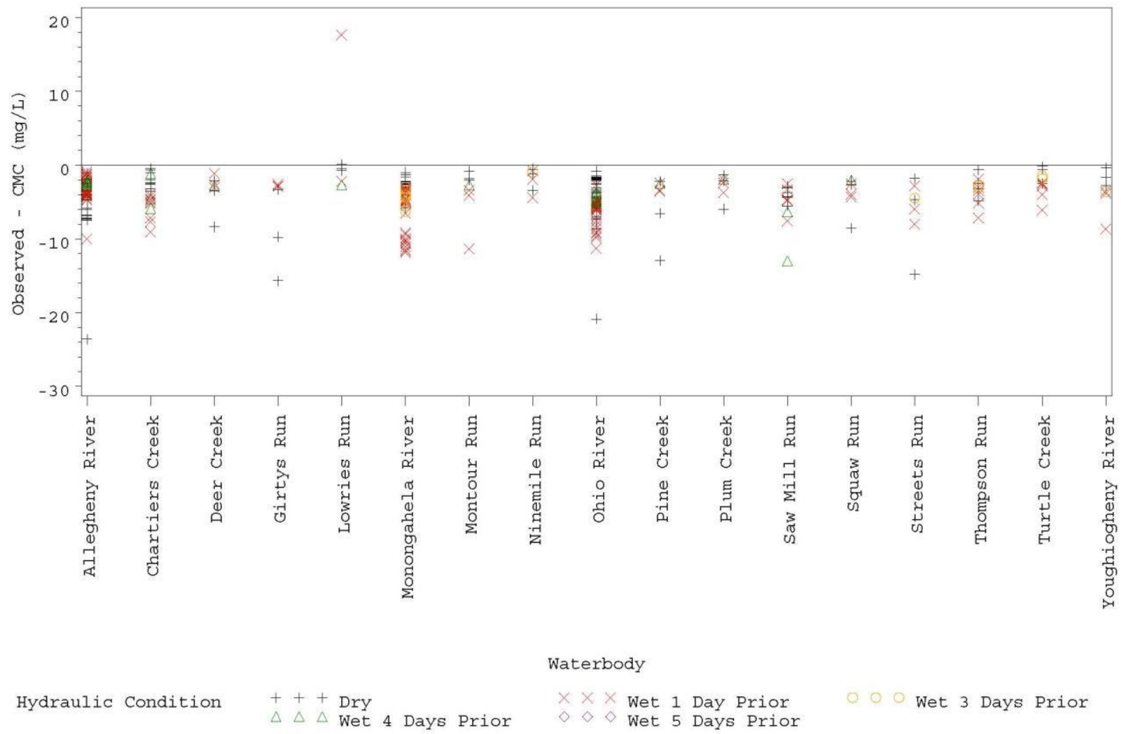


Figure 5-20: Difference between Measured Concentration and CCC for Total Ammonia Nitrogen

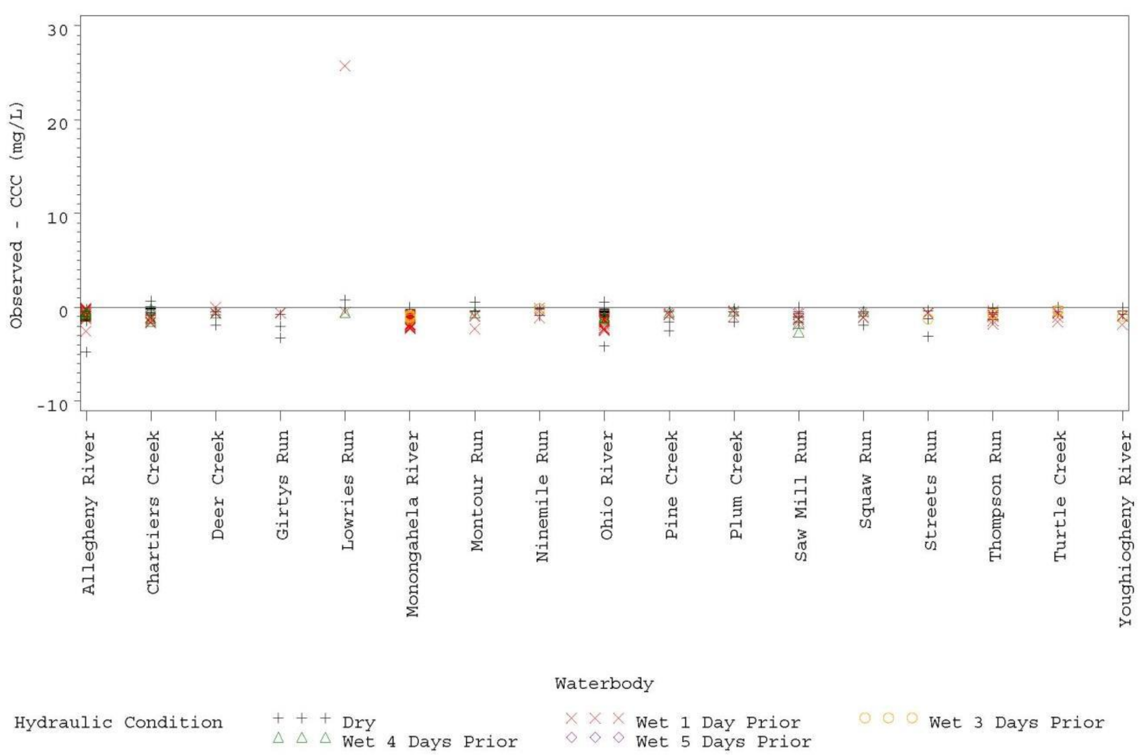


Table 5-26: Samples Exceeding CMC for Total Ammonia Nitrogen

Waterbody	River Mile ID	USGS Station	Sample Date/Time	Qualifier	Value	Units	QA/QC Flag	Hydraulic Condition	pH	Temperature (°C)	CMC (mg/L)
Lowries Run	L-00.0	030859501	9/18/06 12:30 PM	<	1.0	mg/L	P	DW	8.6	18.8	0.9
Lowries Run	L-00.0	030859501	9/28/09 9:15 AM	=	27.8	mg/L	A	PW1	7.1	18.2	10.2

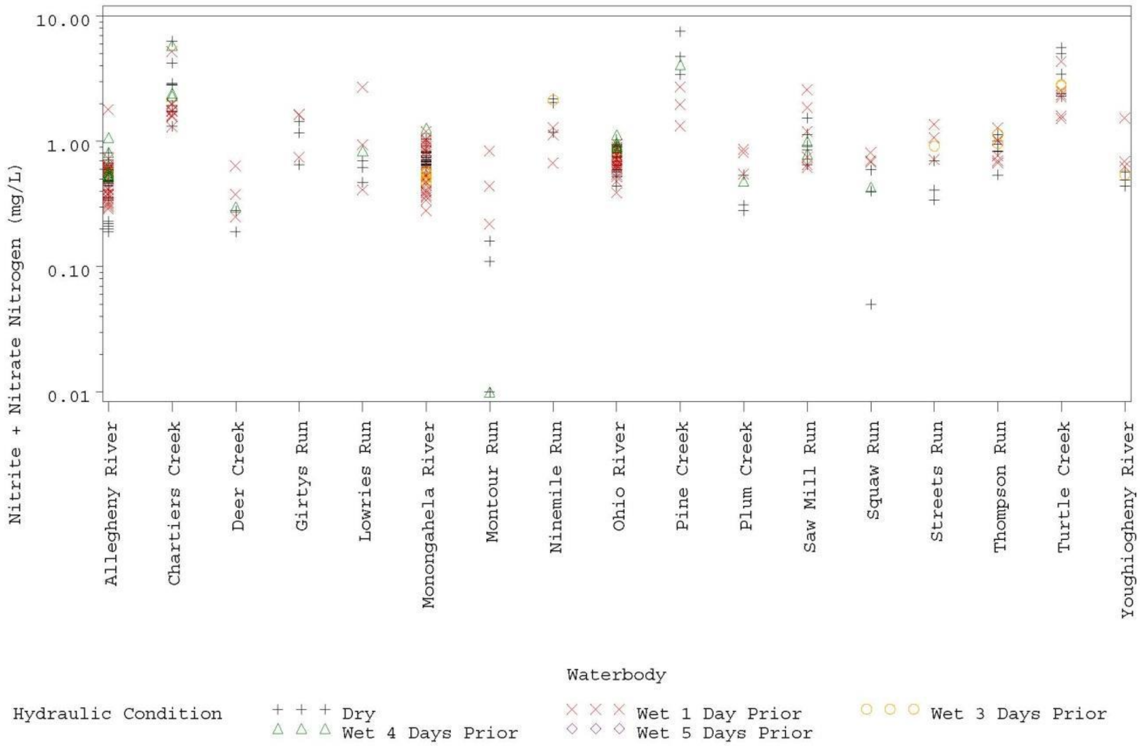
Table 5-27: Samples Exceeding CCC for Total Ammonia Nitrogen

Waterbody	River Mile ID	USGS Station	Sample Date/Time	Qualifier	Value	Units	QA/QC Flag	Hydraulic Condition	pH	Temperature (°C)	CCC (mg/L)
Chartiers Creek	C-04.6	03085550	9/18/06 1:45 PM	<	1.0	mg/L	P	DW	8.3	21.5	0.3
Chartiers Creek	C-16.6	3085290	9/18/06 9:15 AM	<	1.0	mg/L	P	DW	7.9	18.1	0.9
Lowries Run	L-00.0	030859501	9/18/06 12:30 PM	<	1.0	mg/L	P	DW	8.6	18.8	0.2
Lowries Run	L-00.0	030859501	9/28/09 9:15 AM	=	27.8	mg/L	A	PW1	7.1	18.2	2.1
Ohio River	O-04.0	03085670	9/18/06 1:00 PM	<	1.0	mg/L	P	DW	8.2	19.4	0.4
Turtle Creek	T-03.2	03084698	8/26/09 1:40 PM	=	0.1	mg/L	NDJ	DW	9.1	24.6	0.1

Nitrite+Nitrate Nitrogen

The nitrite+nitrate nitrogen standard is a maximum instantaneous concentration of 10 mg/L to protect public water supplies. Figure 5-21 shows the distribution of measured concentrations, none of which exceeded the 10 mg/L standard.

Figure 5-21: Measured Concentrations of Nitrite+Nitrate Nitrogen by Waterbody



Total Phosphorus

Although there is not a numeric water quality standard for total phosphorus (TP), a common in-stream target used throughout the northeast by USEPA and state regulatory agencies is 0.100 mg/L. Figure 5-22 shows the measured TP concentrations by waterbody compared to this threshold. The threshold of 0.100 mg/L was exceeded in all waterbodies except Montour Run, Squaw Run, Thompson Run, and Youghiogheny River, and was exceeded in more than 75% of the samples in Chartiers Creek, Pine Creek and Turtle Creek. Figure 5-23 shows the percent of samples in each water body that exceed the 0.100 mg/L reference threshold. As identified in the Saw Mill Run TMDL, Saw Mill Run has an in-stream target concentration of 0.035 mg/L which was exceeded by 75% of the samples. Total phosphorus appears to be a basin-wide concern, with CSO discharges being a potentially significant source in wet weather. As a result, TP should be considered when comparing the performance of various control alternatives, but should not be the primary consideration when selecting alternatives.

Figure 5-22: Measured Concentrations of Total Phosphorus

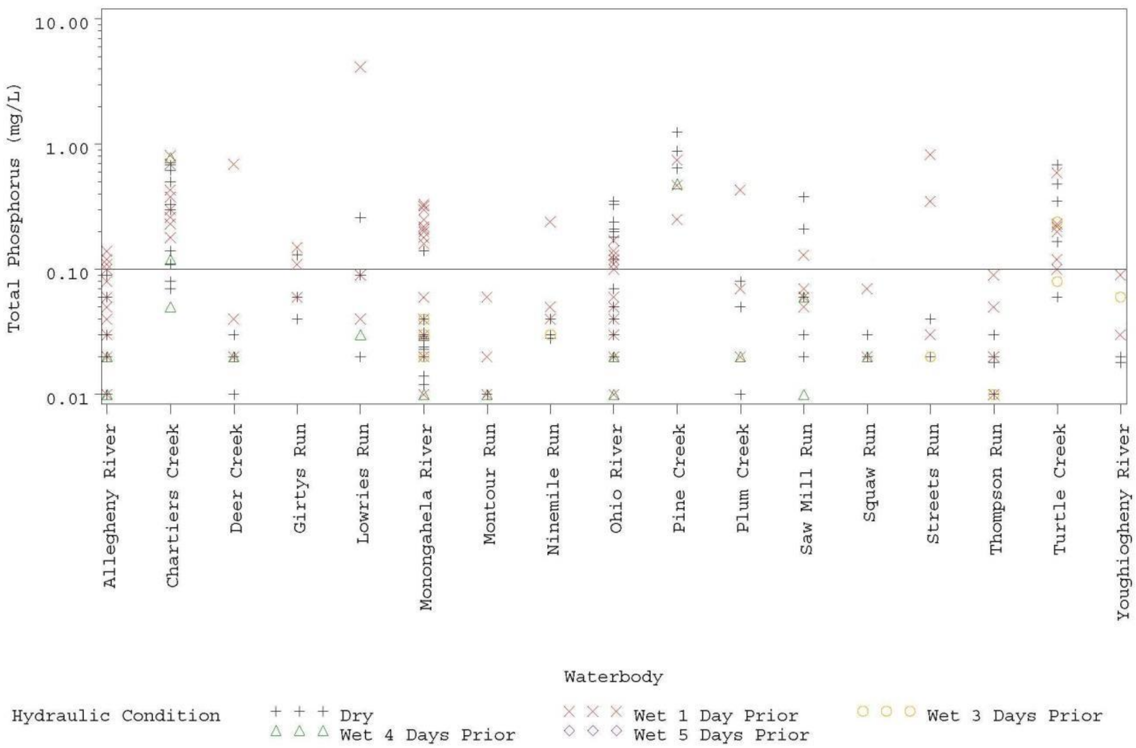
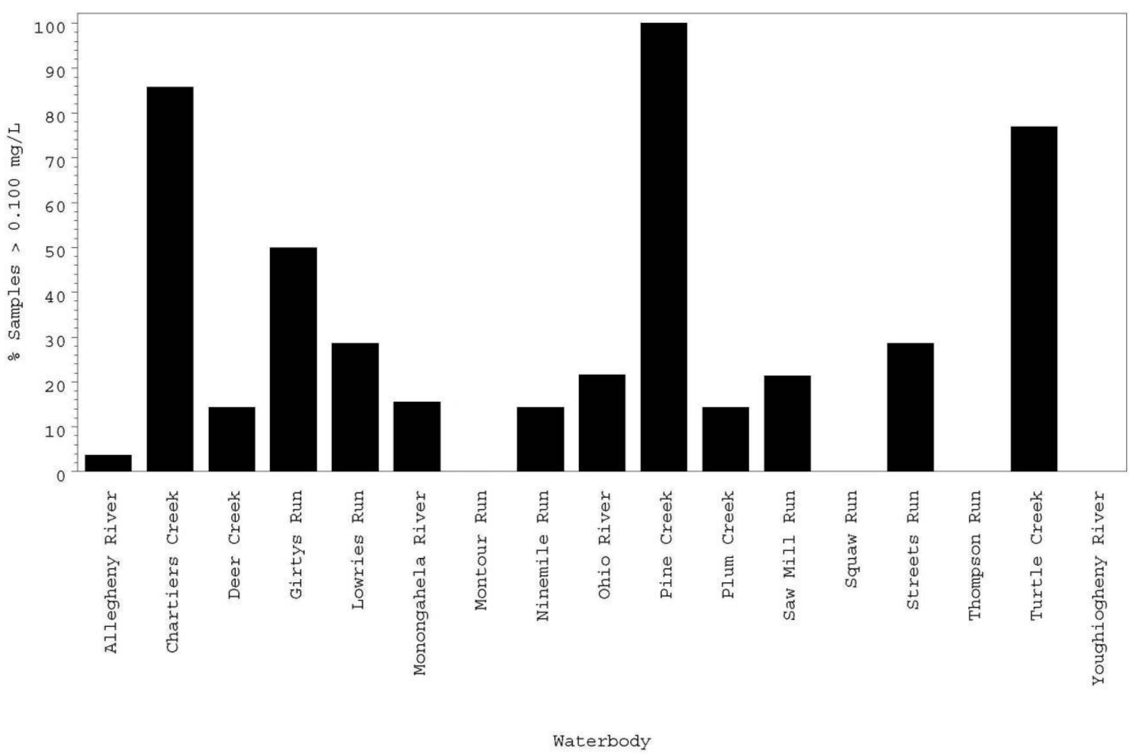


Figure 5-23: Percent of Samples Exceeding Reference Threshold of 0.100 mg/L



Total Suspended Solids

Although there is not a numeric water quality standard for total suspended solids (TSS), measured concentrations were compared to a reference threshold of 60 mg/L, which is the maximum instantaneous effluent limit for the ALCOSAN WWTP. Please note that this threshold is conservative in that it compares an end of pipe threshold concentration to measured in-stream concentrations. At least one exceedance of this threshold was measured in most waterbodies. All exceedances occurred one day after a wet weather event (PW1). Figure 5-24 shows the measured concentrations in each waterbody compared to the 60 mg/L threshold and Figure 5-25 shows the percent of samples exceeding 60 mg/L by waterbody. High TSS concentrations during wet weather may be attributable to watershed sediment washoff associated with stormwater runoff as well as instream bank erosion, bottom scour and resuspension of sediment. Due to the number of exceedances, TSS should be considered when comparing the performance of various control alternatives, but should not be the primary consideration when selecting alternatives.

Figure 5-24: Measured Concentrations of TSS

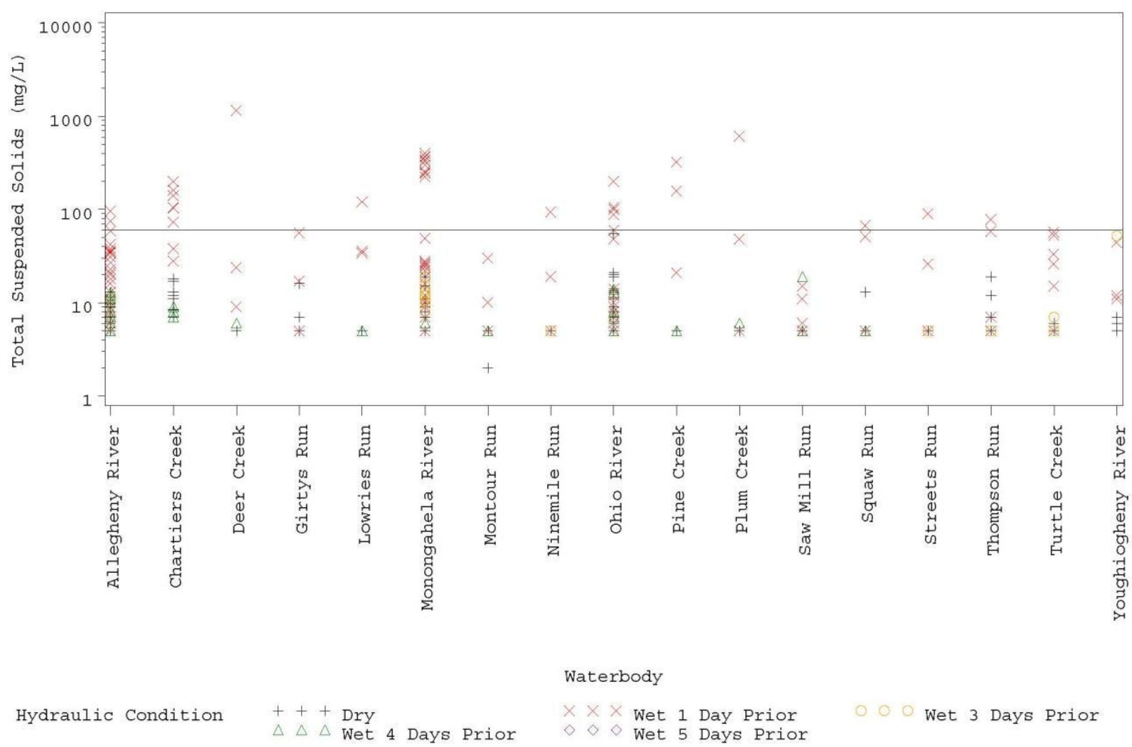
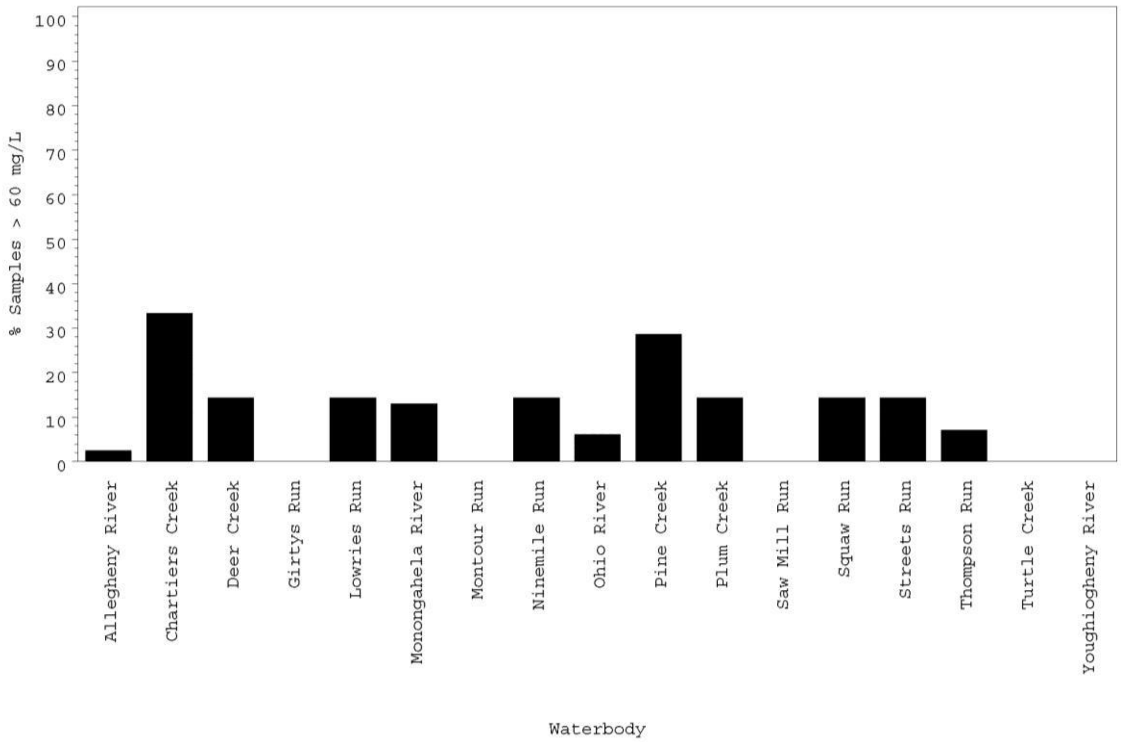


Figure 5-25: Percent of Samples Exceeding 60 mg/L Reference Threshold



pH

The pH observations were compared to the Pennsylvania standards, which include a maximum pH of 9.0 and a minimum pH of 6.0 at all times. The pH level was measured using two different methods for each sample: 1) in situ during sample collection using a pH probe and 2) during sample analysis at the laboratory. Both datasets were included in this evaluation. Figure 5-26 shows the measured pH levels by waterbody compared to the minimum and maximum pH standards. Table 5-28 lists two samples that were either less than the minimum pH or greater than the maximum pH. One sample from Nine Mile Run had a lab pH less than 6.0 and one sample on Turtle Creek had an in-situ pH exceeding 9.0; both deviated from the standard by less than 1.0 standard unit.

