4.0 HYDROLOGIC AND HYDRAULIC CHARACTERIZATION

Executive Summary: ALCOSAN developed and implemented a comprehensive Hydrologic and Hydraulic (H&H) modeling program to build an accurate predictive tool that was used to characterize the collection system under existing conditions, future baseline conditions, and under various control scenarios evaluated during the development of the Wet Weather Plan (WWP). To validate the H&H model and ensure it accurately represents wastewater flow through the collection system and sewer overflow activity, system-wide precipitation and flow monitoring was conducted. The monitoring data were compared to the simulated model responses and the model input parameters were adjusted to facilitate a closer correlation between the observed data and the simulated response. Rainfall patterns corresponding to average or typical year precipitation values were applied to the validated H&H models to quantify and characterize the frequency, duration and volume of combined sewer overflow (CSO) and sanitary sewer overflow (SSO) discharges from ALCOSAN and municipal outfalls. This section summarizes the ALCOSAN monitoring and modeling programs, and documents existing condition CSO and SSO discharges in a series of tables. The model simulations indicate that under existing conditions with typical rainfall over a 12-month period, the ALCOSAN system captures and treats approximately 77 billion gallons of wastewater flow. Approximately 9 billion gallons are discharged from the roughly 350 ALCOSAN and municipal CSO outfalls scattered throughout the service area and approximately 0.7 billion gallons of wastewater is discharged from over 100 SSO outfalls.

Section 4.1 provides overview summaries of the wastewater flow and precipitation monitoring programs that ALCOSAN implemented, explains the quality assurance procedures that were implemented to ensure data reliability, and describes how the data were used to validate the H&H models. Maps show the locations of each of the monitoring sites. Section 4.2 provides an overview of the ALCOSAN H&H modeling program and describes how the models have evolved and been refined over time. Section 4.3 provides a series of tables that document, over the entire ALCOSAN service area, the annual frequency, duration, and volume of overflow discharges from ALCOSAN and municipal CSO and SSO outfalls. Similarly, Sections 4.4 through 4.10 provide a series of tables and figures that document CSO and SSO discharges within each of the designated planning basin areas that comprise the ALCOSAN service area.

A comprehensive monitoring plan was developed as a rule book to document the technical approach, technical protocols, and quality assurance measures that needed to be implemented to achieve a successful monitoring program. The *Regional Collection System Flow Monitoring Plan* (RCS-FMP) was completed in October 2007. Similarly, a comprehensive modeling plan was developed to guide the implementation of a successful H&H modeling program. The *Hydrologic and Hydraulic Modeling Plan* (HHMP) was completed August 2009. In July 2011, a *Hydrologic and Hydraulic Model Validation Summary* was completed which documented the model validation process and demonstrated that the requirements from the HHMP were successfully and consistently implemented. A *Hydrologic and Hydraulic Model Validation and Characterization Report* (HHMVCR) was prepared for each planning basin area. The HHMVCR provides detailed information from which the summaries in this section were developed. These reports are listed in the Bibliography.

4.1 Flow and Precipitation Monitoring

Since 1993, ALCOSAN has maintained a network of short-term portable and long-term sewer flow meters. These meters have been used to monitor wastewater flow through sanitary and combined sewers to quantify and characterize tributary sewershed areas to ALCOSAN interceptors, flow through the ALCOSAN interceptor system, and overflow activity from combined and separate sewers. In late 2007, ALCOSAN initiated the RCS-FMP which involved the concurrent monitoring of flows at over 550 sites located throughout the ALCOSAN service area. To correlate specific storms and periods of wet weather to changes in monitored wastewater depth and flow, rainfall and snowfall over the service area have been continuously monitored using a network of rain gauge stations and Doppler weather radar.

The ALCOSAN Consent Decree (CD) required the continuous monitoring of precipitation and the submission and implementation of a comprehensive flow monitoring plan for the service area. The RCS-FMP documents the technical approach used to quantify and characterize dry and wet weather flow from each of the tributary municipal collection systems connected to the ALCOSAN interceptors and to measure flow through the ALCOSAN system. The ultimate purpose of the RCS-FMP was to produce comprehensive, consistent, standardized wastewater flow data acceptable to, and for use by, the municipalities and ALCOSAN. This wastewater flow data was subsequently used to facilitate the development of the Feasibility Studies and Wet Weather Plan mandated by the ALCOSAN CD and the municipal Administrative Consent Orders and Consent Order Agreements.

4.1.1 Precipitation Monitoring

Spatially Distributed Precipitation: The topography of Allegheny County exerts an orographic influence on rainfall events, particularly on smaller convective cells (thunderstorms). As a result, rain gauges located at different points in the service area can record significantly different volumes from the same storm event. In a rainfall-runoff model, much of the uncertainty in the model results from the uncertainty inherent in the precipitation data. Therefore, a gauge adjusted radar rainfall system has been implemented and maintained since April 2000 to provide high resolution, spatially distributed precipitation data for the ALCOSAN service area. The radar rainfall system accounts for the temporal and spatial distribution of rainfall in greater detail than would otherwise be possible with a traditional rain gauge network, resulting in additional accuracy and confidence in the model results. Since July 2003, a regional network of 33 rain gauges was used to calibrate the recorded radar reflectivity and produce the precipitation data used to populate the radar-rainfall pixel grid with 15-minute increments and a resolution of 1-km by 1-km (0.6 mile by 0.6 mile). The rain gauges were heated so snow and sleet were recorded as water equivalent. A map of the rainfall gauge network and corresponding pixel grid for the ALCOSAN service area is provided in Figure 4-1.

Long-Term Record Precipitation: Long-term precipitation conditions over the ALCOSAN service area were characterized from the historical record dataset obtained from the National Weather Service station located at the Pittsburgh International Airport (PIA). Hourly data were obtained and utilized for the 60-year period from mid-1948 through 2008. This data were used for calculating the historical average annual and monthly event statistics for parameters such as storm volume, storm frequency, peak storm intensity, storm duration, and storm inter-event time. The average annual precipitation volume at the gauge, which for the long-term record is assumed to be representative for precipitation over the ALCOSAN service area, is 36.79 inches. The 68 percent confidence interval (plus and minus one standard deviation) extends from 31.40 inches to 42.18 inches. The average number of significant precipitation events over the long-term record was 94 and the 68 percent confidence interval ranges from 85 to 103 events. A threshold value of 0.05 inches and an inter-event period of 6 hours were used to define significant precipitation events. This threshold value roughly corresponds with the depression storage values used in the SWMM models and approximates the minimum rainfall at which runoff commences from impervious surfaces. Any storms that stopped and restarted within six hours or less were considered a single event.

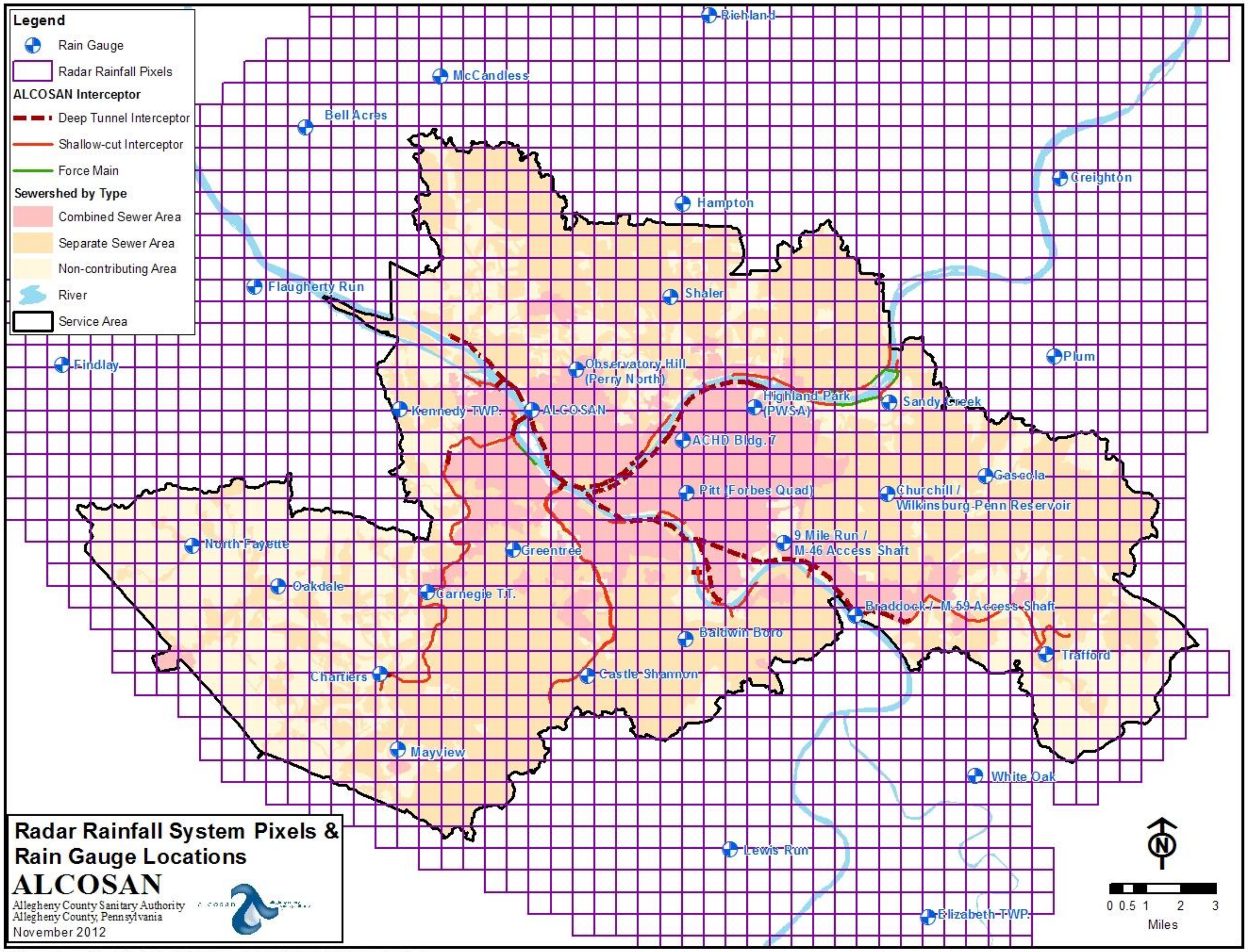
Figure 4-2 shows the average monthly distribution of precipitation volumes based upon the long-term PIA gauge record. Also shown on the figure are the plus and minus one standard deviation (SD) values that depict the statistical 68 percent confidence intervals for the dataset. The analysis results show that precipitation volumes in the greater Pittsburgh region are generally higher in the late spring and summer months and less during the fall and winter months. Average monthly precipitation totals tend to range from approximately 2.3 to 3.9 inches. Figure 4-3 shows the average distribution of precipitation event frequency and the plus and minus one standard deviation values. The figure shows that precipitation events in the greater Pittsburgh region tend to be distributed relatively evenly throughout the year, averaging from 6 to 9 events per month. The 68% confidence interval range would extend from 4 to 12 events per month.

Typical Year Precipitation: In support for the WWP, representative or typical year precipitation for the ALCOSAN service area was developed and applied to the hydrologic and hydraulic (H&H) models to characterize flow from combined sewershed areas, establish the frequency and duration of combined sewer overflow (CSO) discharges, characterize their potential water quality impacts, and develop and assess alternative control strategies. Analysis of monitored data from the PIA gauge showed that calendar year 2003 best matched the historical hydrological conditions. The analysis also showed that refinements needed to be made because the event statistics from the spatially distributed precipitation files for 2003 did not consistently match the corresponding event statistics from the historical record gauge. The implemented refinements allow the typical year model simulations to represent the equivalent results of a model simulation for the entire 60-year historic gage record. These refinements were made to reduce and minimize observed differences that could result in under- or over-sizing wet weather control facilities and an under- or over-estimated assessment of the long-term performance of the facilities.

Three categories of data adjustments were performed on the year 2003 precipitation dataset. These adjustments and refinements only were conducted when and where they were needed to preserve as much of the original monitoring record as possible.

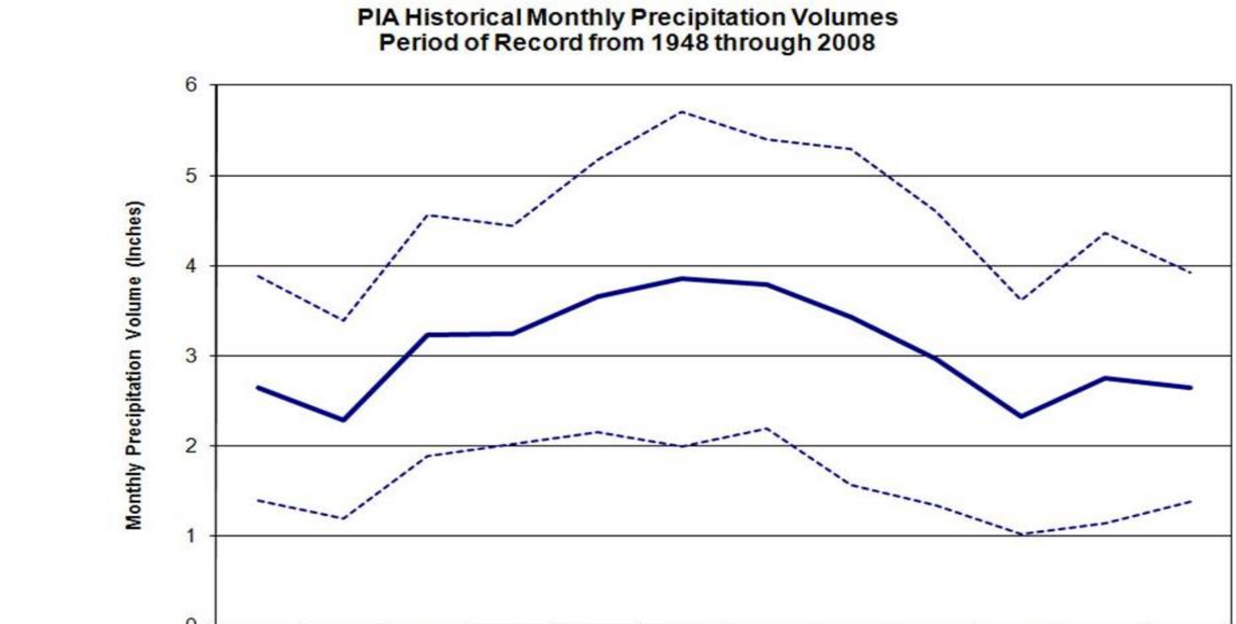
- Pixel precipitation event volumes were adjusted, when and where needed, for the 20 largest storms
- Total annual pixel precipitation volumes were adjusted, when and where needed
- Peak hourly rainfall intensity values were adjusted, when and where needed, for the 12 largest storms within each of the consolidated pixel areas

Figure 4-1: Radar-Rainfall System Pixels and Regional Gauge Locations



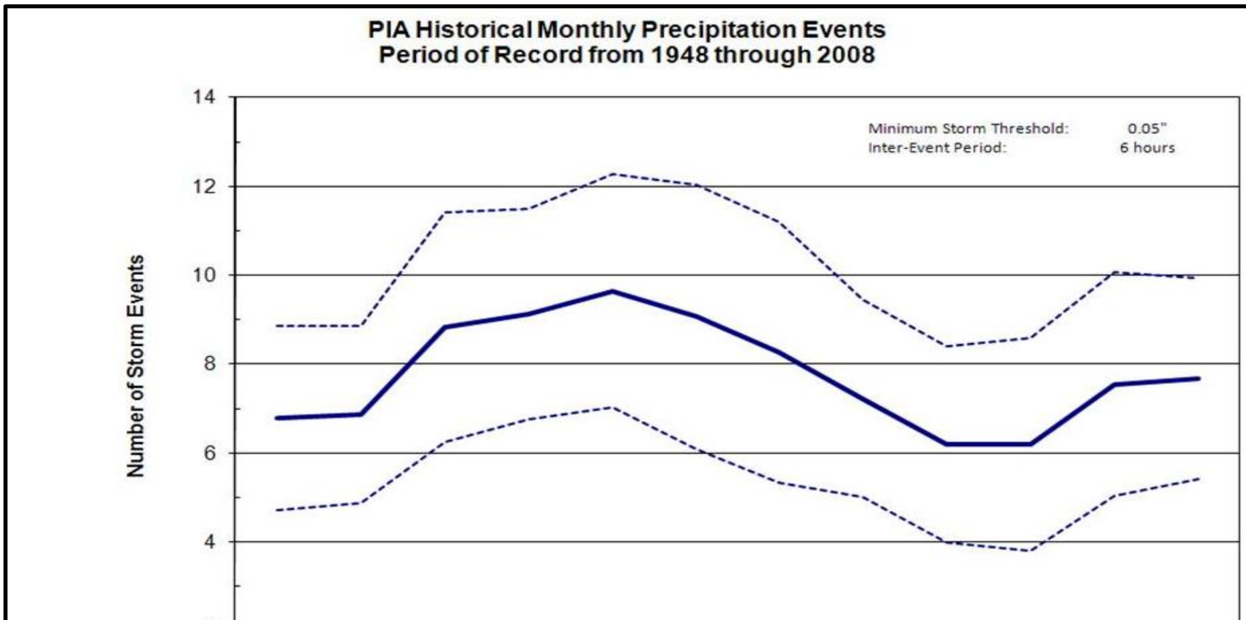
Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 4

Figure 4-2: Average Monthly Precipitation Volumes over the ALCOSAN Service Area in Inches



	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC
PIA Historical	2.65	2.29	3.23	3.24	3.66	3.86	3.79	3.43	2.97	2.33	2.76	2.65
PIA Hist. + 1 SD	3.89	3.39	4.56	4.45	5.18	5.71	5.40	5.30	4.60	3.62	4.37	3.93
PIA Hist. - 1 SD	1.40	1.20	1.89	2.02	2.15	2.00	2.19	1.57	1.35	1.03	1.15	1.38

Figure 4-3: Average Number of Monthly Precipitation Events over the ALCOSAN Service Area



	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PIA Historical	6.80	6.87	8.83	9.13	9.65	9.07	8.27	7.23	6.20	6.20	7.55	7.67
PIA Hist. + 1 SD	8.87	8.86	11.42	11.50	12.28	12.03	11.19	9.45	8.40	8.59	10.06	9.93
PIA Hist. - 1 SD	4.73	4.87	6.25	6.76	7.02	6.10	5.34	5.01	4.00	3.81	5.04	5.41

The three-step data analysis and adjustment process was conducted to assure the spatially distributed typical year precipitation and the modeled sewershed hydrology and CSO event statistics for each of the planning basins within the 309 square mile ALCOSAN service area corresponded well with the historical average event statistics from the long-term PIA gauge. Therefore, the typical year model simulations provide annual overflow statistics that represent the long-term gage record. Documentation for the analytical process for identifying and refining the typical year precipitation is provided in the report, *Development of the Typical Year Precipitation for the ALCOSAN Service Area*, July 2009.

Synthetic Design Storms: To characterize flow from sanitary sewershed areas, establish the frequency and duration of sanitary sewer overflow (SSO) discharges, characterize their potential water quality impacts, and develop and assess alternative control strategies, a series of synthetic design storms were developed and applied to the hydrologic and hydraulic (H&H) models. Design storm values associated with 1-year, 2-year, 5-year and 10-year recurrence intervals for the ALCOSAN service area were obtained from the *Precipitation–Frequency Atlas of the United States*, NOAA Atlas 14. The precipitation volumes presented in the atlas were based upon statistical analyses conducted on the historical precipitation record from the PIA National Weather Service gauge. A Soil Conservation Service (SCS) Type II distribution was applied to the synthetic design storm depths to establish acceptable rainfall temporal distributions for the design storms. The distribution is classified as a stacked distribution where approximations of the 1-hour, 2-hour, 3-hour, 6-hour and 12-hour storm volumes are superimposed symmetrically around the twelfth hour of the synthetic storm. It was assumed that the storm cell size of the synthetic design storm approximates the size and dimensions of the planning basins. Therefore, a uniform distribution was applied over the entire planning basin.

The NOAA atlas analysis results indicated the design storms, typically associated with thunderstorm activity, are most likely to occur during the months of June through August. However, analyses of monitored municipal flows indicated that there were some sewershed areas where observed peak wet weather flow was higher during winter conditions than during summer conditions. This is attributed to the higher quantities of infiltration and inflow (I/I) and the higher ground water infiltration (GWI) flow that can occur under winter conditions. Therefore, a series of design storms was developed that represent winter conditions over the ALCOSAN service area. Table 4-1 summarizes the summer and winter condition 1-hour and 24-hour precipitation volumes for each of the analyzed recurrence intervals.

Table 4-1: Frequency Estimates for Precipitation Depth in Inches

Recurrence Interval	Summer Design Storm Depth*		Winter Design Storm Depth	
	1 Hour	24 Hour	1 Hour	24 Hour
1 Year	0.97	1.96	0.40	1.40
2 Year	1.18	2.33	0.49	1.64
5 Year	1.49	2.85	0.64	1.88
10 Year	1.73	3.27	0.75	2.05

*Note: An SCS Type II Design Storm was used

4.1.2 Historical Flow Monitoring Program and Objectives

From 1993 to the present, ALCOSAN has installed and maintained a network of short-term and long-term wastewater flow meters. A network of long-term flow meters was established at selected locations along shallow-cut interceptor sewers to quantify and characterize how dry weather and pre-relieved wet weather flow changes from month-to-month, season-to-season, and year-to-year from large geographic regions with multiple points of connection to the ALCOSAN system. Extended range depth meters were installed at selected access shaft structures along deep tunnel interceptor sewers to continuously monitor the hydraulic grade line (HGL) depths. Flow was also monitored at the Woods Run wastewater treatment plant as was the operating elevation of the influent pumping station wet well. Monitoring along the deep tunnel and shallow-cut interceptors and at the WWTP continued through the implementation of the RCS-FMP and continues to the present. Portable monitoring equipment was installed at selected points of connection (POCs) between the municipal collection systems and the ALCOSAN interceptor system. These temporary monitors were installed along municipal trunk sewers and left in place for approximately one year so that a sufficient number and range of smaller and larger storms were monitored and seasonal variations were known. To maximize the geographic coverage of the monitoring program with the inventory of portable meters, a system of meter rotations was planned and implemented for the POC sites.

From 1993 through 2007, the ALCOSAN historical monitoring program has collected approximately 1,400 meter-months of data from its long-term shallow-cut interceptor meters. This data has been the primary source of information for the distribution of dry weather flows and the calibration of transport head losses for hydraulic modeling of the ALCOSAN shallow-cut interceptor system. The monitoring network at the access shaft structures continuously measures the operating depth and hydraulic grade line of the deep tunnel interceptor system during dry and wet weather conditions and is the primary source of information for the magnitude of frictional and transitional losses along the tunnel system over a range of flow conditions. The shallow-cut interceptor and deep tunnel monitoring data has been used in conjunction with the hydrologic and hydraulic models to establish the hydraulic capacity along the interceptor system and determine the reserve capacity for conceptual planning and design. The locations of the shallow-cut interceptor and deep tunnel monitoring sites where the data were used for hydraulic model validation are shown on Figure 4-4.

The ALCOSAN monitoring program also included a network of portable trunk sewer monitoring sites located near the points of connection (POC) between municipal trunk sewers and the ALCOSAN interceptor system. Sites were maintained for at least 12 months and then relocated to other locations. The locations of these non-synoptic POC monitoring locations where the data were used for validation of the ALCOSAN H&H models are shown on Figure 4-5. The network of trunk sewer monitors has served as the primary source of information for quantifying and characterizing dry and wet weather flows conveyed by municipal sewer systems to the ALCOSAN interceptor system. The data has been used to characterize the hydraulic and hydrologic response of municipal sewersheds to drought, storms, seasonal groundwater changes and snowmelt.

Trunk sewer monitors have been used to quantify the total influent municipal flow discharged to the ALCOSAN system including residential and commercial wastewater, industrial process flow, and extraneous flow during dry and wet weather periods. The data was analyzed to develop input parameters that are foundational in the development of the H&H models. ALCOSAN initiated the POC monitoring program in 1993 and the number of monitored sites continued to expand. During the period from 2003 through 2007, the ALCOSAN historical monitoring program has collected more than 3,250 meter-months of data from a total of 203 portable trunk sewer monitoring sites.

4.1.3 RCS-FMP Objectives and Site Selection

The ALCOSAN Consent Decree required the development and implementation of an additional regional flow monitoring program that would obtain a sufficient quantity of accurate and reliable data to develop and validate the H&H model and characterize dry and wet weather flows to the ALCOSAN system. The monitoring data collected through this new monitoring program would augment and supplement the data collected during the historical monitoring program. On October 15, 2007 ALCOSAN submitted to the regulatory agencies a *Regional Collection System Flow Monitoring Plan* (RCS-FMP) that described and documented the regional monitoring program. The ALCOSAN plan was based upon June 2006 Regional Flow Monitoring Plan that was prepared by 3 Rivers Wet Weather and submitted to the regulatory agencies on behalf of the participating ALCOSAN customer municipalities. Officially commencing on February 1, 2008, and preceded by several months of site investigations, equipment installation and a mandatory equipment settling in period, ALCOSAN successfully implemented the RCS-FMP, requiring the concurrent monitoring of flows at over 550 sites located throughout the ALCOSAN service area.

One of the important aspects of a wastewater flow monitoring program is to develop a sound and defensible engineering approach for determining the placement and number of flow monitors. The approach used to develop the RCS-FMP addressed regional flow monitoring needs, municipality-specific needs, and accounted for the inherent differences between combined and separate collection systems. The approach also incorporated a methodology that allowed the use of applicable historical monitoring program data collected prior to 2008. The RSC-FMP identified eight different types or categories of flow monitor locations, summarized below. A combination of these flow monitoring location categories was required to adequately characterize the ALCOSAN service area. The locations of monitoring sites are shown in Figure 4-6.

- Non-Synoptic ALCOSAN Point of Connection (POC) Meters – monitors that are located at or near points of municipal connection with the ALCOSAN interceptor system that are not required to be monitored at the same time as municipal monitoring sites
- Synoptic ALCOSAN POC Meters – monitors at or near points of municipal connection with the ALCOSAN interceptor system that will be monitored at the same time as municipal monitoring sites located upstream within the corresponding tributary sewersheds
- Pump Station Meters – monitors at ALCOSAN and municipal pump stations, either at overflow pipes or along influent trunk sewer pipes

Figure 4-4: Locations of Shallow-cut and Deep Tunnel Interceptor Monitoring Sites Used for Model Validation

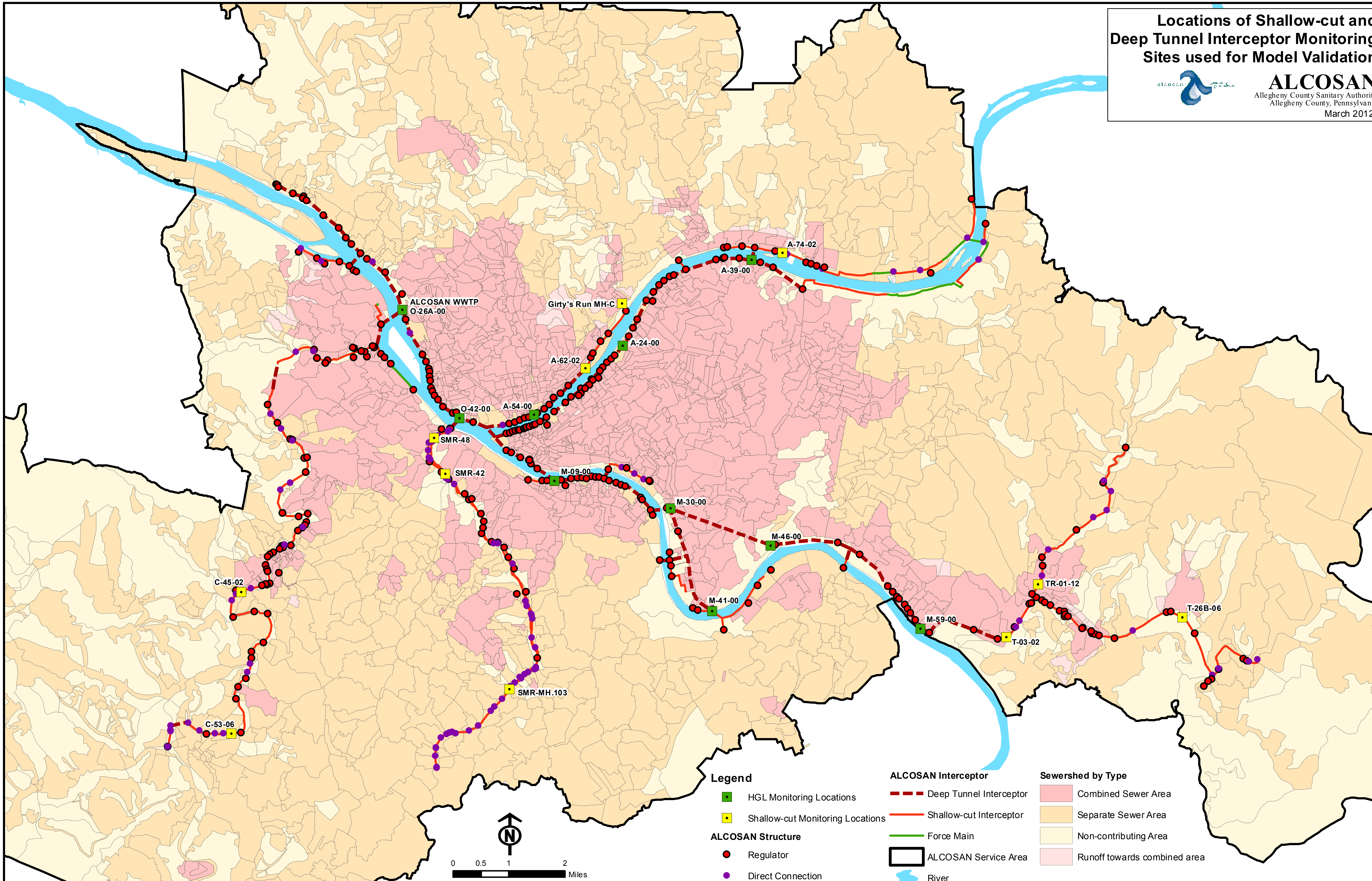


Figure 4-5: Non-Synoptic Point of Connection Monitoring Sites Used for Model Validation

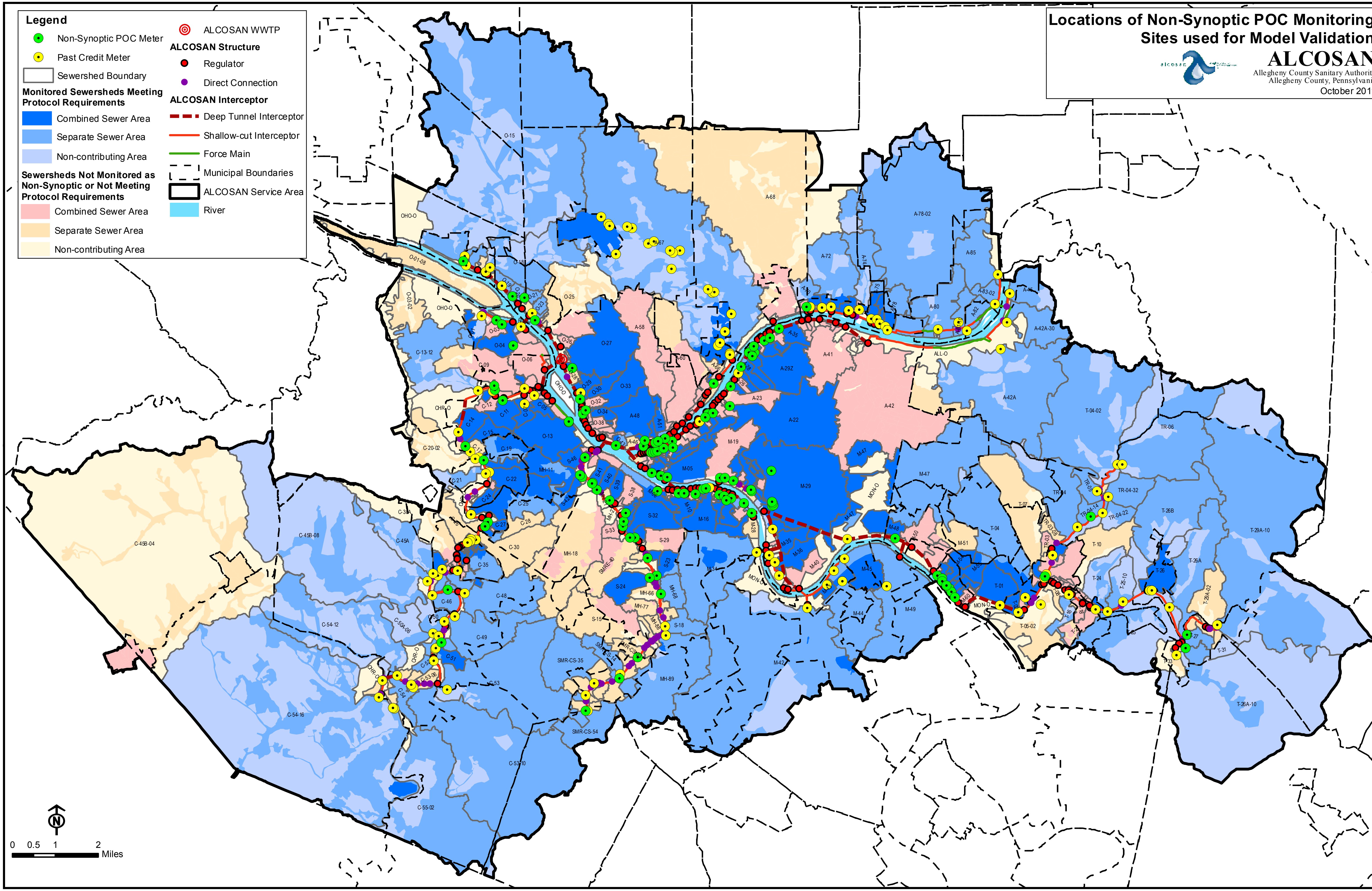
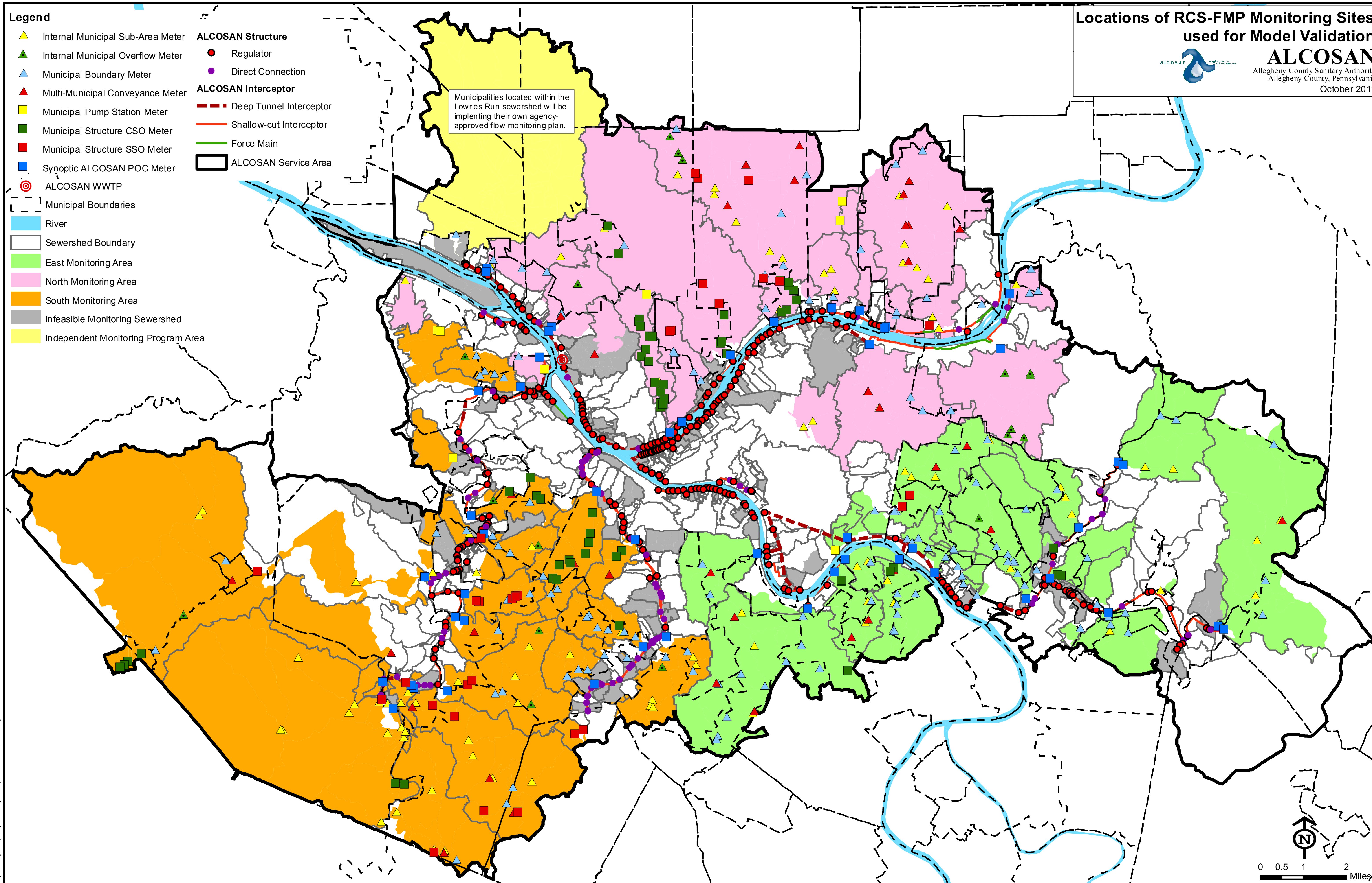


Figure 4-6: RCS-FMP Monitoring Sites used for Model Validation



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

- Municipal Collection System CSO/SSO Structure Meters – monitors that are located on defined CSO/SSO structures constructed along the municipal collection systems
- Municipal Boundary Meters – monitors located at or near a municipal boundary that monitor flow into or out of a given municipality
- Multi-Municipal Conveyance Sewer Meters – monitors located on a trunk sewer that collect flow from more than one municipality
- Internal Municipal Sub-Area Meters – monitors that are located on the internal municipal sewers system used to collect information to characterize the hydrology and hydraulics of the internal municipal system
- Internal Municipal Overflow Meters – monitors installed in municipal collection system manholes to monitor basement flooding and manhole overflow

The monitoring locations identified and implemented for the RCS-FMP were selected by ALCOSAN, the 3 Rivers Wet Weather Project Management Team (3R-PM) in coordination with the individual municipalities and their municipal engineers and consultants, and the regulatory agencies. These proposed monitoring sites and their corresponding flow data met the Consent Decree requirement to establish a flow monitoring network that provides a sufficient quantity of accurate and reliable data with sufficient spatial coverage to validate the hydraulic and hydrological model, determine the frequency and volume of CSO/SSO discharges, characterize dry and wet weather flow, and develop a WWP that assesses a range of alternative control measures.

4.1.4 Program Implementation

ALCOSAN had primary responsibility for implementing the RCS-FMP, but multiple groups had significant involvement in various implementation activities, including the ALCOSAN consultant team, selected professional flow monitoring firms, and the 3R-PM Team. The Flow Monitoring Working Group (FMWG) was formed to represent the interests of the municipal stakeholders and facilitate communication and coordination with the customer municipalities within the ALCOSAN service area.

Monitoring Duration: The schedule and duration for monitoring activities at each of the monitoring site categories was governed by the ALCOSAN Consent Decree. Based on the intended use of each of the flow monitor categories designated within the Consent Decree, three periods of flow monitoring duration were implemented: long-, medium- and short-duration. Short-duration monitors were monitors placed at locations where the tributary area response to rainfall is the main information required. Short-duration monitors were maintained for at least three months. Long-duration monitors were monitors where seasonal impacts on rainfall response were required for wet weather control planning. These monitors were maintained for at least 12 months. Medium-duration monitors encompassed all the municipal CSO structures, and it was determined that at least six months of monitoring data would be required to reliably quantify and characterize CSO discharges from a regulated combined sewershed. Provisions were also made to extend the monitoring periods if insufficient rainfall had occurred. The specific requirements in the ALCOSAN Consent Decree for short-, medium- and long-duration monitors, and the associated minimum precipitation requirements, are documented in Section 4 of the October 2007 *Regional Collection System Flow Monitoring Plan*.

Field Investigations for Monitoring Sites: To maximize the collection of high quality monitoring data, the RCS-FMP documented the protocols that were implemented for screening, assessing and selecting flow monitoring sites and conducting subsequent field verification investigations. A variety of monitoring site factors can contribute to lowering the accuracy and reliability of collected data, and a majority of these factors can be identified and reduced by a comprehensive field evaluation program. When evaluating sites for their suitability for successful flow monitoring, the hydraulic conditions at the manholes were typically given foremost consideration. Other items considered were the presence of excessive sediment or debris and any evidence of backwater interference and surcharging. Site conditions were also evaluated as poor site access may prohibit monitoring at a particular location, affect the cost or quality of maintaining the site, and/or jeopardize the safety of the field technicians maintaining the site. Some proposed/desired monitoring locations were determined to be infeasible because of unsafe conditions, adverse hydraulic conditions or a minimal tributary service area.

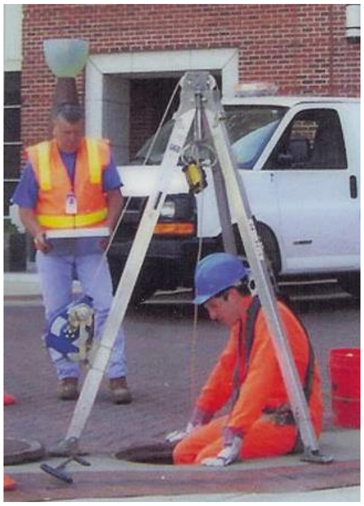


Figure 4-7: Monitoring crew conducting field investigations

Equipment Installation, Data Collection and Maintenance: The October 2007 RCS-FMP documented the standards and methods to be utilized for site-specific monitoring. These protocols extended from the initial selection of monitoring equipment, the installation and setup of the meters and the calibration of the equipment through maintaining the network of installed meters during the scheduled monitoring period. During the detailed field inspections, technologies and equipment were selected for each monitoring site and properly matched to the site's specific geometry and hydraulic conditions. Field observations, equipment and monitoring technology recommendations, and the specific flow monitoring equipment and techniques to be employed at each monitoring site, were documented in Site Investigation Reports. After the flow monitors were installed, a "settling-in" period commenced to assess the performance of the newly installed equipment, allow time to perform any needed refinements to the installation, and refine the calibration of the equipment. The scheduled settling-in period for the RCS-FMP was a minimum of two weeks and a maximum of four weeks. As a result of the data quality reviews conducted during the settling-in period, some sites were identified for which the data quality was not acceptable. Either an alternate site was identified or the monitoring site was dropped from the program.

Figure 4-8: Looking down at flow monitoring equipment installed within a sewer manhole

Field technicians were equipped with notebook computers to upload monitoring data at intervals directed by the RCS-FMP. The collected monitoring data were either reviewed in the field or submitted to office reviewers via wireless technology to verify the equipment was functioning properly. To maximize up-time for the equipment and maximize data quality, maintenance procedures were performed during every required site visit, except when hydraulic conditions or other concerns would compromise the safety of the field crews. The protocols documented in the RCS-FMP governed the frequency and timing of the site visits and the maintenance and calibration activities conducted during the site visits. The RCS-FMP protocols required that these activities were to be documented in a computerized field log.

Figure 4-9: Looking upstream along a sewer pipe with installed flow monitoring equipment

4.1.5 Quality Assurance and Quality Control Plan

The RCS-FMP included a quality assurance and quality control (QA/QC) plan to ensure that the network of flow monitoring equipment provided representative, reasonably reliable data and that data quality is sufficient to characterize dry and wet weather wastewater flow and develop and validate a hydrologic and hydraulic model of the ALCOSAN service area. QA/QC procedures for the ALCOSAN flow monitoring program were divided into two categories: equipment support in the field and data verification in the office.

To maximize the collection of high quality data, comprehensive protocols and standards for field activities were implemented to ensure feasible monitoring sites were selected, appropriate monitoring technologies and equipment were utilized, field crews were properly trained and qualified, site visits were conducted at the required intervals, monitoring equipment was adequately calibrated and maintained, and required field documentation was consistently provided. A team of licensed professional engineers oversaw the implementation of office QA/QC procedures. ALCOSAN engineers conducted the data quality reviews for monitors installed at designated ALCOSAN sites and 3 Rivers Wet Weather engineers performed the reviews for the designated municipal monitoring sites. The same procedures and standards were used for all data quality reviews. A data management system was implemented to standardize the format and file names associated with collected data from the hundreds of flow monitoring sites. To facilitate the data quality review process and maximize data quality, digital data were submitted, reviewed, and archived on a monthly basis. Time series and scatter plots were prepared each month to facilitate data review and verify the reliability and accuracy of the collected flow monitoring data.

4.2 Hydrologic and Hydraulic Modeling

The computer modeling of the ALCOSAN system has been an evolving process, employing the appropriate tools at various stages of development to meet changing needs and objectives. ALCOSAN's strategy for its hydrologic and hydraulic (H&H) modeling program has been to apply an approach where the level of model complexity has increased with the level of detail and refinement needed for planning and design. In this manner, the model takes on different forms during the process, with some elements of the system initially modeled in greater detail than others, depending upon the specific level of detail required to support any given phase of the wet weather planning process. The current validated model has sufficient complexity and detail for the successful characterization of existing and future conditions, the development and evaluation of alternative wastewater control facilities at alternative locations, the selection of optimal system-wide controls, and to arrive at a final recommended Wet Weather Plan.

This section provides an overview of the ALCOSAN H&H modeling program. It provides a brief history of the modeling program and describes how the models have evolved and been refined over time. It describes the requirements established for model objectives and capabilities and the various categories of input data. Summary descriptions are provided explaining how the various sewer system structures and how dry and wet weather flow are represented in the model. The section concludes with a brief overview of the model validation process.

4.2.1 History of ALCOSAN System Modeling

Beginning in 1994, a conceptual planning-level model of the collection system was developed in support of a Regional Long-Term Wet Weather Control Concept Plan (RLTWWCCP). The ALCOSAN computer simulation models needed to represent two categories of interceptor sewers with two very different operating strategies: the deep tunnel interceptors along the main rivers and traditional shallow-cut interceptor system along the tributary streams.

Initial aspects of the modeling were conducted with the NETSTORM program using a more simplified approach. Ultimately, the EPA Storm Water Management Model (SWMM) was the selected computational engine for the ALCOSAN H&H modeling program because of its functional capabilities and because the programming is open code within the public domain. It is widely used throughout the world for planning, analysis and design related to storm water runoff, combined sewers, sanitary sewers, and other drainage systems in urban and rural areas. SWMM is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. During the early development of the model, the RUNOFF component of SWMM operated on a collection of sub-catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transported this runoff through a system of pipes, channels, regulators, pumps, and storage/treatment devices. SWMM tracks the quantity and quality of runoff generated within each sub-catchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps.

For a period of 10 years after the 1998 submission of the RLTWWCCP, models of the existing condition ALCOSAN collection system were further enhanced with additional hydrologic and hydraulic detail and refinement using SWMM version 4.4. The models were subsequently converted to SWMM version 5. Running within a Windows operating system, SWMM 5 provides an integrated environment for editing study area input data, running hydrologic, hydraulic and water quality simulations, and viewing the results in a variety of formats. After conversion, the model validations were confirmed to verify the SWMM5 model results provided a reasonable match to the SWMM4 results. The models also incorporated the results of field investigations conducted to update the configuration of the ALCOSAN regulator structures and the shallow-cut interceptor system.

In January 2008, ALCOSAN entered into a Consent Decree that provided specific requirements for the development of a Wet Weather Plan. In February 2008 the Regional Collection System Flow Monitoring Plan (RCS-FMP) officially commenced to enhance the data collected under historic ALCOSAN monitoring program and supplement the data needed for model validation to ensure simulations are representative of observed conditions. In October 2008, ALCOSAN submitted to the regulatory agencies a Hydrologic and Hydraulic Modeling Plan (HHMP) that documented the modeling approach, protocols and procedures that would be used to characterize existing baseline conditions and develop and assess alternative control and remedial measures. The HHMP was finalized in August 2009.

ALCOSAN divided the service area into seven planning basin areas and selected a basin planner for each area to further the model enhancements. The basin planners coordinated with the municipalities and extended the H&H models into selected portions of the municipal collection systems utilizing the results of the physical surveys, hydraulic capacity analyses, and updated GIS municipal sewer mapping conducted by the municipalities. The basin planners refined the validation of the H&H models using the collected RCS-FMP data.

4.2.2 Model Objectives and Capabilities and CD Requirements

The ALCOSAN H&H modeling program was guided by the requirements contained within the Consent Decree. Specific requirements for the development of the H&H models and the H&H Modeling Plan are documented in paragraphs 38 and 39 and in Appendix P of the CD. ALCOSAN's *Hydrologic and Hydraulic Modeling Plan* (finalized in August 2009) provided the guidance and protocol standards needed to successfully meet the CD requirements and establish the intent and use of the models. Section 2.0 of the plan describes and documents the required objectives and capabilities of the models. The modeling plan established that the overall primary objective of the modeling effort is to develop a predictive tool that will serve two purposes. First, to characterize, on a planning level basis, the performance of the Conveyance and Treatment System and "Critical Portions of the Municipal Collection Systems" under various scenarios for existing, baseline, and future conditions. Secondly, to evaluate alternate control strategies as necessary to arrive at a final Wet Weather Plan that satisfies the requirements of the Consent Decree.

In addition to the goals, standards and protocols established in the H&H Modeling Plan, supplemental guidance and standards for the development of the planning basin models were provided. Several basin-specific goals were also established to permit evaluation of unique institutional circumstances within the individual planning basin areas.

4.2.3 Model Input Data

In order to develop the H&H model, three categories of model input data were required; hydrologic, hydraulic and boundary condition data. To provide the needed input data, ALCOSAN has procured and collected Geographic Information System (GIS) information, flow and precipitation monitoring data, hydraulic grade line (HGL) monitoring data, survey inspection information, sonar inspection data, and field investigation information collected by field crews. To organize and analyze the data, ALCOSAN has utilized various support tools, such as Microsoft Excel spreadsheets, Microsoft Access databases and ESRI ArcGIS. ALCOSAN also used application software like Sewer Hydrograph Analysis Package (SHAPE) for analyzing the quality assured flow monitoring data to characterize the dry weather flows for the monitored sewersheds and develop model parameters to simulate Rainfall Dependent Inflow/Infiltration (RDII) responses from separate sewered areas. GIS tools and scripts were used to develop hydrologic parameters like area, slope and soil characterization to create and update the H&H models. Detailed descriptions of the types of required model input data, the sources of the model input data, and the processes implemented for quality assurance and control were documented in Section 4.0 of the *H&H Modeling Plan* and in Section 2.0 of each of the basin planner *H&H Model Validation and Characterization Reports* (H&HMVCRs).

4.2.4 Model Representations

The ALCOSAN H&H Models are comprised of hydrologic and hydraulic components to simulate dry and wet weather flows from monitored and unmonitored areas of the ALCOSAN system served by combined and separate sewers, and the conveyance of the flows through the ALCOSAN interceptor system to the wastewater treatment plant. Detailed descriptions of the model development process and the means by which these hydrologic and hydraulic components are represented in the models are provided in Section 2.0 of each of the planning basin H&HMVCRs. Brief summary highlights are provided below.

Dry Weather Flow: The accurate representation of diurnal and seasonal variation of dry weather flow was a central component of the ALCOSAN hydrologic models. Accurate depiction of dry weather flow is important to the prediction of CSO and SSO activity and must be represented correctly for the accurate simulation of release rates from any storage/flow equalization components of proposed CSO and SSO control technologies. Accurate characterization and representation of the total dry weather flow was accomplished through utilization of the large amount of quality-assured flow monitoring data that was collected, typically over a

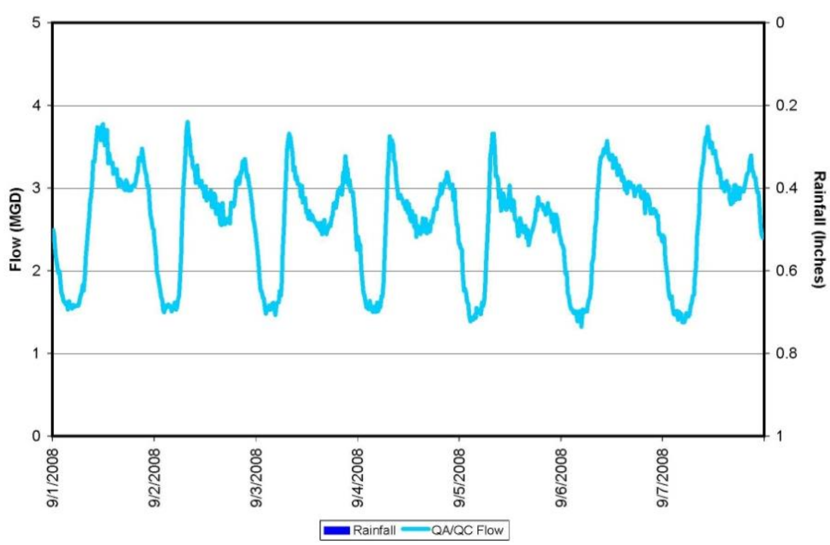


Figure 4-10: Example of monitored dry weather wastewater flow from a residential area with typical diurnal week-day, weekend

duration of 12-months, to monitor and quantify seasonal variability. The dry weather flow for each loading point in the ALCOSAN models is represented by a continuous time-series developed either from actual monitored data or extrapolated monitoring data from a similar sewershed area. The methodology for developing the dry weather flow model representations for monitored and unmonitored sewershed areas is documented in Subsection 2.3.2 of each of the planning basin H&HMVCRs.

Wet Weather Flow: In the ALCOSAN hydrologic models, wet weather flow is represented using two different simulation approaches: one for sewershed areas served by combined sewers and a different approach for sewershed areas served by separate sewers. These modeling approaches and their application are discussed in detail and documented in Subsection 2.3.3 of the H&HMVCRs. For combined sewershed areas, SWMM generates runoff through the use of the hydrologic model parameters summarized below:

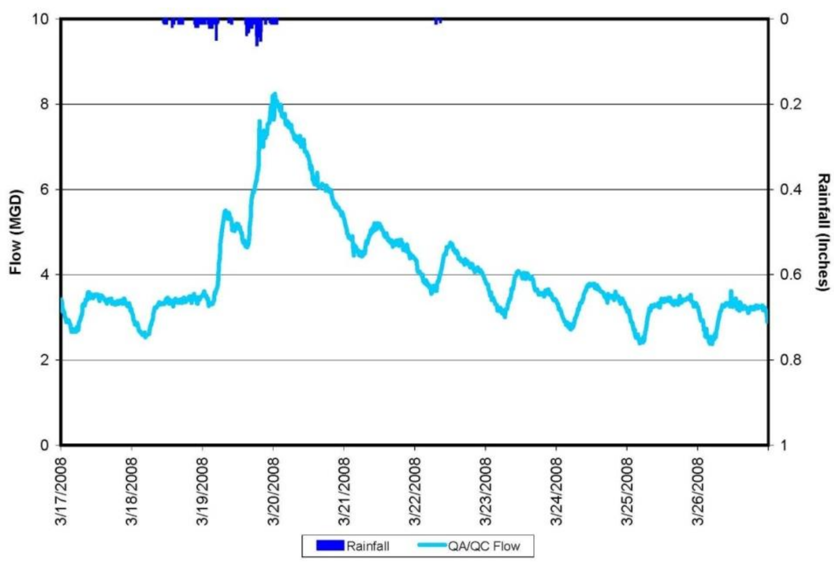


Figure 4-11: Example of a monitored sewer system response to a storm event showing typical storm peak and recession limb

- <u>Sewershed Area:</u> The area that has the potential to generate runoff during the model simulation
- <u>Sewershed Width:</u> Based on the proportioned width of the sub-catchment, impacts the time of concentration and the hydrograph shape
- <u>Ground Slope:</u> Derived directly from topographic data, slope governs the rate of runoff during model simulation. Four slope categories (zero, low, medium and high) were applied for both pervious and impervious catchment areas.
- <u>Directly Connected Impervious Area (DCIA):</u> Represents the fraction of the total area that it impervious and drains directly to the combined sewer collection system
- <u>Manning's coefficient:</u> Accounts for the roughness of the sub-catchment surface, and similar to slope, affects the rate of runoff during model simulations
- <u>Depression Storage:</u> Initial abstraction parameters that represent the volume of storage available in the catchment area that must be filled prior to the occurrence of runoff
- <u>Infiltration Parameters:</u> Dictate the movement of water through the soil surface and into the groundwater table and therefore has an effect on infiltration from a storm event

For separate sewershed areas, the rainfall dependent infiltration and inflow (RDII) entering sewershed areas served by separate sanitary sewer systems was quantified within SWMM by a unit hydrograph curve fitting methodology referred to as the RTK method. This method

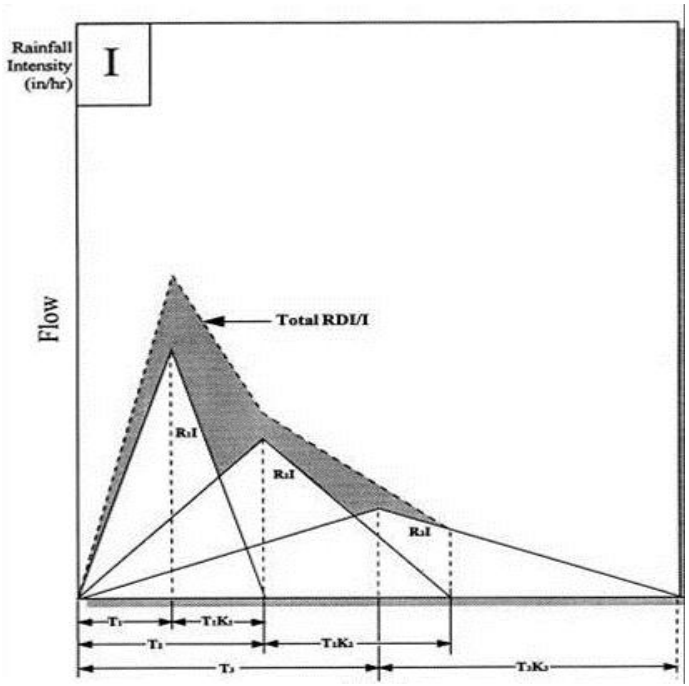


Figure 4-12: Three triangular unit hydrographs used in the H&H models to represent the sewer system response to a storm event

provides for the characterization and model representation of the relationships between precipitation and RDII within separate sewered areas. For the ALCOSAN models, this relationship was characterized through the use of three unit hydrographs which represent the rapid, medium and slow sewer system responses to a precipitation event. Each unit hydrograph is represented by an R, T and K value where R is the fraction of precipitation over the sewershed that enters the sewer system, T is the time to the hydrograph peak in hours, and K is the ratio of the event recession limb to the time of peak.