Figure 5-26: Measured pH

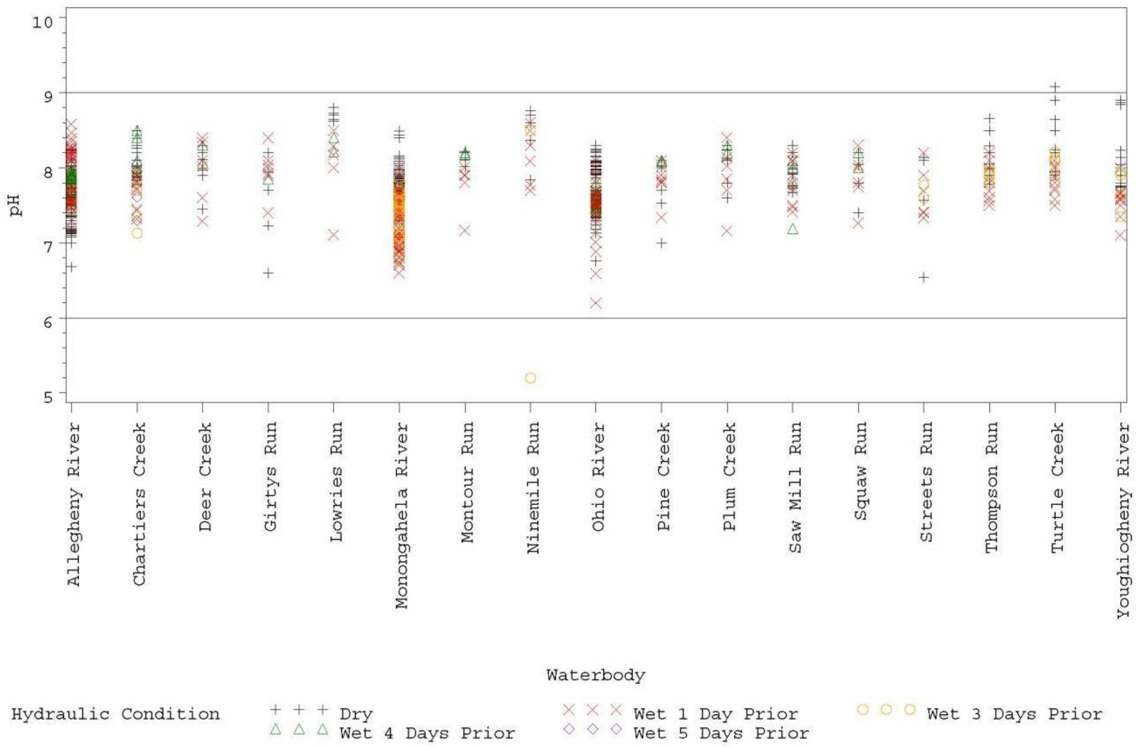


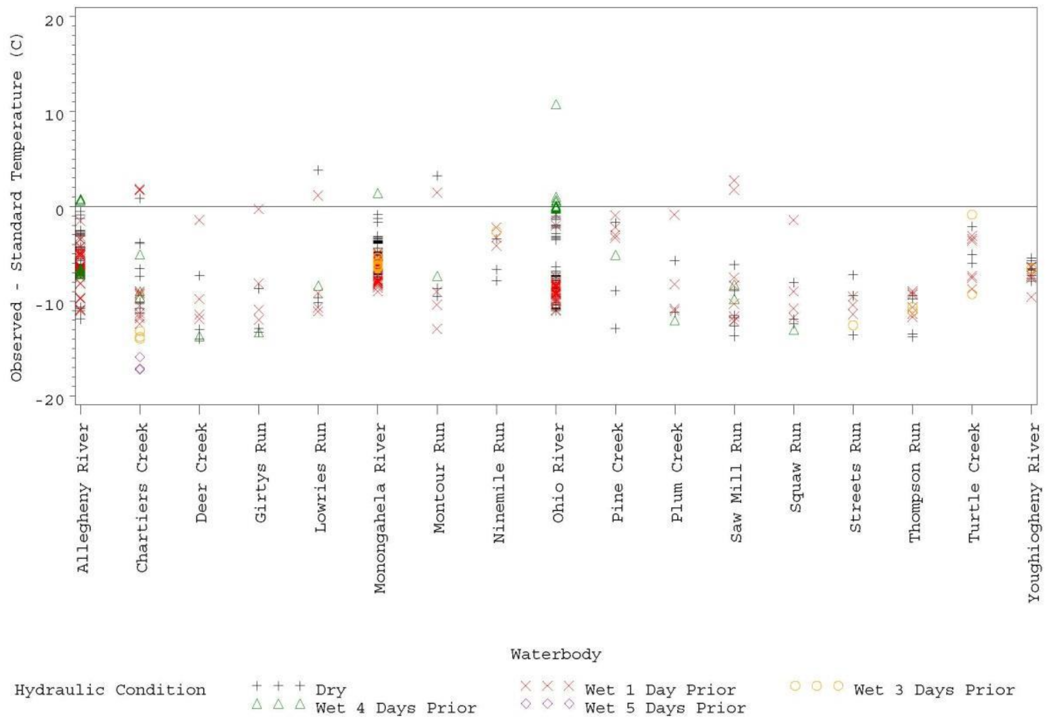
Table 5-28: Samples with pH < 6.0 or pH > 9.0

Waterbody	Lab	River Mile ID	USGS Station	Sample Date/Time	Qualifier	Value	Units	QA/QC Flag	Hydraulic Condition
Ninemile Run	Microbac	N-00.2	03085050	7/12/08 9:20 AM	=	5.2	su	A	PW3
Turtle Creek	Field	T-03.2	03084698	8/26/09 1:40 PM	=	9.1	su	AF	DW

Temperature

Field measurements of temperature were compared to standards of maximum instantaneous temperature. The maximum temperature standards vary seasonally and by designated use for aquatic life. Figure 5-27 shows the deviation of the measured temperatures from the maximum temperature standard. There were no significant deviations from the standard, with the majority of exceedances being less than 5 ˚C. In addition, most of the exceedances occurred on the same day in different locations suggesting climatic forces were the primary cause of elevated temperatures.

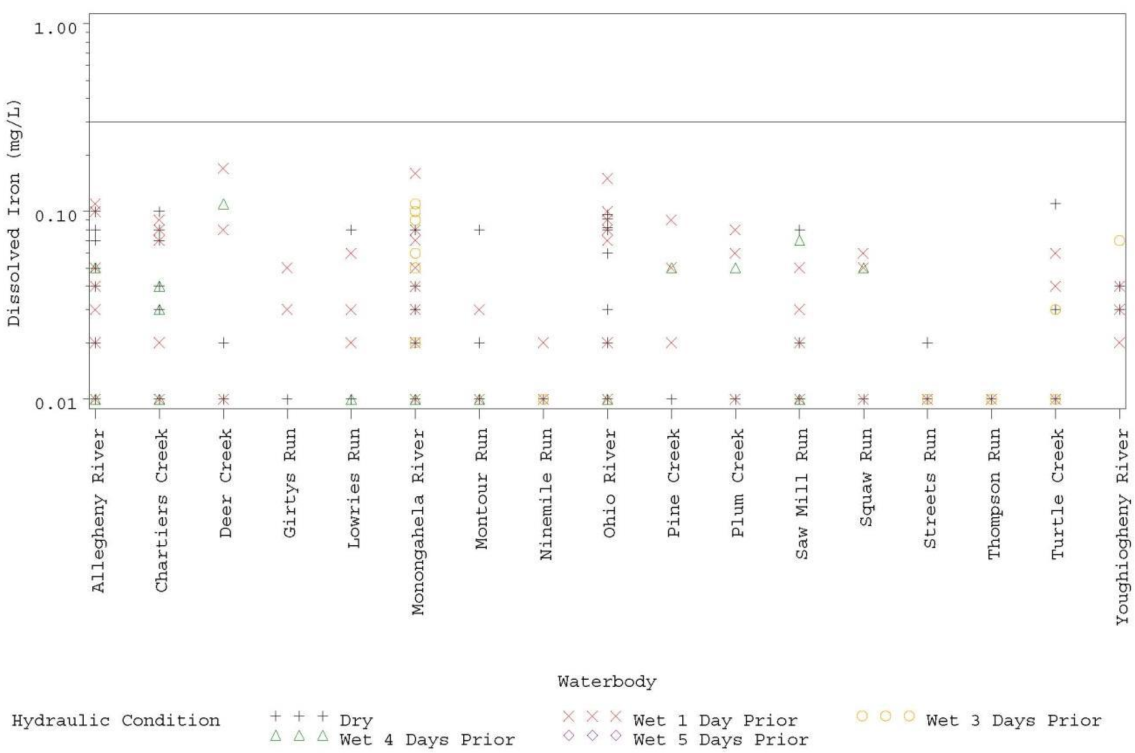
Figure 5-27: Deviation of Measured Temperatures from Maximum Temperature Standard



Dissolved Iron

The Pennsylvania standard for dissolved iron is a maximum instantaneous concentration of 0.3 mg/L. None of the samples exceeded this standard as shown in Figure 5-28.

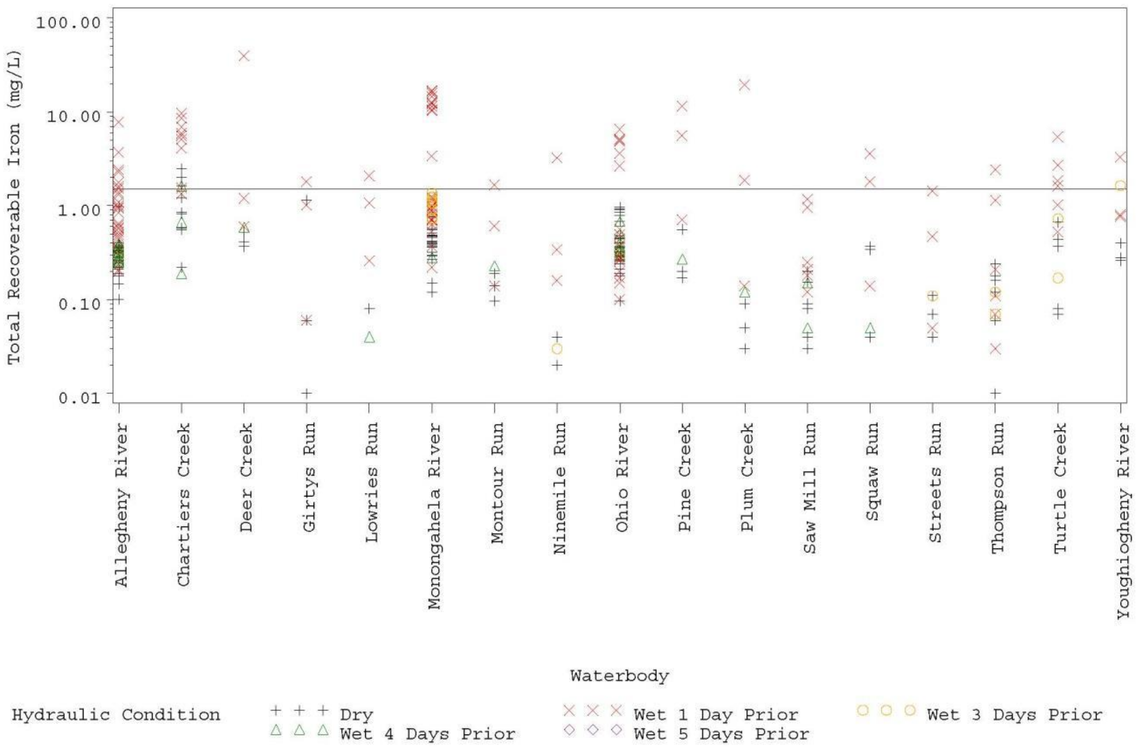
Figure 5-28: Measured Concentrations of Dissolved Iron



Total Recoverable Iron

The Pennsylvania standard for total recoverable iron is a maximum 30-day average of 1.5 mg/L. Figure 5-29 shows the measured total recoverable iron concentrations for each individual result as a conservative comparison to the 30-day average based standard. This threshold was exceeded in at least one sample on each waterbody, except Saw Mill Run and Streets Run. Similar to TSS, the majority of the exceedances occurred one day after a wet weather event (PW1). The PDEP Abandoned Mine Land Inventory database indicates numerous acid mine drainage (AMD) discharge sites within the ALCOSAN service area. As AMD often finds its way into surface waters and typically contains large amounts of iron, it is unclear whether CSO and SSO discharges are significant contributing sources of iron.

Figure 5-29: Measured Concentrations of Total Recoverable Iron



Dissolved Lead

The majority (98%) of the measured dissolved lead concentrations were less than the minimum reporting limit. The original laboratory analysis method (EPA 200.7) had a minimum reporting limit of 0.05 mg/L, while the alternative method (EPA 200.8) had a much lower minimum reporting limit of 0.00025 mg/L. Because the CCC for dissolved lead ranged from 0.002 to 0.020 mg/L, only results using the second method (EPA 200.8) allow for comparison to Pennsylvania standards. Of the samples analyzed using EPA 200.8, all results were less than the CCC, including both detects and non-detects. Figure 5-30 shows the difference between the measured concentration and the CCC for dissolved lead. With the exception of one non-detect sample on the Youghiogheny River, all measured concentrations were less than the CMC as shown in Figure 5-31.

Figure 5-30: Difference between Measured Concentration and CCC for Dissolved Lead

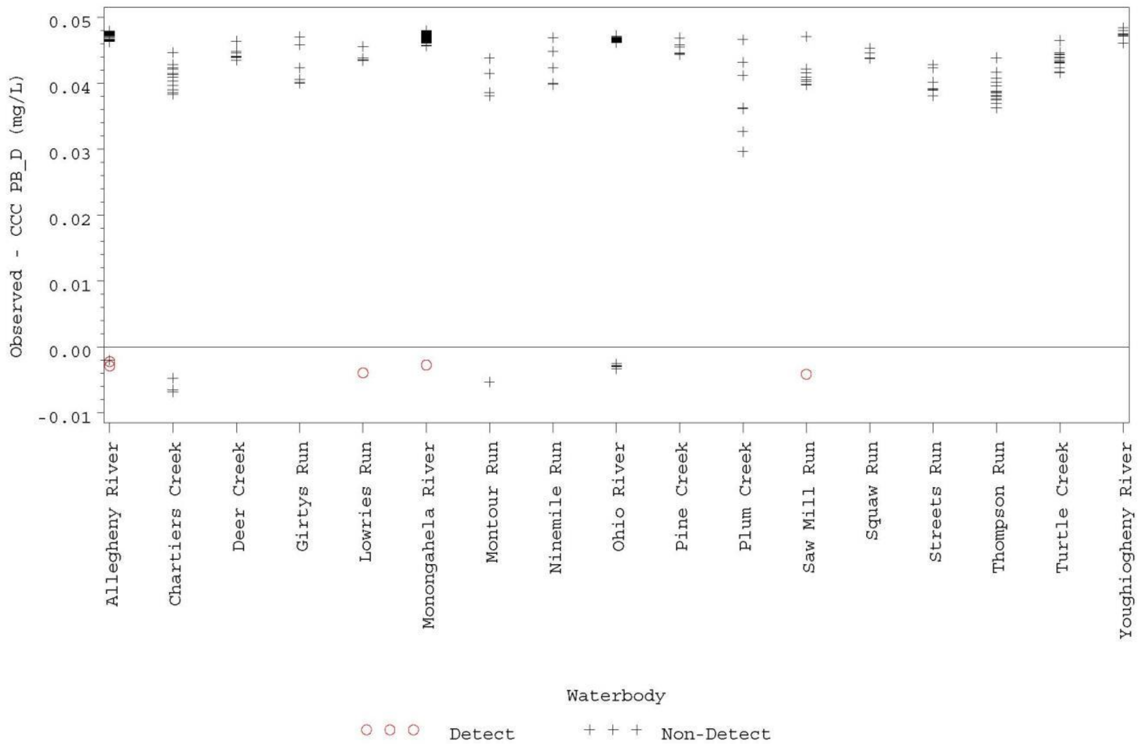
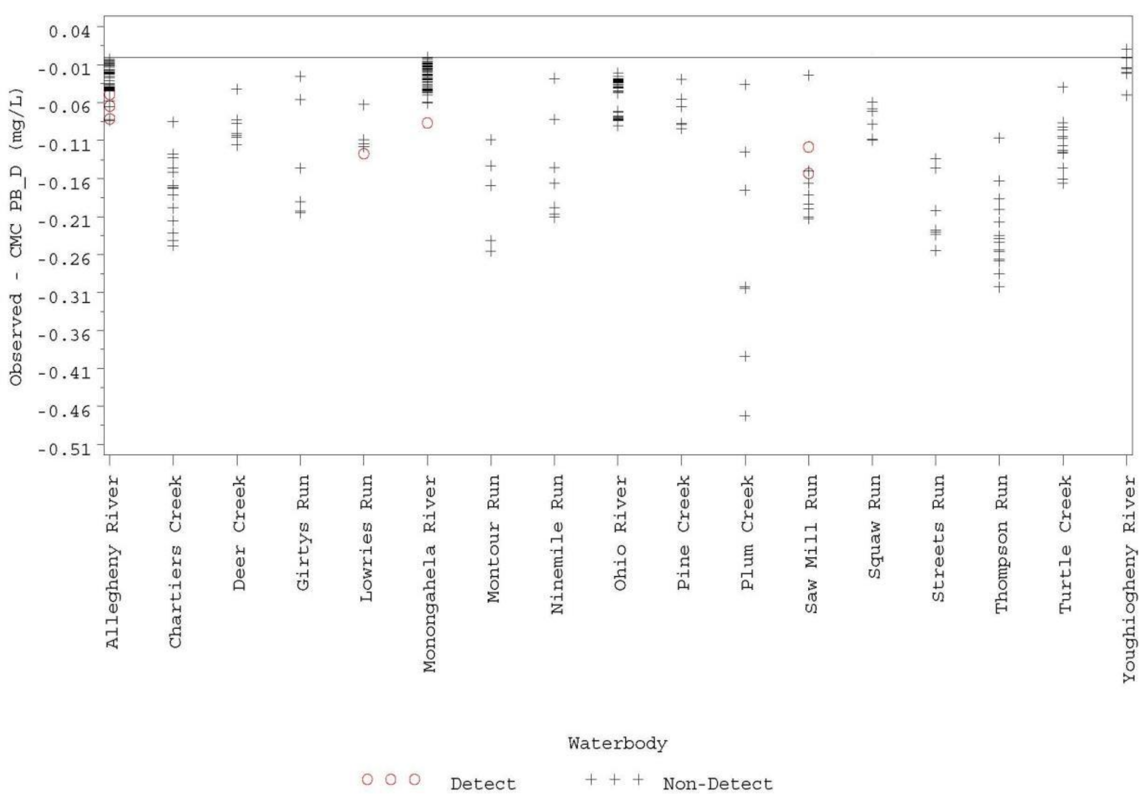


Figure 5-31: Difference between Measured Concentration and CMC for Dissolved Lead



Dissolved Cadmium

The majority (98%) of measured dissolved cadmium concentrations were less than the minimum reporting limit. The original laboratory analysis method (EPA 200.7) had a minimum reporting limit of 0.001 mg/L, while the alternative method (EPA 200.8) had a much lower minimum reporting limit of 0.000125 mg/L. Of the five samples detected above the minimum reporting limit, four exceeded the CCC as shown in Figure 5-32, one exceedance each for Deer Creek, Girtys Run, Pine Creek and Plum Creek. All samples were less than the CMC as shown in Figure 5-33.

Figure 5-32: Difference between Measured Concentration and CCC for Dissolved Cadmium

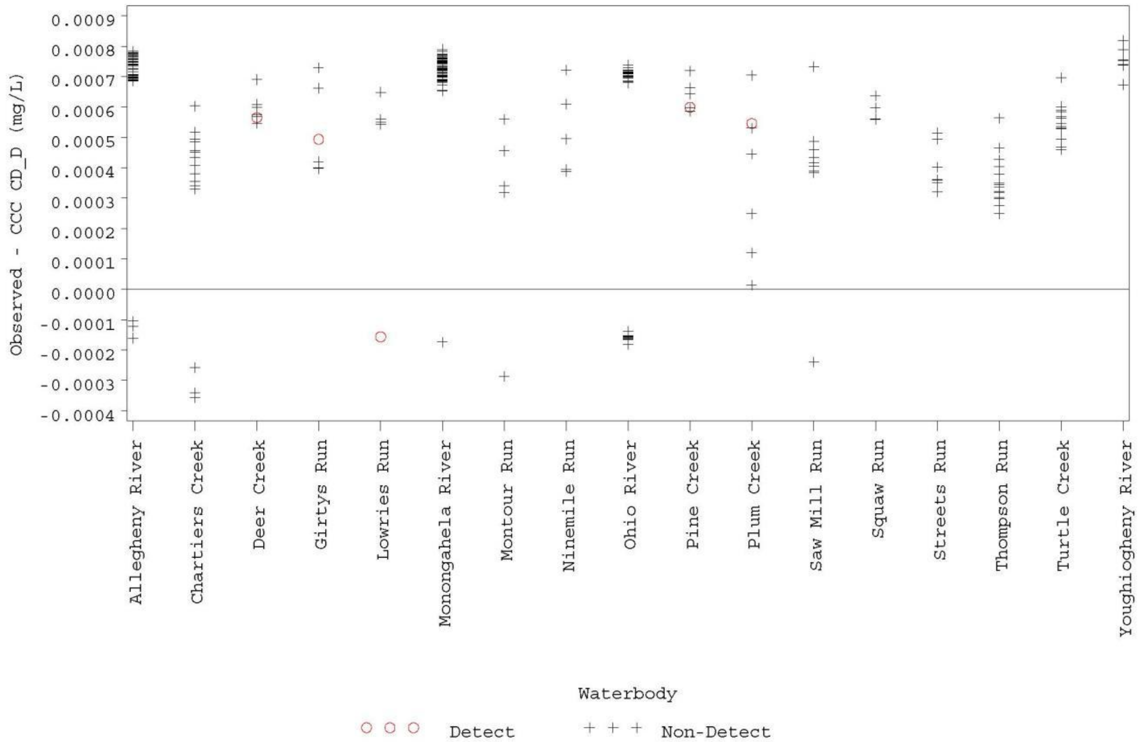
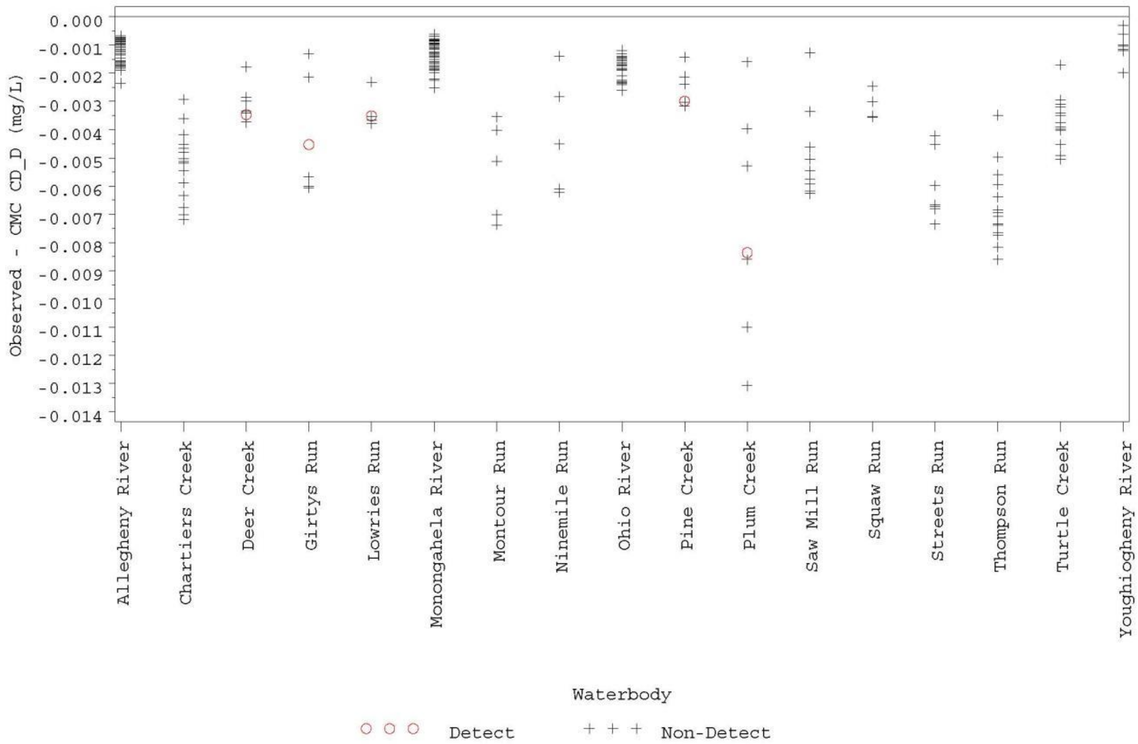


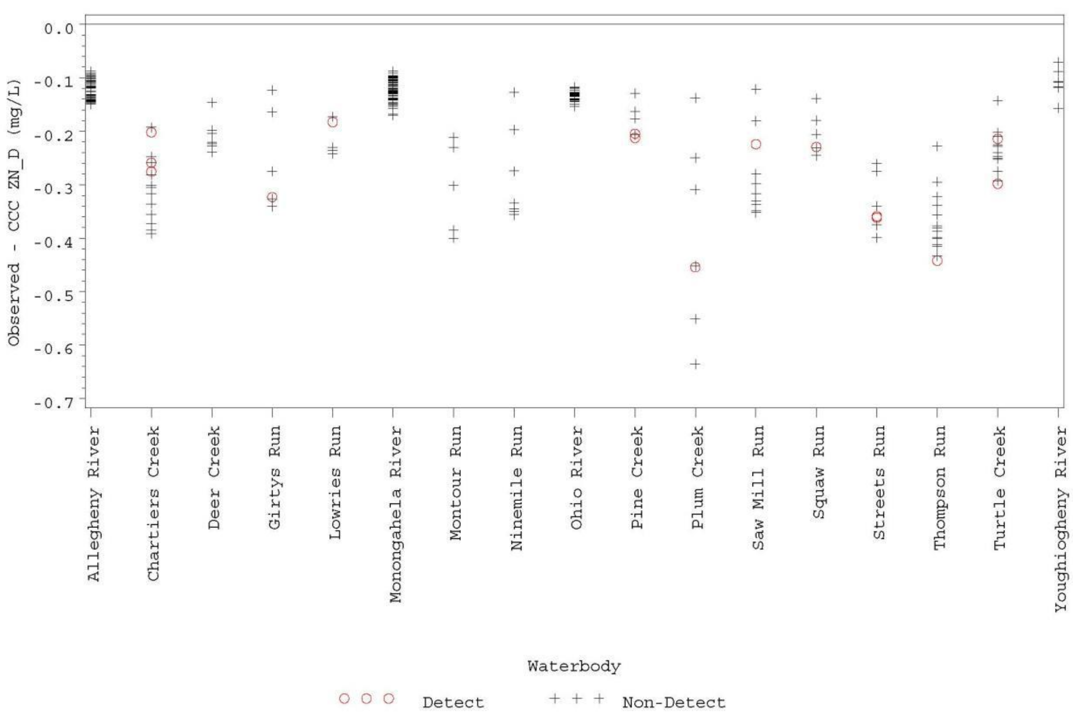
Figure 5-33: Difference between Measured Concentration and CMC for Dissolved Cadmium



Dissolved Zinc

All samples were less than the CCC or CMC for dissolved zinc. Figure 5-34 shows the difference between the measured concentration and the CCC.

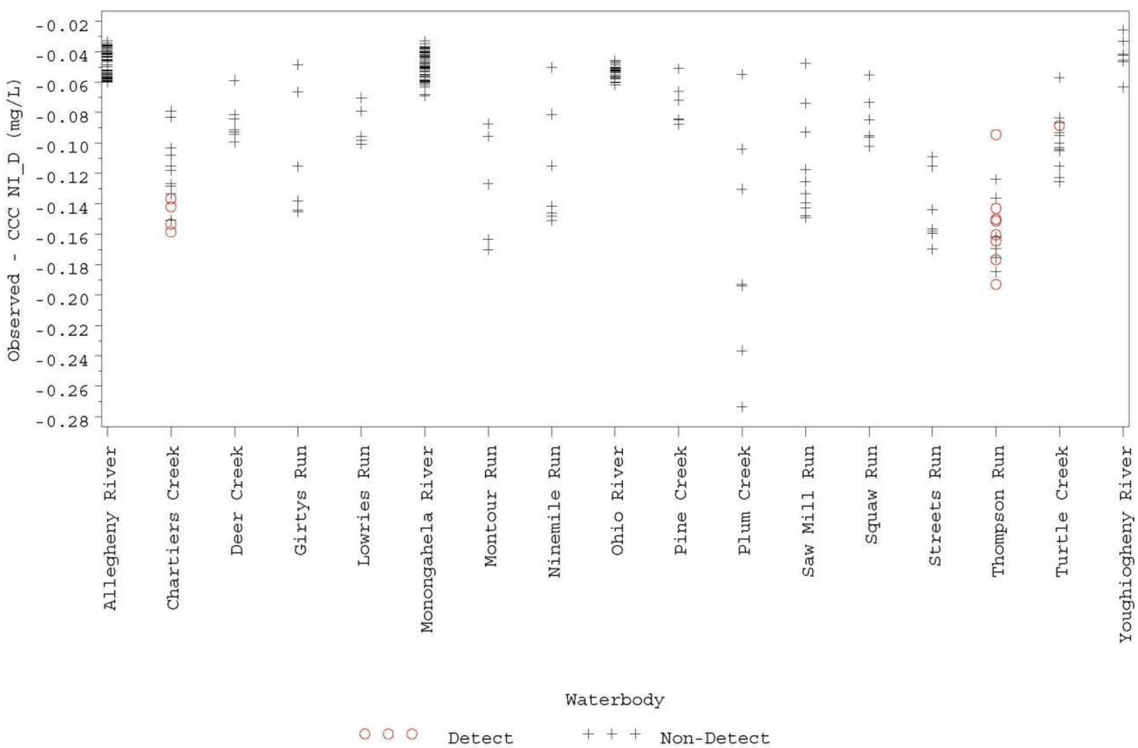
Figure 5-34: Difference between Measured Concentration and CCC for Dissolved Zinc



Dissolved Nickel

All samples were less than the CCC or CMC for dissolved nickel. Figure 5-35 shows the difference between the measured concentration and the CCC.

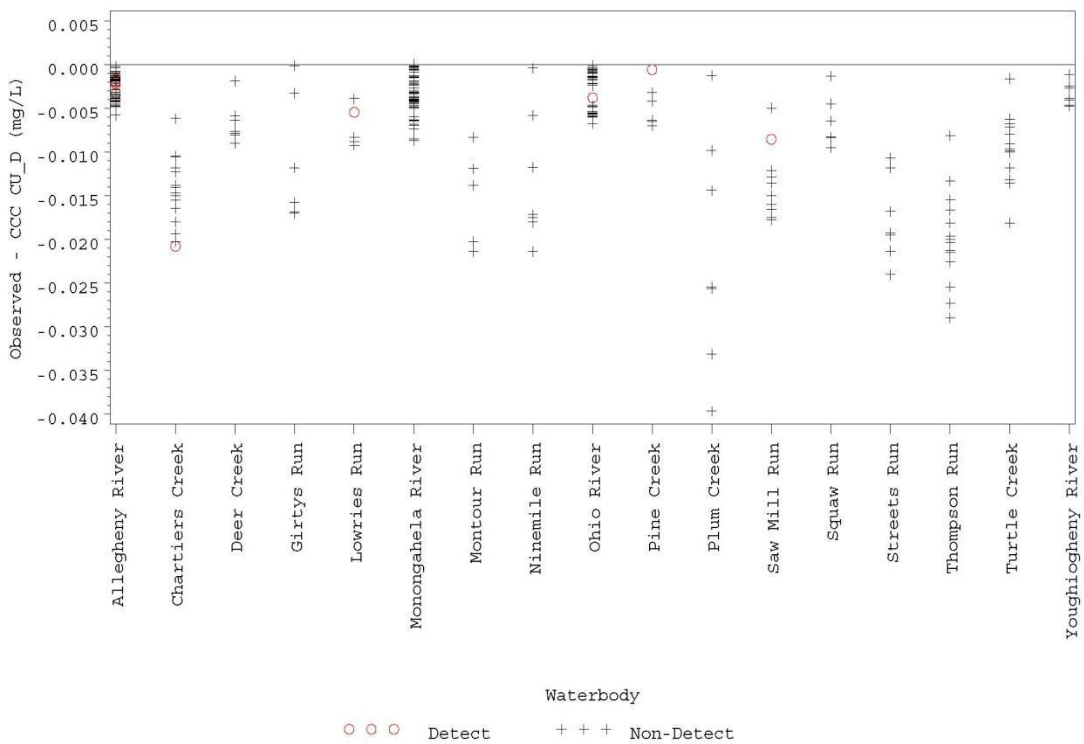
Figure 5-35: Difference between Measured Concentration and CCC for Dissolved Nickel



Dissolved Copper

All samples were less than the CCC or CMC for dissolved copper. Figure 5-36 shows the difference between the measured concentration and the CCC.

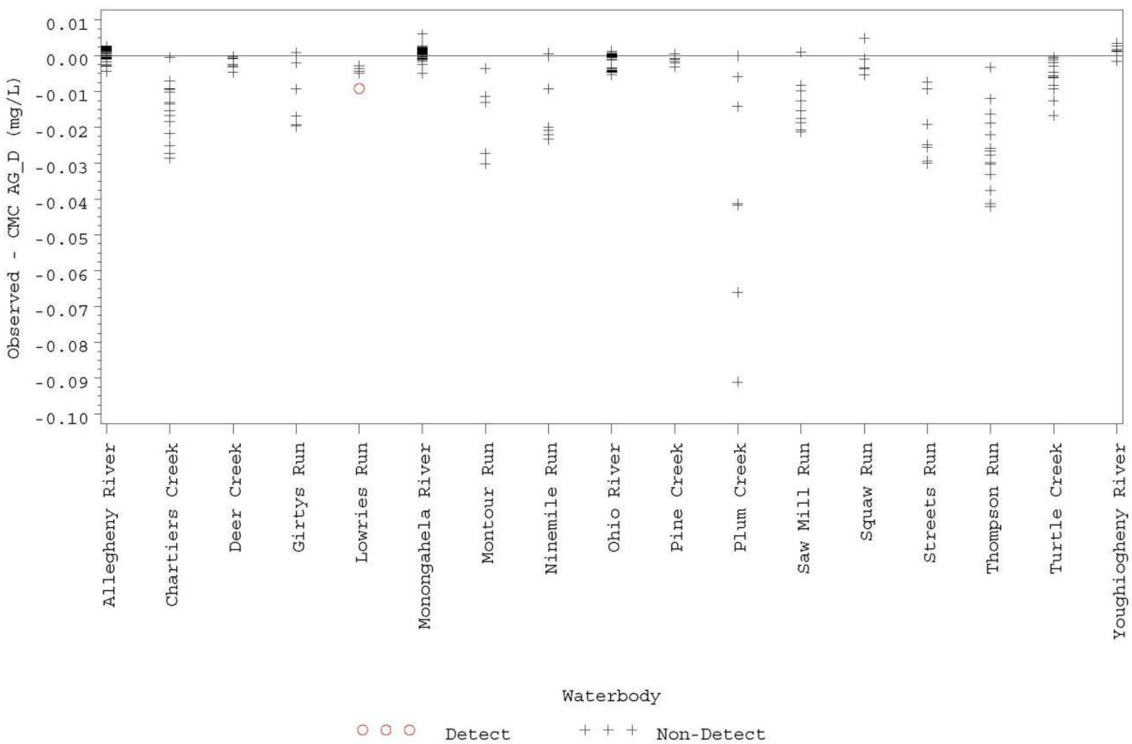
Figure 5-36: Difference between Measured Concentration and CCC for Dissolved Copper



Dissolved Silver

Because there is no CCC for dissolved silver, the measured concentrations were compared only to the CMC. One sample from Lowries Run had a detected concentration greater than the minimum reporting limit and was less than the CMC (Figure 5-37). The majority of the other non-detect samples were less than the CMC. The maximum deviation above the CMC for the non-detect samples was 0.0035 mg/L.

Figure 5-37: Difference between Measured Concentration and CMC for Dissolved Silver



Dissolved Chromium

The chromium results were compared to the CCC for Cr(VI), which is the more toxic form of chromium and also has a lower standard concentration than Cr(III). However, the lab method measures total chromium (including both Cr(III) and Cr(VI)). All chromium results were reported as less than the minimum reporting limit of 0.01 mg/L. Unlike the other heavy metals, the CCC and CMC for Cr(VI) are not calculated as a function of hardness. The CCC for Cr(VI) is equal to 0.01 mg/L. Because all samples were reported as less than 0.01 mg/L, which is the CCC, none of the samples exceeded the CCC or CMC for Cr(VI).

PCBs

All PCB concentrations were less than the practical quantification limit of 1.0 µg/L.

Additional plots of measured parameter concentrations by station are included in Attachment E of ALCOSAN's *Receiving Water and CSO Outfall Monitoring Data Report.*

5.4.2 CSO Discharges

The combined sewer overflow pollutant monitoring program was designed to collect representative wastewater samples throughout the ALCOSAN sewer system in both dry and wet weather conditions. This section presents the results from these sampling efforts. CSO PMP plots of measured concentrations by parameter and location for samples collected from 2007 through 2011 are included as Figures 5-38 through 5-64

The data shown on the plots are designated as dry (x) or wet (o) weather. Sample concentrations reported below the minimum reporting limit are differentiated by color. In general, dry weather samples were collected prior to the wet weather samples for any given event. Not all locations shown on the plots have three dry and three (or more) wet weather sample as this may be a dry sampling location that was not used for wet weather sampling. At some locations where three dry and three wet samples were collected, it appears that not all of the results are shown. This is because results of equal concentration will appear as one result (e.g. metals). There are also some results (e.g. metals_dissolved) reported below the minimum reporting limit, but greater than the method detection limit. This was done to maintain consistency with the receiving water data which required lower reporting limits for evaluation of ALCOSAN data to water quality standards.

A data summary by dry and wet weather and parameter is presented in Table 5-29. Data shown in this table represent combined results for all of the CSO PMP sampling locations.

Attachment F of ALCOSAN's *Receiving Water and CSO Outfall Monitoring Data Report* includes a tabular summary of the CSO PMP dry and wet weather data collected from 2007 through 2010 by location and parameter. Event Summary Reports for each of the CSO PMP wet weather events from 2007 through 2010 are presented in Attachment H of the *Receiving Water and CSO Outfall Monitoring Data Report*. The reports include information on the antecedent dry weather period, number of samples collected, duration and volume of rainfall, overflow duration and quality control analyzed. Plots are included which show rainfall pattern, overflow duration and volume, and sample collection times. Plots of measured concentrations for each parameter analyzed are also shown.