Collection Systems: The ALCOSAN and municipal collection systems are represented in the ALCOSAN hydraulic model as a network of conduits and nodes. The conduits represent segments of sewer pipe and include characteristics such as pipe length, diameter and slope, and a roughness coefficient. The nodes represent manholes, diversion chambers, cross-connections, and other structures and include characteristics such as diameter and invert elevations. These model representations were derived from data obtained from sewer plans and profiles, as-built drawings, field surveys, and field verification investigations. The process was designed to provide high quality, field-verified, survey grade data. These modeling representations are discussed and documented in Subsection 2.4.2 of the H&HMVCRs for each of the seven designated planning basin areas that comprise the ALCOSAN service area.

Hydraulic Control Structures: Flow diversion structures along the ALCOSAN and municipal collection systems consist of a combination of weirs, fixed orifices, variable-orifice tipping gates,

Figure 4-13: Typical example of a variable-orifice tipping gate used to regulate wastewater flow

Figure 4-14: Typical example of a vortex drop-shaft used to convey flow to the deep tunnel system

vortex drop-shafts, and outfall flap gates. Diversion weirs are constructed to redirect wastewater flow from municipal trunk sewers to the ALCOSAN system for treatment. Fixed orifices and variable orifice tipping gates are designed to control the quantity of flow being diverted to the ALCOSAN system. They are also designed to ensure that all dry weather flow is treated and for optimizing the quantity of diverted wet weather flow to utilize available treatment capacity. Drop shaft structures were designed and constructed to convey diverted wastewater flow from municipal trunk sewers down to the ALCOSAN deep tunnel interceptor system. Flap gates are installed at the downstream end of the outfall pipe to prevent storm water from the receiving river or stream from intruding into the ALCOSAN interceptor system. Depending on the location, one or more of these hydraulic controls may be installed within a single structure to control the amount of flow into the ALCOSAN system and protect the collection system from river intrusion. The modeling approaches for representing these structures, and their application, are discussed and documented in Subsection 2.4.3 of the planning basin H&HMVCRs.

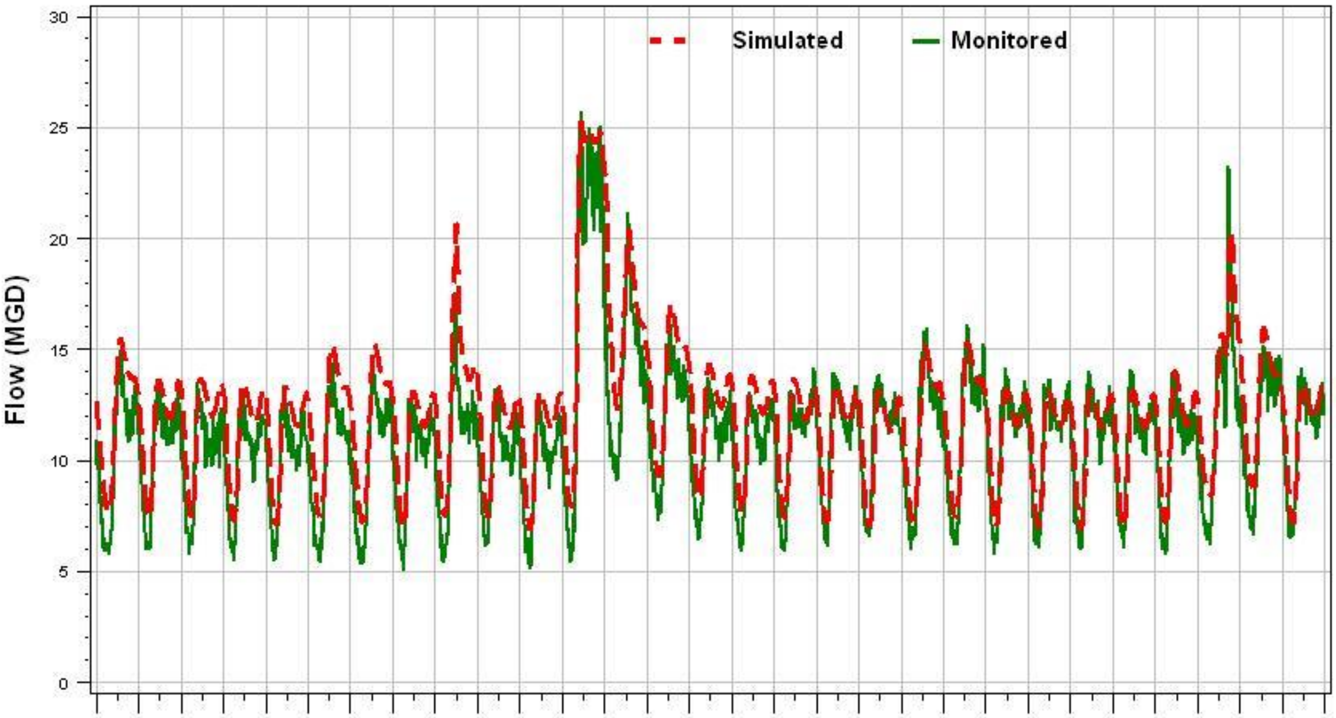
Figure 4-15: Typical example of a flap gate used to prevent stream flow from entering the ALCOSAN system

4.2.5 Model Validation

Model validation is the process of adjusting both hydrologic (flow development) and hydraulic (flow conveyance and routing) variables to best match actual measured flow and depth data. The result is an H&H model of an existing collection system that best represents dry weather conditions, flow responses to wet weather conditions, and hydraulic grade line elevations along the sewer systems. It is the process by which a model is adjusted and refined from a first-cut approximation of the system being simulated to a reliable representation of the system's performance. To validate the ALCOSAN H&H models, extensive system-wide flow and precipitation monitoring was conducted to collect the required data. These data, once subjected to quality assurance procedures, were compared to the modeled responses at the monitored locations. The model input parameters were then subject to validation to facilitate a closer correlation between observed data and the modeled response.

H&H model validation criteria and procedures were established for both dry weather and wet weather flow conditions to guide the model validation processes and to provide a high level of confidence in the validated ALCOSAN model. The validation, confirmation, and verification criteria for dry and wet weather flows were described and documented in the approved *ALCOSAN Hydrologic and Hydraulic Modeling Plan*, the *ALCOSAN Standards and coordination Technical Memorandum Number 4: Hydrologic and Hydraulic Modeling*, and the Wastewater Planning Users Group (WaPUG) *Code of Practice for the Hydraulic Modeling of Sewer Systems*. The Consent Decree also required that a sensitivity analysis be conducted as part of the model validation process.

Figure 4-16: Typical Example of an H&H Model Validation Plot Comparing Simulated and Observed Wastewater Flow



In July of 2011, ALCOSAN submitted to the regulatory agencies an *H&H Model Validation Summary Report* which provided written documentation that Consent Decree requirements and the protocol requirements of the H&H Modeling Plan were properly implemented. The report demonstrated that sufficient flow and precipitation data had been collected to correlate wet weather flow rates with rainfall measurements, provided summary documentation that the model validation process had been successful, and verified that sensitivity analyses had been conducted and relevant Consent Decree requirements had been met. There were two levels of activities that occurred and were documented for the validation of the ALCOSAN H&H models. Model validation was first conducted at the planning basin level within each of the seven designated planning basin areas that comprise the ALCOSAN service area and model validation was subsequently conducted at a system-wide level.

The model validation process at the planning basin level, and the corresponding result summaries, are documented in Section 3.0 of each of the planning basin *H&H Model Validation and Characterization Reports*. Appendix C of these reports contains model validation plots, including dry and wet weather validation plots, flow regression tables and plots, and time-series hydrograph plots. The subsequent model validation process at the system-wide level, and the corresponding result summaries are documented in the *H&H Model Validation Summary Report*.

4.2.6 Subsequent Model Refinements and Updates

The understanding of the configuration and operations of the municipal collection systems continued to change and be refined with ongoing coordination between the Basin Planners and the customer municipalities. Field investigations were conducted to resolve any questions or problems that were encountered. Therefore, the models used to represent the municipal collection systems needed to be updated with the most up-to-date information available to keep them current. This included model updates subsequent to the completion of the *H&H Model Validation and Characterization Reports* (H&HMVCRs) by the Basin Planners. These revisions can be categorized in the following broad categories.

- Rim and invert elevation and surcharge depth updates for manholes
- Addition of ponded areas for manholes to recapture flooded volumes
- Offset, dimension, and roughness coefficient changes for conduits
- Addition and removal of flap-gates in the model to match field investigation results
- Updates to pump curves at municipal pump stations
- Minor updates to sewershed areas and widths to match updated GIS database information
- Recalibration of some individual sewershed areas based on newly available flow monitoring data
- For some combined sewersheds with new flow monitoring data, the removal of recession limb RDII hydrographs to better match monitoring results

All of these model updates were minor in nature and were included in the models used for the system-wide validation analyses and the preparation of *H&H Model Validation Summary Report* of July 2011.

During the model validation process at the planning basin level and the development of the validation reports, the planning basin models were simulated independently and made use of dry weather flow hydrographs developed by the basin planners together with hydraulic grade line (HGL) and flow boundary conditions time-series. Subsequently for the regional integration of the individual planning basin models, an existing conditions regional balance model (RBM) was developed which receives flow inputs from the basin models and also includes the waste water treatment plant pump station. The RBM was part of the system-wide H&H Model Validation analysis. The RBM also was used to characterize the overall system, making use of refined dry weather flow hydrographs. The overall system interaction simulated in the RBM has a significant effect on the downstream HGL boundary conditions for some of the upstream planning basins like, Girty's Run, Upper Allegheny River and Upper Monongahela River and also portions of the Main Rivers planning basin. These model refinements resulted in some change in the overflow statistics reported here in the WWP when compared against those included in the previous individual planning basin H&HMVCRs.

4.3 Regional System Hydrologic and Hydraulic Characterization

The validated H&H model was used to quantify and characterize dry and wet weather flows that were generated and conveyed within each of the municipal collection systems, discharged into the ALCOSAN interceptor system, and conveyed and routed to the Woods Run Wastewater Treatment Plant. To support the development and assessment of alternative measures to control wet weather CSO and eliminate SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was applied to the existing conditions validated model to generate baseline condition statistics of the annual frequency, duration and volume of overflows.

This section provides a summary overview of the H&H characterization of the ALCOSAN service area. It documents existing condition CSO and SSO discharges that were determined from the model simulations. Discharge frequency and duration are provided in a series of histograms organized by ALCOSAN and municipal CSO and SSO outfalls and totaled over the ALCOSAN service area. Discharge volumes are provided in a summary table organized by ALCOSAN and municipal outfalls and totaled over each of the seven designated planning basin areas.

4.3.1 Annual Overflow Frequency

Figures 4-17 through 4-20 provide a concise regional summary of the existing condition annual frequency of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The histogram information was obtained from typical year model simulation results, is organized and grouped by CSO and SSO discharges, and differentiates between ALCOSAN and municipal outfalls.

Figures 4-17 and 4-18 show the system-wide annual overflow frequency of CSO discharges from ALCOSAN and municipal outfalls under existing conditions during a year with average or typical precipitation. The histogram bars indicate the total number of outfalls that discharge on average approximately 0 to 12 times per year (0 to 1 times per month on average), 13 to 24 times per year (1 to 2 times per month on average), and so on to outfalls that discharge over 72 times per year. Similarly, Figures 4-19 and 4-20 indicate the annual overflow frequency of SSO discharges from ALCOSAN and municipal outfalls over the ALCOSAN service area.

These calculated annual overflow frequencies presented in the figures could be compared to rainfall frequency. During a year with average or typical precipitation, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to calculate the average number (median value) of significant precipitation events over a year. The 68 percent confidence limits extended from 85 to 103 events per year. These storm event frequencies were calculated utilizing a 6-hour inter-event time and a minimum event volume threshold value of 0.05 inches which correlates with the approximate minimum rainfall intensity needed to generate surface runoff that would be conveyed to a combined sewer system.

Figure 4-17: Annual Overflow Frequency for ALCOSAN CSO Outfalls

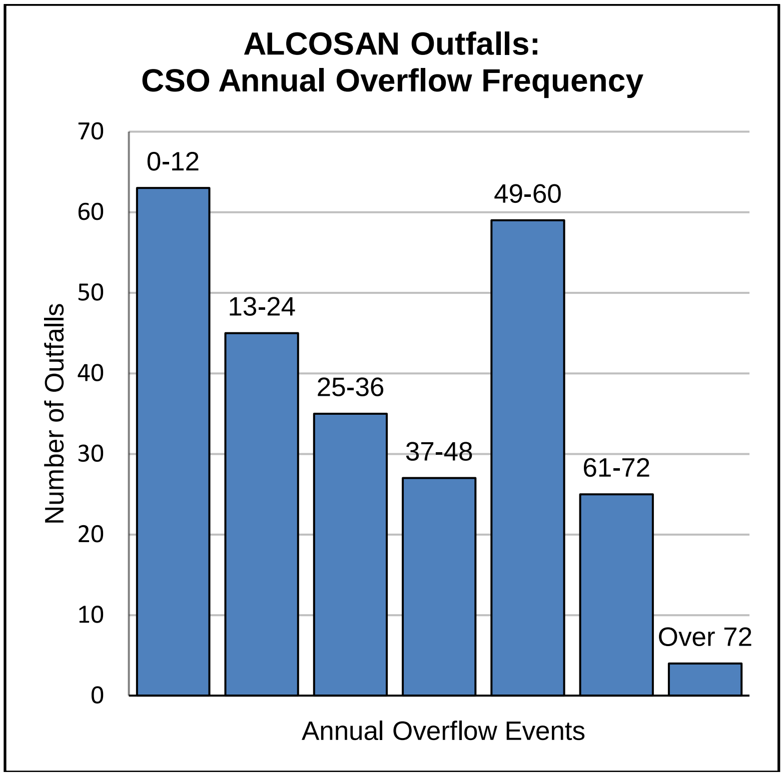


Figure 4-18: Annual Overflow Frequency for Municipal CSO Outfalls

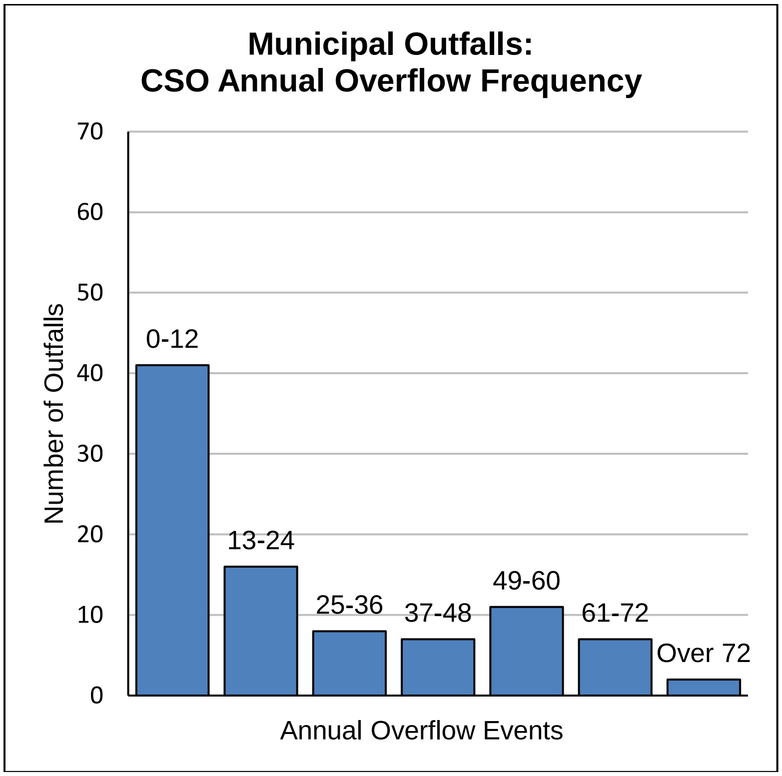


Figure 4-19: Annual Overflow Frequency for ALCOSAN SSO Outfalls

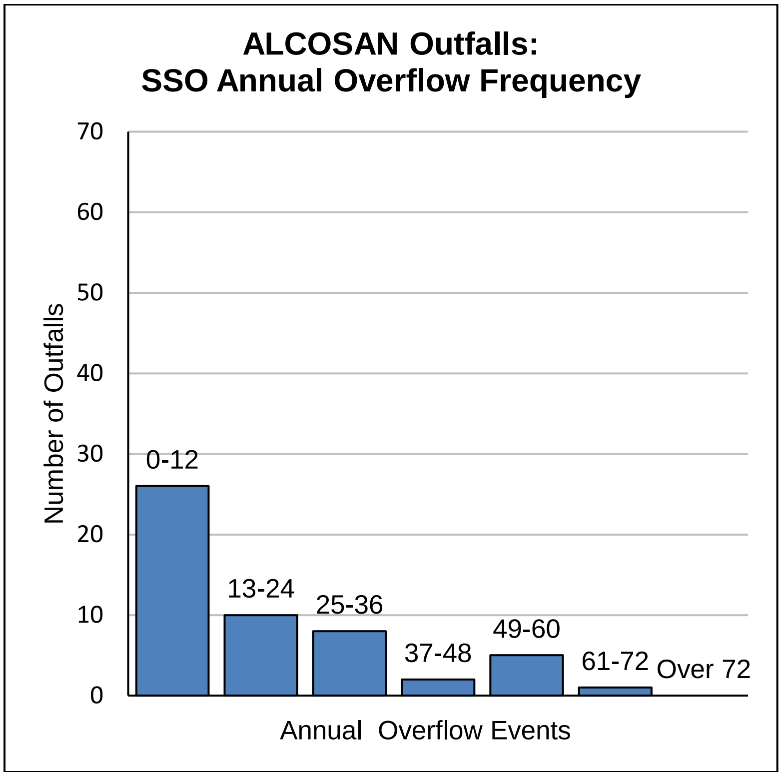
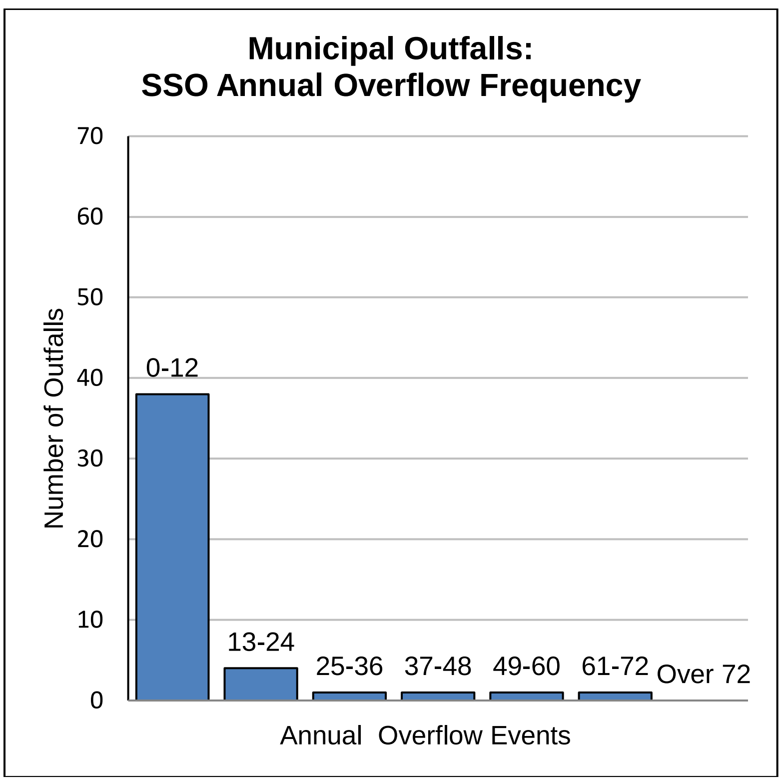


Figure 4-20: Annual Overflow Frequency for Municipal SSO Outfalls



Overflow frequency statistics at a more detailed level, including model results for annual overflow activity for each individual CSO and SSO outfall, are provided in Sections 4.4 through 4.10 of this WWP and are organized by planning basin area. WWP Section 3 provided descriptions, tables and maps of the seven designated planning basin areas and the corresponding ALCOSAN and municipal collection systems and the CSO and SSO regulator structures.

4.3.2 Annual Overflow Duration

Figures 4-21 through 4-24 provide a regional summary of the existing condition annual duration of CSO and SSO discharges over the entire ALCOSAN service area as a whole. The histogram information was obtained from H&H model simulations representing a year with typical precipitation. The histogram bars indicate the total number of outfalls that discharge within the various grouping of annual discharge hours. Discrete overflow durations are provided for CSO and SSO discharges and ALCOSAN and municipal outfalls.

The calculated annual overflow discharge durations could be compared to the annual duration at which the Woods Run treatment plant operates at its peak capacity. The model simulations indicate that during a year with typical year precipitation conditions, the treatment plant would be operating at its peak capacity of 250 million gallons per day for approximately 1,400 hours or 16 percent of the year. The model results indicate that existing operational and hydraulic capacity limits along the existing interceptor system can result in some outfall locations discharging before the peak capacity of the treatment plant is reached.

The annual discharge durations could also be compared with the annual duration of rainfall activity over the ALCOSAN service area. Analysis of the long-term precipitation record at the Pittsburgh International Airport indicates on average, there were approximately 220 hours during an average or typical year for which the monitored precipitation intensity was 0.05 inches per hour or greater. A threshold value of 0.05 inches was selected for the analysis because it correlates with the approximate minimum rainfall intensity needed to generate surface runoff that would be conveyed to a combined sewer system. Overflow durations can, and often do, exceed rainfall durations because municipal collection systems continue to convey rainfall runoff and groundwater infiltration to the ALCOSAN system after the rainfall has stopped. This occurrence is known as the recession limb of a storm event. Overflow durations for municipal CSOs tend to be lower than those for ALCOSAN CSOs because the size of the ALCOSAN sewersheds tributary to the CSO regulator structure tend to be larger and the storm water travel times tend to be longer.

Figure 4-21: Annual Overflow Duration for ALCOSAN CSO Outfalls

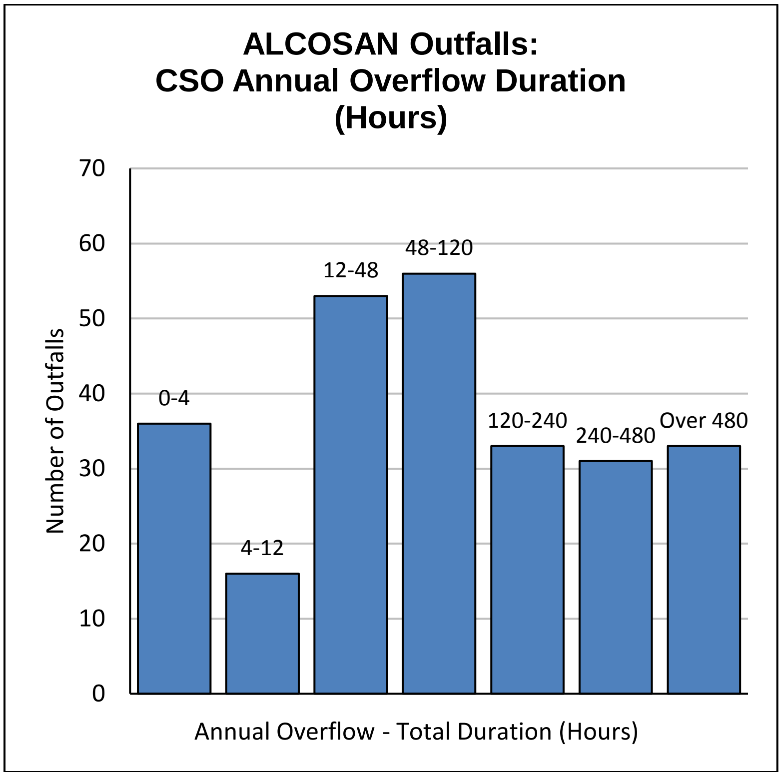


Figure 4-22: Annual Overflow Duration for Municipal CSO Outfalls

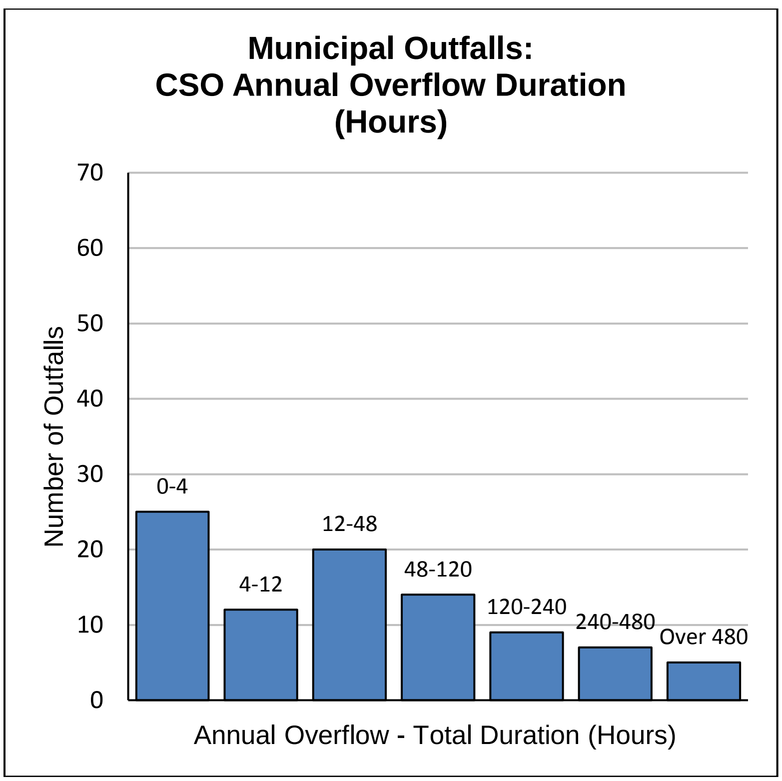


Figure 4-23: Annual Overflow Duration for ALCOSAN SSO Outfalls

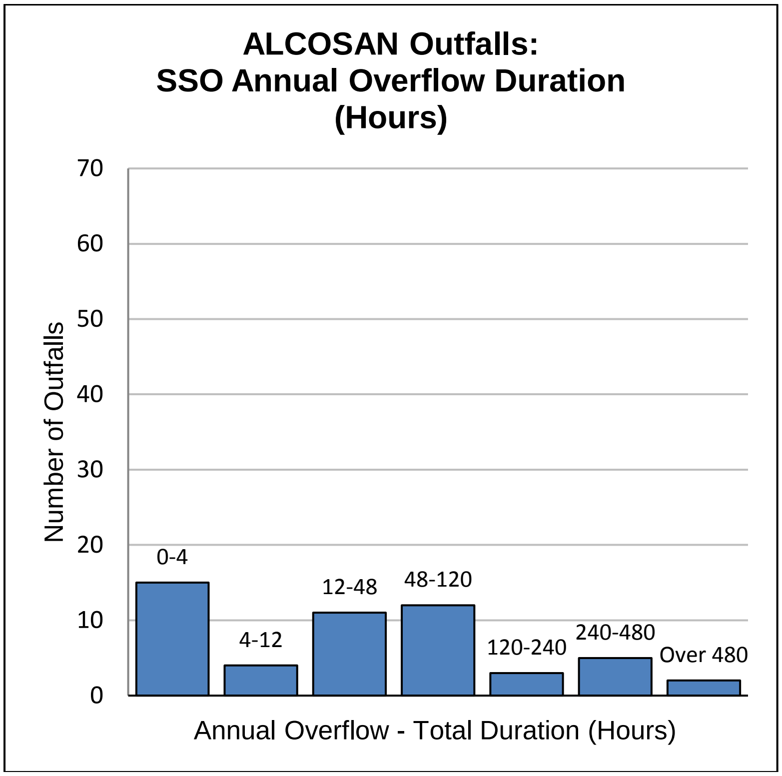
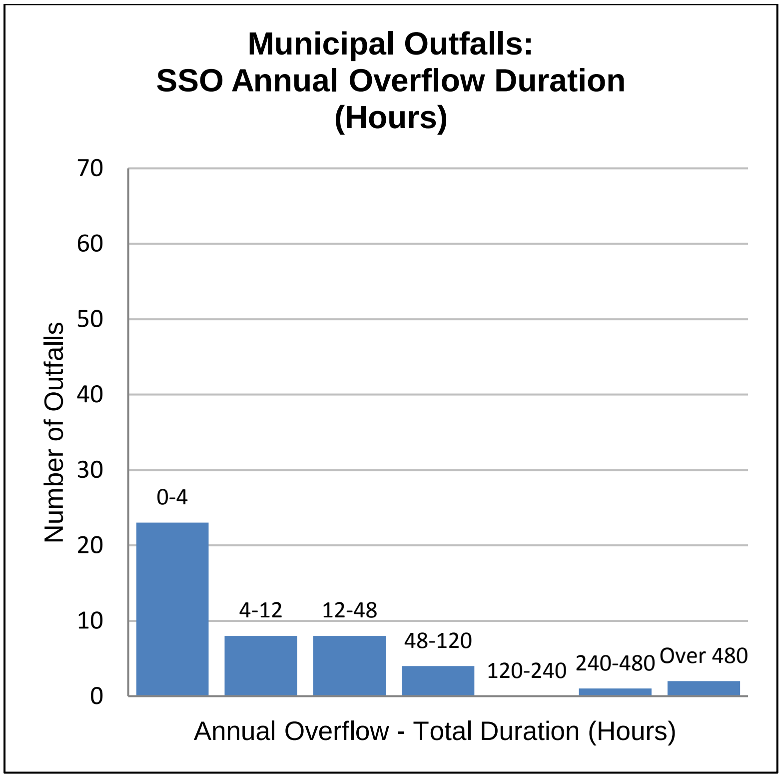


Figure 4-24: Annual Overflow Duration for Municipal SSO Outfalls



4.3.3 Annual Overflow Volume

Table 4-2 provides a regional summary of the existing condition annual volume of CSO and SSO discharges within each of the designated planning basin areas and over the entire ALCOSAN service area as a whole. The distribution of annual discharge volumes over the various planning basin areas are provided in Figures 4-25 through 4-27. During a year with average or typical rainfall over the service area, the model simulations indicate that within the ALCOSAN service area there are approximately 9.6 billion gallons of CSO and SSO discharges into area receiving waters. These annual discharges are comprised of approximately 8.3 billion gallons of CSO discharges from ALCOSAN outfalls and approximately 0.67 billion gallons of CSO discharges from municipal outfalls. These annual discharges also contain approximately 0.33 billion gallons of SSO overflows discharged from ALCOSAN outfalls, and 0.25 billion gallons of SSO overflows discharged from municipal outfalls. An additional 0.095 billion gallons of SSO overflows are discharged from ALCOSAN and municipal manholes located along sanitary trunk sewers and interceptor sewers.