Figure 5-38: CSO PMP Measured Concentrations of Fecal Coliform

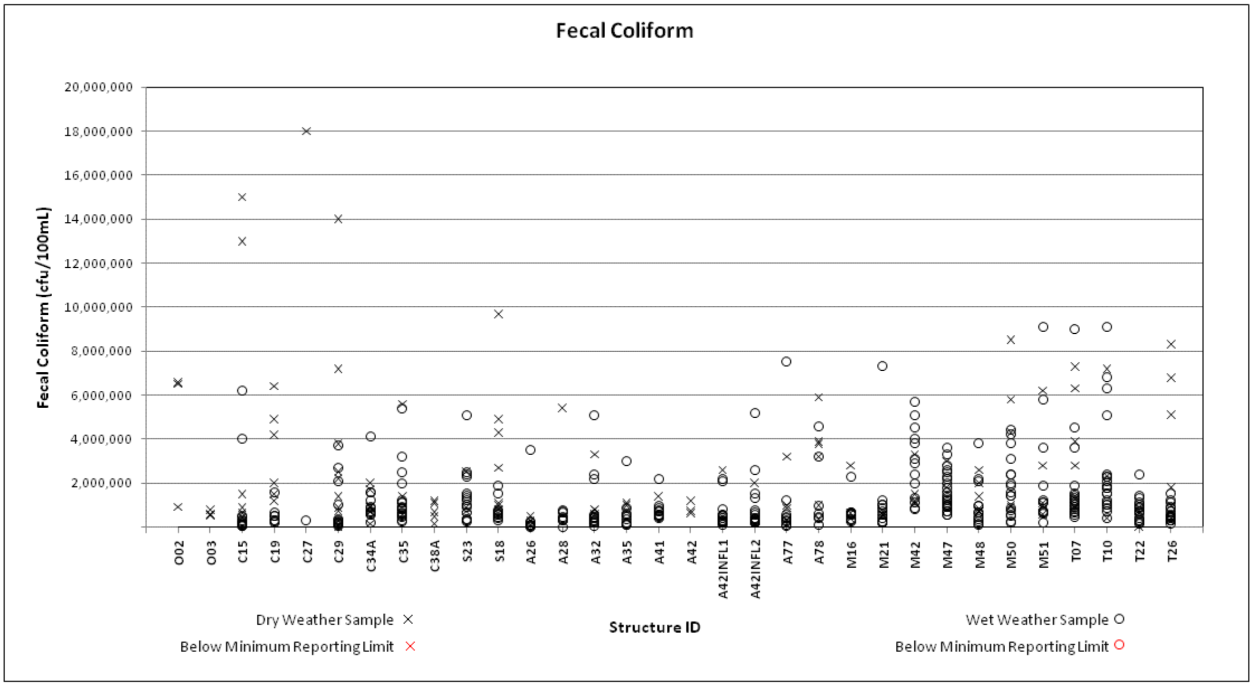


Figure 5-39: CSO PMP Measured Concentrations of E. Coli

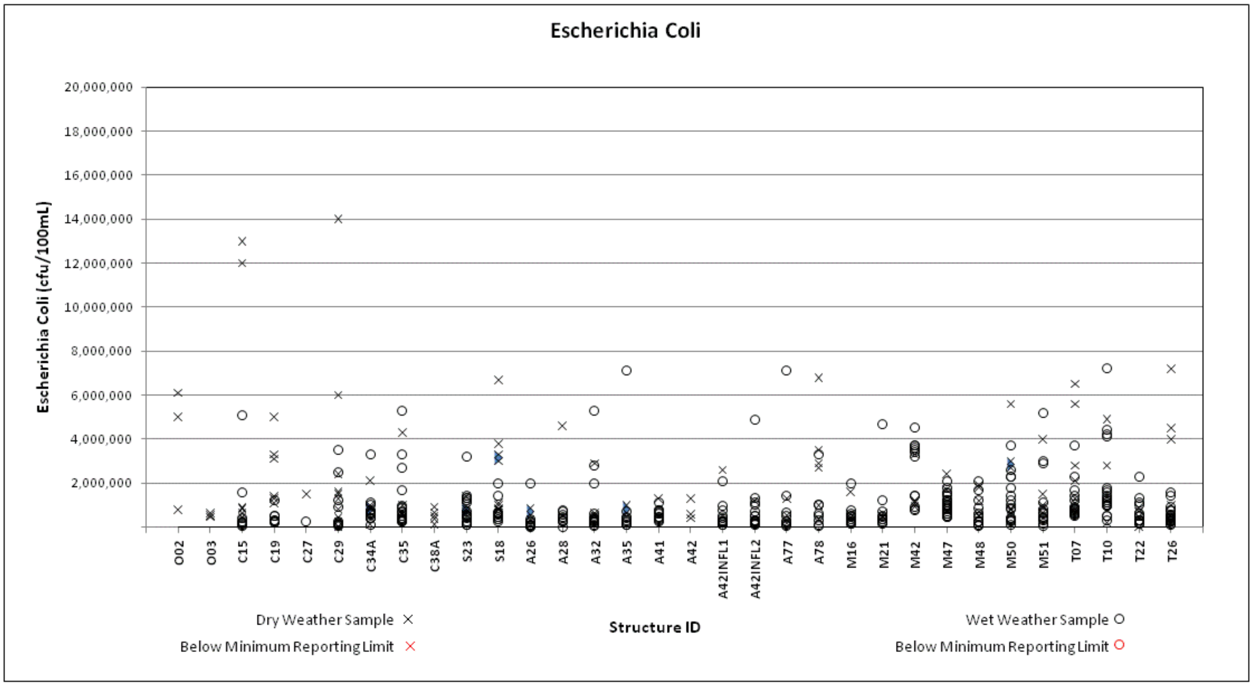


Figure 5-40: CSO PMP Measured Concentrations of BOD_5

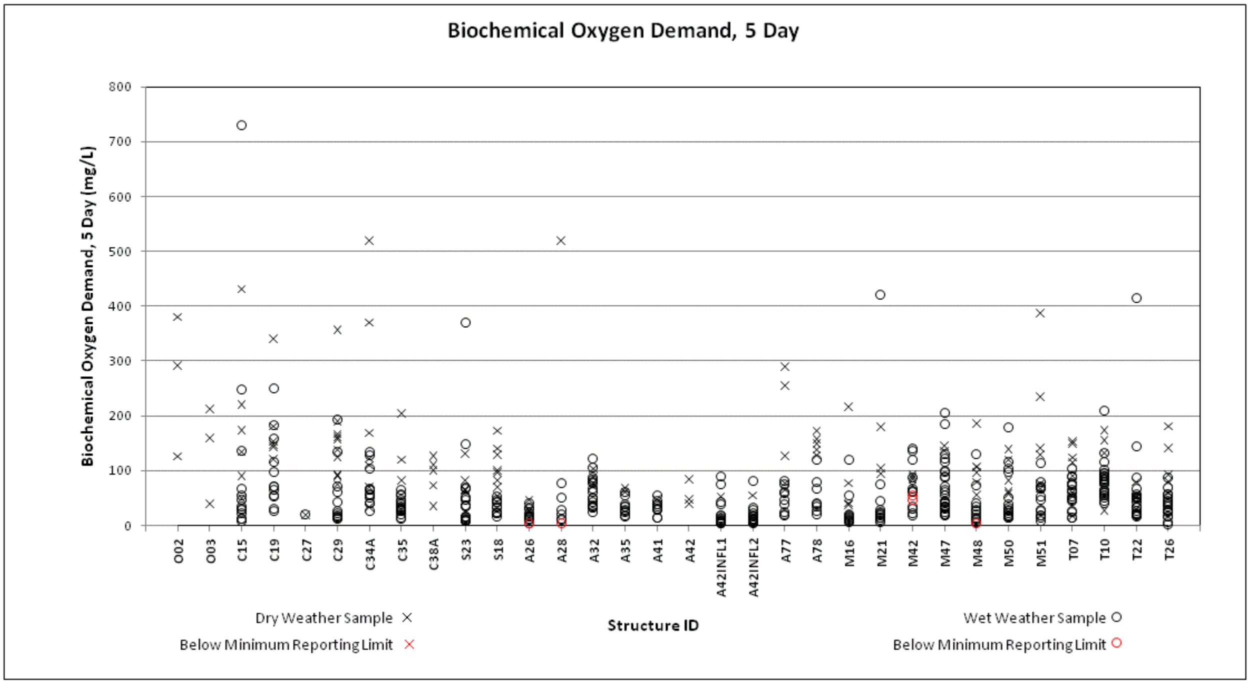


Figure 5-41: CSO PMP Measured Concentrations of COD

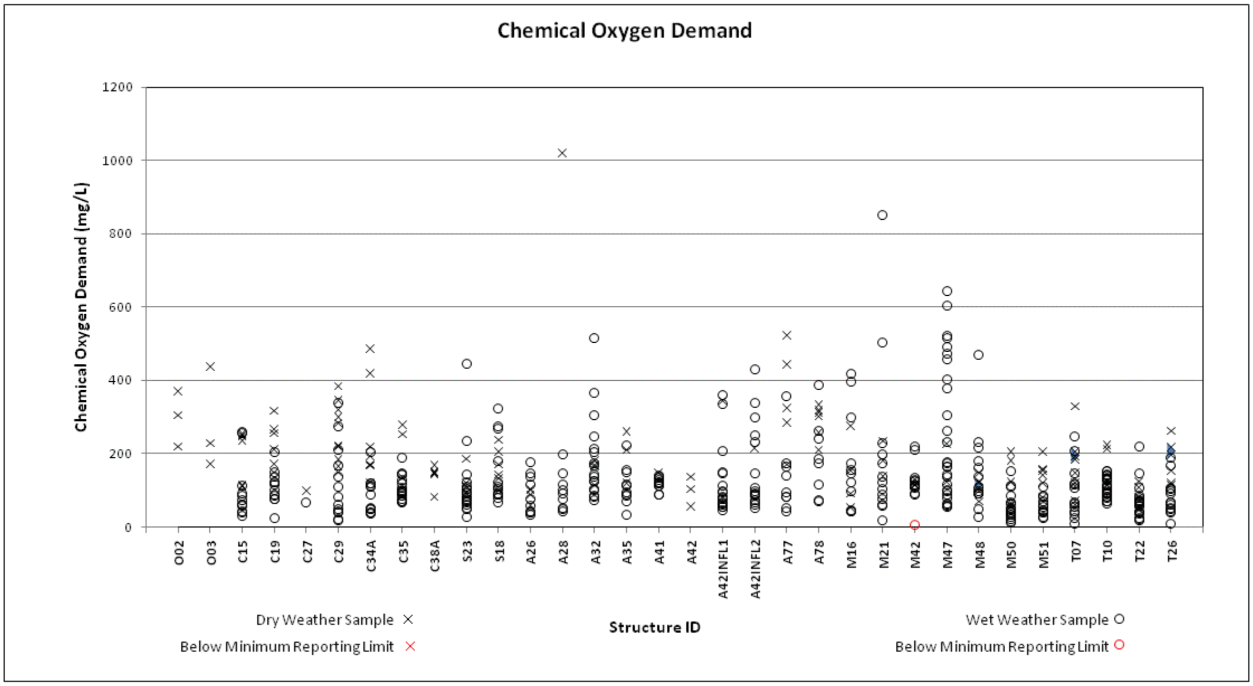


Figure 5-42: CSO PMP Measured Concentrations of DO

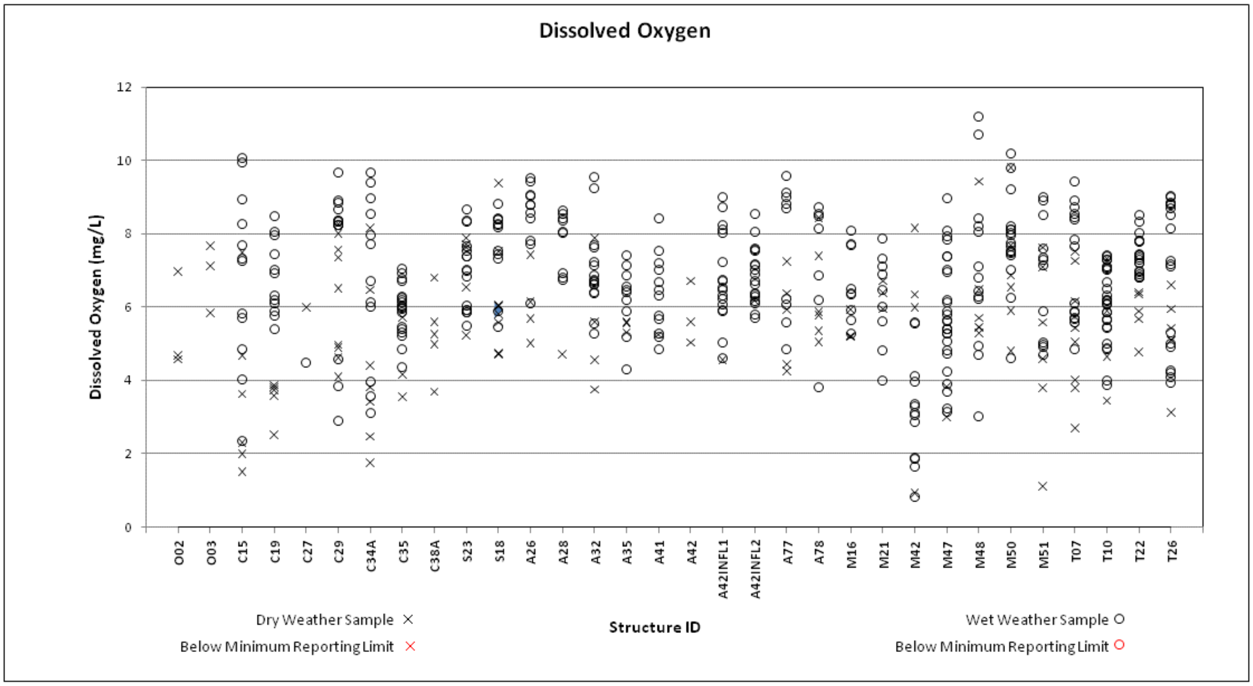


Figure 5-43: CSO PMP Measured Concentrations of Total Ammonia Nitrogen

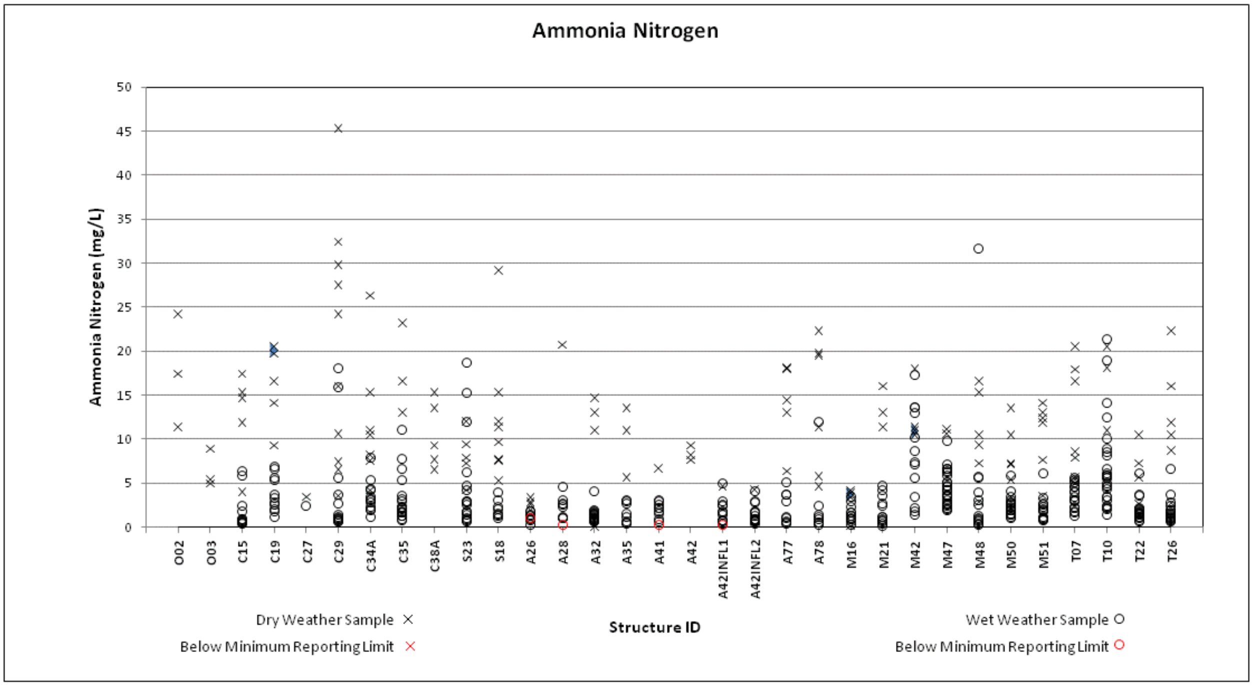


Figure 5-44: CSO PMP Measured Concentrations of Nitrite + Nitrate Nitrogen

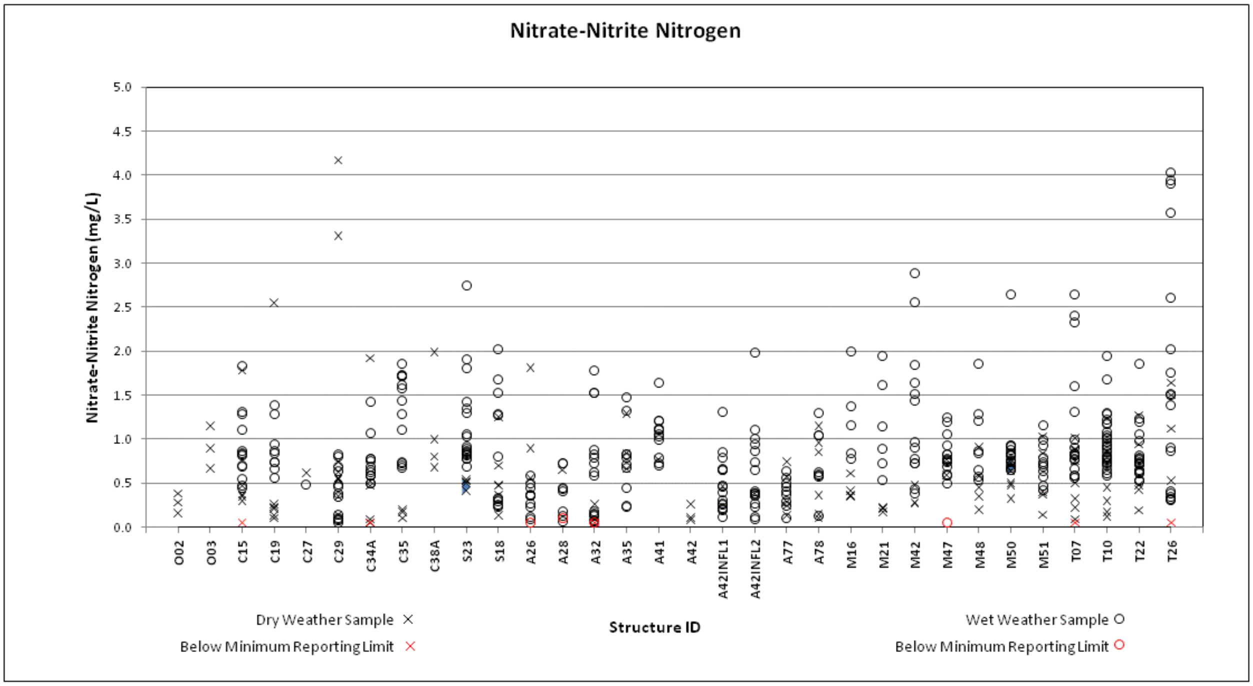


Figure 5-45: CSO PMP Measured Concentrations of Total Phosphorus

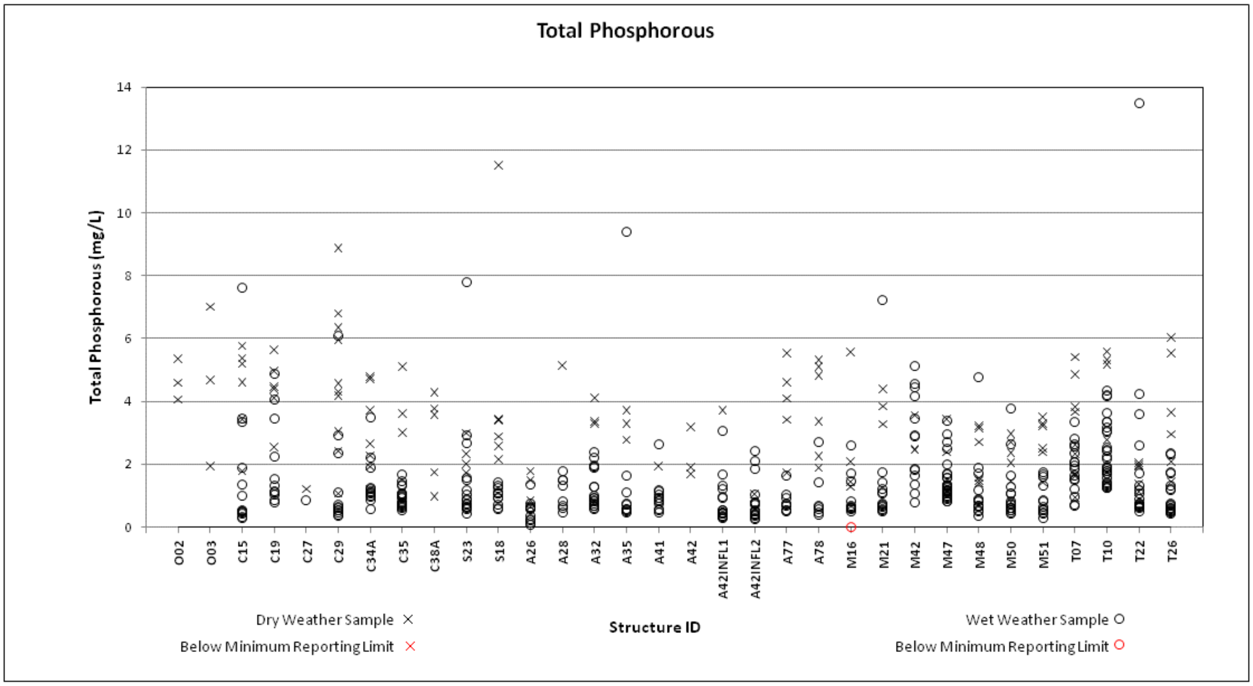


Figure 5-46: CSO PMP Measured Concentrations of TSS

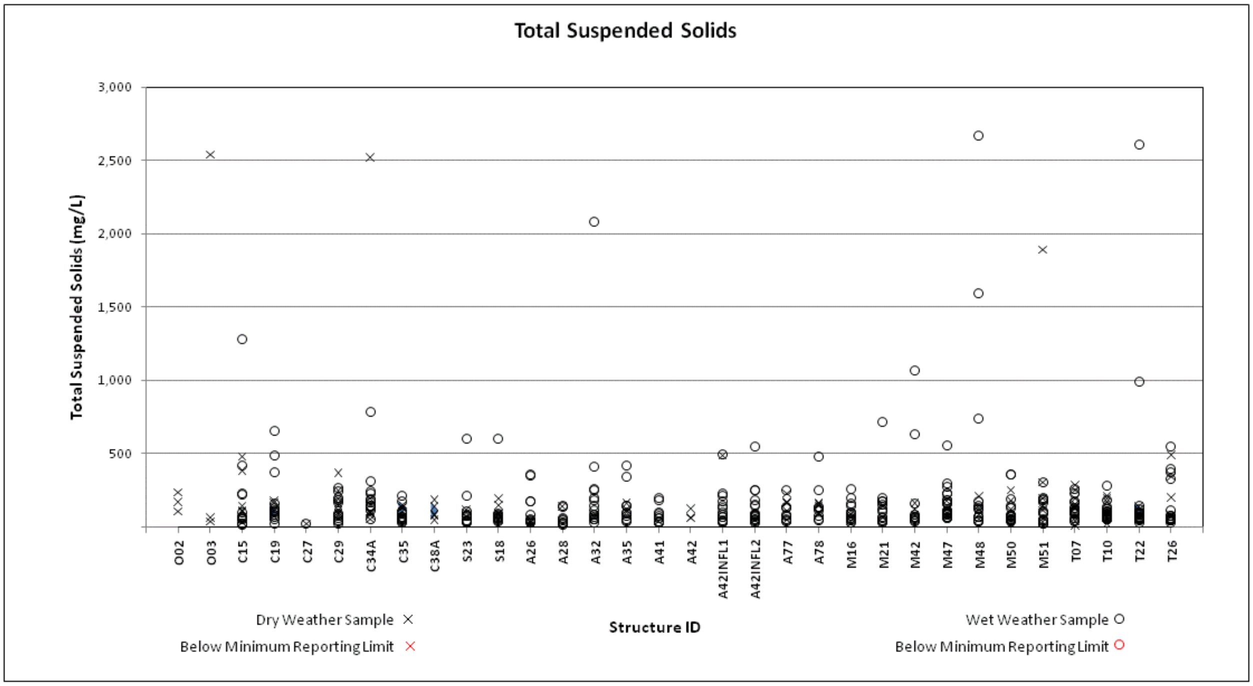


Figure 5-47: CSO PMP Measured pH

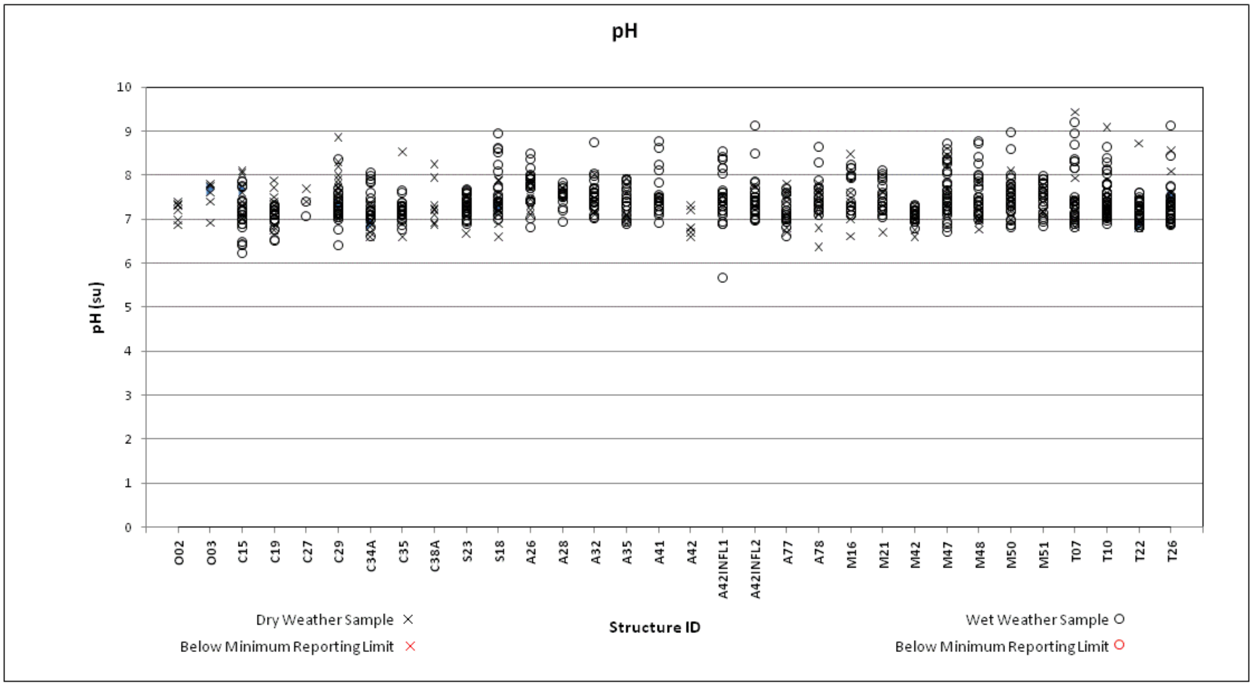


Figure 5-48: CSO PMP Measured Temperatures

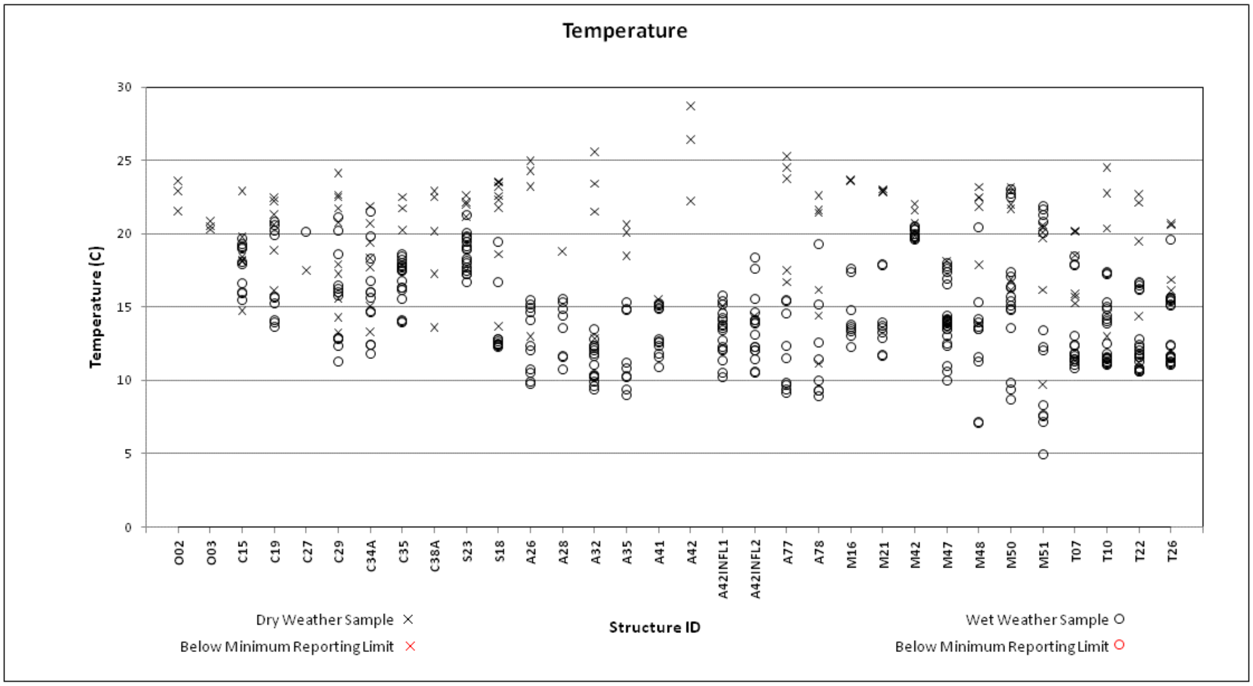


Figure 5-49: CSO PMP Measured Concentrations of Dissolved Iron

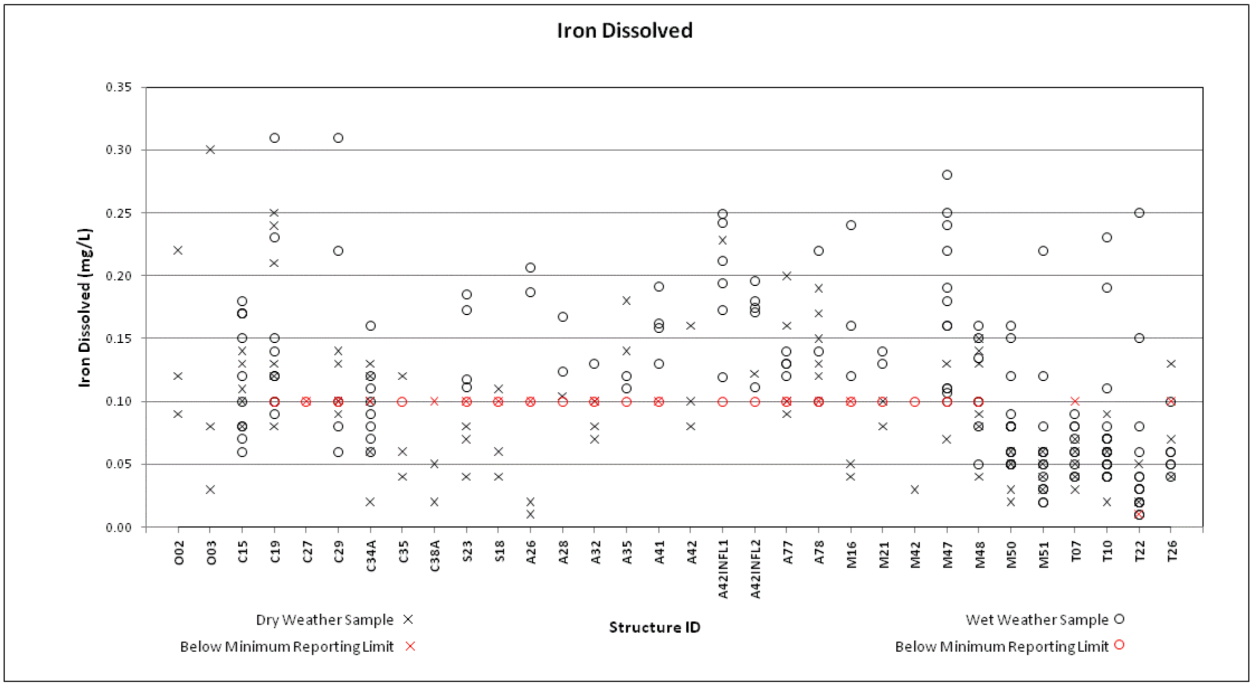


Figure 5-50: CSO PMP Measured Concentrations of Total Recoverable Iron

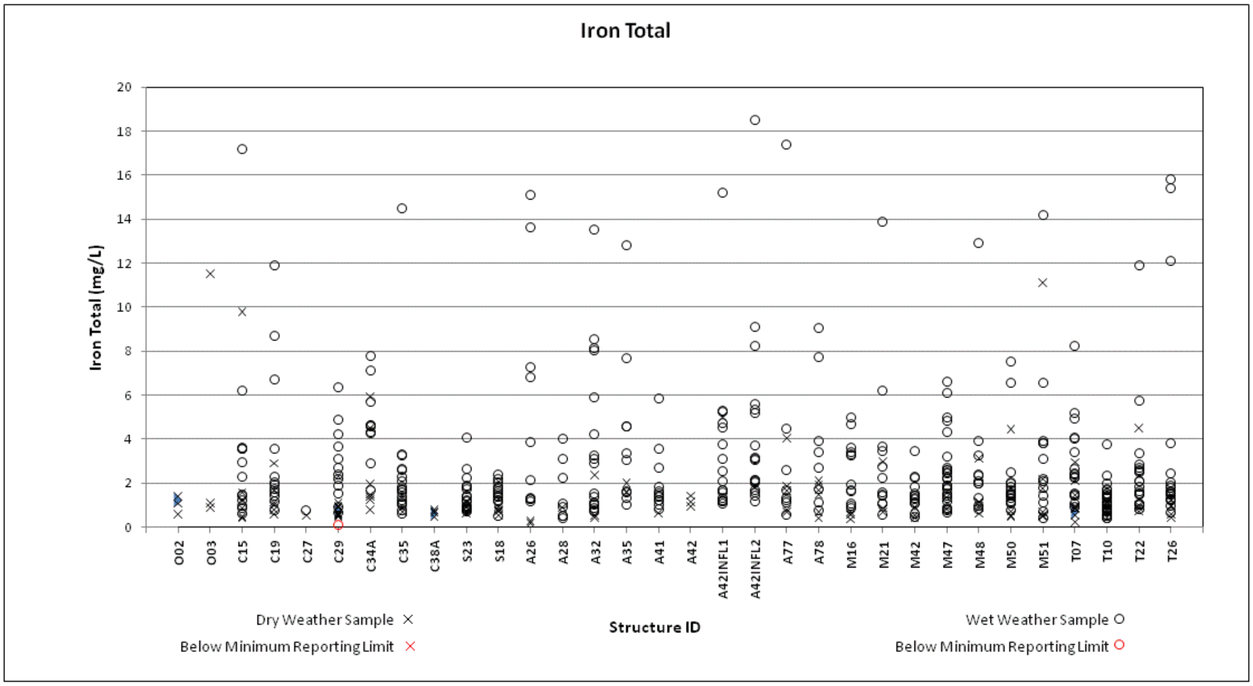


Figure 5-51: CSO PMP Measured Concentrations of Dissolved Lead

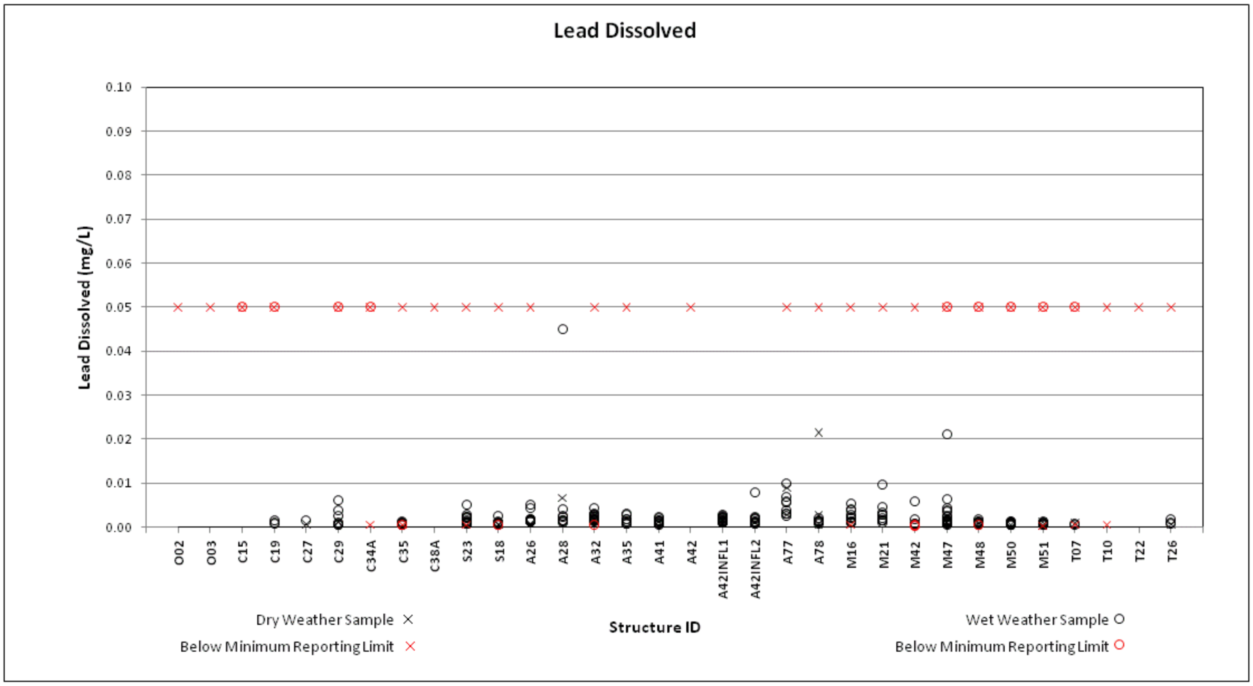


Figure 5-52: CSO PMP Measured Concentrations of Total Lead

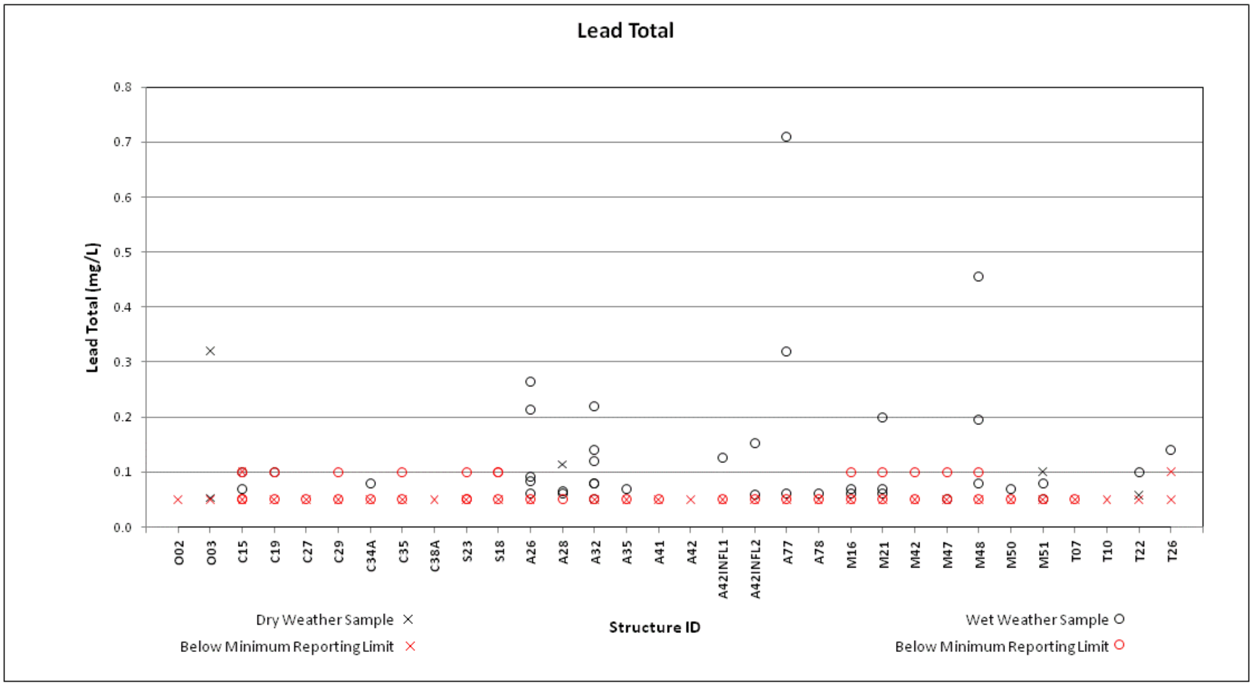


Figure 5-53: CSO PMP Measured Concentrations of Dissolved Cadmium

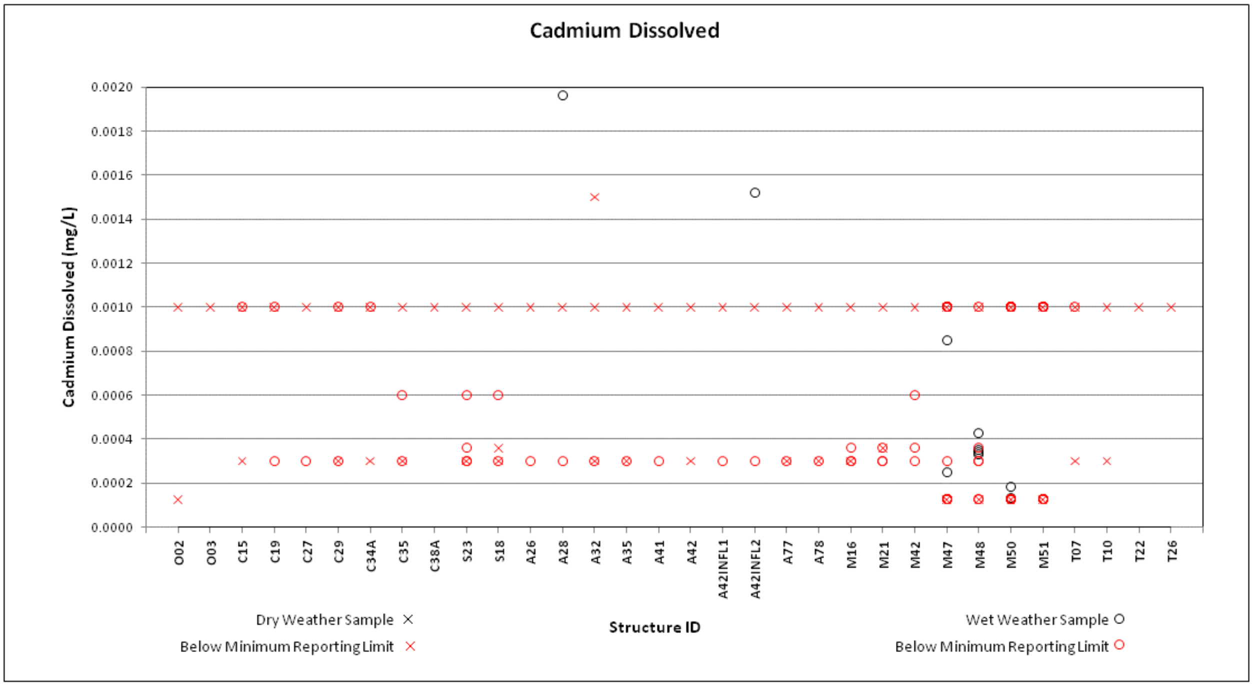


Figure 5-54: CSO PMP Measured Concentrations of Total Cadmium

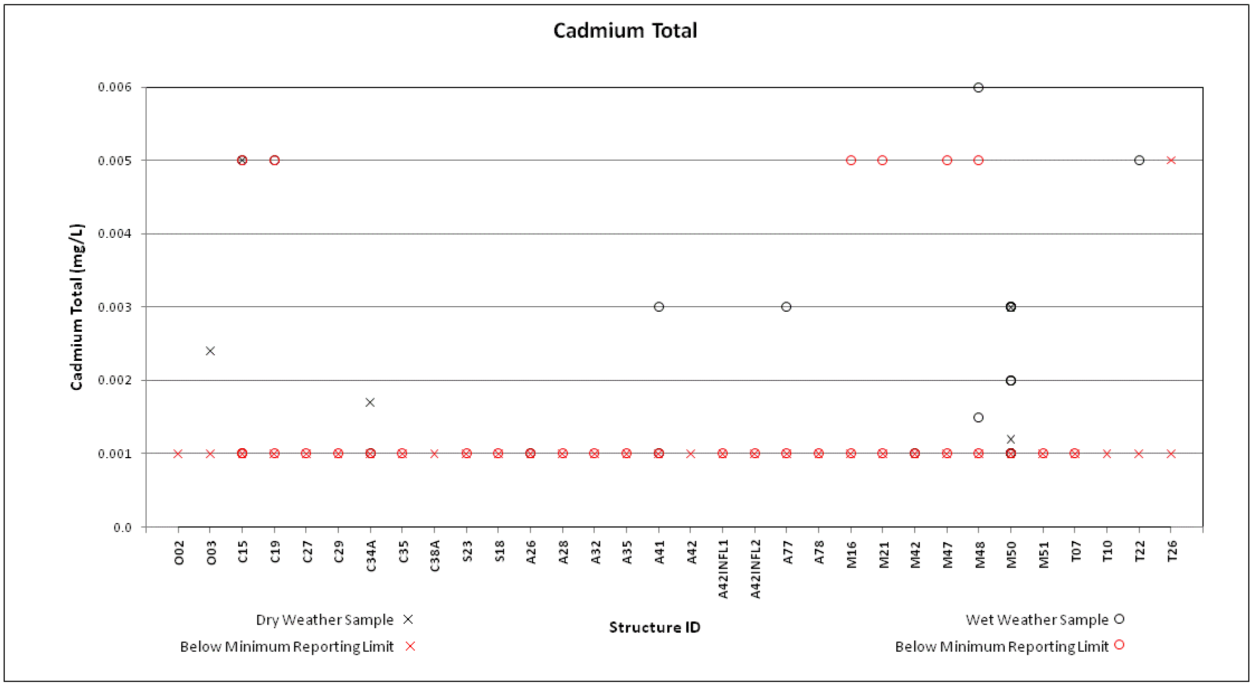


Figure 5-55: CSO PMP Measured Concentrations of Dissolved Zinc

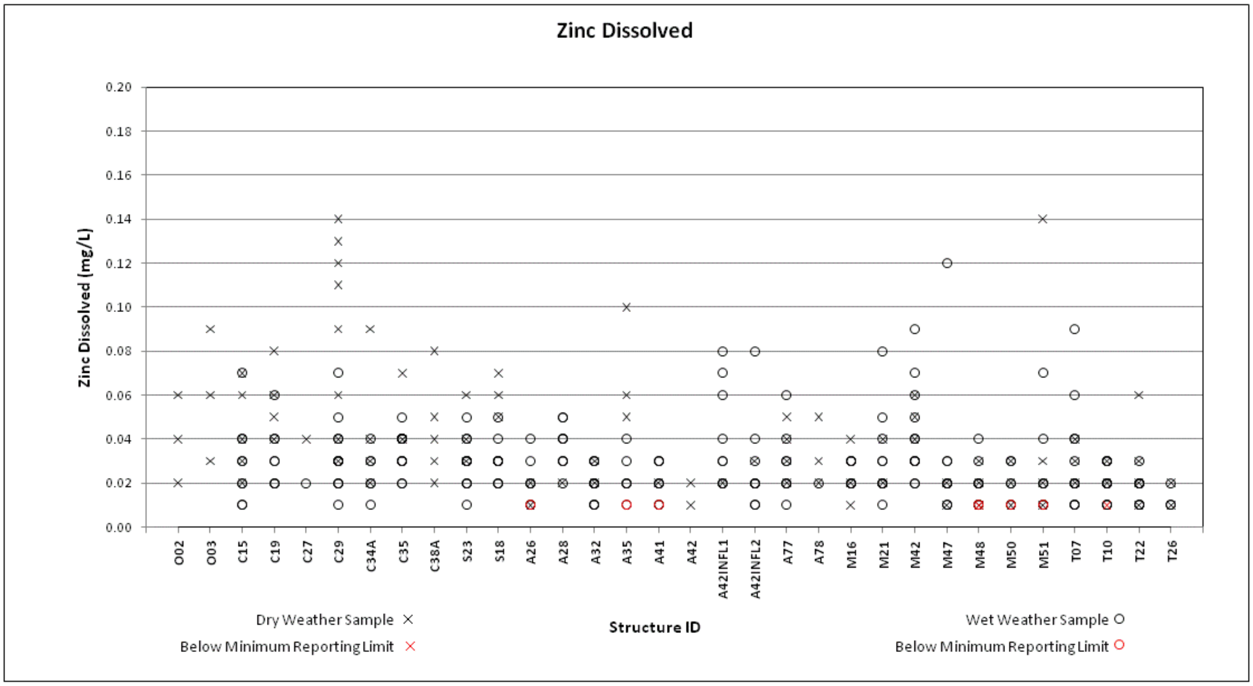


Figure 5-56: CSO PMP Measured Concentrations of Total Zinc

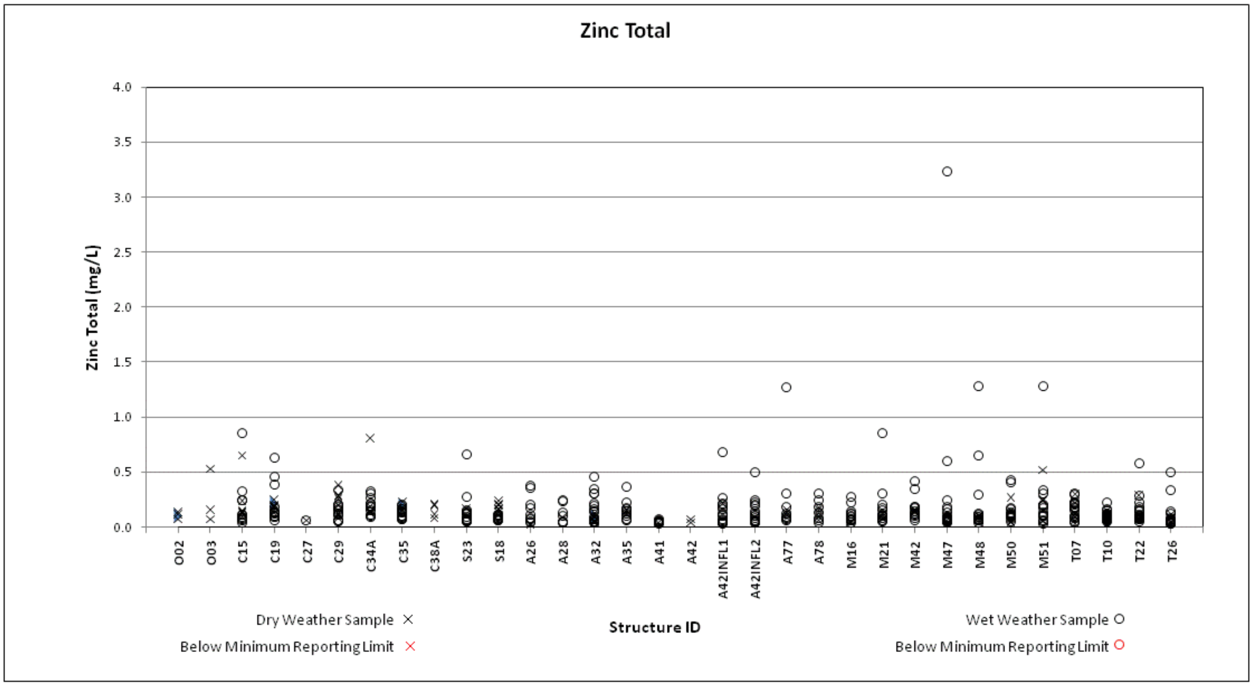


Figure 5-57: CSO PMP Measured Concentrations of Dissolved Nickel

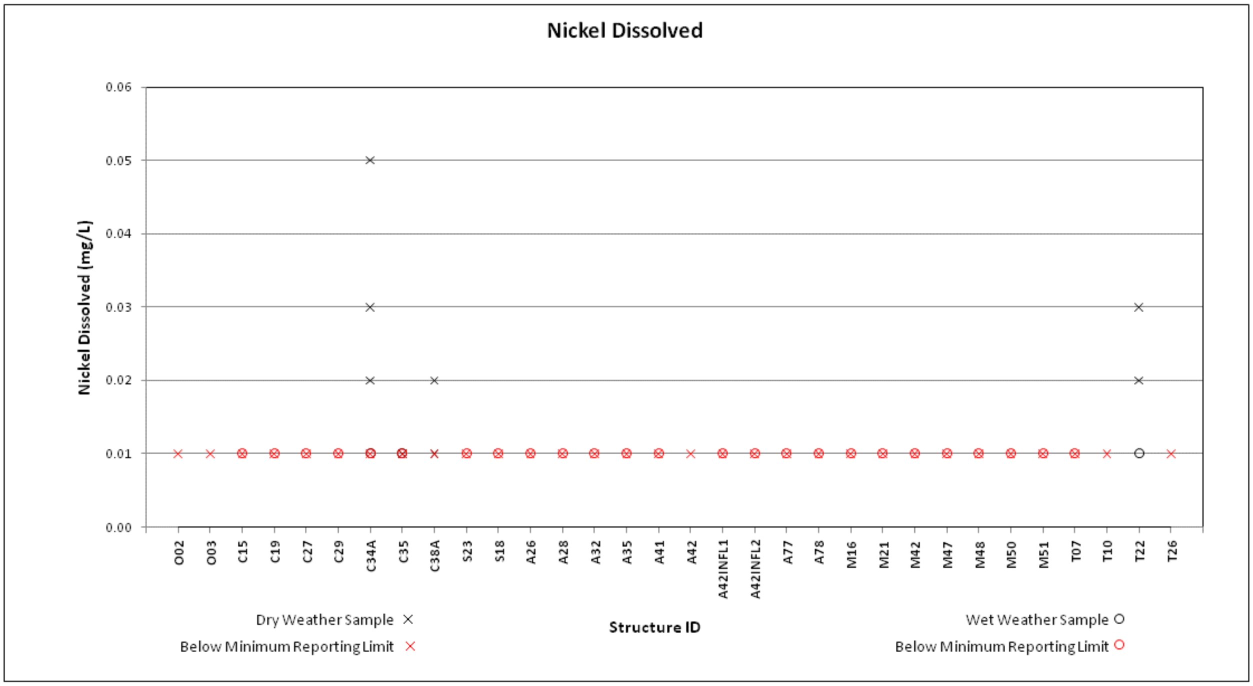


Figure 5-58: CSO PMP Measured Concentrations of Total Nickel

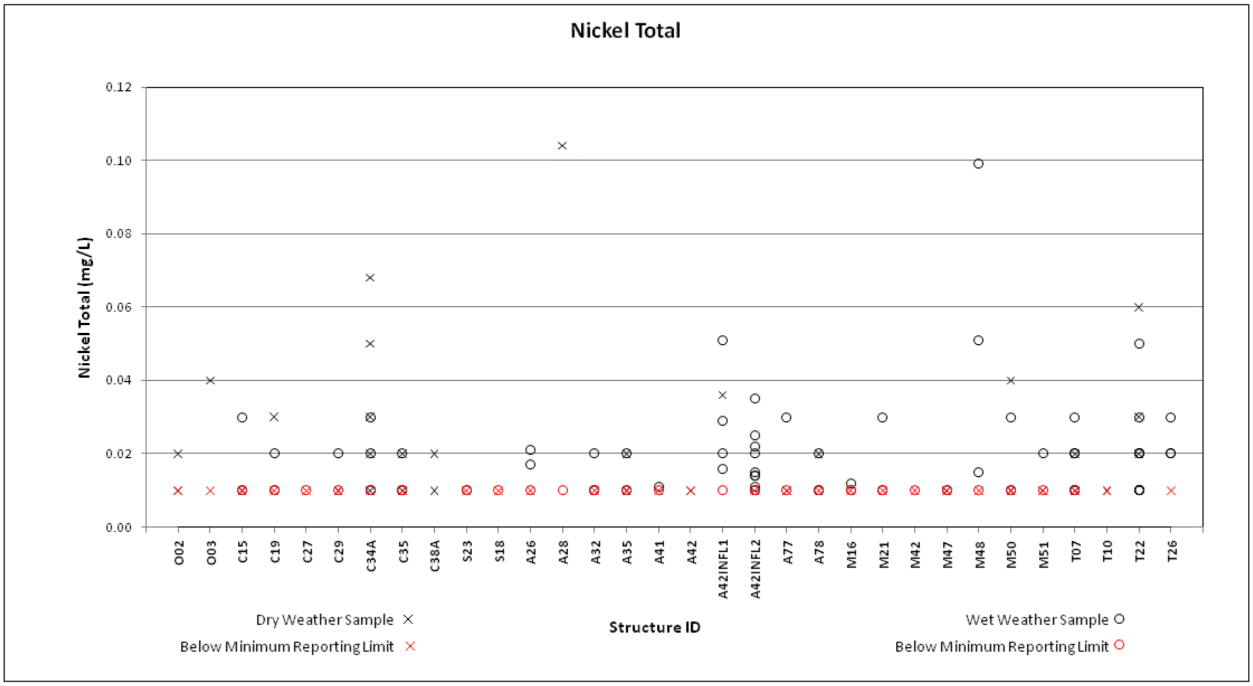


Figure 5-59: CSO PMP Measured Concentrations of Dissolved Copper

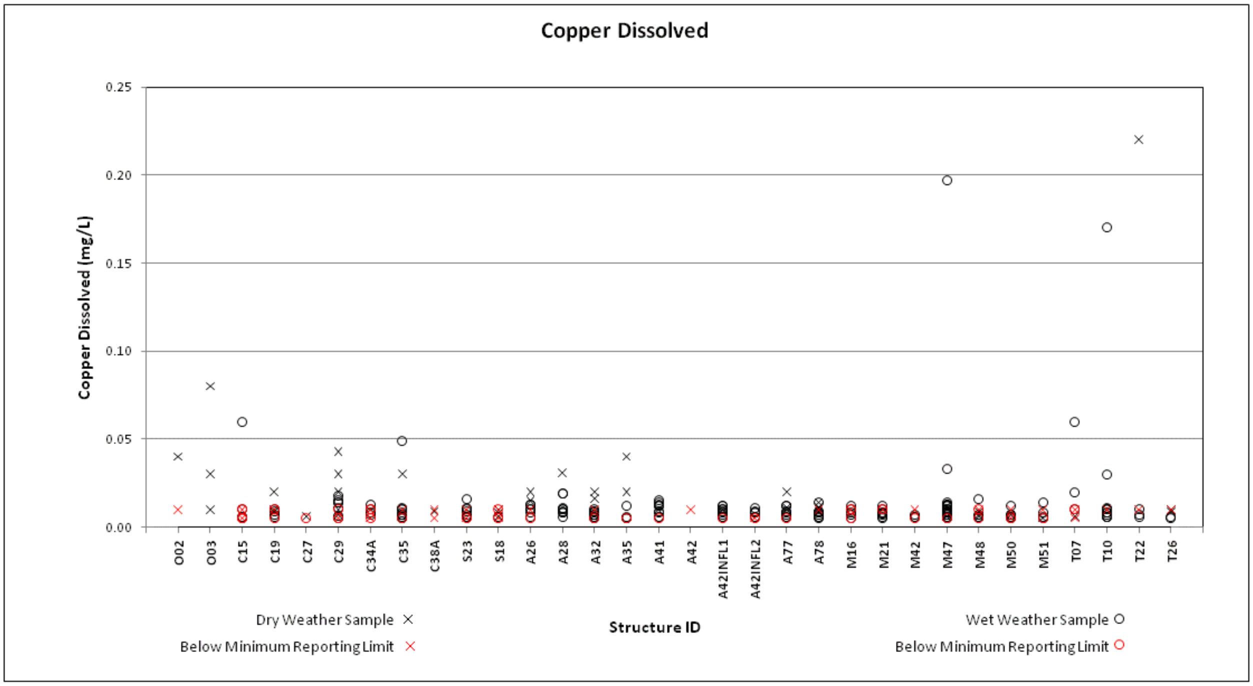


Figure 5-60: CSO PMP Measured Concentrations of Total Copper

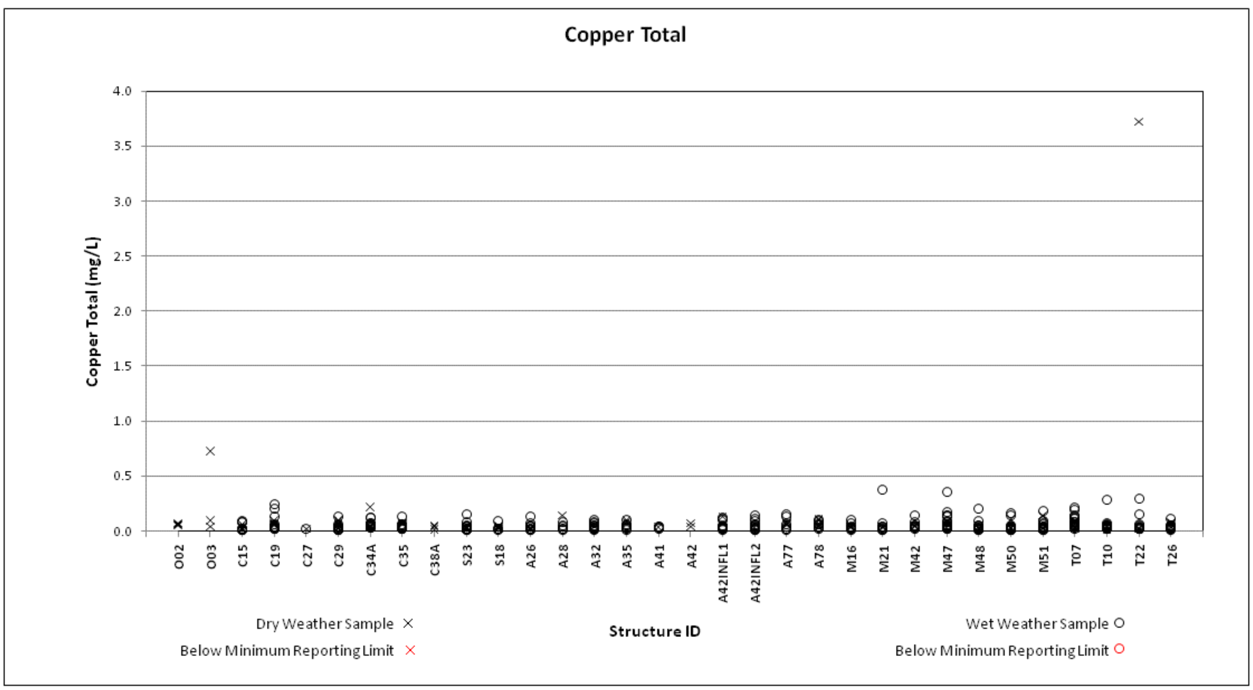


Figure 5-61: CSO PMP Measured Concentrations of Dissolved Silver

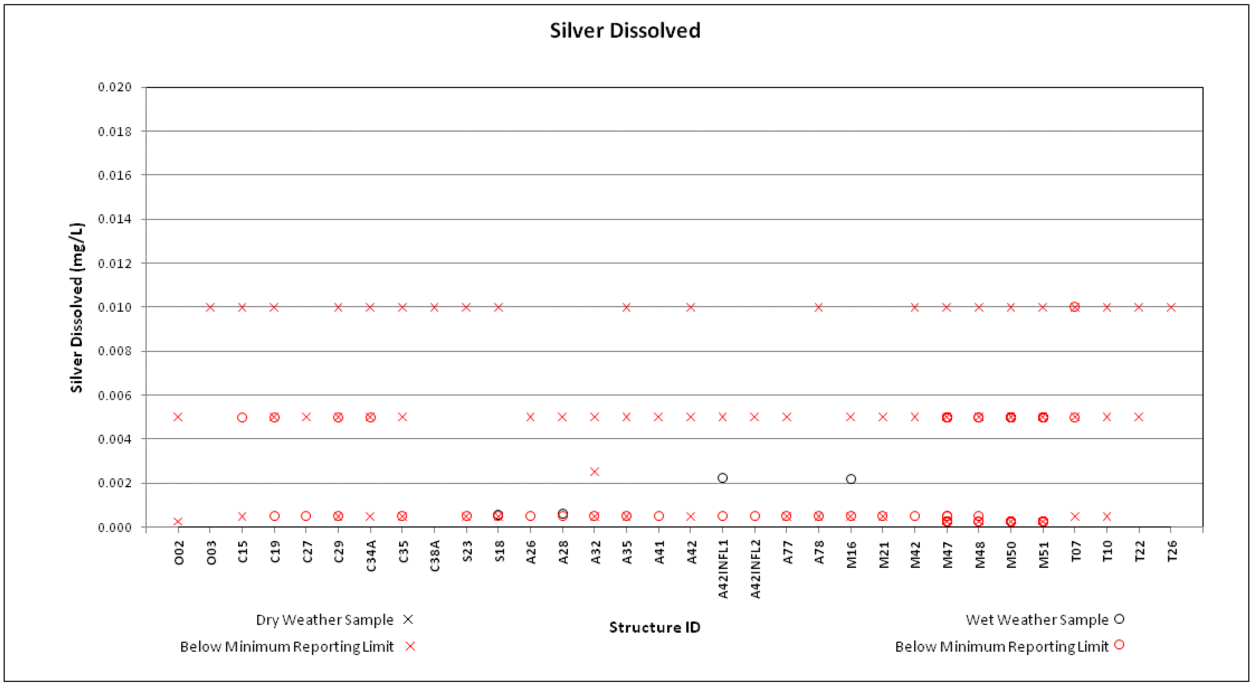


Figure 5-62: CSO PMP Measured Concentrations of Total Silver

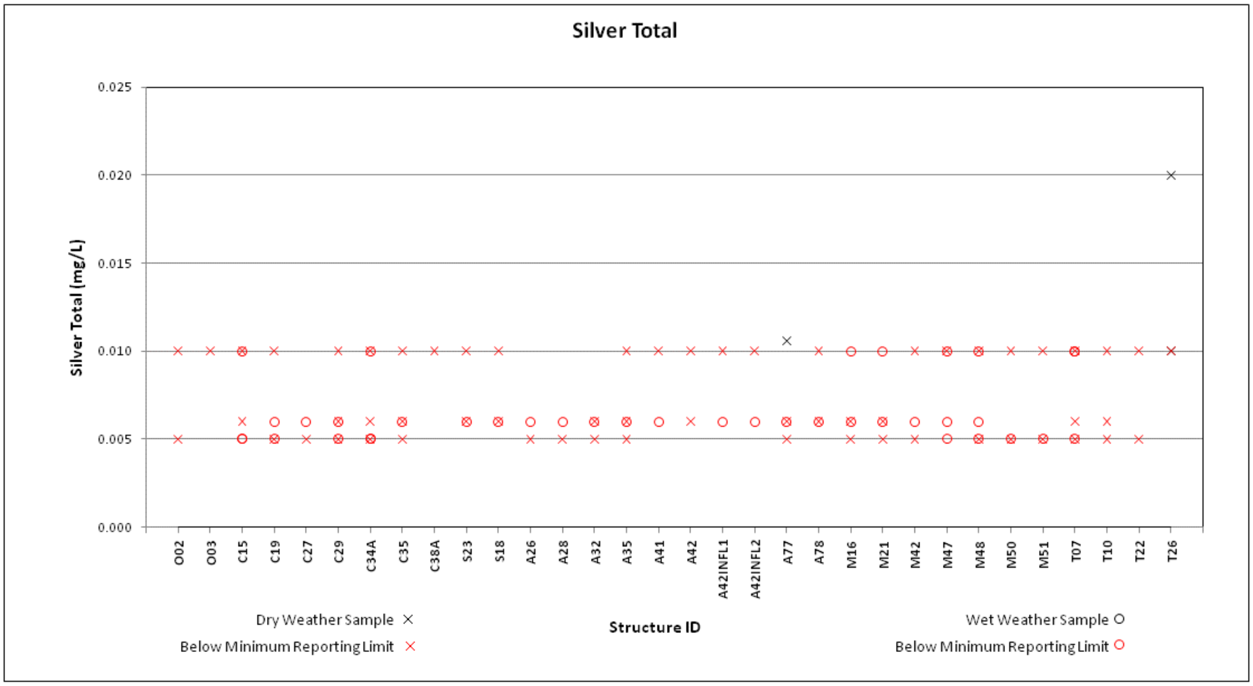


Figure 5-63: CSO PMP Measured Concentrations of Dissolved Chromium

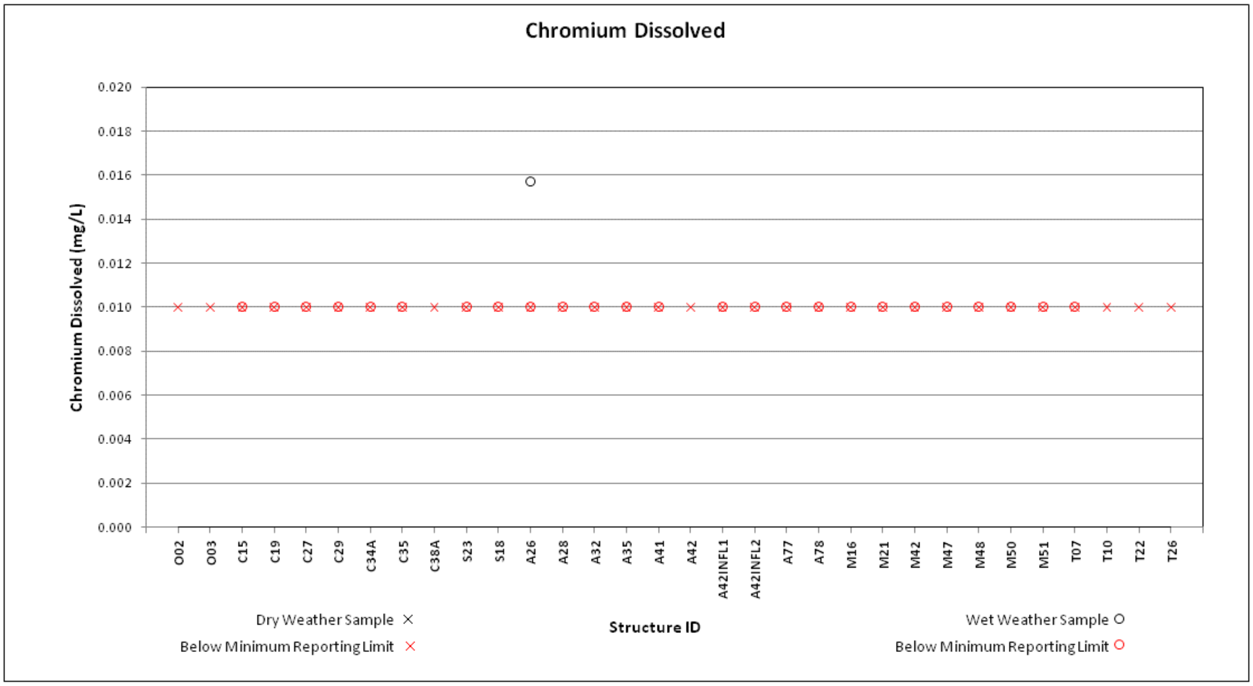


Figure 5-64: CSO PMP Measured Concentrations of Total Chromium

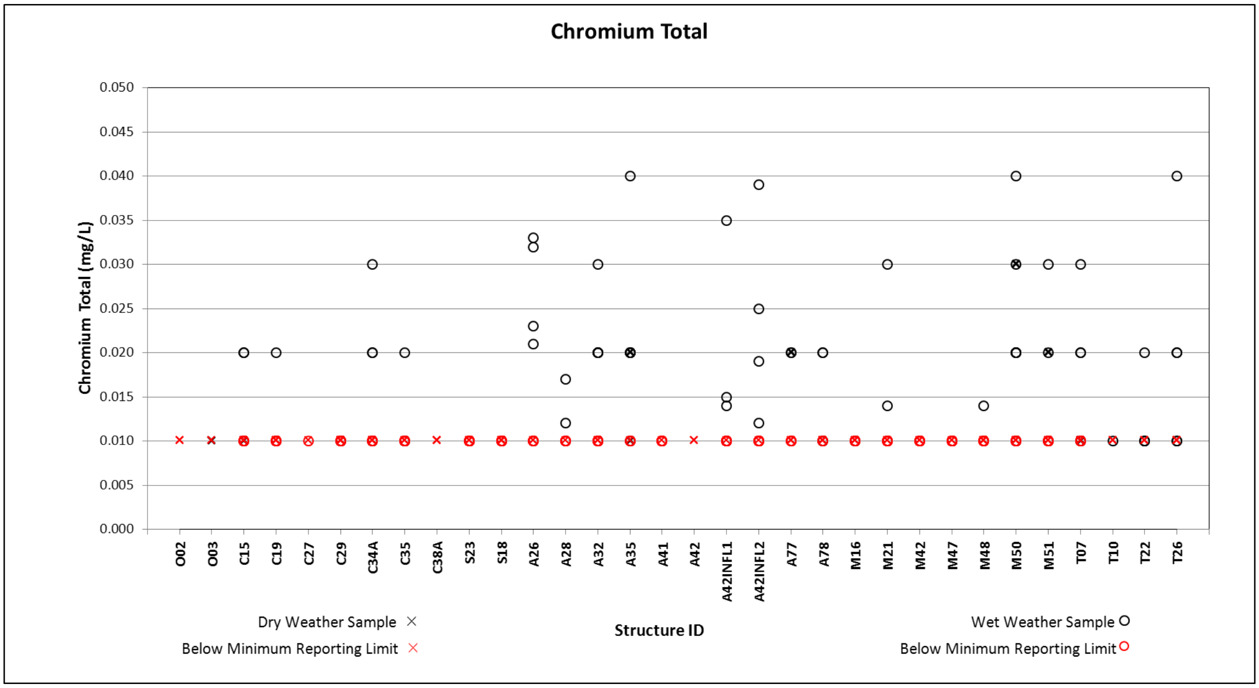


Table 5-29: CSO PMP Summary Data by Parameter 2007 to 2011

PARAMETER	UNITS	Dry Weather						Wet Weather					
		Count	Minimum	Maximum	Mean/Geomean*	Std Dev	# < MRL	Count	Minimum	Maximum	Mean/Geomean*	Std Dev	# < MRL
AG_D	mg/L	141	0.00025	0.01	0.0061	0.0038	141	401	0.00025	0.01	0.0025	0.0028	398
AG_T	mg/L	133	0.005	0.02	0.0079	0.0026	130	368	0.005	0.01	0.0064	0.0017	368
BOD5	mg/L	136	15	520	130	92	0	366	3	730	54	62	5
CA_T	mg/L	133	19	130	62	20	0	357	4.4	100	39	17	0
CD_D	mg/L	141	0.00013	0.0015	0.00083	0.00032	141	401	0.00013	0.002	0.00057	0.00035	391
CD_T	mg/L	133	0.001	0.005	0.0011	0.00052	129	367	0.001	0.02	0.0015	0.0017	336
COD	mg/L	133	46	1000	190	120	0	367	5	850	120	110	6
CR_D	mg/L	133	0.01	0.01	0.01	0	133	367	0.01	0.016	0.01	0.0003	366
CR_T	mg/L	133	0.01	0.03	0.01	0.0023	125	367	0.01	0.12	0.013	0.01	278
CU_D	mg/L	133	0.005	0.22	0.013	0.019	80	367	0.005	0.2	0.0094	0.014	162
CU_T	mg/L	133	0.01	3.7	0.078	0.32	0	367	0.01	0.37	0.047	0.048	0
DO	mg/L	134	0.93	9.8	5.5	1.7	0	356	0.83	11	6.7	1.7	0
ECOLI	cfu/100mL	133	4,000	14,000,000	1,100,000*	2,400,000	0	355	2,000	28,000,000	510,000*	1,800,000	0
FCOLI	cfu/100mL	133	17,000	18,000,000	1,400,000*	3,100,000	0	355	3,000	9,100,000	680,000*	1,500,000	0
FE_D	mg/L	133	0.01	0.25	0.088	0.049	25	367	0.01	0.31	0.099	0.044	176
FE_T	mg/L	133	0.18	11	1.3	1.5	0	367	0.1	140	3.4	8.6	1
HARD	mgCaCO3/L	133	63	500	220	73	0	367	14	370	130	57	0
MG_T	mg/L	133	1.5	43	15	6.4	0	357	0.65	28	7.6	4.2	0
NH3	mg/L	136	0.03	45	12	7.1	0	367	0.12	32	3.2	3.5	4
NI_D	mg/L	133	0.01	0.067	0.012	0.0069	117	367	0.01	0.01	0.01	0	354
NI_T	mg/L	133	0.01	0.1	0.014	0.012	94	367	0.01	0.099	0.011	0.0066	294
NO32	mg/L	131	0.05	4.2	0.58	0.6	6	332	0.05	4	0.9	0.61	7
OP	mg/L	133	0.01	6.7	1.4	0.97	2	367	0.03	2	0.47	0.33	2
PB_D	mg/L	141	0.00025	0.05	0.038	0.021	115	401	0.00038	0.15	0.02	0.024	178
PB_T	mg/L	133	0.05	0.11	0.052	0.0093	130	367	0.05	0.71	0.067	0.05	328
PCB-1016	ug/L	133	1	1	1	0	133	366	1	3.3	1	0.12	366
PCB-1221	ug/L	133	1	1	1	0	133	366	1	3.3	1	0.12	366
PCB-1232	ug/L	133	1	1	1	0	133	366	1	3.3	1	0.12	366
PCB-1242	ug/L	133	1	1	1	0	133	366	1	3.3	1	0.12	366
PCB-1248	ug/L	133	1	1	1	0	133	366	1	3.3	1	0.12	366
PCB-1254	ug/L	133	1	1	1	0	133	366	1	3.3	1	0.12	366
PCB-1260	ug/L	133	1	1	1	0	133	366	1	3.3	1	0.12	366
PH	su	271	6.4	9.4	7.3	0.42	0	724	6.2	9.2	7.4	0.41	0
SC	µS/cm	123	210	1800	870	290	0	349	59	1600	580	290	0
TEMP	C	135	9.7	29	20	3.8	0	359	5	23	15	3.4	0
TKN	mg/L	133	4.2	70	21	11	0	367	0.87	47	7.6	5.5	0
TP	mg/L	133	0.67	12	3.3	1.7	0	367	0.01	14	1.4	1.4	1
TSS	mg/L	133	9	2500	160	270	0	366	19	2700	150	270	0
ZN_D	mg/L	133	0.01	0.14	0.037	0.027	4	367	0.01	0.21	0.024	0.017	22
ZN_T	mg/L	133	0.02	0.81	0.14	0.11	0	367	0.03	3.2	0.15	0.22	0

5.4.3 Industrial User Impacts

The data analysis procedures utilized in evaluating the industrial user sampling results for the CD Appendix F and Appendix O water quality parameters were described in Section 5.3. In general, average concentrations for each facility were computed based on all the samples collected. A mass balance computation was then performed to account for mixing of the industrial user's flow with other sewershed flows and a discharge concentration was computed. The potential environmental impact of Industrial User discharges was assessed by comparing these discharge concentrations to Pennsylvania water quality standards. It is important to emphasize that these criteria are intended for receiving water evaluations. Whereas, the analyses performed compared in-sewer concentrations to receiving water quality criteria for screening purposes only. In instances where an Industrial User was identified as contributing to a potential environmental impact through this screening process, follow-up dilution analysis was performed.

Table 5-30 summarizes the calculated industrial discharge concentrations for each Industrial User and each sampled parameter based on the methodology discussed above. The results include sampling conducted from 2008 to 2010. Instances where discharge concentrations were not computed due to all samples results being below method detection limits are identified on the table with ND. Parameters where results are not available or the overflow events associated with the sewershed did not meet the minimum duration criteria of 1-hour are identified as NA. Parameters where the numerical water quality criteria were exceeded are identified with an asterisk (*) to the left of the value.

Table 5-31 provides a summary of the results for all Industrial Users with a potential to discharge to receiving streams during wet weather. The number of Industrial Users whose estimated discharge concentrations were below the respective detection limit for each parameter and the number where the estimated discharge concentration exceeded the respective water quality criteria are provided.

Table 5-32 provides a summary of a dilution analysis that was conducted for Industrial Users whose estimated discharge concentrations exceeded the instream water quality criteria for a respective parameter(s). The analysis determined the stream flow needed to dilute the maximum parameter end-of-pipe concentrations to meet in-stream criteria. For each Industrial User, shown is the maximum end-of-pipe discharge concentration that is based on the maximum sampled value and the Industrial User's relative contribution factor, the Q710 receiving stream flow, end-of-pipe flow, the stream flow needed to dilute the discharge concentration to meet the standard, and the percentage of the stream flow to meet the standard.

Table 5-30: Industrial User Calculated Discharge Concentrations

					Appendix F, Paragraph 1, Section iii					Appendix O, Paragraph 9							
					Concentrations at Points of Discharge												
Permit No.	Permittee	I.U. Discharge (GPD)	Sewershed Basin ID	Receiving Water	pH	Color (CU)	C.O.D. (mg/L)	T.S.S. (mg/L)	PCBs (ug/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Nickel (mg/L)	Silver (mg/L)	Zinc (mg/L)
P2-0120	Pitt. Allegheny County Thermal	70,000	A-05	Allegheny River	7.59	1.244	54.1	3.50	ND	ND	ND	0.008616	0.28080	ND	ND	ND	0.004786
P3-0096	Packaging Corporation of America	14,500	A-19X	Allegheny River	7.45	0.882	33.1	38.55	ND	* 0.0008989	ND	0.003241	0.24246	* 0.005056	0.0018151	ND	0.005143
P3-0100	Weiss Provision Company	3,000	A-19X	Allegheny River	7.00	0.319	15.4	0.91	ND	ND	ND	0.000512	0.01877	ND	ND	ND	0.001353
P2-0121	Shore Corporation	700	A-20	Allegheny River	7.00	0.087	23.4	0.41	ND	0.0000269	0.0000694	0.000293	0.02344	0.000527	0.0002316	ND	0.000686
P2-0040	UPMC Shadyside Hospital	282,169	A-22	Allegheny River	7.07	0.255	4.7	2.77	ND	0.0001102	0.0003203	0.004692	0.38168	0.001914	0.0015002	0.0003662	0.020540
P3-0056	Trau & Loevner	1,167	A-22	Allegheny River	7.00	0.006	0.1	0.06	ND	0.0000004	0.0000008	0.000006	0.00021	0.000003	0.0000008	0.0000008	0.000009
P2-0055	Western Pennsylvania Hospital	192,000	A-22	Allegheny River	7.23	4.667	118.8	39.83	ND	ND	0.0030100	* 0.059967	0.37534	* 0.019956	0.0032831	* 0.0085446	0.025645
P2-0132	Childrens Hospital of Pittsburgh	186,400	A-28	Allegheny River	NA	6.976	563.8	1104.09	ND	ND	0.0346705	* 0.105489	* 4.46425	* 0.041251	0.0341895	* 0.0329040	* 0.368518