The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the existing interceptor and WWTP capacity (250 MGD) would provide treatment for approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-2: Existing Condition, Typical Year Annual CSO and SSO Discharge Volume Summary for the Entire ALCOSAN Service Area

Planning Area	Number of CSO Outfalls	Annual CSO Overflow Volume (million gallons)	Number of SSO Outfalls	Annual SSO Overflow Volume (million gallons)
Chartiers Creek: ALCOSAN Outfalls	42	837	17	98.0
Chartiers Creek: Municipal Outfalls	27	197	16	60.0
Lower Ohio River/ Girty's Run: ALCOSAN Outfalls	14	287	12	188
Lower Ohio River/ Girty's Run: Municipal Outfalls	11	47.0	6	90.0
Main Rivers: ALCOSAN Outfalls	101	2,724	0	Not Applicable
Main Rivers: Municipal Outfalls	2	101	2	0
Saw Mill Run: ALCOSAN Outfalls	25	393	3	0.0120
Saw Mill Run: Municipal Outfalls	21	41.0	3	0.300
Turtle Creek: ALCOSAN Outfalls	21	124	16	39.0
Turtle Creek: Municipal Outfalls	4	24.0	3	0.0500

Table 4-2: Existing Condition, Typical Year Annual CSO and SSO Discharge Volume Summary for the Entire ALCOSAN Service Area

Planning Area	Number of CSO Outfalls	Annual CSO Overflow Volume (million gallons)	Number of SSO Outfalls	Annual SSO Overflow Volume (million gallons)
Upper Allegheny River: ALCOSAN Outfalls	19	1,977	3	5.90
Upper Allegheny River: Municipal Outfalls	12	231	5	31.0
Upper Monongahela River: ALCOSAN Outfalls	29	1923	0	Not Applicable
Upper Monongahela River: Municipal Outfalls	14	31.0	9	65.0
Total ALCOSAN Service Area: ALCOSAN Outfalls	251	8,265	51	331
Total ALCOSAN Service Area: Municipal Outfalls	91	672	45	247
System-wide Manhole Flooding along ALCOSAN Sanitary Interceptor Sewers				6.67
System-wide Manhole Flooding along Municipal Sanitary Sewer Systems				88.5
Total ALCOSAN Service Area:		8,937		673

Figure 4-25: Existing Condition, Typical Year Annual CSO and SSO Discharge Volume Summary for the Entire ALCOSAN Service Area

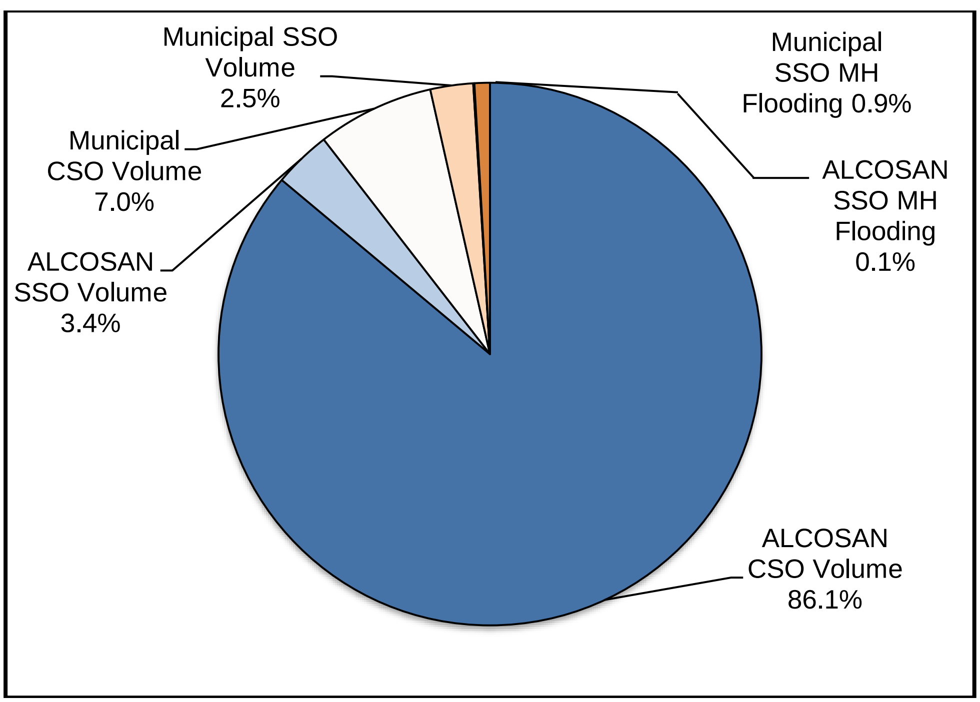


Figure 4-26: Existing Condition, Typical Year Annual CSO Discharge Volume Summary for the Seven Planning Basins Located Within the ALCOSAN Service Area

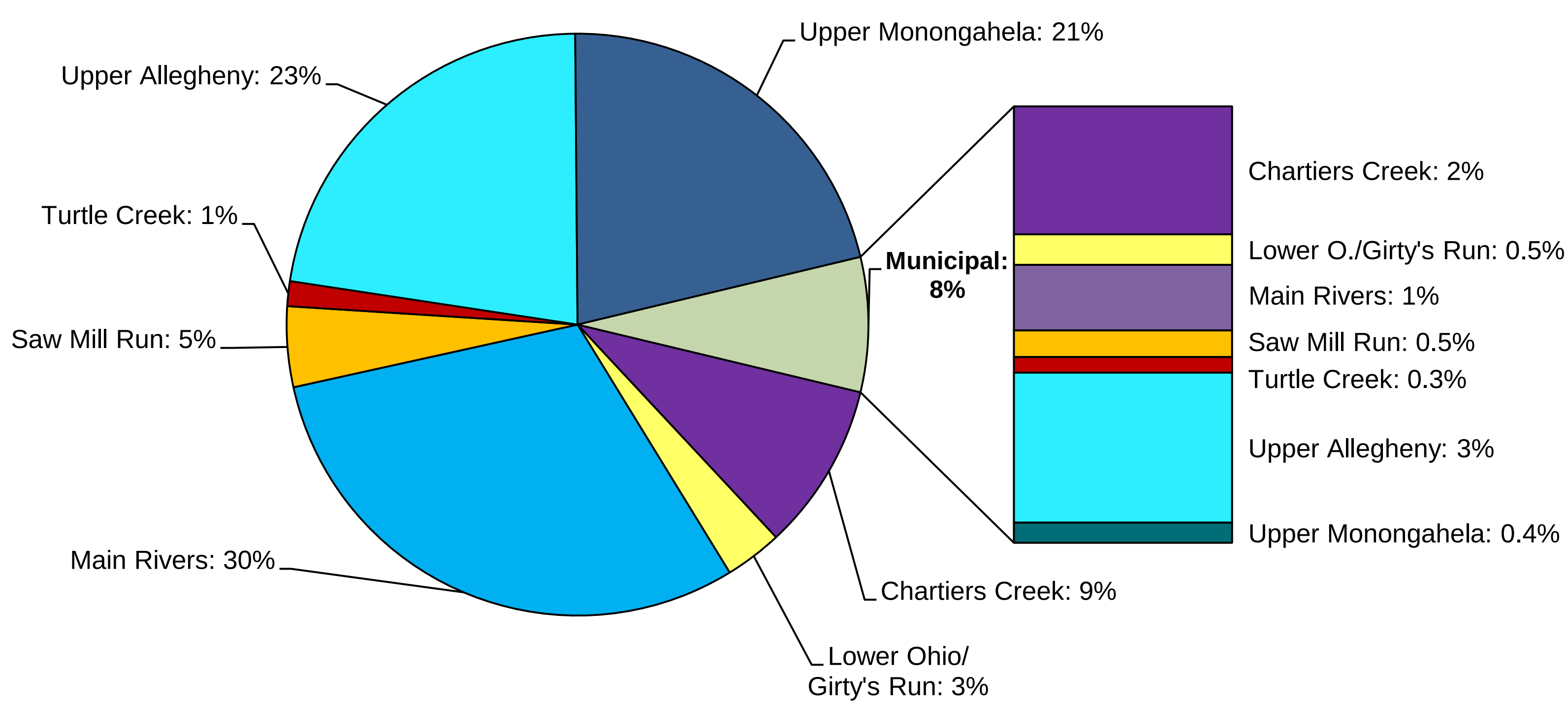
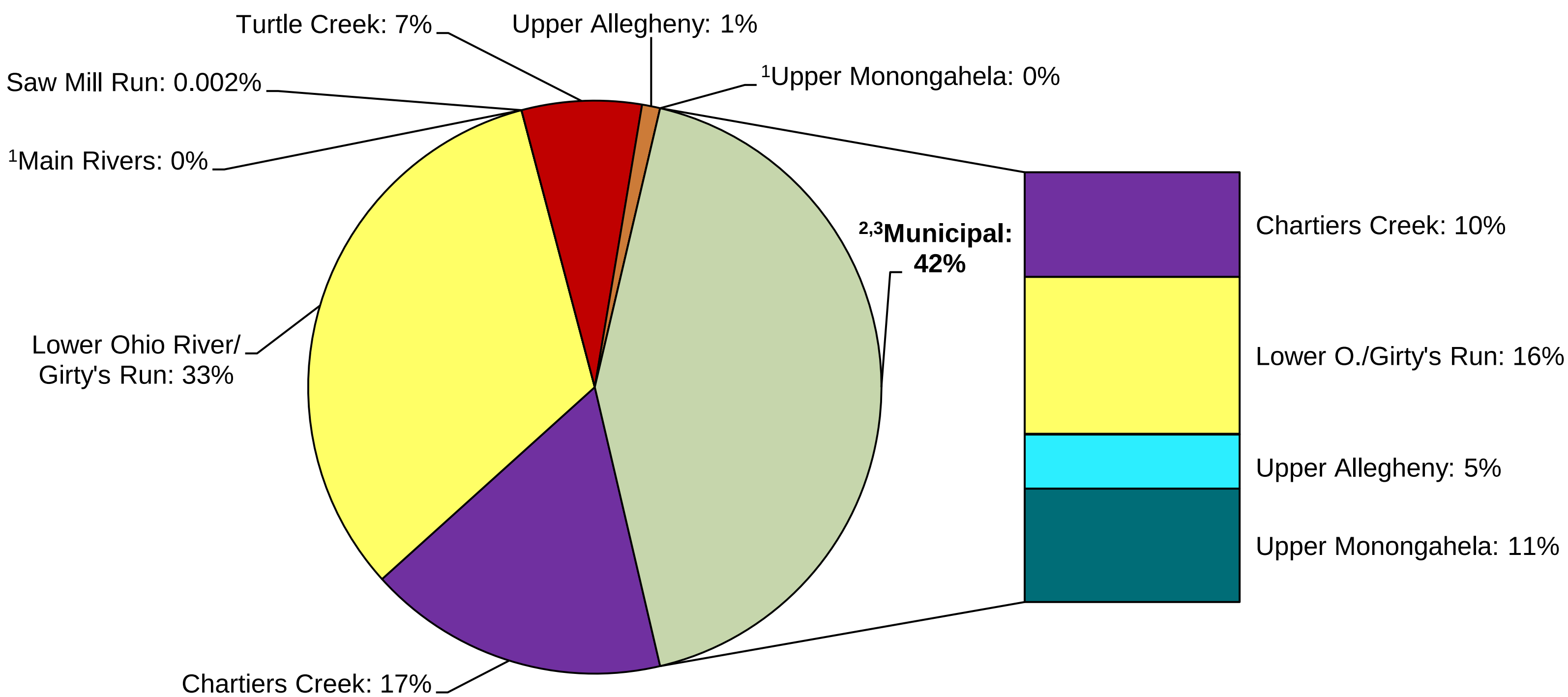


Figure 4-27: Existing Condition, Typical Year Annual SSO Discharge Volume Summary for the Seven Planning Basins Located Within the ALCOSAN Service Area



Notes
(1) Upper Monongahela and Main Rivers planning basins do not contain any ALCOSAN SSOs.
(2) In the Typical Year, under Existing Conditions, municipal SSOs did not discharge in the Main Rivers planning basins.
(3) Saw Mill Run and Turtle Creek planning basins had municipal SSO volumes of less than 0.0X%

Table 4-3 provides a regional summary of the existing condition annual percent of combined sewage that is captured and treated by the ALCOSAN system. For this analysis and summary table, the Lower Ohio – Girty's run (LOGR) planning basin was divided into the Lower Ohio and Lower Northern Allegheny (Girty's Run) areas because distinct model runs were required. The model results cannot be combined or merged into a single planning basin area. The model simulations indicate that during a year with average or typical rainfall, system-wide over the total ALCOSAN service area, approximately 56 percent of the combined sewage generated during precipitation events is captured and treated and the remaining 44 percent is discharged into area receiving waters. Existing condition capture statistics vary among the planning basin areas. The basin area with the highest existing condition percent capture is the Lower Northern Allegheny portion of the LOGR basin with 75% and the basin areas with the lowest existing condition capture are the Chartiers Creek and Upper Allegheny River basins with 41% and 43%, respectively. The differences are largely attributed to existing hydraulic capacities within the ALCOSAN interceptor system.

Table 4-3: Existing Condition Typical Year Combined Sewage Capture Summary for the Entire ALCOSAN Service Area

Planning Basin Area	Number of ALCOSAN CSO Outfalls	Number of Municipal CSO Outfalls	Existing Condition Percent Capture of Wet Weather Flow
Chartiers Creek	42	27	41%
Lower Northern Allegheny	5	11	75%
Lower Ohio	9	0	71%
Main Rivers	101	2	71%
Saw Mill Run	25	21	46%
Turtle Creek	21	4	61%
Upper Allegheny River	19	12	43%
Upper Monongahela River	29	14	54%
Entire ALCOSAN Service Area	251	91	56%

4.4 Characterization of the Chartiers Creek Planning Basin

The adjusted and refined typical year precipitation dataset values were applied to the validated H&H model to quantify and characterize dry and wet weather flows that were generated within each of the municipal collection systems that comprise the Chartiers Creek (CC) Planning Basin area. The model simulations conveyed the flows to the respective point of connection with the ALCOSAN system and through regulating structures where they exist, diverting flow into the ALCOSAN interceptor system and discharging any remaining wet weather flow to CSO or SSO outfalls. The model summed and tabulated CSO and SSO discharges and conveyed and routed the diverted flow to the Woods Run Wastewater Treatment Plant.

To support the development and assessment of alternative measures to the control wet weather CSO and SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was then applied to the existing condition validated model to generate baseline condition statistics on the annual frequency, duration and volume of overflows. This section provides a summary description of the H&H characterization of existing conditions within the Chartiers Creek basin and documents corresponding CSO and SSO discharges in tabular and graphical formats.

Tables 4-4 through 4-7 provide concise regional summaries of the existing condition annual frequency, duration and volume of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The table information, obtained from typical year model simulation results, includes overflow statistics for each individual outfall structure within the Chartiers Creek Planning Basin.

4.4.1 Existing Condition CSO Discharges from ALCOSAN Outfalls

Table 4-4 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by ALCOSAN.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN CSO outfall within the CC basin. The table and models indicate that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 78 times per year. Reported overflow frequencies were calculated utilizing a standardized 24-hour inter-event time and a 0.0646 million gallons/day minimum threshold value. These calculated annual overflow frequencies could be compared to rainfall frequency. During a year with average or typical precipitation, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to find the median value of significant precipitation events over a year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN CSO outfall. The table and models indicate that some CSO outfalls did not discharge at all during typical year precipitation conditions and that the most active CSO outfalls discharge up to 1,000 hours per year or 11 percent of the total year. The calculated annual overflow discharge durations could be compared to the annual duration that the Woods Run treatment plant operates at its peak capacity. The model simulations indicated that for typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day for approximately 1,400 hours. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN CSO outfall. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Chartiers Creek basin, CSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 837 million gallons of CSO discharges into area receiving waters. The table and models indicate that some CSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 245 million gallons throughout the year. The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the current interceptor system and WWTP capacity (250 MGD) would provide treatment for approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-4: Existing Condition, Typical Year Annual CSO Discharge Summary – ALCOSAN Outfalls within the Chartiers Creek Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
C-15-OF	ALCOSAN	59	534	16.8
C-02-OF	ALCOSAN	This outfall has been closed		
C-03-OF	ALCOSAN	13	21	0.467
C-04-02-OF2 (C-03A-OF)(1)	ALCOSAN	1	0.25	0.00127
C-04-OF	ALCOSAN	22	59	5.64
C-05A-OF	ALCOSAN	62	271	15.5
C-05-OF	ALCOSAN	22	43	9.61
C-06-OF	ALCOSAN	13	22	0.578
C-07-OF	ALCOSAN	61	344	26.8
C-08-OF	ALCOSAN	23	58	2.16
C-09-OF	ALCOSAN	65	610	133
C-10-OF	ALCOSAN	41	190	7.79
C-11-OF	ALCOSAN	65	461	46.0
C-12-OF	ALCOSAN	62	411	23.5

Table 4-4: Existing Condition, Typical Year Annual CSO Discharge Summary – ALCOSAN Outfalls within the Chartiers Creek Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
C-13A-IRO	ALCOSAN	62	1002	245
C-13-OF	ALCOSAN McKees Rocks(2)	42	208	3.27
C-14-OF	ALCOSAN	This outfall has been closed		
C-19-OF	ALCOSAN	57	275	17.3
C-20-OF	ALCOSAN	48	141	11.7
C-22-OF	ALCOSAN	76	401	71.6
C-23-OF	ALCOSAN	35	65	1.86
C-24-OF	ALCOSAN	78	699	68.5
C-26A-OF	ALCOSAN	12	9	0.213
C-27-OF	ALCOSAN	28	32	1.34
C-28-OF	ALCOSAN	46	206	3.58
C-29-OF	ALCOSAN	52	107	3.09
C-30-OF	ALCOSAN	51	336	4.85
C-31-OF	ALCOSAN	49	95	3.30
C-34A-OF	ALCOSAN	60	540	27.0
C-34-OF	ALCOSAN	4	3	0.546
C-35-OF	ALCOSAN	51	154	8.06
C-36-OF	ALCOSAN	0	0	0
C-37-OF	ALCOSAN	23	18	0.474
C-38A-OF	ALCOSAN	45	120	5.51
C-38B-OF	ALCOSAN	60	368	12.9
C-38-OF	ALCOSAN	1	0.25	0.000734
C-39-OF	ALCOSAN	0	0	0
C-40-OF	ALCOSAN	This outfall has been closed as an ALCOSAN outfall		
C-41-OF	ALCOSAN	24	17	0.396
C-43-OF	ALCOSAN	6	4	0.0469
C-44-OF	ALCOSAN	5	2	0.0374

Table 4-4: Existing Condition, Typical Year Annual CSO Discharge Summary – ALCOSAN Outfalls within the Chartiers Creek Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
C-51-OF	ALCOSAN	55	145	18.6
O-06-OF	ALCOSAN	0	0	0
O-08-OF	ALCOSAN	12	20	1.05
O-09-OF	ALCOSAN	This outfall has been closed		
O-10-OF	ALCOSAN	This outfall has been closed		
O-11-OF	ALCOSAN	This outfall has been closed		
O-13-OF	ALCOSAN	30	64	39.7

Note(1): Outfall C-04-02-OF2 is listed in the ALCOSAN Consent Decree as outfall C-03A-OF
Note(2): Outfall C-13 is jointly permitted by ALCOSAN and McKees rocks Borough

4.4.2 Existing Condition CSO Discharges from Municipal Outfalls

Table 4-5 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by the customer municipalities and/or their designated municipal authorities. A list of the municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP. Because of the complex variety of institutional arrangements between authorities and their respective municipalities, in the WWP both are indicated as “owners” in the narrative and summary tables regarding the CSO/SSO outfalls.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual municipal CSO outfall within the CC Planning Basin. The table and models indicate that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 62 times per year. As a basis for comparison, during a year with average or typical precipitation there are approximately 94 storms over the ALCOSAN service area.

Annual Overflow Duration: The table lists the annual overflow duration for each individual municipal CSO outfall. The table and models indicate that some CSO outfalls did not discharge at all during typical year precipitation conditions and that the most active CSO outfalls discharge up to 662 hours per year or 7.6 percent of the total year. As a basis for comparison the existing ALCOSAN WWTP would operate at its peak capacity for approximately 1,400 hours during a year with average or typical precipitation.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal CSO outfall. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Chartiers Creek basin, municipal CSO outfalls discharge an annual total of approximately 197 million gallons of CSO discharges into area receiving waters. The table and models indicate that some CSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 71 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-5: Existing Condition, Typical Year Annual CSO Discharge Summary – Municipal Outfalls(1) within the Chartiers Creek Planning Basin Area

CSO Outfall	Owner(2)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
812-48A	Carnegie Borough	10	13	0.450
2000-774	Carnegie Borough	53	662	50.1
B4_MCD0008	Borough of McDonald/ McDonald Borough Sewer Authority (McDonald/MBSA)	0	0	0
A1_MCD0002-3(1)	McDonald / MBSA	15	23	0.209
A2_MCD0082(1)	McDonald / MBSA	43	204	2.28
A3_MCD0104(1)	McDonald / MBSA	10	19	0.0962
A4_MCD0097(1)	McDonald / MBSA	25	126	0.815
B13_MCD0048(1)	McDonald / MBSA	0	0	0
B14_MCD0044(1)	McDonald / MBSA	0	0	0
B16_MCD0063(1)	McDonald / MBSA	0	0	0
B17_MCD0058(1)	McDonald / MBSA	0	0	0
B18_MCD0067(1)	McDonald / MBSA	0	0	0
B2_MCD0004(1)	McDonald / MBSA	0	0	0
B3_MCD0006(1)	McDonald / MBSA	0	0	0
B6_MCD0107(1)	McDonald / MBSA	1	0.75	0.00228
B7_MCD0101(1)	McDonald / MBSA	4	3	0.0174

Table 4-5: Existing Condition, Typical Year Annual CSO Discharge Summary – Municipal Outfalls[1] within the Chartiers Creek Planning Basin Area

CSO Outfall	Owner[2]	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
B8_MCD0094[1]	McDonald / MBSA	0	0	0
B9_MCD0095[1]	McDonald / MBSA	13	38	0.307
MKR-1	Borough of McKees Rocks	52	273	36.9
MKR-2	Borough of McKees Rocks	20	33	1.88
MKR-3	Borough of McKees Rocks	47	145	70.5
ADC07RC13A	City of Pittsburgh/ Pittsburgh Water & Sewer Authority (Pittsburgh/PWSA)	51	83	2.45
CSO-039E001	Pittsburgh / PWSA	1	0.25	0.0441
CSO-039J001	Pittsburgh / PWSA	6	3	0.118
CSO-039K001	Pittsburgh / PWSA	62	258	18.4
CSO-068H001	Pittsburgh / PWSA	22	12	0.405
CSO-068H002	Pittsburgh / PWSA	62	182	4.87

Note[1]: The McDonald Sewage Authority Source Flow Reduction Study (Dec 2017) reports that full separation of its combined sewer system was recently completed and all active CSO structures have been disconnected from the sanitary system, and are now considered dedicated stormwater outfall structures. ALCOSAN will confirm.

Note[2]: In communities where municipal authorities exist, both the municipality and authority are indicated as “owners.” Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

4.4.3 Existing Condition SSO Discharges from ALCOSAN Outfalls

Table 4-6 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by ALCOSAN.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN SSO outfall within the CC Planning Basin. The models indicated that some SSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 60 times per year. There are approximately 94 storms over the ALCOSAN service area during a year with average or typical precipitation.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN SSO outfall. The models indicated that some SSO outfalls did not discharge at all during typical year precipitation conditions and that the most active SSO outfalls discharge up to 476 hours per year or 5.4 percent of the total year. As a basis for comparison the existing ALCOSAN WWTP would operate at its peak capacity for approximately 1,400 hours during a year with average or typical precipitation.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN SSO outfall. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Chartiers Creek basin, SSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 98 million gallons of SSO discharges into area receiving waters. The table and models indicate that some SSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 50 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-6: Existing Condition, Typical Year Annual SSO Discharge Summary ALCOSAN Outfalls within the Chartiers Creek Planning Basin Area

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
C-21-OF	ALCOSAN	4	11	0.123
C-26-OF	ALCOSAN	47	301	9.42
C-33-OF	ALCOSAN	0	0	0
C-42-OF	ALCOSAN	11	15	0.423
C-45A-OF	ALCOSAN	31	98	2.80
C-45-OF	ALCOSAN	3	0.75	0.00900
C-46-OF	ALCOSAN	31	196	2.76
C-47-OF	ALCOSAN	2	1.25	0.00601
C-48-OF	ALCOSAN	20	70	2.86
C-49-OF	ALCOSAN	40	281	12.4
C-50A-OF	ALCOSAN	1	8	0.0846
C-50B-OF	ALCOSAN	18	93	2.34
C-50-OF	ALCOSAN	9	68	1.45
C-52-OF	ALCOSAN	17	47	0.414
C-53-OF	ALCOSAN	58	476	50.0

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
C-54-OF	ALCOSAN	3	6	0.130
C-55-OF	ALCOSAN	0	0	0

It should be noted that in addition to the ALCOSAN SSOs that are listed in Table 4-6 above, there are flooded manholes located along sanitary interceptor sewers that can discharge under surcharge conditions.

4.4.4 Existing Condition SSO Discharges from Municipal Outfalls

Table 4-7 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by the customer municipalities or their designated authorities.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual municipal SSO outfall within the CC Planning Basin. The table and models indicated that some SSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 43 times per year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual municipal SSO outfall. The table and models indicated that some SSO outfalls did not discharge at all during typical year precipitation conditions and that the most active SSO outfalls discharge up to 363 hours per year or 4.1 percent of the total year.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal SSO outfall. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Chartiers Creek Planning Basin area, municipal SSO outfalls discharge an annual total of approximately 60 million gallons of SSO discharges into area receiving waters. The models indicated that some SSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 47 million gallons throughout the year.

Table 4-7 Existing Condition, Typical Year Annual SSO Discharge Summary – Municipal Outfalls within the Chartiers Creek Planning Basin Area

SSO Outfall	Owner(1)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
1D41	Municipality of Bethel Park/ Bethel Park Municipal Authority	0	0	0
2000-57	Borough of Bridgeville	15	80	7.36
KH-47A	Collier Township/ Collier Township Municipal Authority (Collier / CTMA)(2)	0	0	0
KH-1	Collier / CTMA	4	24	0.320
DCKH	Collier / CTMA	0	0	0
RR-SI	Collier / CTMA	3	21	0.560
W-2D (3)	Scott Township	13	9	0.200
H-11 (4)	Scott Township	0	0	0
H-30-1	Scott Township	0	0	0
H-30-2	Scott Township	9	12	0.230
H-30-2C	Scott Township	2	1	0
950-2213	Township of Upper St. Clair	0	0	0
950-1733	Township of Upper St. Clair	2	6	0.0800
950-4750	Township of Upper St. Clair	2	15	0.940
950-4382	Township of Upper St. Clair	9	45	3.24
950-4785	Township of Upper St. Clair/ Bridgeville	43	363	46.6

Note(1): In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.
Note(2): Collier Twp. owns and operates the sewer system tributary to POC C-50. The CTMA owns and operates the remaining sewer systems, including the SSO regulators and outfalls, tributary to its other ALCOSAN POCs.
Note(3): The Scott Township Feasibility Study Report (July 2013) indicates CCTV has shown this is not a constructed overflow. ALCOSAN will confirm.
Note(4): The Scott Township Source Reduction Study (Dec 2017) indicates this overflow pipe was eliminated as part of the Phase 1 COA Demonstration Project. ALCOSAN will confirm.

It should be noted that in addition to the municipal SSOs that are listed in Table 4-7 above, South Fayette Township and the Municipal Authority of South Fayette have emergency overflows at the Chartiers and Oakdale pump stations that would discharge under emergency conditions or if the station capacity were to be exceeded. There can be additional overflows from the other municipal pumping station emergency overflows located within the CC basin. There also can be flooded manholes located along sanitary trunk sewers that can discharge under surcharge conditions.

In addition to the numerical summaries provided in Tables 4-4 through 4-7, graphical depictions of the model simulation results for the typical precipitation year within the Chartiers Creek planning basin area are provided in Figures 4-28 through 4-30.