P2-0002	Clean Textile Systems, Inc.	105,000	A-30	Allegheny River	7.36	0.243	10.7	1.23	ND	0.0000453	0.0000889	0.000896	0.00804	0.000540	0.0002625	ND	0.001464
P2-0022	Iron City Uniform	47,000	A-42	Allegheny River	7.00	0.183	1.5	0.36	ND	ND	0.0000468	0.000537	0.09387	0.000322	0.0002172	ND	0.002314
P2-0061	Vet. Adm. Medical Center (Highland Drive)	179,000	A-42	Allegheny River	7.09	0.725	6.4	6.07	ND	ND	ND	0.002568	0.02805	ND	0.0002675	0.0002853	0.004140
P2-0106	Port Authority - East Liberty Garage	11,000	A-42	Allegheny River	7.00	0.029	0.6	0.06	ND	ND	0.0000219	0.000071	0.00492	0.000051	0.0000219	ND	0.000306
P2-0011	Daily Juice Products	79,452	A-45	Allegheny River	7.04	4.786	328.5	3.07	ND	ND	ND	* 0.010880	0.19424	ND	ND	ND	0.009241
P3-0054	Lamagna Cheese Company	4,000	A-45	Allegheny River	7.00	0.214	164.6	7.87	ND	0.0000492	ND	0.000089	0.00126	0.000460	0.0002124	ND	0.000842
P2-0001	Allegheny General Hospital	90,000	A-48	Allegheny River	7.04	0.741	20.4	14.46	ND	ND	0.0004226	0.004742	0.22468	0.002676	0.0005251	0.0008519	0.008827
P2-0012	Kindred Healthcare	9,340	A-48	Allegheny River	7.00	0.051	1.4	0.35	ND	ND	0.0000271	0.000768	0.01239	0.000354	0.0000443	0.0000271	0.000514
P3-0097	Process Reproductions, Inc	335	A-48	Allegheny River	7.00	0.006	0.1	0.05	ND	ND	0.0000013	0.000023	0.00076	0.000010	0.0000022	0.0000022	0.000056
P2-0020	Bay Valley Foods, LLC [(1)]	1,025,000	A-60	Allegheny River	NA	NA	NA	NA	NA	NA	NA	* 0.026085	1.40234	ND	NA	NA	* 0.119079
			A-61	Allegheny River	7.43	36.758	1262.5	748.70	ND	ND	0.0211400	* 0.038829	* 4.31383	ND	0.0181200	ND	* 0.137440
P3-0084	Port Authority - Ross Garage	7,500	A-67	Allegheny River	7.00	0.015	0.7	0.39	ND	ND	0.0000114	0.000072	0.00158	ND	0.0000228	ND	0.000409
P1-0010	East Liberty Electroplating	9,500	A-68	Allegheny River	7.09	0.010	0.1	0.04	ND	ND	0.0005852	0.000126	0.00109	ND	0.0002728	ND	0.001250
P3-0003	A I D Parts Company	60	A-68	Allegheny River	7.00	0.000	0.0	0.00	ND	0.0000001	0.0000008	0.000005	0.00019	0.000005	0.0000013	ND	0.000004
P3-0035	Hunter Leasing, Inc.	300	A-68	Allegheny River	7.00	0.002	0.1	0.01	ND	0.0000013	0.0000024	0.000013	0.00042	0.000007	0.0000060	ND	0.000118
P3-0120	Borough of Sharpsburg	48,000	A-72	Allegheny River	6.99	0.173	3.4	5.72	ND	ND	ND	0.003118	0.01247	ND	ND	ND	ND
P2-0048	UPMC St. Margaret	82,000	A-78	Allegheny River	7.46	4.207	62.6	34.80	ND	ND	ND	* 0.012225	0.13716	ND	0.0021388	0.0016830	* 0.130782
P3-0127	Cleaveland Brothers	10,000	A-82	Allegheny River	7.02	0.066	0.6	9.72	ND	ND	0.0010306	0.001643	0.49353	0.002192	0.0018125	ND	0.004822
P2-0031	Ohio Valley General Hospital	49,444	C-09/C-13	Chartiers Creek	7.10	1.512	15.2	6.37	ND	ND	0.0007619	0.006412	0.06268	0.002321	0.0010058	0.0009448	0.003779
P2-0041	Silver Star Meats Inc.	22,000	C-09/C-13	Chartiers Creek	7.03	0.331	7.4	0.24	ND	ND	ND	ND	0.00579	ND	ND	ND	0.001085
P3-0076	Professional Service Inc. (PSI)	3,000	C-25	Chartiers Creek	7.01	0.175	3.1	1.76	* 0.55503	0.0001393	0.0035397	* 0.017108	0.05583	* 0.006841	0.0016945	0.0008325	0.015092
P1-0054	Advanced Electrocircuits	8,500	C-30	Chartiers Creek	7.01	0.212	8.6	0.20	ND	0.0001884	0.0001547	0.007534	0.00127	0.000673	0.0004395	0.0002963	0.001682
P3-0023	Nalco Company	1,200	C-30	Chartiers Creek	7.00	0.026	0.5	0.25	ND	0.0000120	0.0002139	0.000104	0.01420	0.000110	0.0002315	ND	0.000652
P2-0044	Saint Clair Memorial Hospital	100,000	C-49	Chartiers Creek	7.15	3.274	41.5	26.53	ND	ND	0.0031197	* 0.021653	0.70254	ND	0.0030510	0.0016185	* 0.112193
P2-0036	Pittsburgh Post-Gazette	25,175	M-01	Monongahela River	7.60	57.714	83.9	12.04	ND	ND	ND	* 0.183651	0.07838	ND	ND	ND	0.013247
P2-0018	Sodexho Pittsburgh Linen	110,000	M-05	Monongahela River	7.03	0.637	17.0	1.28	ND	ND	0.0002602	* 0.011647	0.01246	0.002196	0.0003156	NA	0.020843
P2-0028	Mercy Hospital	111,000	M-05	Monongahela River	7.13	0.747	16.8	8.65	ND	0.0001544	0.0003724	* 0.015745	0.10158	* 0.003863	0.0007836	0.0004423	0.010139
P2-0043	UPMC South Side Hospital	25,520	M-16	Monongahela River	7.01	0.279	11.1	1.47	ND	ND	ND	0.002165	0.01422	ND	ND	0.0001103	0.001103
P2-0054	Vet. Adm. Medical Center (Oakland)	125,000	M-19	Monongahela River	7.05	0.607	20.2	6.55	ND	ND	0.0002221	0.003742	0.02980	ND	0.0003886	0.0002776	0.004336
P2-0119	University of Pittsburgh - Steam Plant	21,000	M-19	Monongahela River	NA	0.021	0.3	0.03	ND	ND	ND	0.000209	0.00472	ND	0.0000713	ND	0.000222
P2-0027	Magee-Womens Hospital of Pittsburgh	110,000	M-19Y	Monongahela River	7.29	2.135	48.1	29.37	ND	ND	ND	* 0.023175	0.15135	* 0.012778	0.0024560	0.0014124	0.013794
P2-0029	UPMC Montefiore Hospital	316,607	M-19Y	Monongahela River	7.17	5.859	107.4	41.59	ND	* 0.0054514	0.0052441	* 0.112941	0.36983	* 0.038256	0.0095544	* 0.0313604	0.096449
P2-0122	RAFF Printing	256	M-21	Monongahela River	7.00	0.000	0.0	0.00	ND	0.0000019	ND	0.000029	ND	0.000029	0.0000068	ND	0.000007
P2-0099	UPMC Presbyterian [(2)]	305,433	M-19W	Monongahela River	7.54	8.479	212.4	146.90	ND	ND	0.0086637	* 0.174862	* 8.22139	* 0.055778	0.0121833	* 0.0208599	0.100101
			M-29	Monongahela River	7.05	0.502	15.4	4.24	ND	ND	0.0003450	0.002649	0.07757	0.002385	0.0004899	0.0004481	0.009100

Table 5-30: Industrial User Calculated Discharge Concentrations

					Appendix F, Paragraph 1, Section iii					Appendix O, Paragraph 9							
					Concentrations at Points of Discharge												
Permit No.	Permittee	I.U. Discharge (GPD)	Sewershed Basin ID	Receiving Water	pH	Color (CU)	C.O.D. (mg/L)	T.S.S. (mg/L)	PCBs (ug/L)	Cadmium (mg/L)	Chromium (mg/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Nickel (mg/L)	Silver (mg/L)	Zinc (mg/L)
P2-0130	Bellefield Boiler Plant	24,600	M-29	Monongahela River	NA	0.025	0.5	0.21	ND	0.0000093	0.0000219	0.001645	0.00739	0.000139	0.0000453	0.0000186	0.000533
P3-0101	Pennsylvania-American Water	800	M-34	Monongahela River	7.00	0.001	0.0	0.00	ND	0.0000034	ND	0.000013	0.00008	ND	0.0000122	ND	0.000094
P1-0046	Galvtech	500	M-42	Monongahela River	7.00	0.001	0.1	0.01	ND	ND	ND	0.000005	0.00019	ND	ND	ND	0.000033
P3-0085	Port Authority - West Mifflin Garage	13,500	M-42	Monongahela River	7.13	0.387	9.7	3.71	ND	ND	0.0013715	0.002941	0.27243	0.001365	0.0009129	ND	0.007526
P2-0009	LifeCare Hospitals	31,000	M-47	Monongahela River	7.00	0.099	2.2	1.17	ND	ND	0.0000650	0.000210	0.08319	ND	0.0001118	ND	0.001078
P2-0115	Marcegaglia USA, Inc.	5,102	M-49	Monongahela River	7.01	0.008	0.1	0.06	ND	ND	0.0001104	0.000044	0.00117	ND	0.0002131	ND	0.000099
P3-0072	Pittsburgh Die & Casting	4,967	M-50	Monongahela River	7.01	0.032	1.2	0.90	ND	0.0001407	0.0002568	0.002527	0.15555	0.000831	0.0003794	ND	0.016419
P2-0110	Linde, Inc.	187,200	M-58	Monongahela River	7.33	2.694	18.9	16.01	ND	ND	0.0051306	* 0.015917	1.45827	ND	0.0115439	ND	0.034119
P3-0131	Axiom Automotive	3,333	O-03	Ohio River	7.02	0.064	15.4	1.17	ND	0.0000244	0.0000741	0.002063	0.05536	0.001033	0.0001452	0.0002370	0.001775
P3-0046	Horix Manufacturing	800	O-04	Ohio River	7.00	0.017	0.1	0.04	ND	0.0000192	0.0000339	0.000126	0.01106	ND	0.0000452	ND	0.000389
P2-0118	Pepsi Bottling Group	450	O-06	Ohio River	7.00	0.182	4.1	0.60	ND	ND	ND	0.000173	0.08951	ND	ND	ND	0.000279
P3-0037	Gordon Terminal Service	10,123	O-06	Ohio River	7.27	2.028	11.9	5.40	ND	ND	ND	* 0.012374	0.12728	* 0.012884	ND	ND	0.054036
P2-0105	United Environmental Group	4,657	O-15	Ohio River	7.00	0.022	0.1	0.00	ND	ND	ND	0.000013	0.00009	ND	0.0000188	ND	0.000029
P2-0049	Allegheny General Hospital - Suburban Campus	22,000	O-21	Ohio River	7.18	2.040	57.7	22.98	ND	ND	0.0023261	0.008459	0.06997	ND	0.0025220	0.0028403	ND
P3-0107	Valspar Corporation	2,000	O-27	Ohio River	7.00	0.001	0.0	0.05	ND	0.0000030	0.0000223	0.000009	0.00622	0.000344	0.0000116	0.0000057	0.000099
P3-0075	Pittsburgh Post-Gazette	1,712	O-30	Ohio River	7.10	0.068	2.2	0.82	ND	ND	0.0002288	0.001858	0.08179	0.000270	0.0001093	ND	0.003255
P3-0082	Port Authority - Manchester Garage	21,500	O-30	Ohio River	7.17	2.008	58.7	11.88	ND	ND	0.0006610	0.006102	0.20760	* 0.011017	0.0006356	ND	0.024559
P2-0021	Clean Textile Systems, Inc.	35,000	O-33	Ohio River	7.65	0.129	4.5	2.61	ND	0.0000926	0.0001367	0.000385	0.00300	0.000853	0.0002151	ND	0.003616
P2-0124	J.B. Kreider	480	O-33	Ohio River	7.00	0.037	1.1	0.01	ND	0.0000021	0.0000177	0.000008	0.00279	0.000020	0.0000152	0.0001269	0.000043
P3-0083	Port Authority - South Hills Garage	5,000	S-32	Saw Mill Run	7.00	0.189	4.1	0.51	ND	0.0000222	0.0000593	0.000424	0.01936	ND	0.0000548	ND	0.000759
P1-0029	Nextech	1,300	T-04	Turtle Creek	7.00	0.004	0.0	0.01	ND	ND	ND	0.000017	0.00617	ND	0.0000183	ND	0.000003
P2-0107	LaBarge, Inc.	243	T-04	Turtle Creek	7.00	0.000	0.0	0.01	ND	0.0000007	0.0000053	0.000002	0.00147	0.000082	0.0000027	0.0000013	0.000023
P2-0127	SMS Millcraft	400	T-04	Turtle Creek	7.00	0.032	2.7	0.04	ND	ND	0.0000608	0.000147	0.01319	ND	0.0001463	ND	0.000080
P1-0033	CBS Corporation	44,600	T-07	Turtle Creek	7.48	2.886	39.2	19.08	ND	ND	0.0013048	0.008455	0.18454	* 0.005526	0.0029550	ND	0.027862
P2-0123	Compunetix	1,440	T-26A	Turtle Creek	7.01	0.124	2.9	1.60	ND	0.0000330	0.0002146	0.001347	0.00899	0.000789	0.0001519	NA	0.000799

1) Bay Valley Foods (P2-0020) has process waste streams that discharge to both the A-60 and A-61 regulator structures.

2) UPMC Presbyterian (P2-0099) has process waste streams that discharge to both the M-19W and M-29 regulator structures.

Table 5-31: Summary of Industrial User Sampled Parameter Concentrations at Points of Discharge

Parameter	CD Appendix	Below Detection Limit		Calculated Discharge Concentration > Water Quality Criteria		Protection Criterion
		#	%	#	%	
Toxicity	F	(Addressed through metals)				
pH	F, O	0	0%	0	0%	
Color (CU)	F	0	0%	0	0%	
C.O.D.	F, O	0	0%	No PA WQS		
T.S.S.	F	0	0%			
PCBs	F, O	66	99%	1	2%	
Cadmium	O	42	63%	3	5%	continuous
				2	3%	maximum
Chromium	O	20	30%	0	0%	continuous
				0	0%	maximum
Copper	O	1	6%	16	25%	continuous
				12	19%	maximum
Iron	O	1	1%	3	5%	
Lead	O	28	41%	11	17%	continuous
				0	0%	maximum
Nickel	O	10	15%	0	0%	continuous
				0	0%	maximum
Silver	O	39	60%	4	6%	
Zinc	O	2	3%	5	8%	continuous
				5	8%	maximum

5.4.4 PCB CTS Sampling

The CD required ALCOSAN to investigate and, if found, eliminate PCB discharges. In accordance with this requirement ALCOSAN collected samples of wastewater within interceptors and wastewater influent at the Sewage Treatment Plant. The samples were collected and analyzed for PCBs in two dry weather events and two wet weather events and for TSS in one dry weather event and one wet weather event throughout the ALCOSAN conveyance and treatment system. Re-analyses for PCBs and TSS were performed to verify results when indicated through data quality assurance reviews. PCBs were not detected in any of the samples collected with the exception of one field duplicate quality control sample and only for aroclor 1260. The interpretation of this result was considered questionable due to matrix interferences and a sample was recollected and analyzed by the original laboratory. A split sample was also sent for PCB and TSS analyses to a separate laboratory. PCBs were not detected by either laboratory.

5.4.5 Constituents of Concern

The water quality monitoring programs were developed to evaluate water quality conditions in ALCOSAN receiving waters during both dry and wet weather conditions, to evaluate attainment with Pennsylvania water quality standards, and identify constituents of concern to focus the development and selection of alternative overflow control strategies.

The water quality monitoring results indicate that fecal coliform is the primary constituent of concern for all ALCOSAN receiving waters. Measured concentrations frequently exceeded the 200 and 400 cfu/100 mL thresholds in the recreational season and the 2,000 cfu/100 mL threshold during the non-recreational season.

Although a numeric water quality standard does not exist for total phosphorus (TP), elevated concentrations were found during both dry and wet weather conditions in ALCOSAN receiving waters. Similarly, elevated total suspended solids (TSS) concentrations were evident during wet weather, particularly in the Monongahela and Chartiers Creek and to a lesser degree on the Ohio and Allegheny Rivers. As a result, these parameters should be considered when comparing the performance of various control alternatives, but should not be the primary consideration when selecting alternatives.

Table 5-32: Industrial User Dilution Analysis

Permit No.	Permittee	I.U. Discharge (GPD)	Relative Contribution Factor	Sewershed Basin ID	Receiving Water	PCBs (ug/L)	Copper (mg/L)	Iron (mg/L)	Lead (mg/L)	Silver (mg/L)	Zinc (mg/L)	
						0.000044	0.0085	1.5	0.0028	0.0034	0.110	← continuous
							0.013		0.071		0.110	← maximum
P2-0055	Western Pennsylvania Hospital	192,000	13.9%	A-22	Allegheny River		0.752			0.0653		Maximum Concentration - End-Of Pipe (mg/L)
							1,430			1,430		Q710 Stream Flow (cfs)
							2.13			2.13		End of Pipe Flow (cfs)
							123.0			40.9		Stream Flow Needed to Dilute Discharge Concentartion to Meet Standard (cfs)
							8.6%			2.9%		Percentage of Q710 Stream Flow Needed to Meet Standard
P2-0132	Childrens Hospital of Pittsburgh	186,400	67.9%	A-28	Allegheny River		2.08	126	0.377	0.365	9.2	Maximum Concentration - End-Of Pipe (mg/L)
							1,430	1,430	1,430	1,430	1,430	Q710 Stream Flow (cfs)
							0.42	0.42	0.42	0.42	0.42	End of Pipe Flow (cfs)
							67.6	35.5	2.2	45.4	35.5	Stream Flow Needed to Dilute Discharge Concentartion to Meet Standard (cfs)
							4.7%	2.5%	0.2%	3.2%	2.5%	Percentage of Q710 Stream Flow Needed to Meet Standard
P2-0020	Bay Valley Foods, LLC	1,025,000	90.6%	A-61	Allegheny River		0.0453	25.3				Maximum Concentration - End-Of Pipe (mg/L)
							1,430	1,430				Q710 Stream Flow (cfs)
							1.74	1.74				End of Pipe Flow (cfs)
							6.1	29.4				Stream Flow Needed to Dilute Discharge Concentartion to Meet Standard (cfs)
							0.4%	2.1%				Percentage of Q710 Stream Flow Needed to Meet Standard
P3-0076	Professional Services Inc. (PSI)	3,000	1.3%	C-25	Chartiers Creek	1.61						Maximum Concentration - End-Of Pipe (mg/L)
						31.4						Q710 Stream Flow (cfs)
						0.36						End of Pipe Flow (cfs)
						13,020.0						Stream Flow Needed to Dilute Discharge Concentartion to Meet Standard (cfs)
						41465.0%						Percentage of Q710 Stream Flow Needed to Meet Standard
P2-0036	Pittsburgh Post-Gazette	25,175	22.1%	M-01	Monongahela River		0.566					Maximum Concentration - End-Of Pipe (mg/L)
							1,210					Q710 Stream Flow (cfs)
							0.18					End of Pipe Flow (cfs)
							7.6					Stream Flow Needed to Dilute Discharge Concentartion to Meet Standard (cfs)
							0.6%					Percentage of Q710 Stream Flow Needed to Meet Standard
P2-0029	UPMC Montefiore Hospital	316,607	39.9%	M-19Y	Monongahela River		1.11			0.303		Maximum Concentration - End-Of Pipe (mg/L)
							1,210			1,210		Q710 Stream Flow (cfs)
							1.22			1.22		End of Pipe Flow (cfs)
							104.6			109.0		Stream Flow Needed to Dilute Discharge Concentartion to Meet Standard (cfs)
							8.6%			9.0%		Percentage of Q710 Stream Flow Needed to Meet Standard
P2-0099	UPMC Presbyterian	305,433	64.6%	M-19W	Monongahela River			42.3				Maximum Concentration - End-Of Pipe (mg/L)
								1,210				Q710 Stream Flow (cfs)
								0.73				End of Pipe Flow (cfs)
								20.5				Stream Flow Needed to Dilute Discharge Concentartion to Meet Standard (cfs)
								1.7%				Percentage of Q710 Stream Flow Needed to Meet Standard

This page was intentionally left blank to facilitate double-sided printing.

5.5 Water Quality Modeling

There are two plans and two reports that documented the efforts to produce and validate the ALCOSAN water quality models. The *ALCOSAN Receiving Water Quality Model Plan (September, 2011)* provided the modeling approach employed, described the model objectives and capabilities, and model development and validation procedures. Similarly, the *Receiving Water Quality Model Validation Monitoring Plan (September, 2011)* established the objectives and protocols for conducting water quality sampling and performing the associated analyses for the validation of the model. The *Receiving Water Quality and CSO Pollutant Monitoring Plan Data Report (September 2011)* documented the field sampling program and analysis results and the *Water Quality Model Validation Report* documented the model validation process.

The ALCOSAN Water Quality modeling program was also guided by the requirements contained within the ALCOSAN Consent Decree. Specific requirements for the development of the water quality models and the Receiving Water Quality Model Plan are documented in Appendix R of the ALCOSAN Consent Decree. Section 2.0 of the plan describes and documents the required objectives and capabilities of the models. The *Receiving Water Quality Model Plan* established that the overall primary objective of the modeling effort is to develop a set of reliable, predictive tools to be used to characterize water quality impacts on receiving waters from CSOs.

As discussed in Section 5.4.5 (*Constituents of Concern)* of this Wet Weather Plan, the findings indicated that fecal coliform is the primary constituent of concern for the development of overflow control alternatives. The water quality modeling program was focused on understanding the fecal coliform conditions within the receiving waters and assessing attainment with the water quality standards under various control alternatives.

5.5.1 Collection System, Watershed and Tributary Approach

Appendix R of the Consent Decree specifies that the following "receiving waters" must be included in the ALCOSAN Water Quality modeling program: Ohio River, Monongahela River, Allegheny River, Turtle Creek, Chartiers Creek, and Saw Mill Run. It also requires that the "remaining receiving streams" within the service area utilize either the same or other appropriate models and assessment tools."

The Ohio River, Monongahela River, and Allegheny River are collectively referred to as the Main Rivers. Chartiers Creek, Saw Mill Run and Turtle Creek are collectively referred to as the Tributaries and discharge into the Main Rivers. Flow and pollutants can enter the Main Rivers and Tributaries through:

- Overflows from sewer systems
- Runoff (direct and through storm water collection systems)
- Baseflow (groundwater)
- Tributary waterways

As discussed in Section 4, the ALCOSAN H&H models were developed and validated to provide reasonable estimates of combined and sanitary sewer overflows resulting from precipitation events. These SWMM5 H&H models were also adapted to perform the water quality modeling for the combined and sanitary sewer area collection systems. Event mean concentration pollutant washoff functionality was added to simulate surface runoff pollutant loadings and constant concentrations were assigned directly to influent baseflow and industrial discharge time series based upon results of the respective sampling programs. The model mixes and transports pollutants through the collection system, along with the flows, and discharges through the outfalls to the receiving waters during an overflow event. The resultant overflow concentrations were validated to the CSO Pollution Monitoring Plan (CSO PMP) monitoring data, as discussed in ALCOSAN's *Water Quality Model Validation Report (September, 2011).*

Watershed areas not tributary to the combined sewer collection system contribute runoff and associated pollutant loads to the receiving waters either through storm water collection systems, direct runoff, or through minor waterways. SWMM5 hydrologic and water quality models were developed to simulate the storm water runoff and water quality loadings to the receiving waters throughout the ALCOSAN service area. The hydrologic models were developed using methods similar to those employed for the H&H models and are described in Section 4.2 of the *Water Quality Model Validation Report*. Event mean concentration washoff was used to simulate surface runoff pollutant loadings.

As discussed in Section 2.2 of the *Water Quality Model Validation Report*, it was determined that one-dimensional transport models were appropriate for modeling the Tributaries. A one-dimensional model utilizes a uniform cross-sectional average for flow and/or concentration and assumes cross sectional differences do not need to be taken into account. The USEPA SWMM5 model was selected to model transport through the Tributaries. The models mix and transport flows and pollutant loads from the collection system overflows, watershed models, and base stream flow. SWMM5 utilizes full dynamic wave routing of flow and routes pollutants by assuming completely mixed modeling segments.

Base Wastewater Flow Concentrations: The sanitary sewage flow rates in the sewer systems throughout the ALCOSAN service area have been studied extensively, as discussed in Section 4.1 of the Wet Weather Plan. System wide median pollutant concentrations obtained from the CSO PMP dry weather sampling results were assigned and then adjusted during the model validation process, as discussed in the Section 3.4.1 of the *Water Quality Model Validation Report*, to develop the modeled base wastewater flow concentrations provided in Table 5-33.

Table 5-33: ALCOSAN Water Quality Model Base Wastewater Flow Concentrations

Parameter	Units	Concentration		Parameter	Units	Concentration
Fecal Coliform	col/100ml	1,000,000		Total Cadmium	ug/L	1
Escherichia coli	col/100ml	860,000		Total Chromium	ug/L	10
5-Day Biochemical Oxygen Demand	mg/L	113		Total Copper	ug/L	57
Chemical Oxygen	mg/L	153		Total Iron	ug/L	990

Table 5-33: ALCOSAN Water Quality Model Base Wastewater Flow Concentrations

Parameter	Units	Concentration		Parameter	Units	Concentration
Demand						
Total Suspended Solids	mg/L	123		Lead	ug/L	50
Ammonium	mg/L	5.85		Total Nickel	ug/L	10
Nitrite Nitrate	mg/L	1.08		Total Silver	ug/L	10
Total Kjeldahl Nitrogen (TKN)	mg/L	18.6		Total Zinc	ug/L	107
Total Phosphorus	mg/L	3.37				

Stormwater Event Mean Concentrations: The Event Mean Concentration (EMC) dataset presented in Table 5-34 was developed for the ALCOSAN Water Quality models by combining the Nationwide Urban Runoff Program (NURP) dataset, USGS urban runoff studies, and the National Stormwater Quality Dataset (NSQD), as described in Section 4.1.1 of the *Receiving Water Quality Model Plan*.

Table 5-34: ALCOSAN Event Mean Concentration Dataset

Parameter	Units	EMC		Parameter	Units	EMC
Fecal Coliform	col/100ml	3,821		Total Cadmium	ug/L	1.06
Escherichia coli	col/100ml	3,298		Total Chromium	ug/L	10.3
5-Day Biochemical Oxygen Demand	mg/L	8.45		Total Copper	ug/L	17.7
Chemical Oxygen Demand	mg/L	56.5		Total Iron	ug/L	1,629
Total Suspended Solids	mg/L	65.7		Lead	ug/L	42. 7
Ammonium	mg/L	0.400		Total Nickel	ug/L	6.80
Nitrite Nitrate	mg/L	0.600		Total Silver	ug/L	0.033
Total Kjeldahl Nitrogen (TKN)	mg/L	1.41		Total Zinc	ug/L	127
Total Phosphorus	mg/L	0.287				

Industrial User Flows and Pollutant Loads: As discussed in Section 3.3 of the *Water Quality Model Validation Report*, the industrial discharge flow and water quality loads from the 22 most significant industrial users, based upon the July 2009 Industrial User Assessment, were incorporated into the ALCOSAN Water Quality Models. These industrial discharges were added within their respective sewersheds as direct and constant loads at the point of connection between the municipal sewer system and the ALCOSAN interceptor system.

RDII Pollutant Loads: There is no known quantification of Rainfall Dependant Inflow and Infiltration (RDII) water quality. It would be expected that the quality would vary widely based upon the relative proportions of the inflow and infiltration as well as the multiple pathways by which each reach the collection system. It is likely that RDII concentrations would tend to be lower than that of stormwater due to the additional filtration provided through the infiltration process and potential mixing with groundwater. Therefore, an assumption was made to use 10% of the stormwater EMC values shown in Table 5-34 as the RDII concentrations in the ALCOSAN Water Quality Models.

Tributary In-Stream Baseflow: In-stream baseflow concentrations were estimated using the results of the RWQMP. Dry weather flow samples were collected on Chartiers Creek, Girty's Run, Lowries Run, Saw Mill Run, Thompson Run and Turtle Creek. A total of 32 fecal coliform observations were included in the dry weather sampling dataset with concentrations ranging from 30 cfu/100 ml up to 14,000 cfu/100 ml. Table 5-35 presents the median values and number of samples taken from each waterbody. During the validation phase, the system-wide median value of 450 cfu/100ml was applied to all tributaries. Table 5-36 presents the system wide median values for the remaining modeled parameters.

Table 5-35: Fecal Coliform Sample Site Specific
In-Stream Base Flow Concentrations

Parameter	Median cfu/100ml	Number of Samples
Chartiers Creek	450	9
Girty's Run	980	3
Lowries Run	1,800	3
Saw Mill Run	760	6
Turtle Creek/Thompson Run	240	11
System Wide	450	32

Table 5-36: ALCOSAN Water Quality Model In-Stream Base Flow Concentrations

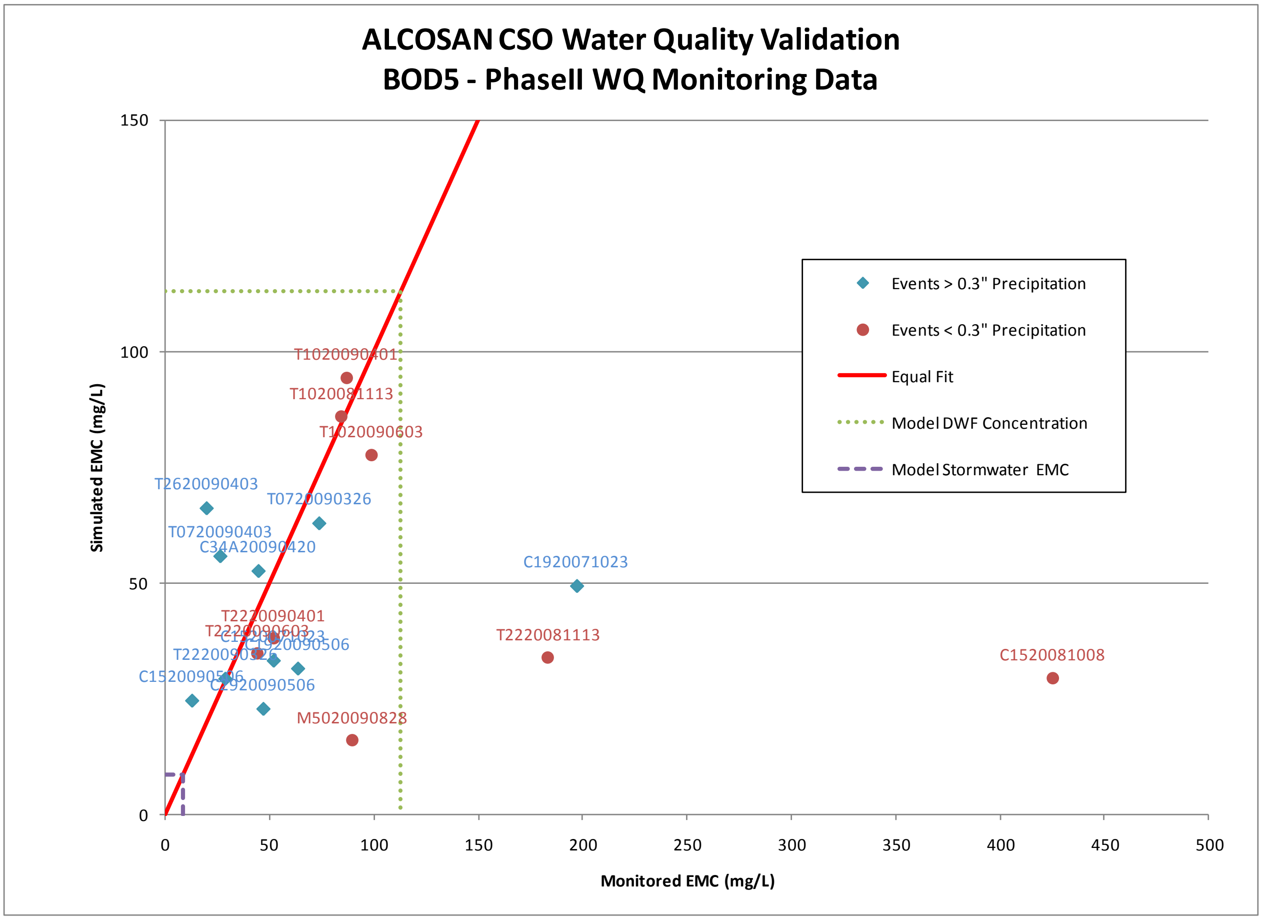
Parameter	Units	Conc		Parameter	Units	Conc
Fecal Coliform	col/100ml	450		Total Cadmium	ug/L	1
Escherichia coli	col/100ml	385		Total Chromium	ug/L	10
5-Day Biochemical Oxygen Demand	mg/L	2		Total Copper	ug/L	10
Chemical Oxygen Demand	mg/L	7		Total Iron	ug/L	170
Total Suspended Solids	mg/L	5		Lead	ug/L	50
Ammonium	mg/L	0.1		Total Nickel	ug/L	10
Nitrite Nitrate	mg/L	1.17		Total Silver	ug/L	10
Total Kjeldahl Nitrogen (TKN)	mg/L	0.445		Total Zinc	ug/L	10
Total Phosphorus	mg/L	0.085				

Collection System Model Validation: The details of the collection system water quality model validation can be found in the *Water Quality Model Validation Report*. As discussed in Section 3.7 of that report, the validation approach involved visually comparing simulated overflow loads and concentrations with the observed data collected during the Phase II CSO monitoring program. These comparisons were performed using time series plots of individual sampling events as well as loading scatter plots which incorporate all of the CSO sampling events for a given parameter. The validations were judged on a system wide basis for each parameter. An example validation plot from the model validation report is provided in Figure 5-65.