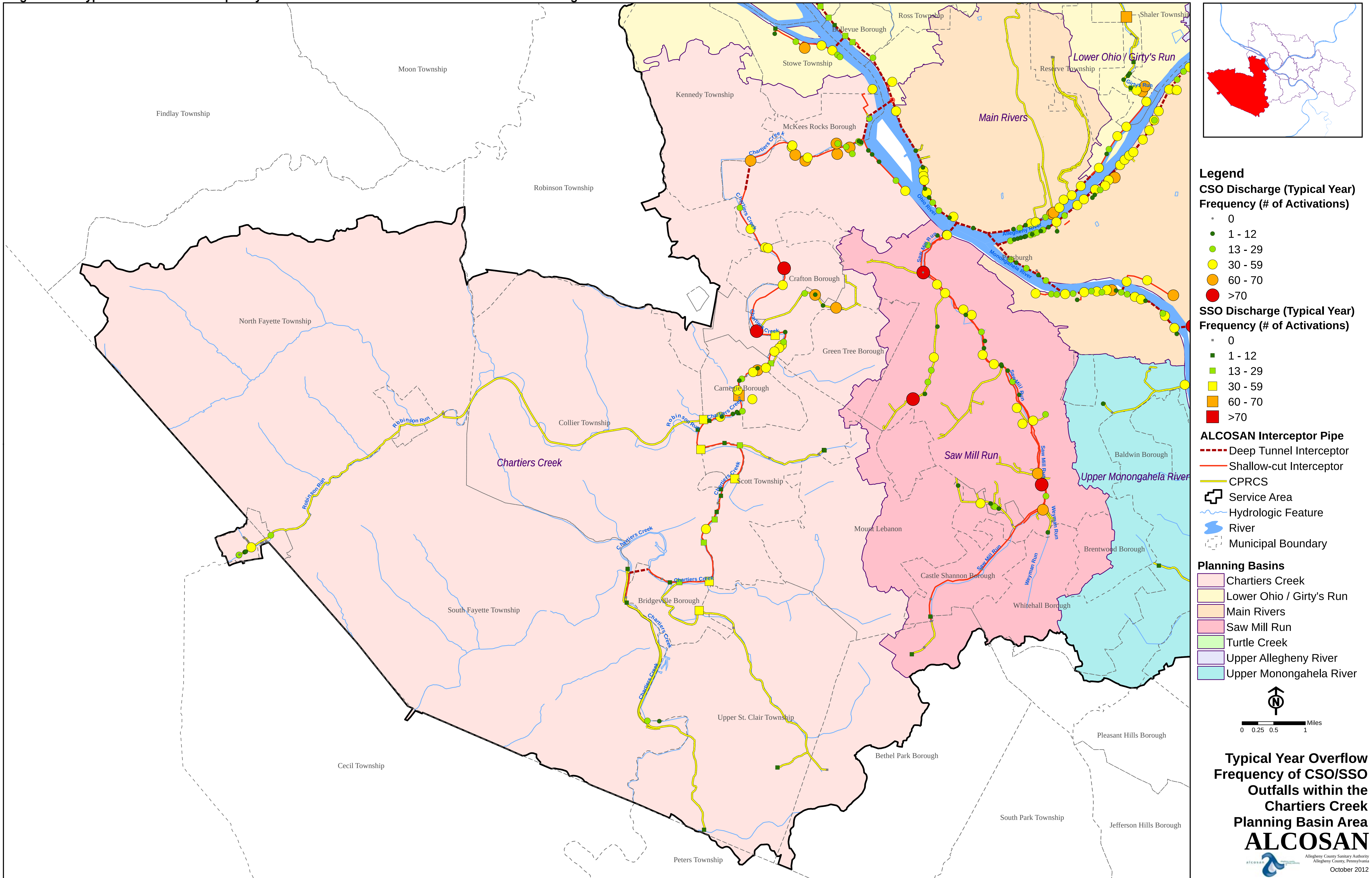
Figure 4-28 depicts the annual overflow frequency of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest number of activations during an average precipitation year. Outfalls with more than 70 activations per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 60 to 70 activations per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 30 to 59 activations per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 13 to 29 activations per year (averaging a little more than 1 to 2 overflows per month) were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 1 to 12 activations per year (averaging 1 or less overflows per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-29 depicts the annual overflow duration of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest total hours of discharge activity during an average precipitation year. Outfalls with more than 1,000 hours of discharge activity per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 500 to 1,000 hours of discharge per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 100 to 499 hours of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 25 to 99 hours of overflow discharge per year were placed into this category (outfalls were active less than 1.1 percent of the year). Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 0.25 to 24 hours of discharge per year (averaging 2 or less hours of overflow per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-30 depicts the annual overflow volume of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest volume of discharge activity during an average precipitation year. Outfalls discharging more than 200 million gallons per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls discharging 50 to 200 million gallons per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 10 to 49.9 million gallons of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow volume. Outfalls discharging 1.0 to 9.99 million gallons per year were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively low overflow volumes. Outfalls discharging less than 1.00 million gallons per year were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

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

Figure 4-28: Typical Year Overflow Frequency of CSO/SSO Outfalls within the Chartiers Creek Planning Basin Area



Typical Year Overflow Frequency of CSO/SSO Outfalls within the Chartiers Creek Planning Basin Area

ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Figure 4-29: Typical Year Overflow Duration of CSO/SSO Outfalls within the Chartiers Creek Planning Basin Area

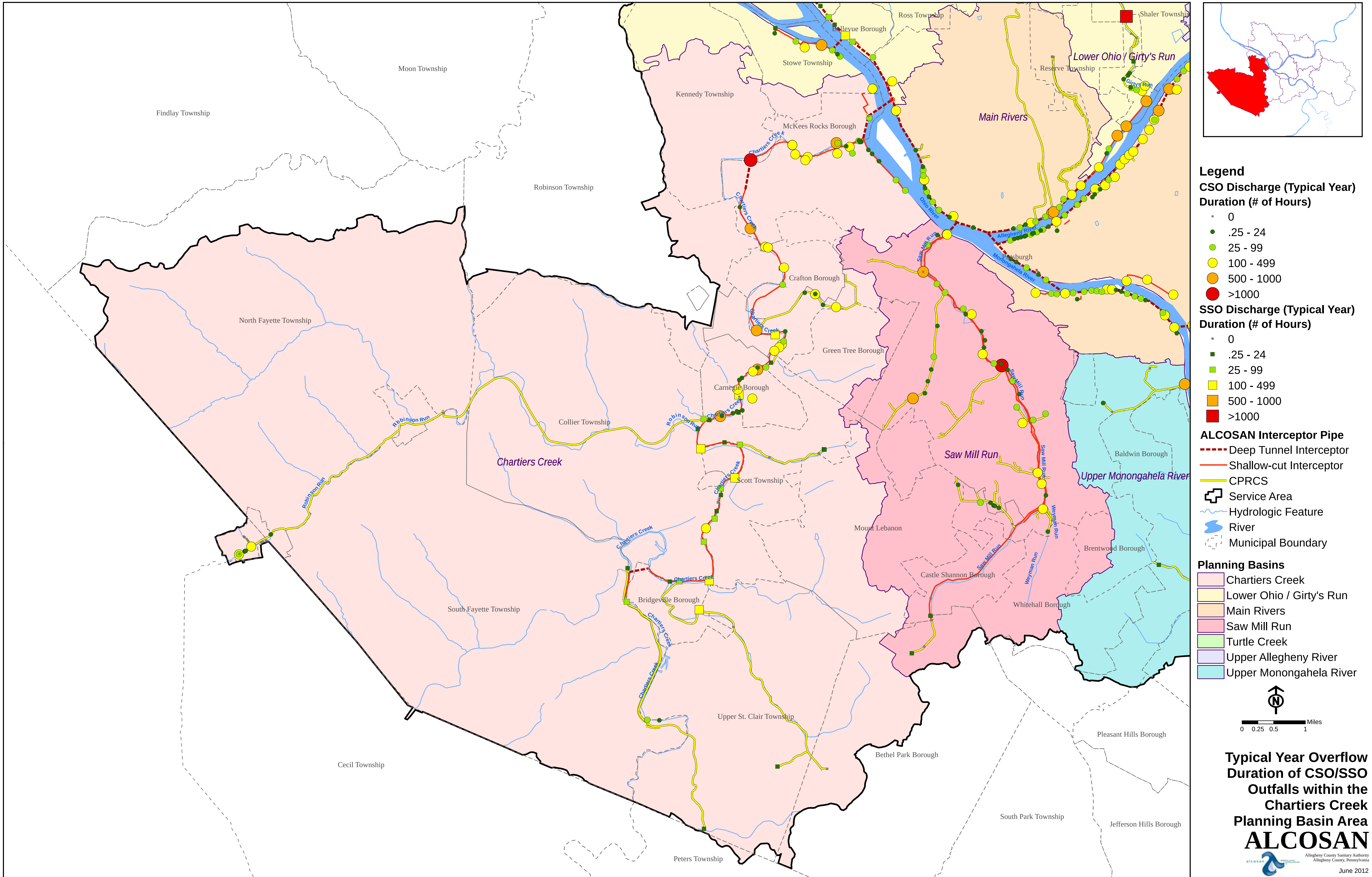
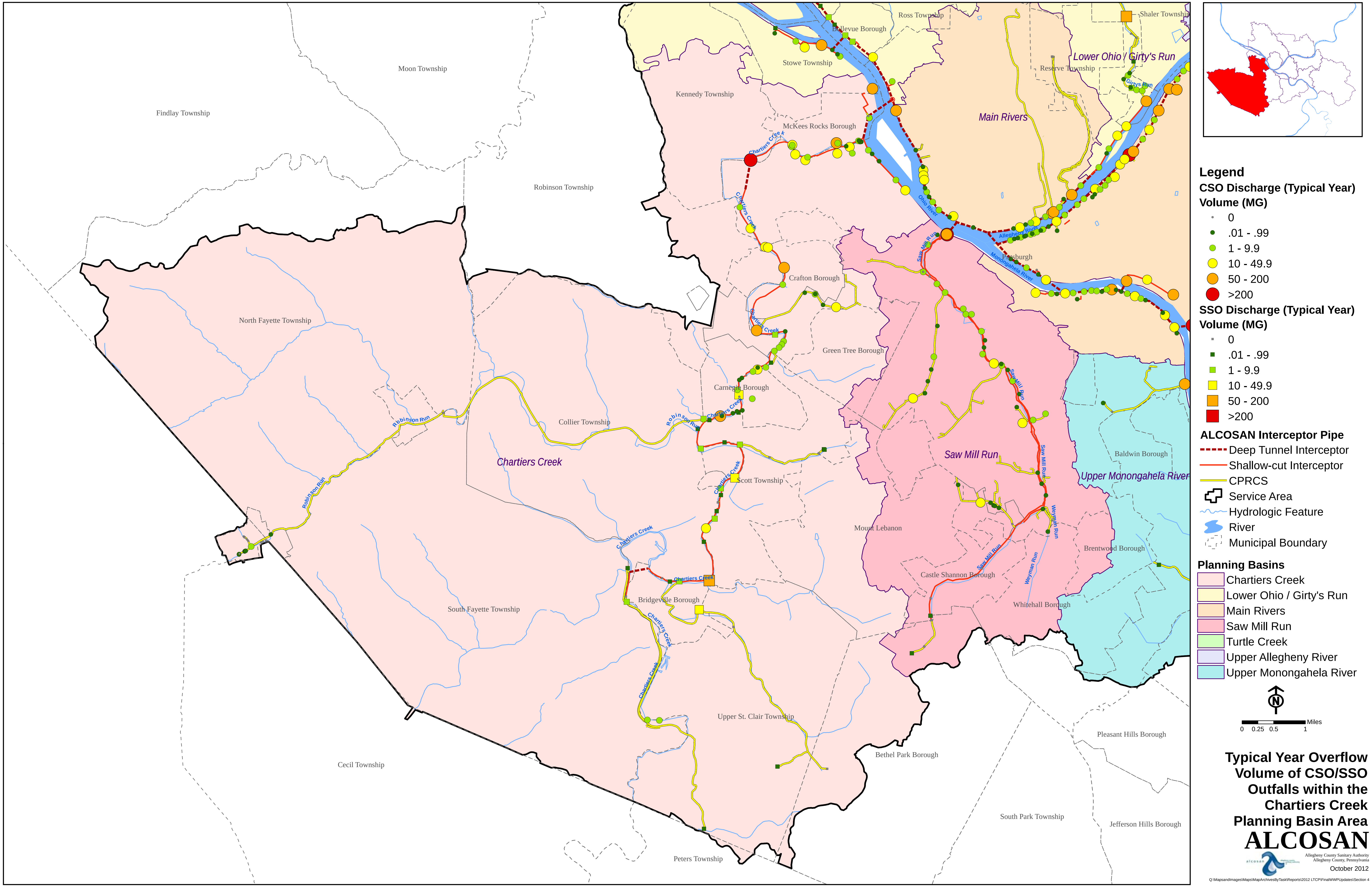


Figure 4-30: Typical Year Overflow Volume of CSO/SSO Outfalls within the Chartiers Creek Planning Basin Area



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

4.5 Characterization of the Lower Ohio / Girty's Run Planning Basin

The adjusted and refined typical year precipitation dataset values were applied to the validated H&H model to quantify and characterize dry and wet weather flows that were generated within each of the municipal collection systems that comprise the Lower Ohio / Girty's Run (LOGR) Planning Basin area. The model simulations conveyed the flows to the respective point of connection with the ALCOSAN system and through regulating structures where they exist, diverting flow into the ALCOSAN interceptor system and discharging any remaining wet weather flow to CSO or SSO outfalls. The model summed and tabulated CSO and SSO discharges and conveyed and routed the diverted flow to the Woods Run Wastewater Treatment Plant.

To support the development and assessment of alternative measures to the control wet weather CSO and SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was then applied to the existing condition validated model to generate baseline condition statistics on the annual frequency, duration and volume of overflows. This section provides a summary description of the H&H characterization of existing conditions within the LOGR basin and documents corresponding CSO and SSO discharges in tabular and graphical formats.

Tables 4-8 through 4-11 provide concise regional summaries of the existing condition annual frequency, duration and volume of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The table information was obtained from typical year model simulation results. The table information includes overflow statistics for each individual outfall structure within the LOGR Planning Basin.

4.5.1 Existing Condition CSO Discharges from ALCOSAN Outfalls

Table 4-8 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by ALCOSAN.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN CSO outfall within the Lower Ohio - Girty's Run Planning Basin. The table and models indicated that the least active CSO outfalls discharged twice under typical year precipitation conditions and the most active outfalls discharge up to 62 times per year. Reported overflow frequencies were calculated utilizing a standardized 24-hour inter-event time and a 0.0646 million gallons/day minimum threshold value. These calculated annual overflow frequencies could be compared to rainfall frequency. During a year with average or typical precipitation, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to find the median value of significant precipitation events over a year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN CSO outfall within the LOGR Planning Basin. The table and models indicated that least active CSO outfall discharged an annual total of two hours during typical year precipitation conditions and that the most active CSO outfalls discharge up to 843 hours per year or 9.6 percent of the total year. The calculated annual overflow discharge durations could be compared to the annual duration that the Woods Run treatment plant operates at its peak capacity. The model simulations indicate that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day, for approximately 1400 hours. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN CSO outfall within the LOGR Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the LOGR planning basin area, CSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 287 million gallons of CSO discharges into area receiving waters. The table and models indicated that the least active CSO outfall discharged 0.027 mg under typical year precipitation conditions and the most active individual outfall discharged a total of 128 million gallons throughout the year. The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the treatment plant would provide treatment for approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-8: Existing Condition, Typical Year Annual CSO Discharge Summary
ALCOSAN Outfalls within the LOGR Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
A-62-OF	ALCOSAN	47	260	8.20
A-63-OF	ALCOSAN	5	4	0.158
A-64-OF	ALCOSAN	25	52	3.86
A-65-OF	ALCOSAN	57	549	19.8
A-66-OF	ALCOSAN	This outfall has been closed as a CSO outfall		
A-67-OF	ALCOSAN	55	843	128
O-01-OF	ALCOSAN	2	2	0.027
O-02-OF	ALCOSAN	24	43	0.999
O-03-OF	ALCOSAN	62	267	14.5
O-04-OF	ALCOSAN	57	678	54.6
O-05-OF	ALCOSAN	43	83	0.900
O-05A-OF	ALCOSAN	14	9	0.206

Table 4-8: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls within the LOGR Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
O-05B-OF	ALCOSAN	22	34	1.72
O-25-OF	ALCOSAN	22	40	12.4
O-26-OF	ALCOSAN	57	117	7.02

4.5.2 Existing Condition CSO Discharges from Municipal Outfalls

Table 4-9 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by the customer municipalities and/or their designated municipal authorities. A list of the municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP. Because of the complex variety of institutional arrangements between authorities and their respective municipalities, in the WWP both are indicated as "owners" in the narrative and summary tables regarding the CSO/SSO outfalls.

Annual Overflow Frequency: The table lists the annual overflow duration for each individual municipal CSO outfall within the LOGR Planning Basin. The table and models indicated that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 63 times per year. As a basis for comparison, during a year with average or typical precipitation there are approximately 94 storms over the ALCOSAN service area.

Annual Overflow Duration: The table lists the annual overflow duration for each individual municipal CSO outfall within the LOGR Planning Basin. The table and models indicated that some CSO outfalls did not discharge at all during typical year precipitation conditions and that the most active CSO outfalls discharge up to 241 hours per year or 2.7 percent of the total year. As a basis for comparison, there are approximately 220 hours during an average or typical year for which there is significant rainfall over the ALCOSAN service area.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal CSO outfall within the LOGR Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the LOGR planning basin area, municipal CSO outfalls discharge an annual total of approximately 47 million gallons of CSO discharges into area receiving waters. The table and models indicated that some CSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 24 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-9: Existing Condition, Typical Year Annual CSO Discharge Summary Municipal Outfalls within the LOGR Planning Basin Area

CSO Outfall	Owner(1)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
ML-CSO#1-OF	Millvale Borough/ Girty's Run Joint Sewer Authority (Millvale / GRJSA)	63	241	5.63
ML-CSO#2-OF	Millvale / GRJSA	34	86	2.66
ML-CSO#3-OF	Millvale / GRJSA	7	5	0.343
ML-CSO#4-OF	Millvale / GRJSA	5	4	0.440
ML-CSO#5-OF	Millvale / GRJSA	9	11	1.12
ML-CSO#6-OF	Millvale / GRJSA	12	20	0.258
ML-CSO#7-OF	Millvale / GRJSA	0	0	0
ML-CSO#8-OF	Millvale / GRJSA	0	0	0
ML-CSO#9-OF	Millvale / GRJSA	60	114	6.73
WV-CSO#1-OF	West View Borough/ Municipal Authority of West View (West View / MAWV)	34	78	5.40
WV-CSO#2-OF	West View / MAWV	54	160	24.2

Note(1): In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

4.5.3 Existing Condition SSO Discharges from ALCOSAN Outfalls

Table 4-10 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by ALCOSAN.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN SSO outfall within the LOGR Basin. The table and models indicated that some SSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 55 times per year. There are approximately 94 storms over the ALCOSAN service area during a year with average or typical precipitation.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN SSO outfall within the LOGR Planning Basin. The table and models indicated that some SSO outfalls did not discharge at all during typical year precipitation conditions and that the most active SSO outfalls discharge up to 685 hours per year or 7.8 percent of the total year. The model simulations indicate that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day, for approximately 1,400 hours. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN SSO outfall within the LOGR Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the LOGR planning basin area, SSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 188 million gallons of SSO discharges into area receiving waters. The table and models indicated that some SSO outfalls discharge no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 165 million gallons throughout the year. The existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-10: Existing Condition, Typical Year Annual SSO Discharge Summary
ALCOSAN Outfalls within the LOGR Planning Basin Area

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
O-15-OF	ALCOSAN	55	685	165
O-16-OF	ALCOSAN	30	107	3.69
O-17-OF	ALCOSAN	0	0	0
O-18-OF	ALCOSAN	32	87	10.3
O-18Y-OF	ALCOSAN	0	0	0
O-18Z-OF	ALCOSAN	0	0	0
O-19-OF	ALCOSAN	21	47	2.13
O-20-OF	ALCOSAN	13	14	0.304
O-21-OF	ALCOSAN	20	36	1.22
O-22-OF	ALCOSAN	9	13	0.184
O-23-OF	ALCOSAN	26	108	3.62
O-24-OF	ALCOSAN	17	53	1.23

It should be noted that in addition to the ALCOSAN SSOs that are listed in Table 4-10 above, there are flooded manholes located along sanitary interceptor sewers that can discharge under surcharge conditions.

4.5.4 Existing Condition SSO Discharges from Municipal Outfalls

Table 4-11 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by the customer municipalities or their designated authorities.

Annual Overflow Frequency: The table lists the annual overflow frequency for each individual municipal SSO outfall within the LOGR Planning Basin. The table and models indicated that some SSO outfalls did not discharge at all under typical year precipitation and the most active outfalls discharge up to 63 times per year. There are approximately 94 storms over the ALCOSAN service area during a year with average or typical precipitation.

Annual Overflow Duration: The table lists the annual overflow duration for each individual municipal SSO outfall within the LOGR Planning Basin. The models indicated that some SSO outfalls did not discharge at all during typical year precipitation conditions. The most active SSO outfall was GRJSA Interceptor Relief Overflow (IRO) manhole 25 that discharged 1,100 hours per year or 13 percent of the total year. The second most active SSO outfall discharged 79 hours per year or less than 1 percent of the year. As a basis for comparison the existing ALCOSAN WWTP would operate at its peak capacity for approximately 1,400 hours during a year with average or typical precipitation.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal SSO outfall within the LOGR Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the LOGR planning basin area, municipal SSO outfalls discharge an annual total of approximately 87 million gallons of SSO discharges into area receiving waters. It should be noted that most of this annual volume is discharged from a single IRO manhole. The models indicated that some SSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 82 million gallons throughout the year. The existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-11: Existing Condition, Typical Year Annual SSO Discharge Summary Municipal Outfalls within the LOGR Planning Basin Area

SSO Outfall	Owner(1)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
MH.37-IRO-OF	Ross Township/ Girty's Run Joint Sewer Authority (GRJSA)	0	0	0
MH.25-IRO-OF	Millvale Borough/ GRJSA	63	1101	81.6
MH.07-IRO-OF	Millvale Borough/ GRJSA	5	3	0.290
MH.I-IRO-OF	Millvale Borough/ GRJSA	20	79	4.38
Lowries Run MH-59	Ross Township/ Lowries Run Joint Operating Committee	3	21	0.380
Neville_SSO-3-OF	Neville Township	5	7	0.140

Note(1): In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

In addition to the municipal SSO outfalls listed in Table 4-11 above, Neville Township has an emergency overflow at each of their two sanitary sewer pump stations that could discharge under emergency conditions. There can be additional overflows from the other municipal pumping station emergency overflows located within the LOGR basin. There also are emergency overflow outfalls at each of the two flow equalization facilities located along the Girty's Run trunk sewer that would discharge under emergency conditions or if the facility capacity were to be exceeded. The Lowries Run Joint Operating Committee has a manhole, Lowries Run MH-62, where the models indicate and field investigations confirm that surcharge elevations during typical year simulations can flood and discharge. There are other flooded manholes located along sanitary trunk sewers that also can discharge under surcharge conditions.

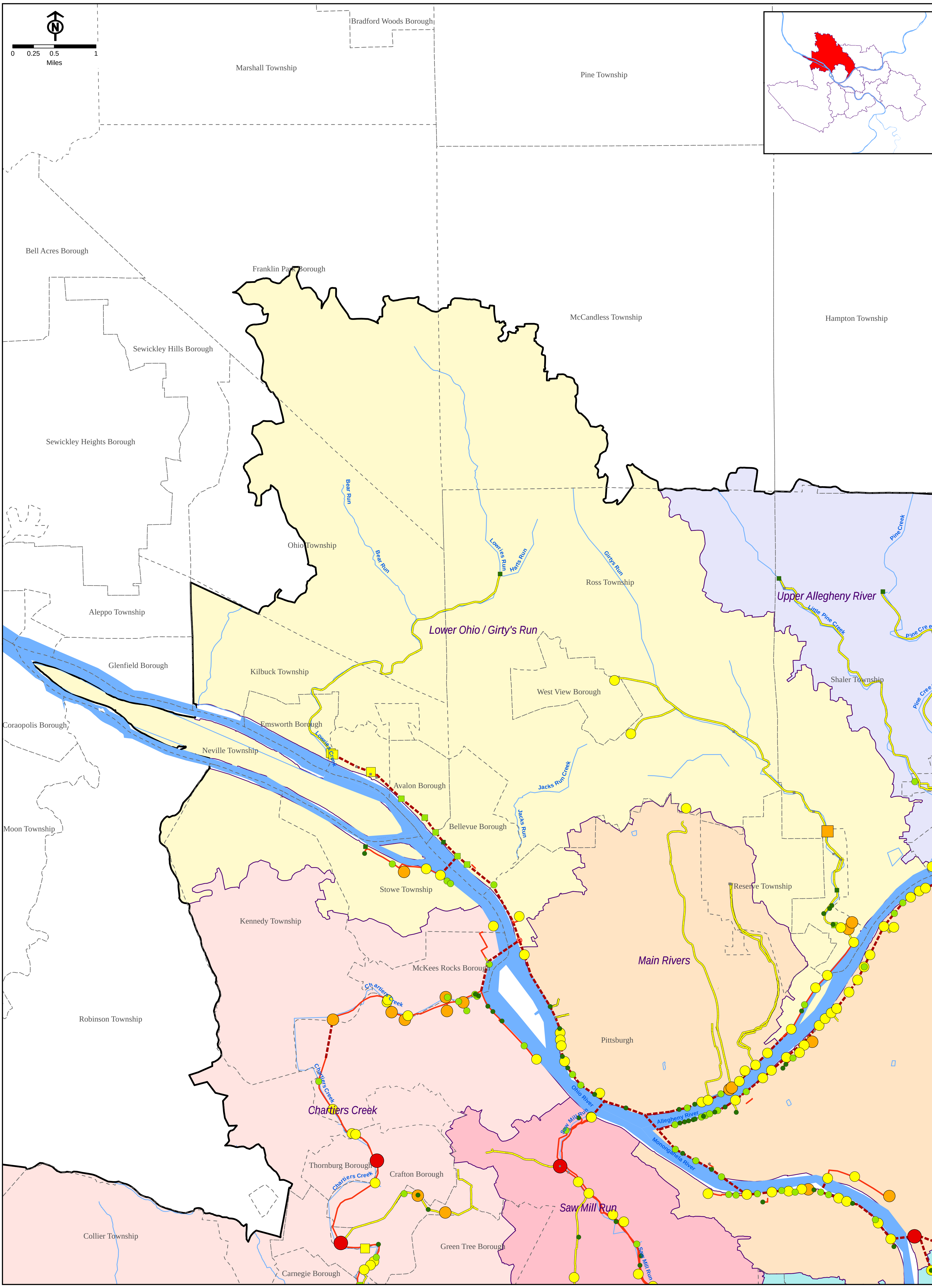
In addition to the numerical summaries provided in Tables 4-8 through 4-11, graphical depictions of the model simulation results for the typical precipitation year within the Lower Ohio – Girty's Run Planning Basin area are provided in Figures 4-31 through 4-33.