Tributary and Watershed Model Flow Validations: The details of the watershed and tributary model hydrologic validations can be found in the *Water Quality Validation Report*. As discussed in Section 5.3 of that report, the validation approach involved event based comparisons of simulated stream flow with the observed data collected at USGS monitoring stations. These comparisons were performed using time series plots of individual sampling events as well as event based regression plots similar to the method used for validation of the H&H models.

Tributary and Watershed Model Water Quality Validations: The details of the watershed and tributary model water quality validations can be found in the *Water Quality Validation Report*. As discussed in Section 5.4 of that report, the validation approach involved comparisons of simulated in-stream water quality concentration with the observed data collected as part of the Receiving Water Quality Monitoring Program between 2006 and 2009. These comparisons were performed using time series plots of individual sampling events for each modeled parameter on each Tributary.

Figure 5-65: Sample CSO Validation Scatter Plot



5.5.2 Main Rivers Approach

The Ohio, Monongahela, and Allegheny River are collectively referred to as the Main Rivers. These are wide waterways with surface elevations controlled by lock and dams operated by the US Army Corps of Engineers. For these waterways it was determined that a two-dimensional transport model, capable of both horizontal and lateral dynamics, was needed to represent differences in flow and concentration across the river cross sections. The US Army Corp of Engineers RMA2 and RMA4 models were selected to model transport through the Main Rivers. RMA2 is a two-dimensional depth averaged finite element hydrodynamic model, and RMA4 is an accompanying two-dimensional depth averaged finite element water quality model.

Four model pools were created to simulate the flow in the Main Rivers. The pools were divided at lock and dam (L/D) structures. Channel bathymetry measurements were used to define the model channel geometry. The model boundary was extended into some tributaries for a short distance in order to accurately model inflows and allow for model convergence during high flow periods. The model was divided into the following four pools, shown in Figure 5-66 based on the locations of L&D structures.

- L/D2 Pool – C.W. Bill Young Lock and Dam (River Mile 14.5) to L&D 2 (River Mile 6.7) on the Allegheny River
- Braddock Pool –L/D 3 (River Mile 23.8) to L&D at Braddock (River Mile 11.2) on the Monongahela River
- Emsworth Pool – L&D 2 on the Allegheny and Braddock L&D on the Monongahela to the Emsworth L&D (River Mile 6.2) including the confluence of the rivers at the Point at Pittsburgh (River Mile 0.0)
- Dashields Pool – Emsworth L&D to the Dashields L&D (River Mile 13.3) on the Ohio River

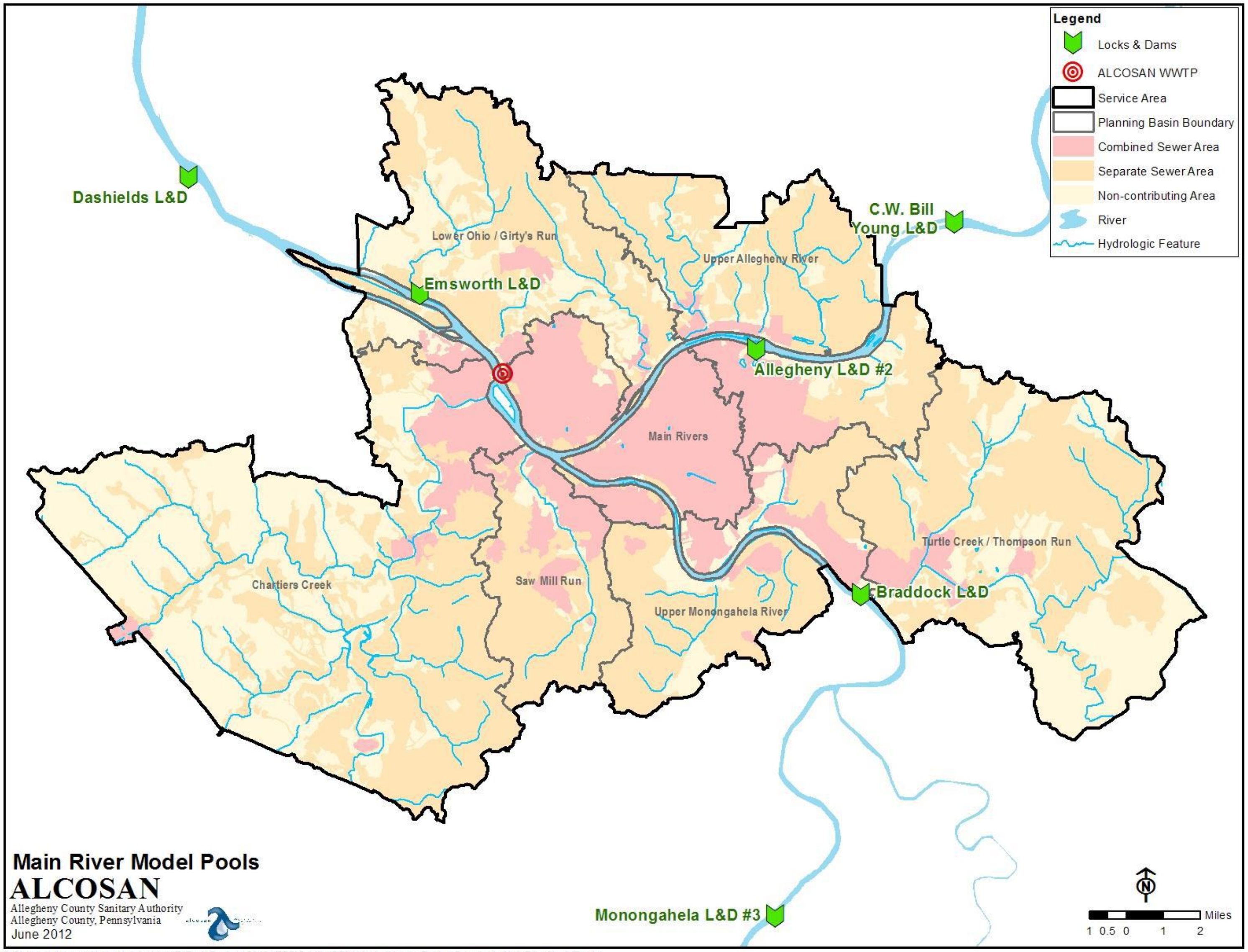
Detailed descriptions of the types of required model input data and the sources of the model input data were documented in Section 4.1.2 of the *Receiving Water Quality Model Plan*. The details of the RMA2 validation can be found in the ALCOSAN *Water Quality Validation Report.* The model was validated to field measurements of velocity profiles, water surface elevations and total cross-sectional flow over 2006-2009.

The Main Rivers water quality model was developed using RMA4, which is designed to be coupled with an RMA2 hydraulic model. RMA4 computes the transport and reaction kinetics of a water quality constituent in the lateral and longitudinal dimensions assuming vertically uniform concentrations. Fecal coliform was the only constituent included in the RMA4 model, as a result of the analysis for constituents of concern, discussed in Section 5.4.5 of this Wet Weather Plan. Reaction kinetics are limited to first order decay, which is a common approach for bacteria modeling. The velocity fields and water surface elevations computed by the RMA2 hydraulic model are input to the RMA4 water quality model. Boundary conditions define the coliform counts at each upstream boundary. Tributary and CSO/SSO loads are defined based on the tributary and collection system models. The RMA4 model was validated to field sampling observations between 2006-2009 by adjusting model parameters controlling eddy dispersion and the first order decay rate. Results were spatially averaged into a series of river segments that varied in length from 0.5 to 1 mile.

The Main Rivers RMA4 model water quality loads were specified based on the regression model for upstream inflows, time series from the tributary SWMM models, and outflows from the H&H Collection System Models. Detailed descriptions of the types of required model input data and the sources of the model input data were documented in Section 4.1.2 of the *Receiving Water Quality Model Plan.* The details of the RMA4 validation can be found in the ALCOSAN *Water Quality Validation Report.*

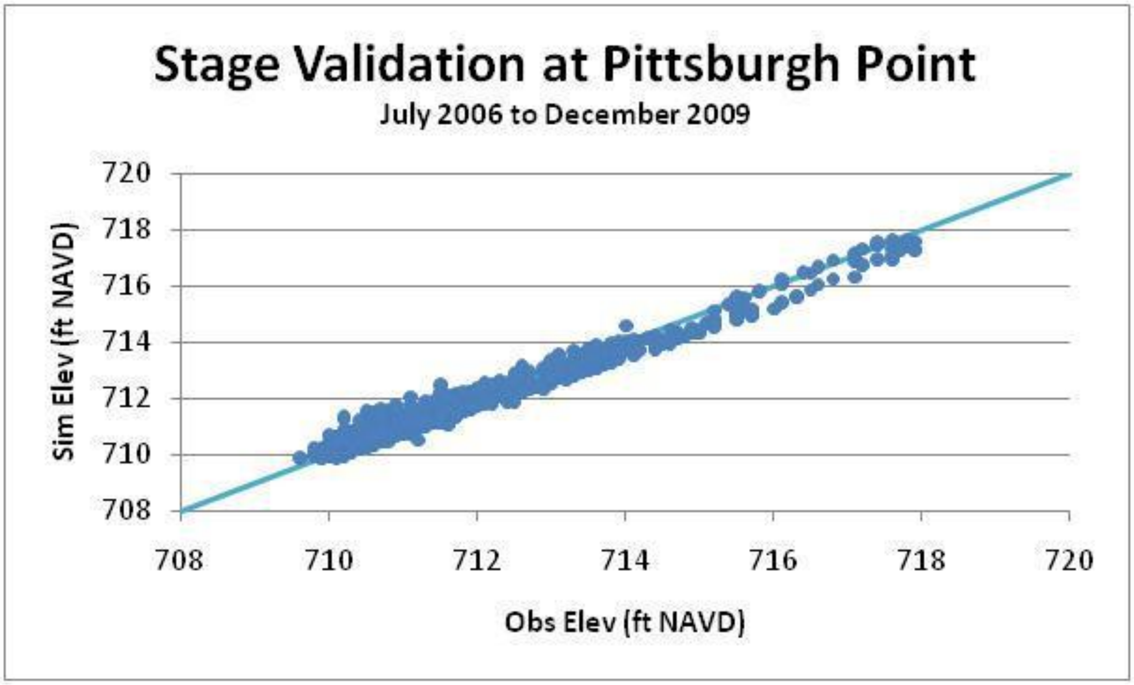
Main Rivers RMA2 Hydraulic Model Validations: The details of the RMA2 model velocity, flow and stage validations can be found in the *Water Quality Validation Report*. As discussed in Section 6.3.5 of that report, the validation approach involved comparisons of simulated and observed velocity profiles, water surface elevations, and total flow. The validations were performed by adjusting the Peclet number, Manning n and bathymetry to match observed data in each of the pools. A sample validation plot is provided in Figure 5-67.

Figure 5-66: Main Rivers Model Pools



Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\Section5\FINAL\UpdatesperReviewComments\MainRiverModelPools

Figure 5-67: RMA2 Stage Validation



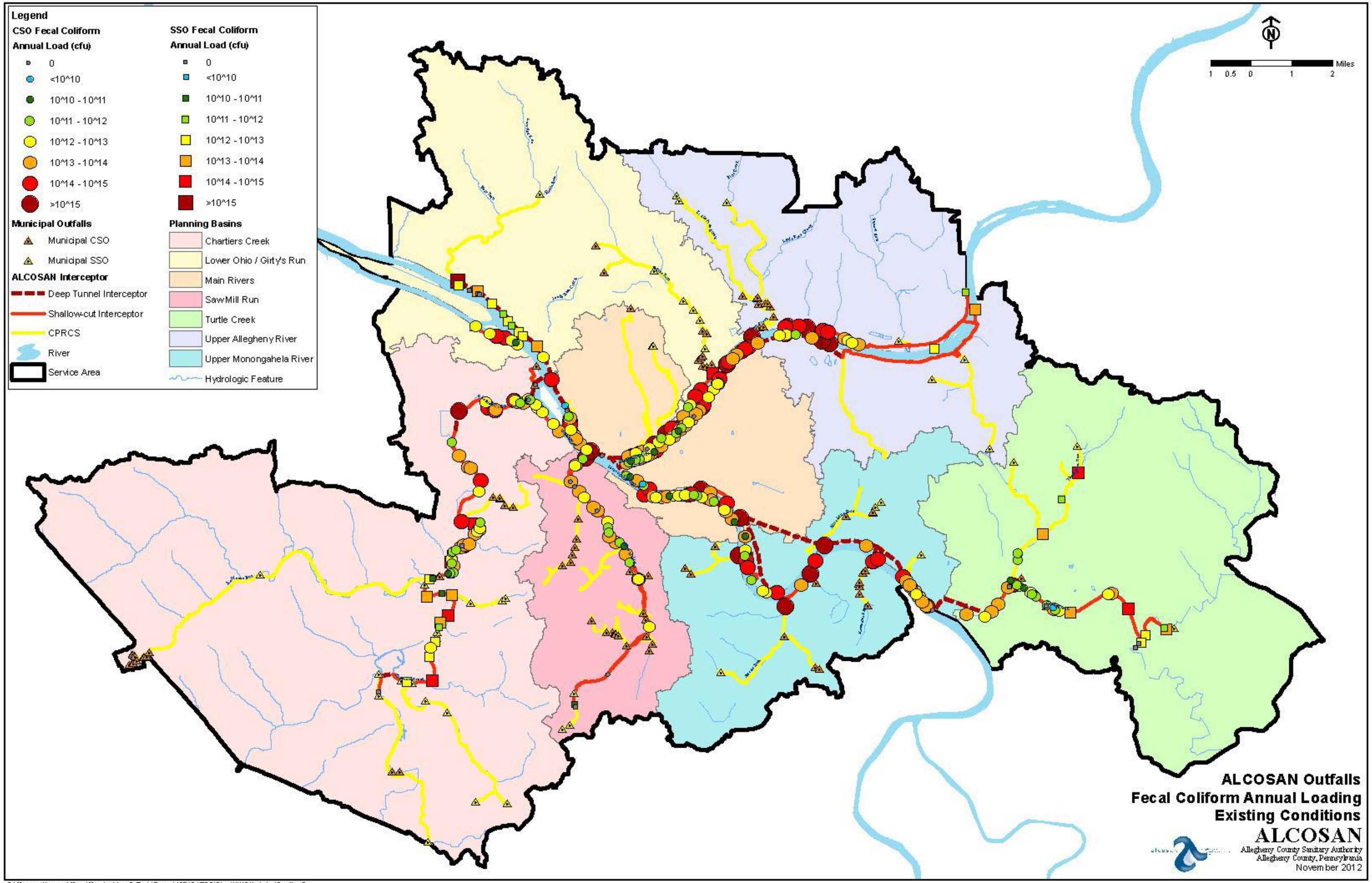
5.5.3 Water Quality Model Results for Existing Conditions

Collection System Overflow Loadings: Combined and separate sewer overflow discharges are only two of many pathways for pollutants to enter the area receiving waters. The relative contribution of overflows to the total pollutant load varies by pollutant and receiving water. Other major sources of pollutant loads can include point discharges from stormwater collection systems, non-points source runoff, atmospheric deposition, illicit discharges, leaking collection systems, and upstream boundary conditions. In stream dry weather baseflow loads, which are primarily functions of natural sources, illicit discharges and leaking sanitary systems, can comprise a majority of the annual pollutant load.

The distribution of overflow loads varies by constituent, but generally the Allegheny River receives the largest load, followed by the Monongahela River, Chartiers Creek, and Ohio River. (excludes the discharge from the Wood's Run WWTP). Those waterbodies receive a total of 89% of the fecal coliform overflow load, 39%, 27%, 12%, and 11%, respectively. The typical year fecal coliform overflow loading mass, represented in cfu's, is presented in Figure 5-68.

This page was intentionally left blank to facilitate double-sided printing.

Figure 5-68: Existing Conditions Typical Year Annual Fecal Coliform Overflow Loadings



This page was intentionally left blank to facilitate double-sided printing.

Water Quality Standards Assessment Methodology: The State of Pennsylvania water quality standards for bacteria are based on fecal coliform and state:

> *(Fecal Coliforms/100 ml) – During the swimming season (May 1 through September 30), the maximum fecal coliform level shall be a geometric mean of 200 per 100 milliliters (ml) based on a minimum of five consecutive samples each sample collected on different days during a 30-day period. No more than 10% of the total samples taken during a 30-day period may exceed 400 per 100 ml. For the remainder of the year, the maximum fecal coliform level shall be a geometric mean of 2,000 per 100 milliliters (ml) based on a minimum of five consecutive samples collected on different days during a 30-day period.*

These criteria are based on the use of in-stream water quality sampling data for assessing water quality standard attainment. Generally, the cost of sample collection and analysis limits water quality sampling programs in terms of the frequency of sample collection, the duration of the sampling program, and the number of sampling locations that can be cost effectively assessed. The water quality models, however, provide continuous simulations of in-stream concentrations across the extents of the modeling domain. More importantly, the model can be used as a predictive tool to assess the potential impacts future growth and overflow control scenarios will have on water quality conditions.

To evaluate the attainment of the fecal coliform standards using the model results, a sampling algorithm was developed to generate a series of 10,000 random sample groups for each model display segment in the recreational and non-recreational season. Each sample group contains ten samples selected randomly on different days over a 30-day period. The geometric mean of each sample group was calculated to compare to the 200 cfu per 100 ml and 2,000 cfu per 100 ml criteria for the recreational and non-recreational seasons, respectively. In addition, the percent of samples exceeding 400 cfu per 100 ml in each sample group during the recreational season was calculated. For each model display segment, the number of sample groups exceeding each criterion was divided by the total number of sample groups (10,000) to calculate the frequency of water quality standard exceedances. This exceedance frequency was considered representative of the probability of not meeting the water quality standard. Attainment of water quality standards was judged for each model display segment as meeting these criteria in at least 99% of the randomly selected sample sets.

Water Quality Standards Assessment Results: The assessment results for all of the modeled receiving streams are shown in Figures 5-69 through 5-71. The figures demonstrate that the receiving waters are not achieving attainment with the bacteria water quality standards established to protect water contact recreation. This should be anticipated since most of the contributing sources in the water quality models are greater than 400 cfu per 100 ml.

Figure 5-69: Existing Conditions Recreational Season Fecal Coliform Geometric-Mean Water Quality Standard Assessment

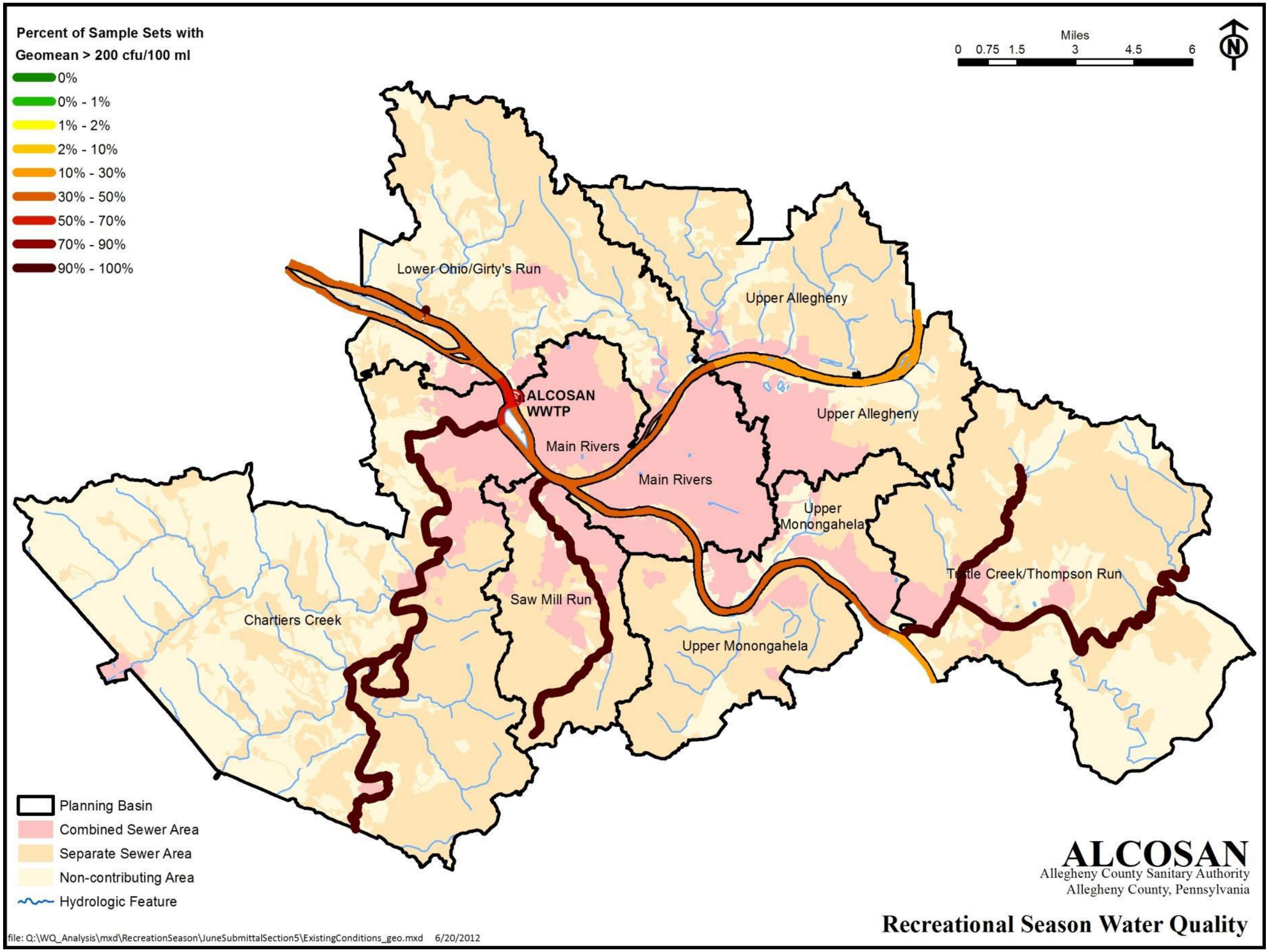


Figure 5-70: Existing Conditions Recreational Season Fecal Coliform 10% Water Quality Standard Assessment

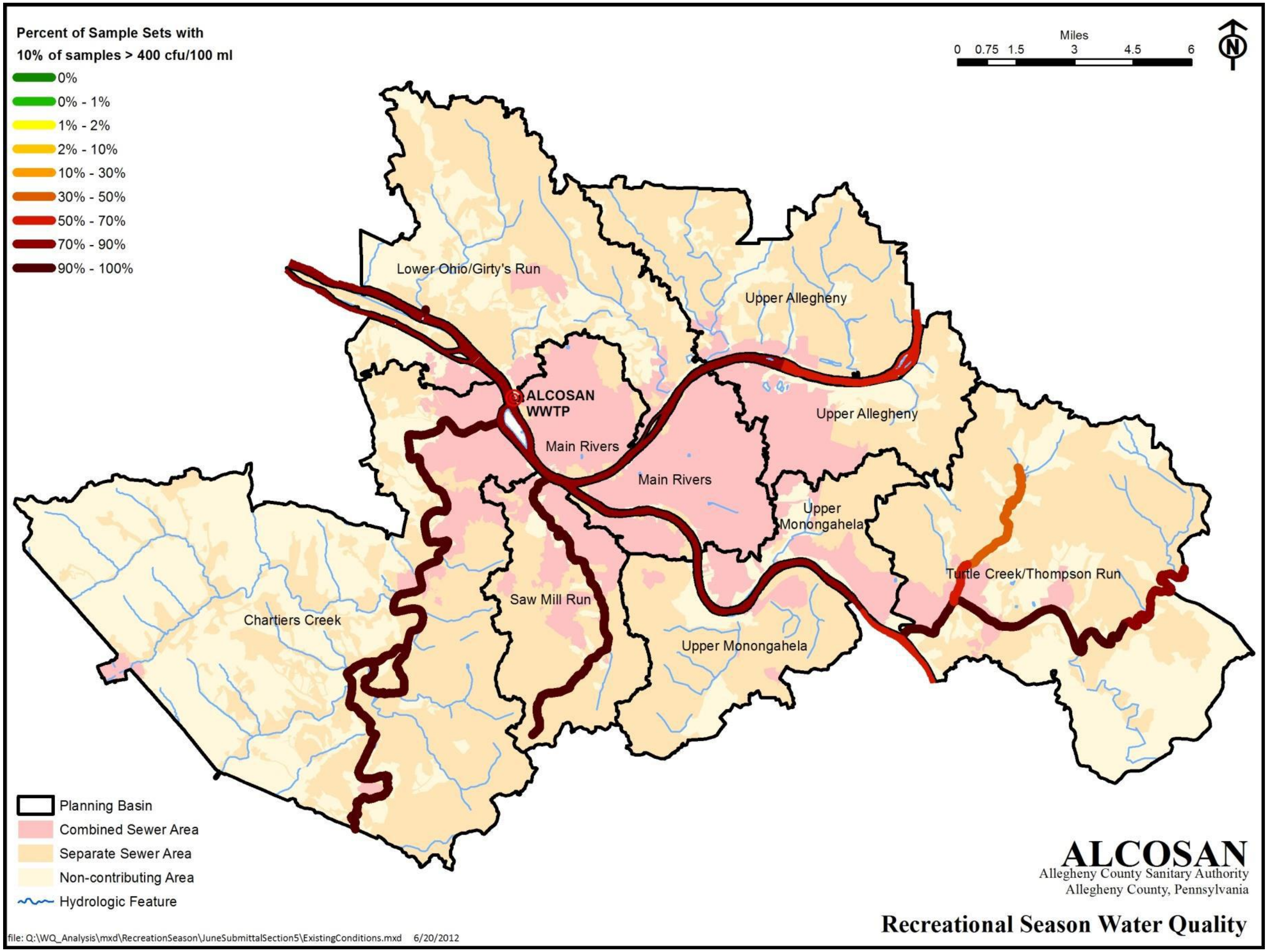


Figure 5-71: Existing Conditions Non-Recreational Season Fecal Coliform Geometric-Mean Water Quality Standard