Figure 4-31 depicts the annual overflow frequency of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest number of activations during an average precipitation year. Outfalls with more than 70 activations per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 60 to 70 activations per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 30 to 59 activations per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 13 to 29 activations per year (averaging a little more than 1 to 2 overflows per month) were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 1 to 12 activations per year (averaging 1 or less overflows per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-32 depicts the annual overflow duration of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest total hours of discharge activity during an average precipitation year. Outfalls with 1000 or more hours of discharge activity per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 500 to 999 hours of discharge per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 100 to 499 hours of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 25 to 99 hours of overflow discharge per year were placed into this category (outfalls were active less than 1.1 percent of the year). Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 0.25 to 24 hours of discharge per year (averaging 2 or less hours of overflow per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-33 depicts the annual overflow volume of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest volume of discharge activity during an average precipitation year. Outfalls discharging more than 200 million gallons per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls discharging 50 to 200 million gallons per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 10 to 49.9 million gallons of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow volume. Outfalls discharging 1.0 to 9.99 million gallons per year were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively low overflow volumes. Outfalls discharging less than 1.00 million gallons per year were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-31: Typical Year Overflow Frequency of CSO/SSO Outfalls within the Lower Ohio - Girty's Run Planning Basin Area



Legend

CSO Discharge (Typical Year) Frequency (# of Activations)
- 0
- 1 - 12
- 13 - 29
- 30 - 59
- 60 - 70
- >70

SSO Discharge (Typical Year) Frequency (# of Activations)
- 0
- 1 - 12
- 13 - 29
- 30 - 59
- 60 - 70
- >70

ALCOSAN Interceptor Pipe
- Deep Tunnel Interceptor
- Shallow-cut Interceptor
- CPRCS
- Service Area
- Hydrologic Feature
- River
- Municipal Boundary

Planning Basins
- Chartiers Creek
- Lower Ohio / Girty's Run
- Main Rivers
- Saw Mill Run
- Turtle Creek
- Upper Allegheny River
- Upper Monongahela River

Typical Year Overflow Frequency of CSO/SSO Outfalls within the Lower Ohio / Girty's Run Planning Basin Area

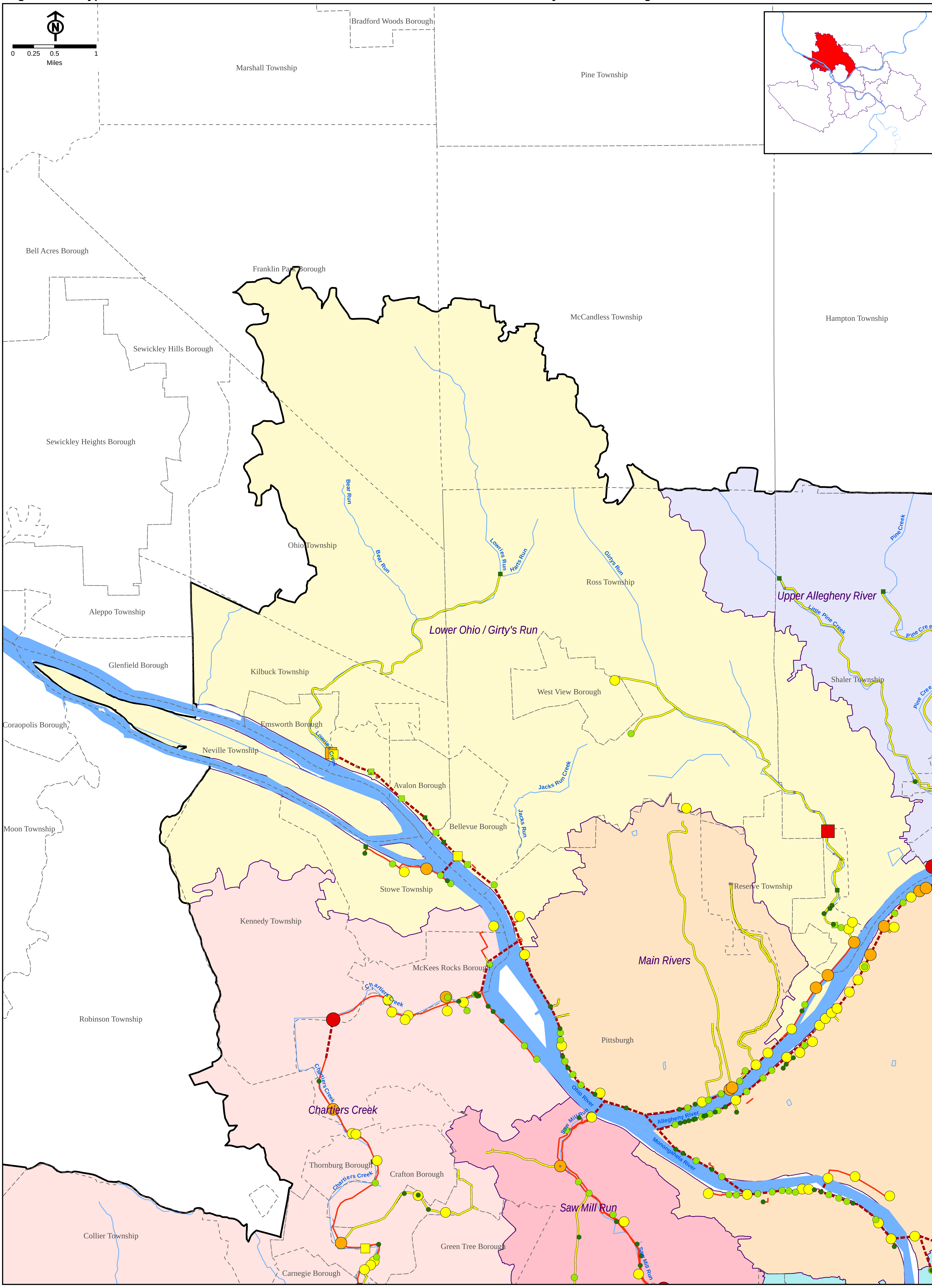
ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 4

Figure 4-32: Typical Year Overflow Duration of CSO/SSO Outfalls within the Lower Ohio - Girty's Run Planning Basin Area



Legend

CSO Discharge (Typical Year) Duration (# of Hours)	SSO Discharge (Typical Year) Duration (# of Hours)	ALCOSAN Interceptor Pipe	Planning Basins
0	0	Deep Tunnel Interceptor	Chartiers Creek
.25 - 24	.25 - 24	Shallow-cut Interceptor	Lower Ohio / Girty's Run
25 - 99	25 - 99	CPRCS	Main Rivers
100 - 499	100 - 499	Service Area	Saw Mill Run
500 - 1000	500 - 1000	Hydrologic Feature	Turtle Creek
>1000	>1000	River	Upper Allegheny River
		Municipal Boundary	Upper Monongahela River

Typical Year Overflow Duration of CSO/SSO Outfalls within the Lower Ohio / Girty's Run Planning Basin Area

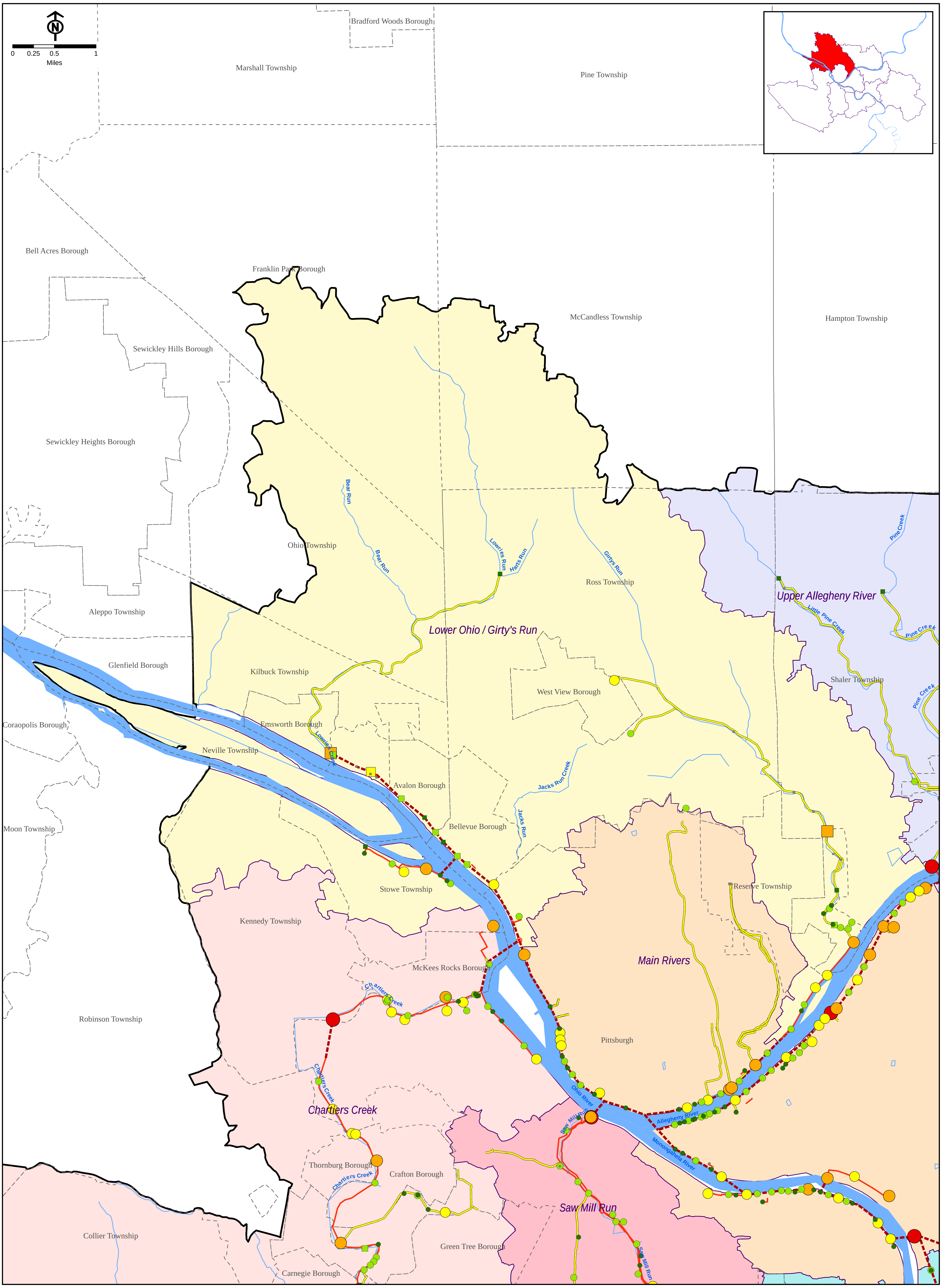
ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Q:\Mapsandimages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 4

Figure 4-33: Typical Year Overflow Volume of CSO/SSO Outfalls within the Lower Ohio - Girty's Run Planning Basin Area



Legend

CSO Discharge (Typical Year) Volume (MG)
- 0
- .01 - .99
- 1 - 9.9
- 10 - 49.9
- 50 - 200
- >200

SSO Discharge (Typical Year) Volume (MG)
- 0
- .01 - .99
- 1 - 9.9
- 10 - 49.9
- 50 - 200
- >200

ALCOSAN Interceptor Pipe
- Deep Tunnel Interceptor
- Shallow-cut Interceptor
- CPRCS
- Service Area
- Hydrologic Feature
- River
- Municipal Boundary

Planning Basins
- Chartiers Creek
- Lower Ohio / Girty's Run
- Main Rivers
- Saw Mill Run
- Turtle Creek
- Upper Allegheny River
- Upper Monongahela River

Typical Year Overflow Volume of CSO/SSO Outfalls within the Lower Ohio / Girty's Run Planning Basin Area

ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 4

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

4.6 Characterization of the Main Rivers Planning Basin

The adjusted and refined typical year precipitation dataset values were applied to the validated H&H model to quantify and characterize dry and wet weather flows that were generated within each of the municipal collection systems that comprise the Main Rivers (MR) Planning Basin area. The model simulations conveyed the flows to the respective point of connection with the ALCOSAN system and through regulating structures where they exist, diverting flow into the ALCOSAN interceptor system and discharging any remaining wet weather flow to CSO or SSO outfalls. The model summed and tabulated CSO and SSO discharges and conveyed and routed the diverted flow to the Woods Run Wastewater Treatment Plant.

To support the development and assessment of alternative measures to the control wet weather CSO and SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was then applied to the existing condition validated model to generate baseline condition statistics on the annual frequency, duration and volume of overflows. This section provides a summary description of the H&H characterization of existing conditions within the Main Rivers basin and documents corresponding CSO and SSO discharges in tabular and graphical formats.

Tables 4-12 and 4-13 provide concise regional summaries of the existing condition annual frequency, duration and volume of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The table information was obtained from typical year model simulation results. The table information includes overflow statistics for each individual outfall structure within the Main Rivers Planning Basin.

4.6.1 Existing Condition CSO Discharges from ALCOSAN Outfalls

Table 4-12 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by ALCOSAN.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN CSO outfall within the Main Rivers Planning Basin. The table and models indicate that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 79 times per year. Reported overflow frequencies were calculated utilizing a standardized 24-hour inter-event time and a 0.0646 million gallons/day minimum threshold value. These calculated annual overflow frequencies could be compared to rainfall frequency. During a year with average or typical precipitation, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to find the median value of significant precipitation events over a year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN CSO outfall within the MR Planning Basin. The table and models indicate that some CSO outfalls did not discharge at all during typical year precipitation conditions and that the most active CSO outfalls discharge up to 722 hours per year or 8.2 percent of the total year. The calculated annual overflow discharge durations could be compared to the annual duration that the Woods Run treatment plant operates at its peak capacity. The model simulation indicated that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day for approximately 1,400 hours during the year. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN CSO outfall within the MR Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Main Rivers basin, CSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 2.72 billion gallons of CSO discharges into area receiving waters. The models indicated that some CSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 593 million gallons throughout the year. The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the current interceptor system and treatment plant would provide treatment for approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-12: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls within the Main Rivers Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
A-01-OF	ALCOSAN	29	43	1.89
A-02-OF	ALCOSAN	5	1	0.0224
A-03-OF	ALCOSAN	2	1.25	0.0257
A-04-OF	ALCOSAN	12	20	2.39
A-05-OF	ALCOSAN	9	13	0.455
A-06-OF	ALCOSAN	1	0.25	0.0517
A-07-OF	ALCOSAN	17	50	1.31
A-08-OF	ALCOSAN	8	5	0.140
A-09-OF	ALCOSAN	13	23	2.61
A-10-OF	ALCOSAN	16	26	1.57
A-11-OF	ALCOSAN	9	7	0.370
A-12-OF	ALCOSAN	22	45	7.61
A-13-OF	ALCOSAN	9	15	0.450
A-14-OF	ALCOSAN	44	178	18.1

Table 4-12: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls within the Main Rivers Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
A-14Z-OF	ALCOSAN	2	0.5	0.0762
A-15-OF	ALCOSAN	18	25	2.57
A-16-OF	ALCOSAN	31	65	5.16
A-17-OF	ALCOSAN	37	80	7.18
A-18-OF	ALCOSAN	46	119	20.0
A-18X-OF	ALCOSAN	16	12	1.27
A-18Y-OF	ALCOSAN	8	5	0.157
A-18Z-OF	ALCOSAN	9	9	0.222
A-19X-OF	ALCOSAN	60	262	18.2
A-19Y-OF	ALCOSAN	46	96	5.68
A-19Z-OF	ALCOSAN	54	270	6.26
A-20-OF	ALCOSAN	49	170	23.1
A-20Z-OF	ALCOSAN	0	0	0
A-21-OF	ALCOSAN	50	190	18.5
A-22-OF	ALCOSAN	59	489	593
A-23-OF	ALCOSAN	53	273	56.0
A-25-OF	ALCOSAN	48	95	9.85
A-26-OF	ALCOSAN	53	122	11.0
A-27-OF	ALCOSAN	39	101	6.38
A-27Z	ALCOSAN	23	53	4.33
A-28-OF	ALCOSAN	48	624	54.5
A-29-OF	ALCOSAN	59	493	173
A-29Z-OF	ALCOSAN	58	320	51.5
A-30-OF	ALCOSAN	24	58	2.84
A-31-OF	ALCOSAN	23	39	2.86
A-32-OF	ALCOSAN	58	356	43.3
A-33-OF	ALCOSAN	58	691	34.0

Table 4-12: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls within the Main Rivers Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
A-34-OF	ALCOSAN	58	722	52.0
A-47-OF	ALCOSAN	8	15	0.740
A-48-OF	ALCOSAN	28	60	47.9
A-49-OF	ALCOSAN	9	11	0.488
A-50-OF	ALCOSAN	40	178	8.79
A-51-OF	ALCOSAN	36	93	12.8
A-55-OF	ALCOSAN	0	0	0
A-56-OF	ALCOSAN	18	27	1.03
A-58-OF	ALCOSAN	62	503	82.0
A-59-OF	ALCOSAN	39	75	4.41
A-59Z-OF	ALCOSAN	31	32	0.921
A-60-OF	ALCOSAN	57	378	198
A-61-OF	ALCOSAN	45	111	5.32
M-01-OF	ALCOSAN	18	17	0.866
M-02-OF	ALCOSAN	7	5	0.187
M-03-OF	ALCOSAN	21	33	9.45
M-04Z-OF	ALCOSAN	0	0	0
M-04-OF	ALCOSAN	6	4	0.270
M-05-OF	ALCOSAN	20	41	19.0
M-06-OF	ALCOSAN	57	243	32.2
M-07-OF	ALCOSAN	25	59	2.81
M-08-OF	ALCOSAN	17	30	0.797
M-10-OF	ALCOSAN	45	140	29.2
M-11-OF	ALCOSAN	19	35	1.20
M-12-OF	ALCOSAN	43	90	7.06
M-12Z-OF	ALCOSAN	5	3	0.154
M-13-OF	ALCOSAN	28	61	2.37

Table 4-12: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls within the Main Rivers Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
M-14-OF	ALCOSAN	31	76	2.50
M-15-OF	ALCOSAN	29	135	4.04
M-15Z-OF	ALCOSAN	24	27	0.608
M-16-OF	ALCOSAN	61	434	102
M-17-OF	ALCOSAN	11	8	0.375
M-18-OF	ALCOSAN	19	15	0.598
M-19B-OF	ALCOSAN	56	173	17.1
M-19-OF	ALCOSAN	58	238	150
M-19A-OF	ALCOSAN	63	296	84.5
M-20-OF	ALCOSAN	17	28	1.29
M-21-OF	ALCOSAN	30	80	10.9
M-22-OF	ALCOSAN	30	86	6.31
M-23-OF	ALCOSAN	9	13	0.212
M-24-OF	ALCOSAN	14	33	0.516
M-26-OF	ALCOSAN	50	243	13.0
M-27-OF	ALCOSAN	53	212	19.2
M-28-OF	ALCOSAN	1	0.5	0.00361
M-29-OF	ALCOSAN	79	467	400
O-27-OF	ALCOSAN	47	148	96.6
O-29-OF	ALCOSAN	2	2	0.0455
O-30-OF	ALCOSAN	0	0	0
O-31-OF	ALCOSAN	6	4	0.196
O-32-OF	ALCOSAN	30	60	10.7
O-33-OF	ALCOSAN	31	95	19.3
O-34-OF	ALCOSAN	51	165	38.1
O-35-OF	ALCOSAN	11	17	0.394
O-36-OF	ALCOSAN	30	53	4.57

Table 4-12: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls within the Main Rivers Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
O-37-OF	ALCOSAN	8	9	0.641
O-38-OF	ALCOSAN	24	31	9.61
O-39-OF	ALCOSAN	27	52	6.71
O-40-OF	ALCOSAN	4	2	0.127
O-41-OF	ALCOSAN	53	160	13.6
O-43-OF	ALCOSAN	8	2	0.389

Outfall A-27z is not listed in the Consent Decree Appendix A list of ALCOSAN CSO outfalls but is included on Table 4-12, above. At the time the CD was issued, this outfall was attributed to PWSA. Subsequent field investigations indicated the regulator structure and outfall should be allocated to ALCOSAN.

4.6.2 Existing Condition CSO Discharges from Municipal Outfalls

Table 4-13 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from the two municipal outfall structures within the MR basin that are owned and operated by the City of Pittsburgh and the Pittsburgh Water and Sewer Authority (PWSA). A list of the other municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP.

Annual Overflow Frequency: The table lists the annual overflow frequency for the two municipal CSO outfalls within the Main Rivers Planning Basin. The table and models indicate that the CSO outfalls discharged 66 and 59 times per year under typical year precipitation conditions. As a basis for comparison, during a year with average or typical precipitation there are approximately 94 storms over the ALCOSAN service area.

Annual Overflow Duration: The table lists the annual overflow durations for the municipal CSO outfalls within the MR Basin. The table and models indicate that the CSO outfalls discharged for 657 and 106 hours per year during typical year precipitation conditions. The model simulation indicated that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day for approximately 1,400 hours during the year. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for the two municipal CSO outfalls within the MR Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Main Rivers basin, the CSO outfalls owned and operated by the PWSA discharge an annual total of approximately 101 million gallons of CSO discharges into area receiving waters.

Table 4-13: Existing Condition, Typical Year Annual CSO Discharge Summary Municipal Outfalls within the Main Rivers Planning Basin Area

CSO Outfall	Owner[1]	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
OF009E001	City of Pittsburgh/ Pittsburgh Water and Sewer Authority (Pittsburgh / PWSA)	66	657	99.5
OF163G001	Pittsburgh / PWSA	59	106	1.39

Note[1]: In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

4.6.3 Existing Condition SSO Discharges from ALCOSAN Outfalls

Within the Main Rivers planning basin area, there are no SSO outfalls that are owned or operated by ALCOSAN. Therefore, there are no ALCOSAN SSO discharges to report.

4.6.4 Existing Condition SSO Discharges from Municipal Outfalls

Within the Main Rivers planning basin area, there are two SSO outfalls located within the collection system of Reserve Township. They are identified by the municipality as outfalls B-122A-OF and F-101-OF. Also, the Evergreen and Ivory pump station, owned and operated by the City of Pittsburgh and the Pittsburgh Water and Sewer Authority, has an emergency overflow that could potentially discharge under emergency conditions or should the influent flow exceed the station capacity. The H&H models indicated that during a year with average or typical rainfall over the service area, there are no SSO discharges from these outfalls.

In addition to the numerical summaries provided in Tables 4-12 and 4-13, graphical depictions of the model simulation results for the typical precipitation year within the Main Rivers planning basin area are provided in Figures 4-34 through 4-36.

Figure 4-34 depicts the annual overflow frequency of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest number of activations during an average precipitation year. Outfalls with more than 70 activations per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 60 to 70 activations per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 30 to 59 activations per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity.

Outfalls with 13 to 29 activations per year (averaging a little more than 1 to 2 overflows per month) were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 1 to 12 activations per year (averaging 1 or less overflows per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-35 depicts the annual overflow duration of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest total hours of discharge activity during an average precipitation year. Outfalls with more than 1000 hours of discharge activity per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 500 to 100 hours of discharge per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 100 to 499 hours of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 25 to 99 hours of overflow discharge per year were placed into this category (outfalls were active less than 1.1 percent of the year). Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 0.25 to 24 hours of discharge per year (averaging 2 or less hours of overflow per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-36 depicts the annual overflow volume of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest volume of discharge activity during an average precipitation year. Outfalls discharging more than 200 million gallons per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls discharging 50 to 200 million gallons per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 10 to 49.9 million gallons of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow volume. Outfalls discharging 1.0 to 9.99 million gallons per year were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively low overflow volumes. Outfalls discharging less than 1.00 million gallons per year were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-34: Typical Year Overflow Frequency of CSO/SSO Outfalls within the Main Rivers Planning Basin Area

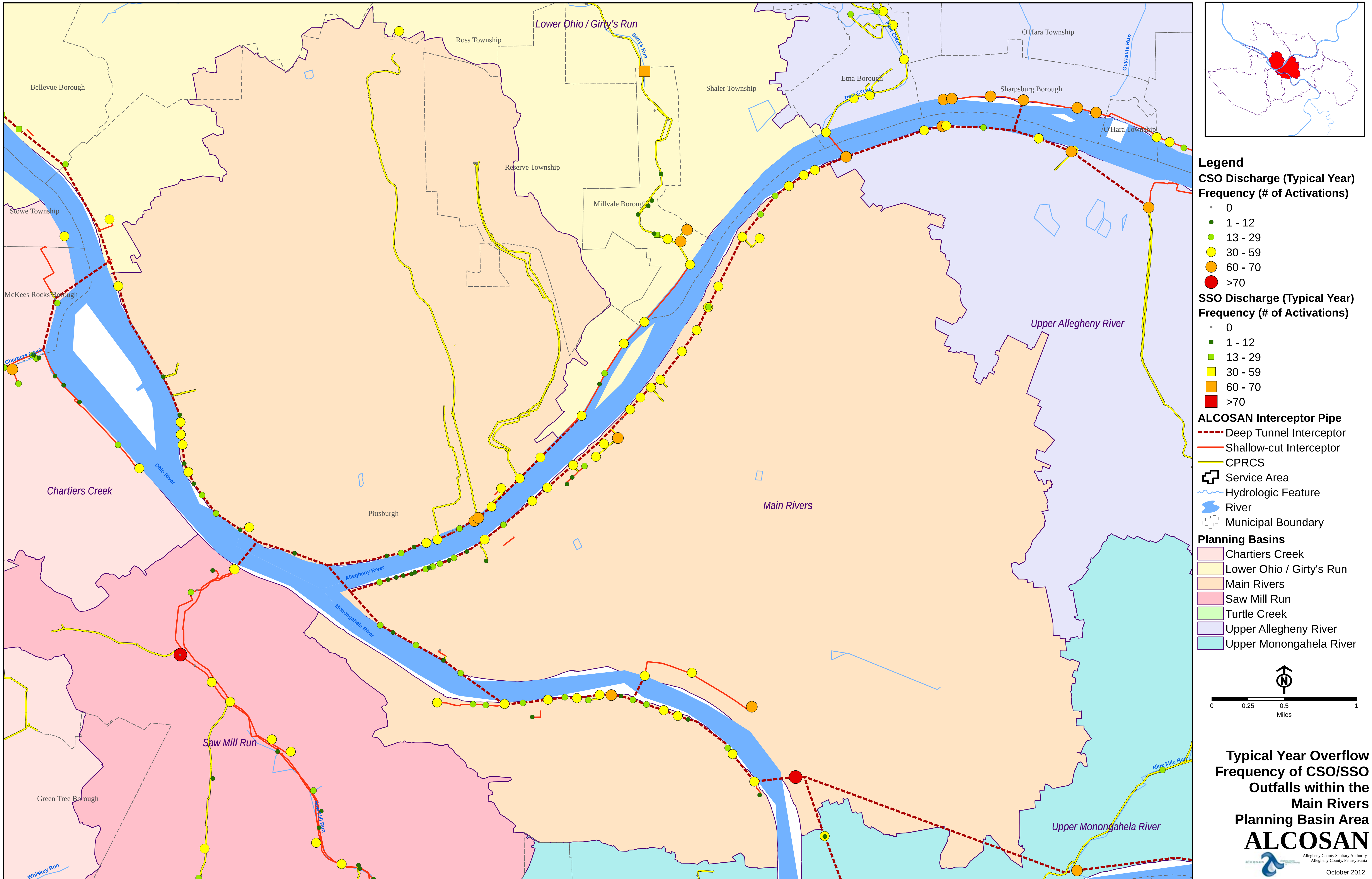


Figure 4-35: Typical Year Overflow Duration of CSO/SSO Outfalls within the Main Rivers Planning Basin Area

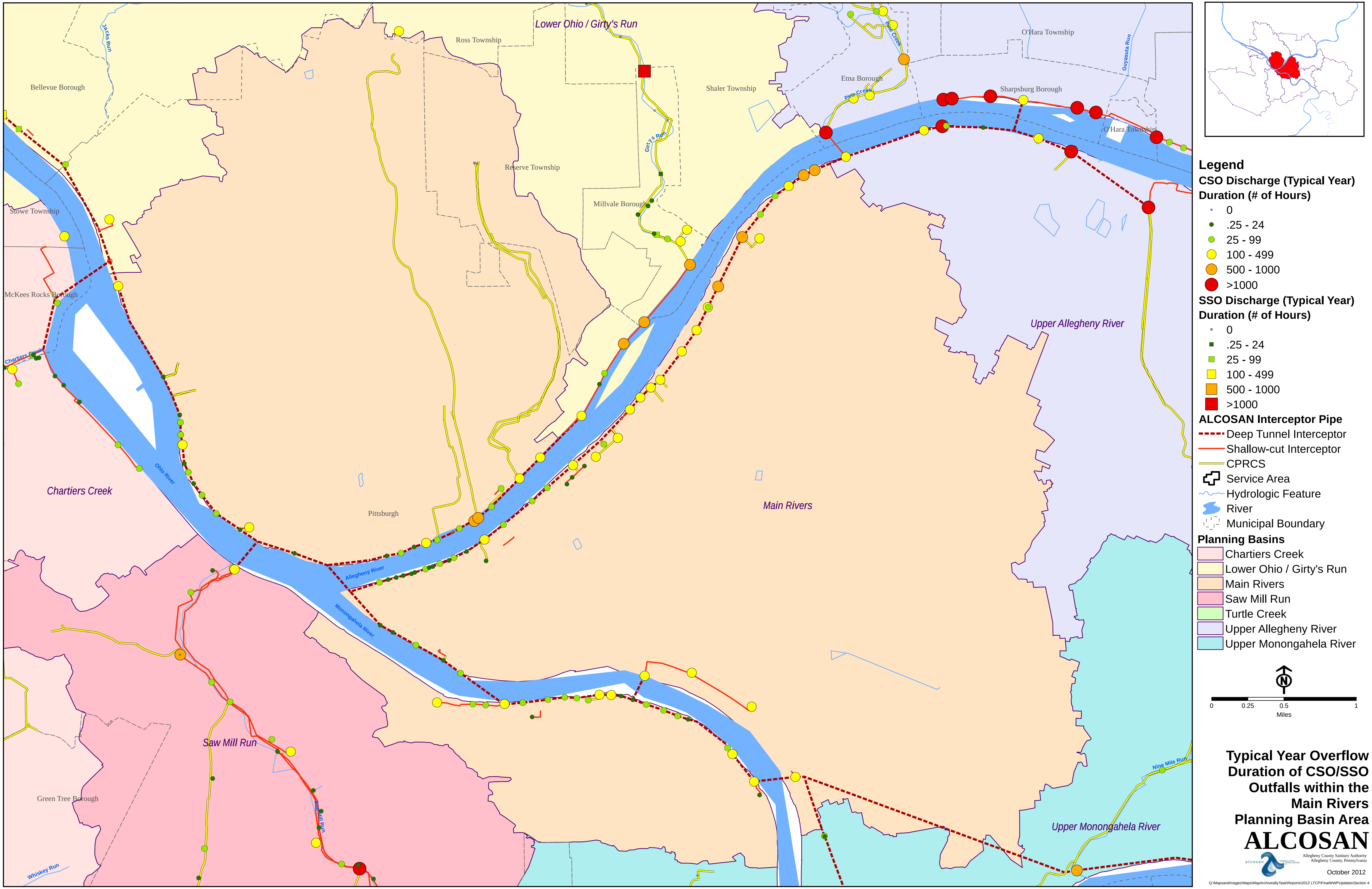
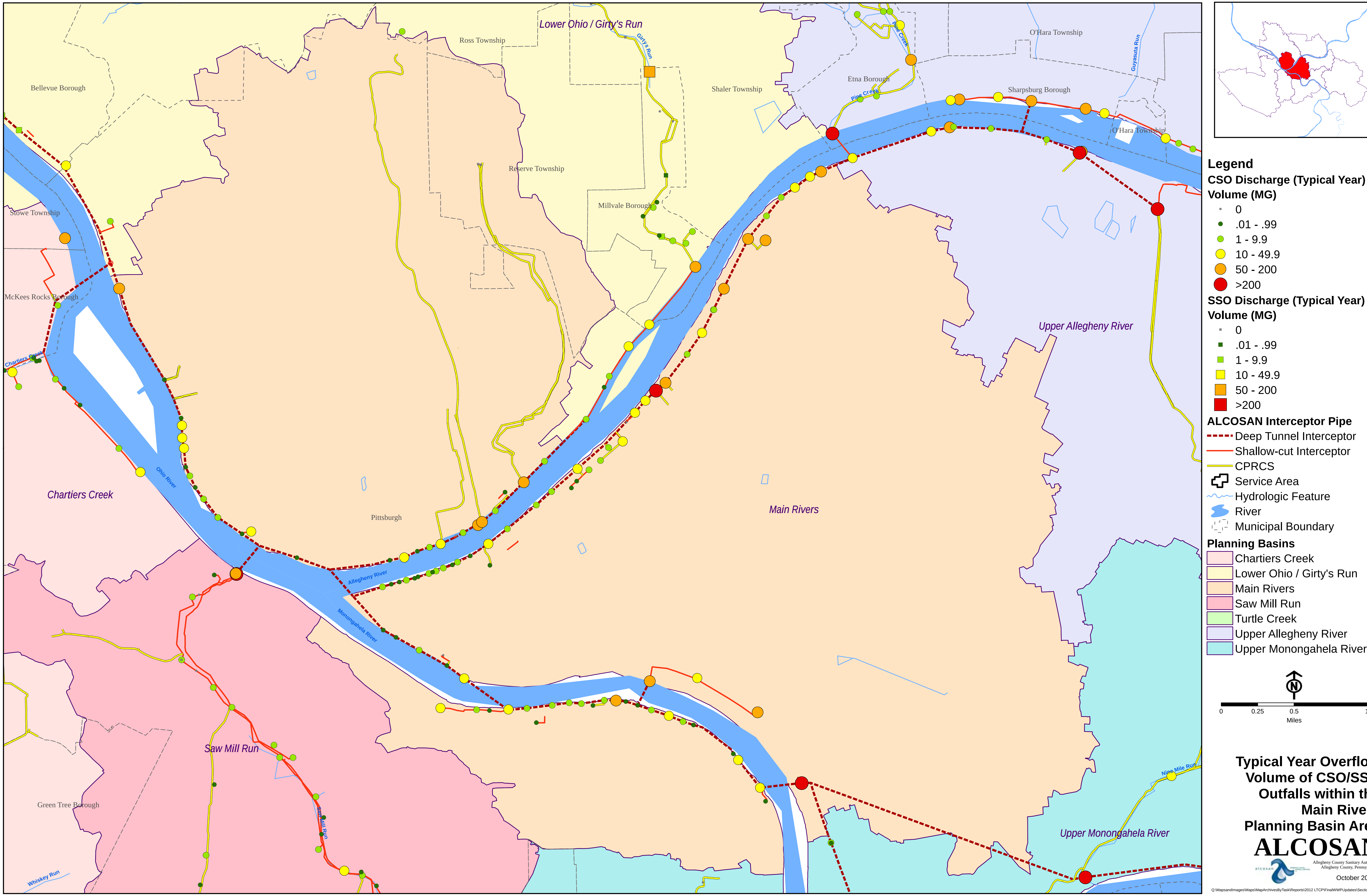


Figure 4-36: Typical Year Overflow Volume of CSO/SSO Outfalls within the Main Rivers Planning Basin Area



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

4.7 Characterization of the Saw Mill Run Planning Basin

The adjusted and refined typical year precipitation dataset values were applied to the validated H&H model to quantify and characterize dry and wet weather flows that were generated within each of the municipal collection systems that comprise the Saw Mill Run Planning Basin area. The model simulations conveyed the flows to the respective point of connection with the ALCOSAN system and through regulating structures where they exist, diverting flow into the ALCOSAN interceptor system and discharging any remaining wet weather flow to CSO or SSO outfalls. The model summed and tabulated CSO and SSO discharges and conveyed and routed the diverted flow to the Woods Run Wastewater Treatment Plant.

To support the development and assessment of alternative measures to the control wet weather CSO and SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was then applied to the existing condition validated model to generate baseline condition statistics on the annual frequency, duration and volume of overflows. This section provides a summary description of the H&H characterization of existing conditions within the Saw Mill Run basin and documents corresponding CSO and SSO discharges in tabular and graphical formats.

Tables 4-14 through 4-17 provide concise regional summaries of the existing condition annual frequency, duration and volume of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The table information was obtained from typical year model simulation results. The table information includes overflow statistics for each individual outfall structure within the Saw Mill Run Planning Basin.

4.7.1 Existing Condition CSO Discharges from ALCOSAN Outfalls

Table 4-14 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by ALCOSAN. CSO outfall S-17, which is listed in the Consent Decree Appendix A list of ALCOSAN outfalls, was subsequently sealed by ALCOSAN in December 2008 and is not included in the table list.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN CSO outfall within the SMR Planning Basin. The table and models indicate that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 76 times per year. Reported overflow frequencies were calculated utilizing a standardized 24-hour inter-event time and a 0.0646 million gallons/day minimum threshold value. These calculated annual overflow frequencies could be compared to rainfall frequency. During a year with average or typical precipitation, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to find the median value of significant precipitation events over a year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN CSO outfall within the SMR Planning Basin. The table and models indicate that some CSO outfalls did not discharge at all during typical year precipitation conditions and that the most active CSO outfalls discharge up to 539 hours per year or 6 percent of the total year. The calculated annual overflow discharge durations could be compared to the annual duration that the Woods Run treatment plant was operating at its peak capacity. The model simulations indicated that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day for approximately 1,400 hours. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN CSO outfall within the SMR Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Saw Mill Run basin, CSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 393 million gallons of CSO discharges into area receiving waters. The models indicated that some CSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 227 million gallons throughout the year. The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the current interceptor system and treatment plant capacity (250 MGD) would provide treatment for approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-14: Existing Condition, Typical Year Annual CSO Discharge Summary
ALCOSAN Outfalls Within the Saw Mill Run Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
O-14-00-EAST-OF	ALCOSAN	57	399	227
O-14-00-WEST-OF	ALCOSAN	57	363	69.2
O-14Z-OF	ALCOSAN	6	3	0.272
S-01A-OF	ALCOSAN	4	12	4.23
S-02A-IRO	ALCOSAN	0	0	0
S-03A-OF	ALCOSAN	0	0	0
S-18-OF	ALCOSAN	21	24	0.489
S-23-OF	ALCOSAN	40	80	1.40
S-24-OF	ALCOSAN	59	157	18.6
S-28-OF	ALCOSAN	4	3	0.178

Table 4-14: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls Within the Saw Mill Run Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
S-29-OF	ALCOSAN	29	26	7.86
S-30-OF	ALCOSAN	4	2	0.0669
S-31-OF	ALCOSAN	5	4	0.337
S-32-OF	ALCOSAN	44	83	23.3
S-33-OF	ALCOSAN	59	126	6.11
S-34-OF	ALCOSAN	7	3	0.285
S-35-OF	ALCOSAN	5	4	0.673
S-36-OF	ALCOSAN	28	18	1.68
S-38-OF	ALCOSAN	53	110	9.74
S-39-OF	ALCOSAN	51	92	7.52
S-40-OF	ALCOSAN	39	52	3.61
S-41-OF	ALCOSAN	36	72	6.30
S-42A-OF CSO019M001*	ALCOSAN/PWSA	76	539	2.41
S-42-OF	ALCOSAN	0	0	0
S-46-OF	ALCOSAN	22	25	2.13

*Note: Overflow statistics exclude simulated storm water runoff from modeled separate sewer areas

4.7.2 Existing Condition CSO Discharges from Municipal Outfalls

Table 4-15 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by the customer municipalities and/or their designated municipal authorities. A list of the municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP. Because of the complex variety of institutional arrangements between authorities and their respective municipalities, in the WWP both are indicated as "owners" in the narrative and summary tables regarding the CSO/SSO outfalls.

Annual Overflow Frequency: The table lists the annual overflow frequency for each individual municipal CSO outfall within the SMR Planning Basin. The table and models indicate that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 89 times per year. As a basis for comparison, during a year with average or typical precipitation there are approximately 94 storms over the ALCOSAN service area.

Annual Overflow Duration: The table lists the annual overflow duration for each individual municipal CSO outfall within the SMR Planning Basin. The models indicated that some CSO outfalls did not discharge at all during typical year precipitation conditions and that the most active CSO outfall discharges up to 869 hours per year or 10 percent of the total year. As a basis for comparison the existing ALCOSAN WWTP would operate at its peak capacity for approximately 1,400 hours during a year with average or typical precipitation.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal CSO outfall within the SMR Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Saw Mill Run basin, municipal CSO outfalls, when taken collectively as a whole, discharge an annual total of approximately 41 million gallons of CSO discharges into area receiving waters. The models indicated that some CSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 13.5 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

**Table 4-15: Existing Condition, Typical Year Annual CSO Discharge Summary
Municipal Outfalls within the Saw Mill Run Planning Basin Area**

CSO Outfall	Owner[1]	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
CSO015P001[2]	City of Pittsburgh/ Pittsburgh Water and Sewer Authority (Pittsburgh / PWSA)	89	869	6.72
CSO016A001	Pittsburgh / PWSA	46	63	2.75
CSO016A002	Pittsburgh / PWSA	4	2	0.398
CSO034R001	Pittsburgh / PWSA	32	73	0.516
CSO035A001	Pittsburgh / PWSA	13	7	0.656
CSO035E001	Pittsburgh / PWSA	13	7	0.731

**Table 4-15: Existing Condition, Typical Year Annual CSO Discharge Summary
Municipal Outfalls within the Saw Mill Run Planning Basin Area**

CSO Outfall	Owner[1]	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
CSO035J001	Pittsburgh / PWSA	3	2	0.141
CSO036R001[3]	Pittsburgh / PWSA	77	506	13.5
CSO060A001	Pittsburgh / PWSA	27	28	2.97
CSO095E001[3]	Pittsburgh / PWSA	70	426	0.150
CSO095J001[3]	Pittsburgh / PWSA	74	363	0.0110
CSO097L001	Pittsburgh / PWSA	7	14	0.612
CSO138E001[3]	Pittsburgh / PWSA	64	142	0.0243
CSO138K001	Pittsburgh / PWSA	0	0	0
CSO138P001	Pittsburgh / PWSA	9	6	0.286
CSO139A001	Pittsburgh / PWSA	32	57	10.8
CSO139B001	Pittsburgh / PWSA	3	2	0.0490
CSO139B002	Pittsburgh / PWSA	13	10	0.452
CSO139B003	Pittsburgh / PWSA	21	16	0.240
CSO139F001	Pittsburgh / PWSA	10	6	0.212
S1500POCL01A-OF	Pittsburgh / PWSA	0	0	0

Note(1): In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.
Note(2): Overflow statistics exclude stream base (dry weather) flow
Note(3): Overflow statistics exclude simulated storm water runoff from modeled separate sewer areas

4.7.3 Existing Condition SSO Discharges from ALCOSAN Outfalls

Table 4-16 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by ALCOSAN. SSO outfalls S-15 and S-16, which are listed in the Consent Decree Appendix B list of ALCOSAN SSO outfalls, were subsequently sealed by ALCOSAN in December 2008.

Within the Saw Mill Run Planning Basin area, there are 3 SSO outfalls owned and operated by ALCOSAN, and of these outfalls, only one was active during typical year precipitation. The tables and H&H model simulations indicate that this SSO outfall discharged only once during the year and the other two outfalls had no discharge. The annual duration of this single SSO discharge was two hours and the total annual overflow volume was 10 thousand gallons.

Table 4-16: Existing Condition, Typical Year Annual SSO Discharge Summary ALCOSAN Outfalls within the Saw Mill Run Planning Basin Area

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
SMR-CS-14-IRO	ALCOSAN	0	0	0
SMR-CS-50-IRO	ALCOSAN	1	2	0.0100
SMR-CS-53-IRO	ALCOSAN	0	0	0

4.7.4 Existing Condition SSO Discharges from Municipal Outfalls

Table 4-17 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by the customer municipalities and/or their designated municipal authorities. Within the Saw Mill Run planning basin area, there are 3 municipal SSO outfalls, and of these outfalls, only one was active during typical year precipitation. The table and H&H model simulations indicate that this SSO outfall discharged twice during the year and the other two outfalls had no discharge. The total annual duration of these two SSO discharges was 10 hours and the total annual overflow volume was 260 thousand gallons.

Table 4-17: Existing Condition, Typical Year Annual SSO Discharge Summary Municipal Outfalls within the Saw Mill Run Planning Basin Area

SSO Outfall	Owner(1)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
3B1001OF	Municipality of Bethel Park / Bethel Park Municipal Authority (Bethel Park/BPMA)	0	0	0
3B1002OF	Bethel Park / BPMA	2	10	0.260
CS-MLSSO	Castle Shannon	0	0	0

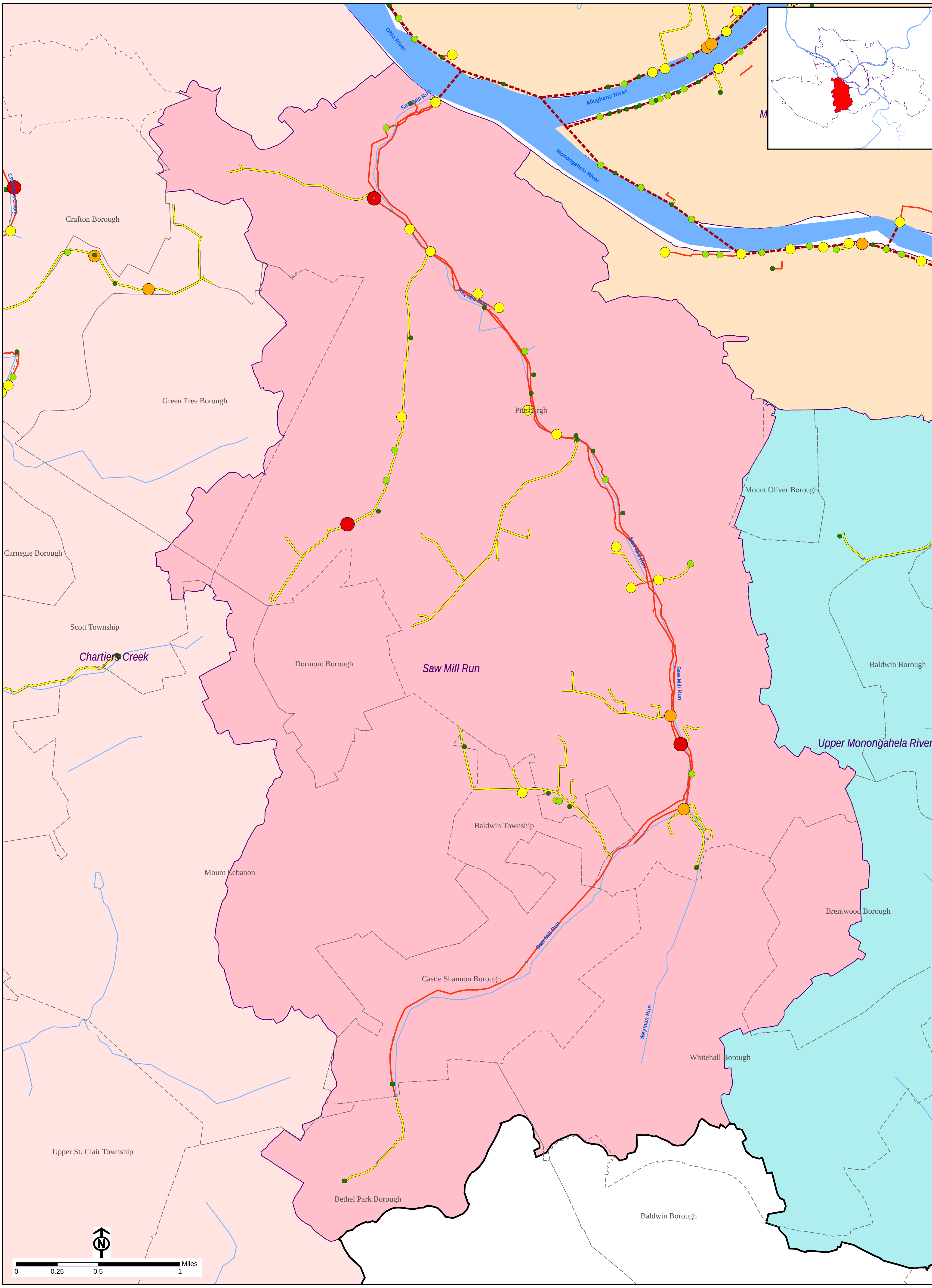
Note(1): In communities where municipal authorities exist, both the municipality and authority are indicated as “owners.” Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

In addition to the numerical summaries provided in Tables 4-14 through 4-17, graphical depictions of the model simulation results for the typical precipitation year within the Saw Mill Run planning basin area are provided in Figures 4-37 through 4-39.
Figure 4-37 depicts the annual overflow frequency of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest number of activations during an average precipitation year. Outfalls with more than 70 activations per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 60 to 70 activations per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 30 to 59 activations per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 13 to 29 activations per year (averaging a little more than 1 to 2 overflows per month) were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 1 to 12 activations per year (averaging 1 or less overflows per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-38 depicts the annual overflow duration of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest total hours of discharge activity during an average precipitation year. Outfalls with more than 1000 hours of discharge activity per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 500 to 1000 hours of discharge per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 100 to 499 hours of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 25 to 99 hours of overflow discharge per year were placed into this category (outfalls were active less than 1.1 percent of the year). Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 0.25 to 24 hours of discharge per year (averaging 2 or less hours of overflow per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-39 depicts the annual overflow volume of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest volume of discharge activity during an average precipitation year. Outfalls discharging more than 200 million gallons per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls discharging 50 to 200 million gallons per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 10 to 49.9 million gallons of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow volume. Outfalls discharging 1.0 to 9.99 million gallons per year were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively low overflow volumes. Outfalls discharging less than 1.00 million gallons or less per year were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-37: Typical Year Overflow Frequency of CSO/SSO Outfalls within the Saw Mill Run Planning Basin Area



Legend

CSO Discharge (Typical Year) Frequency (# of Activations)	SSO Discharge (Typical Year) Frequency (# of Activations)	ALCOSAN Interceptor Pipe	Planning Basins
0	0	Deep Tunnel Interceptor	Chartiers Creek
1 - 12	1 - 12	Shallow-cut Interceptor	Lower Ohio / Girty's Run
13 - 29	13 - 29	CPRCS	Main Rivers
30 - 59	30 - 59	Service Area	Saw Mill Run
60 - 70	60 - 70	Hydrologic Feature	Turtle Creek
>70	>70	River	Upper Allegheny River
		Municipal Boundary	Upper Monongahela River

Typical Year Overflow Frequency of CSO/SSO Outfalls within the Saw Mill Run Planning Basin Area

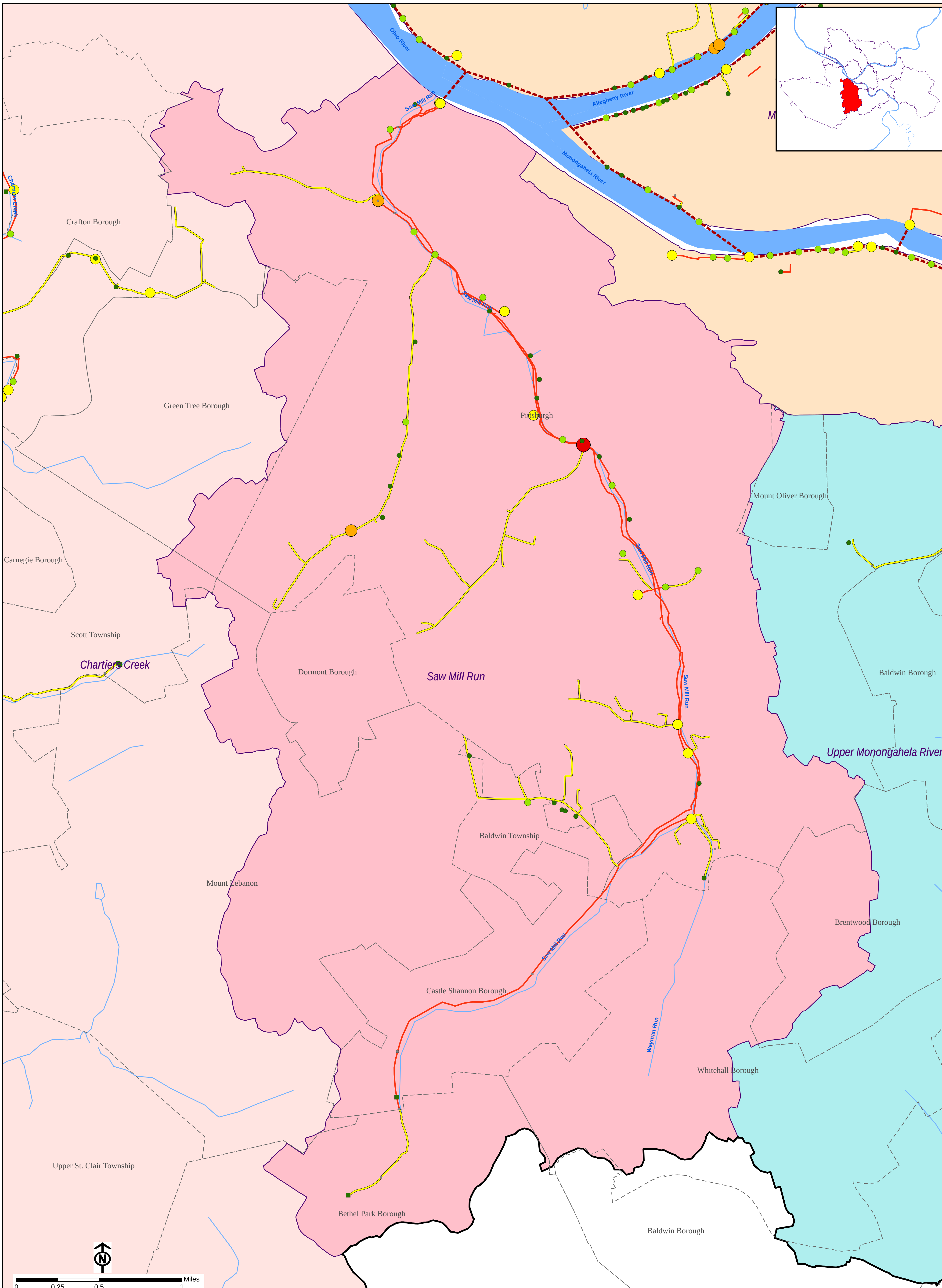
ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Q:\Mapsand\Images\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 4

Figure 4-38: Typical Year Overflow Duration of CSO/SSO Outfalls within the Saw Mill Run Planning Basin Area



Legend

CSO Discharge (Typical Year) Duration (# of Hours)
- 0
- .25 - 24
- 25 - 99
- 100 - 499
- 500 - 1000
- >1000

SSO Discharge (Typical Year) Duration (# of Hours)
- 0
- .25 - 24
- 25 - 99
- 100 - 499
- 500 - 1000
- >1000

ALCOSAN Interceptor Pipe
- Deep Tunnel Interceptor
- Shallow-cut Interceptor
- CPRCS
- Service Area
- Hydrologic Feature
- River
- Municipal Boundary

Planning Basins
- Chartiers Creek
- Lower Ohio / Girty's Run
- Main Rivers
- Saw Mill Run
- Turtle Creek
- Upper Allegheny River
- Upper Monongahela River

Typical Year Overflow Duration of CSO/SSO Outfalls within the Saw Mill Run Planning Basin Area

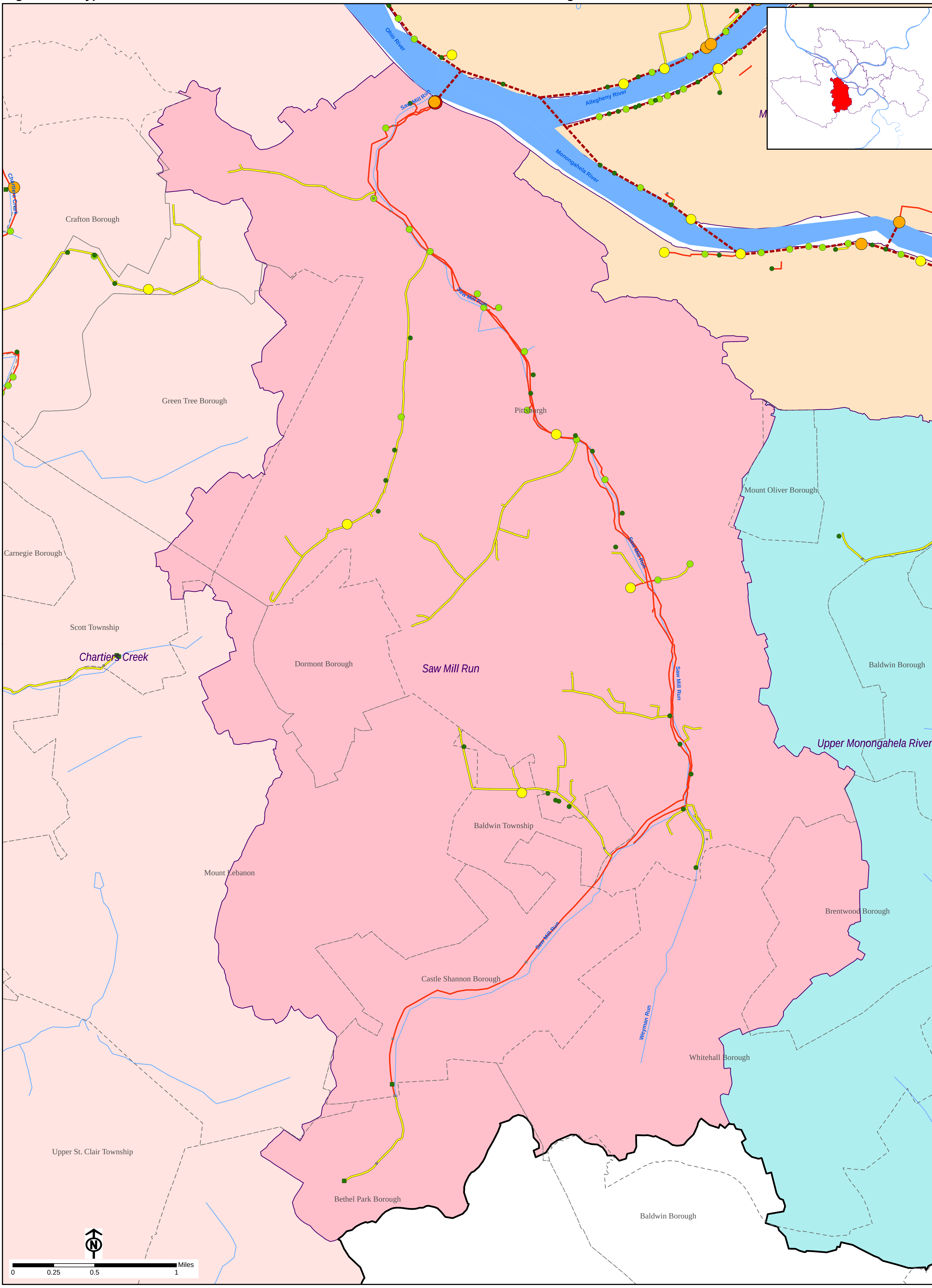
ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 4

Figure 4-39: Typical Year Overflow Volume of CSO/SSO Outfalls within the Saw Mill Run Planning Basin Area



Legend

CSO Discharge (Typical Year) Volume (MG)
- 0
- .01 - .99
- 1 - 9.9
- 10 - 49.9
- 50 - 200
- >200

SSO Discharge (Typical Year) Volume (MG)
- 0
- .01 - .99
- 1 - 9.9
- 10 - 49.9
- 50 - 200
- >200

ALCOSAN Interceptor Pipe
- Deep Tunnel Interceptor
- Shallow-cut Interceptor
- CPRCS
- Service Area
- Hydrologic Feature
- River
- Municipal Boundary

Planning Basins
- Chartiers Creek
- Lower Ohio / Girty's Run
- Main Rivers
- Saw Mill Run
- Turtle Creek
- Upper Allegheny River
- Upper Monongahela River

Typical Year Overflow Volume of CSO/SSO Outfalls within the Saw Mill Run Planning Basin Area

ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Q:\MapsandImages\Maps\MapArchivesByTask\Reports\2012 LTCP\FinalWWPUpdates\Section 4

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

4.8 Characterization of the Turtle Creek Planning Basin

The adjusted and refined typical year precipitation dataset values were applied to the validated H&H model to quantify and characterize dry and wet weather flows that were generated within each of the municipal collection systems that comprise the Turtle Creek (TC) Planning Basin. The model simulations conveyed the flows to the respective point of connection with the ALCOSAN system and through regulating structures where they exist, diverting flow into the ALCOSAN interceptor system and discharging any remaining wet weather flow to CSO or SSO outfalls. The model summed and tabulated CSO and SSO discharges and conveyed and routed the diverted flow to the Woods Run Wastewater Treatment Plant.

To support the development and assessment of alternative measures to the control wet weather CSO and SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was then applied to the existing condition validated model to generate baseline condition statistics on the annual frequency, duration and volume of overflows. This section provides a summary description of the H&H characterization of existing conditions within the TC basin and documents corresponding CSO and SSO discharges in tabular and graphical formats.

Tables 4-18 through 4-21 provide concise regional summaries of the existing condition annual frequency, duration and volume of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The table information was obtained from typical year model simulation results. The table information includes overflow statistics for each individual outfall structure within the TC Planning Basin.

4.8.1 Existing Condition CSO Discharges from ALCOSAN Outfalls

Table 4-18 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by ALCOSAN. The Consent Decree Appendix A list of ALCOSAN outfalls includes T-16 as a CSO outfall. Subsequent to the issuance of the CD, North Versailles Township disconnected and rerouted catch basins from the municipal sewer system. As a result of these efforts, the sewershed was reclassified as a separate sewershed area and the ALCOSAN outfall was reclassified as an SSO.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN CSO outfall within the TC Planning Basin. The table and models indicate that the least active CSO outfalls discharged twice under typical year precipitation conditions and the most active outfalls discharge up to 62 times per year. Reported overflow frequencies were calculated utilizing a standardized 24-hour inter-event time and a 0.0646 million gallons/day minimum threshold value. These calculated annual overflow frequencies could be compared to rainfall frequency. During a year with average or typical precipitation, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to find the median value of significant precipitation events over a year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN CSO outfall within the TC Planning Basin. The table and models indicate that the least active CSO outfall discharged for 3 hours during typical year precipitation conditions and that the most active CSO outfalls discharge up to 360 hours per year or 4.1 percent of the total year. The calculated annual overflow discharge durations could be compared to the annual duration that the Woods Run treatment plant was operating at its peak capacity. The model simulations indicated that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day for approximately 1,400 hours. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN CSO outfall within the TC Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the TC basin, CSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 124 million gallons of CSO discharges into area receiving waters. The models indicated that the least active CSO outfall discharged approximately 100 thousand gallons under typical year precipitation conditions and the most active individual outfall discharged a total of 39 million gallons throughout the year. The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the current interceptor system and WWTP capacity (250 MGD) would provide treatment for approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-18: Existing Condition, Typical Year Annual CSO Discharge Summary
ALCOSAN Outfalls within the Turtle Creek Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
T-01-OF	ALCOSAN	54	309	39.0
T-02-OF	ALCOSAN	39	71	8.92
T-03-OF	ALCOSAN	17	63	1.84
T-04-OF	ALCOSAN	30	224	20.3
T-07-OF	ALCOSAN	30	214	11.7
T-10-OF	ALCOSAN	62	360	19.5
T-11-OF	ALCOSAN	8	39	0.709
T-12-OF	ALCOSAN	22	106	3.29

**Table 4-18: Existing Condition, Typical Year Annual CSO Discharge Summary
ALCOSAN Outfalls within the Turtle Creek Planning Basin Area**

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
T-13-OF	ALCOSAN	8	16	0.373
T-14-OF	ALCOSAN	25	80	3.06
T-15-OF	ALCOSAN	11	14	0.734
T-16A-OF	ALCOSAN	23	32	1.24
T-17-OF	ALCOSAN	14	19	1.42
T-19-OF	ALCOSAN	13	15	0.534
T-21-OF	ALCOSAN	2	7	0.102
T-22-OF	ALCOSAN	55	101	4.77
T-23-OF	ALCOSAN	26	54	1.66
T-24-OF	ALCOSAN	29	68	2.00
T-26-OF	ALCOSAN	40	50	2.26
TR-01-OF	ALCOSAN	6	3	0.309
TR-02-OF	ALCOSAN	7	19	0.547

4.8.2 Existing Condition CSO Discharges from Municipal Outfalls

Table 4-19 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by the customer municipalities. Two of the five municipal outfalls were previously unknown to ALCOSAN and were brought to the attention of ALCOSAN during the public review and comment period for the draft WWP. These two new CSOs were field verified, are identified in Table 4-19, and were added to the GIS database information. These newly identified CSO outfalls will need to be added to the H&H models as well as their corresponding Critical Portions of the Municipal Collection System, as defined by the ALCOSAN CD. The municipality may need to provide additional physical data to ALCOSAN regarding these new outfalls and the new critical portion pipe segments from the POC with ALCOSAN up to these new outfalls. The updated models will be used to quantify the frequency, duration and volume for these new overflows. The current Table 4-19 and corresponding Figures 4-40 through 4-42 include placeholders for these new municipal CSOs.

Annual Overflow Frequency: The table lists the annual overflow frequency for three [(1)] of the municipal CSO outfalls located within the TC Planning Basin. The table and models indicate that under typical year precipitation conditions, the least active outfall discharges 5 times per year and the most active outfalls discharge up to 48 times per year. As a basis for comparison, during a year with average or typical precipitation there are approximately 94 storms over the ALCOSAN service area.

Annual Overflow Duration: The table lists the annual overflow duration for three [(1)] of the municipal CSO outfalls located within the TC Planning Basin. The tables and models indicate that during typical year precipitation conditions, the least active CSO outfall discharged 14 hours per year and the most active CSO outfalls discharge up to 83 hours per year or less than 1 percent of the total year. As a basis for comparison, there are approximately 220 hours during an average or typical year for which there is significant rainfall over the ALCOSAN service area.

Annual Overflow Volume: The table lists the annual overflow volume for three [(1)] of the municipal CSO outfalls within the TC Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Turtle Creek basin, CSO outfalls owned and operated by the municipalities discharge an annual total of approximately 24 million gallons of CSO discharges into area receiving waters. The models indicated that under typical year precipitation conditions, the least active CSO outfall discharged a total of 311 thousand gallons and the most active individual outfall discharged a total of 17 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-19: Existing Condition, Typical Year Annual CSO Discharge Summary Municipal Outfalls within the Turtle Creek Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
T-10C-0F	Turtle Creek	43	74	17.0
T-MH-075[(1)]	Turtle Creek Borough	(1)	(1)	(1)
GI-12[(1)]	Turtle Creek Borough	(1)	(1)	(1)
CSO MH#1	Wilkins	5	14	0.311

Note[(1)]: Two of the five municipal CSO outfalls in the TC basin were previously unknown and were brought to the attention of ALCOSAN during the public review and comment period for the draft WWP. Annual overflows will be modeled and quantified at a future date.

4.8.3 Existing Condition SSO Discharges from ALCOSAN Outfalls

Table 4-20 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by ALCOSAN. As was explained previously, outfall T-16 was reclassified as an SSO outfall and is included in this table list.

Annual Overflow Frequency: The table lists the annual overflow frequency for each individual ALCOSAN SSO outfall within the TC Planning Basin. The models indicated that some SSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 69 times per year. There are approximately 94 storms over the ALCOSAN service area during a year with average or typical precipitation.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN SSO outfall within the TC Planning Basin. The table and models indicate that some SSO outfalls did not discharge at all during typical year precipitation conditions and that the most active SSO outfalls discharge up to 526 hours per year or 6 percent of the total year. The calculated annual overflow discharge durations could be compared to the annual duration that the Woods Run treatment plant was operating at its peak capacity. The model simulations indicated that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day for approximately 1,400 hours. Therefore, the WWTP was likely operating at full capacity when the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN SSO outfall within the TC Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Turtle Creek planning basin area, SSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 39 million gallons of SSO discharges into area receiving waters. The table and models indicate that some SSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 11.5 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

**Table 4-20: Existing Condition, Typical Year Annual SSO Discharge Summary
ALCOSAN Outfalls within the Turtle Creek Planning Basin Area**

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
T-08-OF	ALCOSAN	0	0	0
T-16-OF	ALCOSAN	3	3	0.0484
T-18-OF	ALCOSAN	0	0	0

Table 4-20: Existing Condition, Typical Year Annual SSO Discharge Summary ALCOSAN Outfalls within the Turtle Creek Planning Basin Area

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
T-25-OF	ALCOSAN	69	526	11.5
T-26A-OF	ALCOSAN	33	238	6.05
T-26B-OF	ALCOSAN	15	66	1.79
T-27-OF	ALCOSAN	50	211	3.79
T-29A-IRO	ALCOSAN	5	31	0.733
T-29-OF	ALCOSAN	7	17	0.131
T-31-OF	ALCOSAN	35	100	1.60
T-32-OF	ALCOSAN	0	0	0
T-33-OF	ALCOSAN	0	0	0
TR-03-OF	ALCOSAN	4	13	0.310
TR-04-OF	ALCOSAN	19	57	1.35
TR-05-OF	ALCOSAN	6	9	0.0600
TR-06-OF	ALCOSAN	52	299	11.5

It should be noted that in addition to the ALCOSAN SSOs that are listed in Table 4-20 above, there are flooded manholes located along sanitary interceptor sewers that can discharge under surcharge conditions.

4.8.4 Existing Condition SSO Discharges from Municipal Outfalls

Table 4-21 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by the customer municipalities and/or their designated municipal authorities. A list of the municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP. Because of the complex variety of institutional arrangements between authorities and their respective municipalities, in the WWP both are indicated as "owners" in the narrative and summary tables regarding the CSO/SSO outfalls.

Within the TC Planning Basin area, there are four municipal SSO outfalls. One of these municipal outfalls was previously unknown to ALCOSAN and was brought to the attention of ALCOSAN during the public review and comment period for the draft WWP. This new SSO was field verified, is identified in Table 4-21, and was added to the GIS database information. This newly identified SSO outfall will need to be added to the H&H models as well as its corresponding Critical Portions of the Municipal Collection System, as defined by the ALCOSAN CD. The municipality may need to provide additional physical data to ALCOSAN regarding this new outfall and the new critical portion pipe segments from the POC with ALCOSAN up to this new outfall. The updated models will be used to quantify the frequency, duration and volume for this new overflow. The current Table 4-21 and corresponding Figures 4-40 through 4-42 include placeholders for this new municipal SSO.

In addition to the municipal overflows listed in the table, there is an emergency overflow at the Gascola flow equalization facility that could discharge in an emergency or if the facility capacity were to be exceeded. Additional overflows can also occur from the other municipal pumping station emergency overflows and/or basement back-ups and surcharged or "popping" manhole covers.

Annual Overflow Frequency: The table lists the annual overflow frequency for each of the three municipal SSO outfalls located within the TC Planning Basin. The models indicated that one of the SSO outfalls discharge once under typical year precipitation conditions and the other two discharged 3 times per year.

Annual Overflow Duration: The table lists the annual overflow duration for each of the three municipal SSO outfalls located within the TC Planning Basin. The results of the typical precipitation year H&H model simulation runs indicate that within the TC Planning Basin, under typical year precipitation conditions, the least active municipal SSO outfall discharged less than an hour and the most active outfall discharged 8 hours per year.

Annual Overflow Volume: The table lists the annual overflow volume for each of the three municipal SSO outfalls located within the TC Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the TC basin the municipal SSO outfalls discharged an annual total of approximately 54 thousand gallons of SSO discharges into area receiving waters.

Table 4-21: Existing Condition, Typical Year Annual SSO Discharge Summary Municipal Outfalls within the Turtle Creek Planning Basin Area

SSO Outfall	Owner[(1)]	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
T-29A-10-M1-OF	Municipality of Monroeville/ Monroeville Municipal Authority (Monroeville / MMA)	3	8	0.0311
T-29A-10B-OF	Trafford Borough	3	4	0.0222
T-05-OF	North Versailles Township/ North Versailles Township Authority	1	0.25	0.00114

Note[(1)]: In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

In addition to the numerical summaries provided in Tables 4-18 through 4-21, graphical depictions of the model simulation results for the typical precipitation year within the Turtle Creek planning basin area are provided in Figures 4-40 through 4-42.
Figure 4-40 depicts the annual overflow frequency of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest number of activations during an average precipitation year. Outfalls with more than 70 activations per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 60 to 70 activations per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 30 to 59 activations per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 13 to 29 activations per year (averaging a little more than 1 to 2 overflows per month) were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 1 to 12 activations per year (averaging 1 or less overflows per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-41 depicts the annual overflow duration of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest total hours of discharge activity during an average precipitation year. Outfalls with more than 1000 hours of discharge activity per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 500 to 1000 hours of discharge per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 100 to 499 hours of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 21 to 99 hours of overflow discharge per year were placed into this category (outfalls were active less than 1.1 percent of the year). Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 0.25 to 24 hours of discharge per year (averaging less than 2 hours of overflow per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-42 depicts the annual overflow volume of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest volume of discharge activity during an average precipitation year. Outfalls discharging more than 200 million gallons per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls discharging 50 to 200 million gallons per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 10 to 49.9 million gallons of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow volume. Outfalls discharging 1.0 to 9.99 million gallons per year were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively low overflow volumes. Outfalls discharging less than 1.00 million gallons per year were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

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

Figure 4-40: Typical Year Overflow Frequency of CSO/SSO Outfalls within the Turtle Creek Planning Basin Area

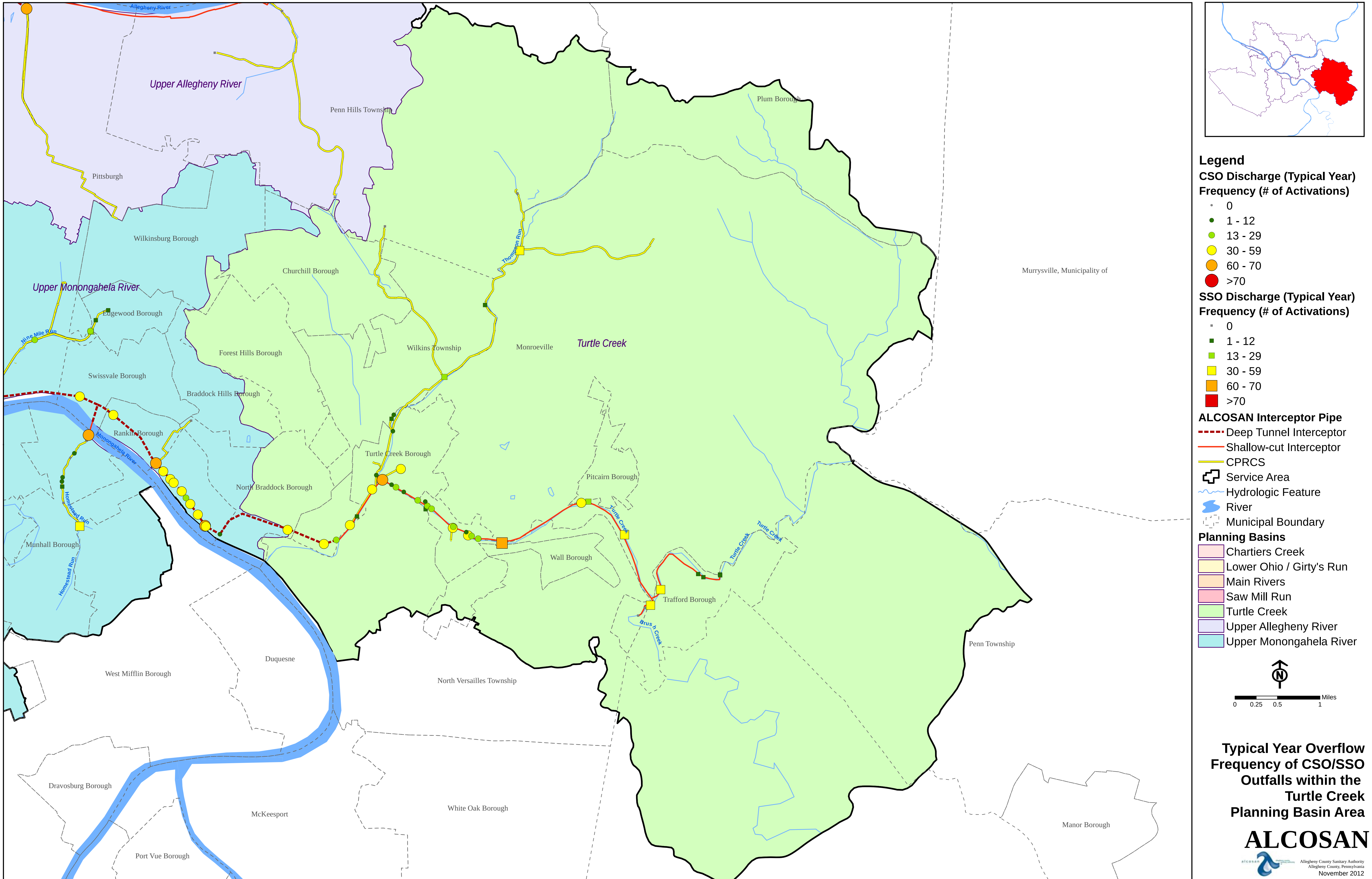


Figure 4-41: Typical Year Overflow Duration of CSO/SSO Outfalls within the Turtle Creek Planning Basin Area

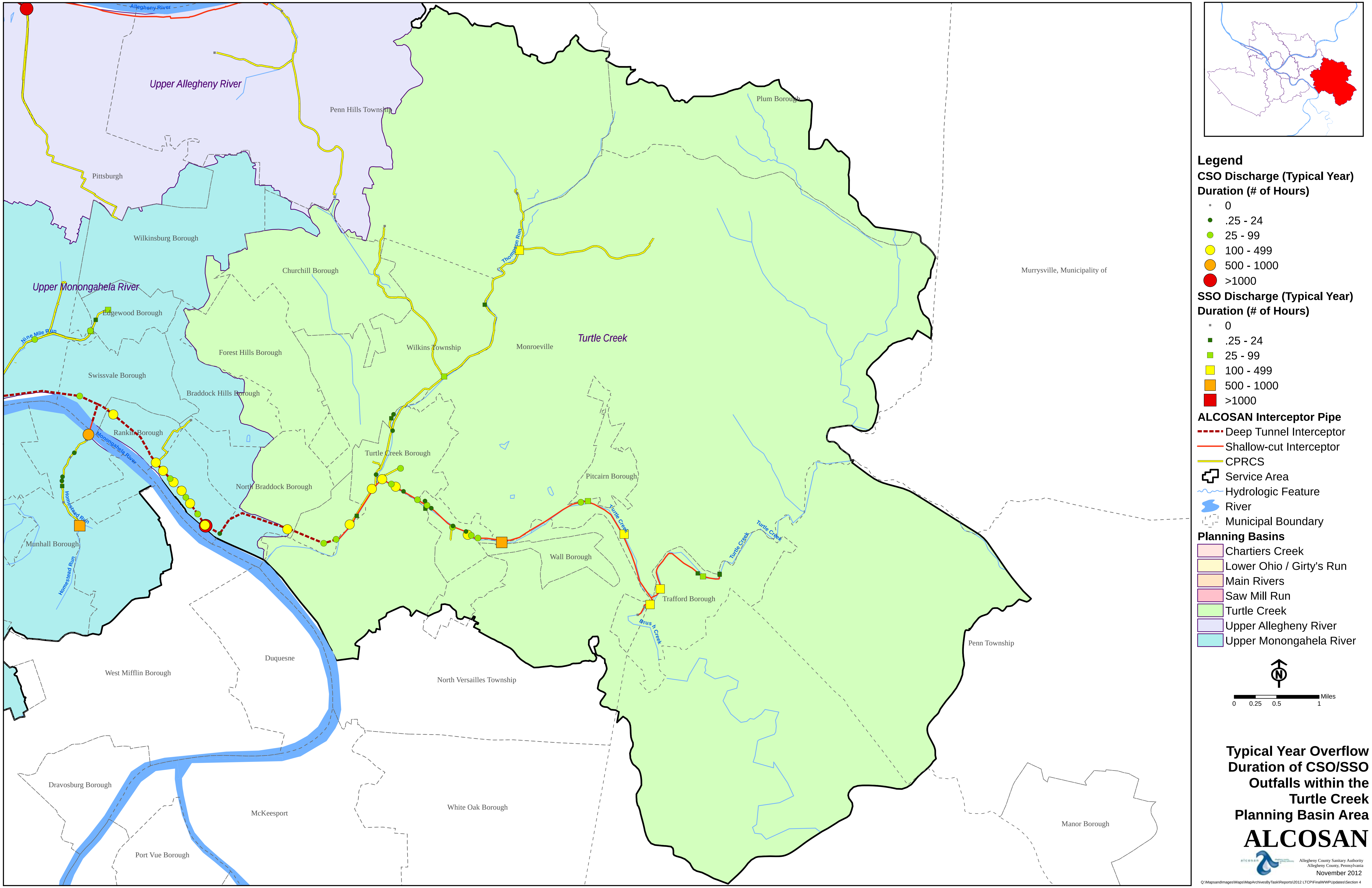
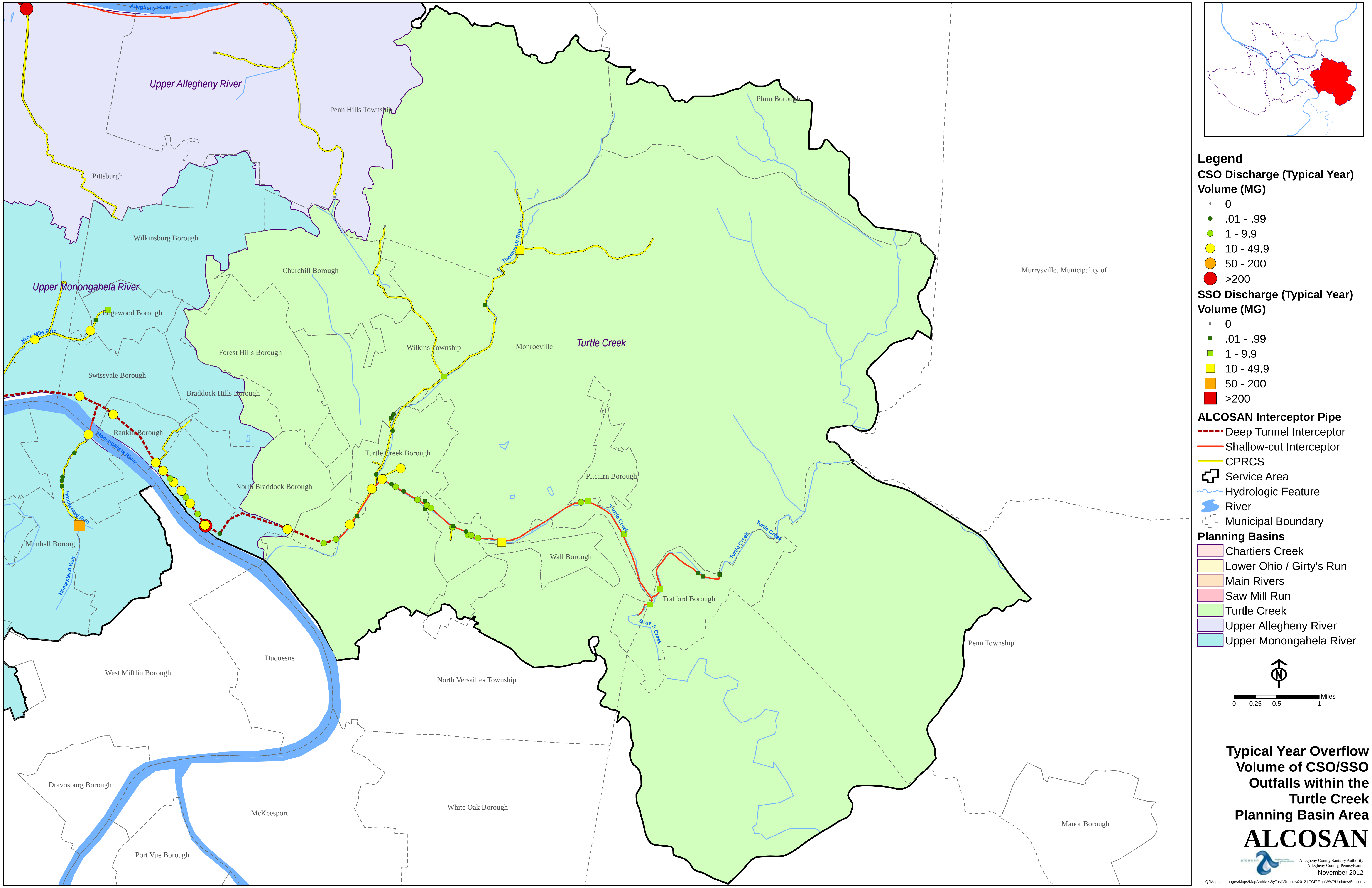


Figure 4-42: Typical Year Overflow Volume of CSO/SSO Outfalls within the Turtle Creek Planning Basin Area



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

4.9 Characterization of the Upper Allegheny River Planning Basin

The adjusted and refined typical year precipitation dataset values were applied to the validated H&H model to quantify and characterize dry and wet weather flows that were generated within each of the municipal collection systems that comprise the Upper Allegheny River (UA) Planning Basin area. The model simulations conveyed the flows to the respective point of connection with the ALCOSAN system and through regulating structures where they exist, diverting flow into the ALCOSAN interceptor system and discharging any remaining wet weather flow to CSO or SSO outfalls. The model summed and tabulated CSO and SSO discharges and conveyed and routed the diverted flow to the Woods Run Wastewater Treatment Plant.

To support the development and assessment of alternative measures to the control wet weather CSO and SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was then applied to the existing condition validated model to generate baseline condition statistics on the annual frequency, duration and volume of overflows. This section provides a summary description of the H&H characterization of existing conditions within the Upper Allegheny River basin and documents corresponding CSO and SSO discharges in tabular and graphical formats.

Tables 4-22 through 4-25 provide concise regional summaries of the existing condition annual frequency, duration and volume of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The table information was obtained from typical year model simulation results. The table information includes overflow statistics for each individual outfall structure within the Upper Allegheny River Planning Basin.

4.9.1 Existing Condition CSO Discharges from ALCOSAN Outfalls

Table 4-22 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by ALCOSAN.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN CSO outfall within the UA Planning Basin. The table and models indicate that under typical year precipitation conditions, the least active outfall discharges 13 times per year and the most active outfalls discharge up to 66 times per year. Reported overflow frequencies were calculated utilizing a standardized 24-hour inter-event time and a 0.0646 million gallons/day minimum threshold value. These calculated annual overflow frequencies could be compared to rainfall frequency. During a year with average or typical rainfall, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to find the median value of significant precipitation events over a year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN CSO outfall within the UA Planning Basin. The models indicated that during typical year precipitation conditions, the least active outfall discharged 19 hours per year and the most active CSO outfall discharged up to 2,000 hours per year.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN CSO outfall within the UA Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Upper Allegheny River planning basin area, CSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 1,977 million gallons of CSO discharges into area receiving waters. The models indicated that under typical year precipitation conditions, the least active outfalls discharged a total of 1.2 million gallons per year and the most active individual outfall discharged a total of 777 million gallons throughout the year. The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the current interceptor system and WWTP capacity (250 MGD) would treat approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-22: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls Within the Upper Allegheny River Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
A-35-OF	ALCOSAN	60	214	36.4
A-36-OF	ALCOSAN	59	381	11.8
A-37-OF	ALCOSAN	61	1,041	51.5
A-37Z-OF	ALCOSAN	32	57	4.19
A-38-OF	ALCOSAN	13	19	1.21
A-40-OF	ALCOSAN	58	330	9.01
A-41-OF	ALCOSAN	62	1,066	256
A-42-OF	ALCOSAN	66	1,085	777
A-68-OF	ALCOSAN	58	1,780	319
A-69-OF	ALCOSAN	62	1,586	46.6
A-70-OF	ALCOSAN	60	2,024	76.3
A-71-OF	ALCOSAN	64	1,437	49.2

Table 4-22: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls Within the Upper Allegheny River Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
A-72-OF	ALCOSAN	61	441	199
A-73-OF	ALCOSAN	63	1,611	53.4
A-74-OF	ALCOSAN	62	1,607	37.6
A-75-OF	ALCOSAN	39	1,743	24.4
A-76-OF	ALCOSAN	30	77	7.46
A-77-OF	ALCOSAN	21	65	2.87
A-78-OF	ALCOSAN	32	148	14.5

4.9.2 Existing Condition CSO Discharges from Municipal Outfalls

Table 4-23 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by the customer municipalities or their associated municipal authority. A list of the municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP. Because of the complex variety of institutional arrangements between authorities and their respective municipalities, in the WWP both are indicated as "owners" in the narrative and summary tables regarding the CSO/SSO outfalls.

Annual Overflow Frequency: The table lists the annual overflow frequency for each individual municipal CSO outfall within the UA Planning Basin. The table and models indicate that under typical year precipitation conditions, the least active outfall discharges 12 times per year and the most active outfalls discharge up to 59 times per year. As a basis for comparison, during a year with average or typical precipitation there are approximately 94 storms over the ALCOSAN service area.

Annual Overflow Duration: The table lists the annual overflow duration for each individual municipal CSO outfall within the UA Planning Basin. The table and models indicate that during typical year precipitation conditions, the least active CSO outfall discharged 22 hours per year and most active CSO outfall discharged up to 595 hours per year or 6.8 percent of the total year. As a basis for comparison the existing ALCOSAN WWTP would operate at its peak capacity for approximately 1,400 hours during a year with average or typical precipitation.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal CSO outfall within the UA Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Upper Allegheny River basin, municipal CSO outfalls discharge an annual total of approximately 231 million gallons of CSO discharges into area receiving waters. The models indicated that under typical year precipitation conditions, the least active outfall discharged a total of 1.3 million gallons per year and most active individual outfall discharged a total of 84 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-23: Existing Condition, Typical Year Annual CSO Discharge Summary
Municipal Outfalls within the Upper Allegheny River Planning Basin Area

CSO Outfall	Owner[1]	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
CSO-1A-OF	Etna Borough	50	306	35.8
CSO-1-OF	Etna Borough	55	595	55.5
CSO-2-OF	Etna Borough	50	313	4.40
CSO-3-OF	Etna Borough	19	31	1.90
CSO-4-OF	Etna Borough	12	24	3.42
CSO-5-OF	Etna Borough	18	34	5.21
CSO-7-OF	Etna Borough	19	22	1.63
CSO-8-OF	Etna Borough	41	110	7.38
MH-C108-OF	Etna Borough	21	30	1.25
MH-M7-OF	Etna Borough	46	149	7.55
177K001-OF	City of Pittsburgh/ Pittsburgh Water and Sewer Authority (Pittsburgh / PWSA)	19	34	22.8
121H001-OF	Pittsburgh / PWSA	59	218	84.1

Note[1]: In communities where municipal authorities exist, both the municipality and authority are indicated as “owners.” Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

4.9.3 Existing Condition SSO Discharges from ALCOSAN Outfalls

Table 4-24 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by ALCOSAN. Within the Upper Allegheny River basin, there are three ALCOSAN SSO outfalls.

Annual Overflow Frequency: The table lists the annual overflow frequency for each individual ALCOSAN SSO outfall within the UA Planning Basin. The models indicated that the least active outfall discharged 5 times under typical year precipitation conditions and the most active outfall discharged up to 30 times per year. There are approximately 94 storms over the ALCOSAN service area during a year with average or typical precipitation.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN SSO outfall within the UA Planning Basin. The table and models indicate that the least active SSO outfall discharged for 13 hours during typical year precipitation conditions and that the most active SSO outfall discharged up to 90 hours per year or approximately one percent of the total year. As a basis for comparison the existing ALCOSAN WWTP would operate at its peak capacity for approximately 1,400 hours during a year with average or typical precipitation.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN SSO outfall within the UA Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Upper Allegheny River basin, SSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 5.3 million gallons of SSO discharges into area receiving waters. The models indicated that the least active SSO outfall discharged 280 thousand gallons under typical year precipitation conditions and the most active individual outfall discharged a total of 4.7 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-24: Existing Condition, Typical Year Annual SSO Discharge Summary ALCOSAN Outfalls within the Upper Allegheny River Planning Basin Area

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
A-45-OF	ALCOSAN	30	90	4.70
A-82-OF	ALCOSAN	15	18	0.358
A-85-OF	ALCOSAN	5	13	0.280

In addition to the ALCOSAN SSO outfalls listed in Table 4-24 above, there is an emergency overflow at each of the Montrose, Sandy Creek, Squaw Run and Verona sanitary sewer pump stations that could discharge under emergency conditions such as equipment failure. There are also flooded manholes located along sanitary interceptor sewers that can discharge under surcharge conditions.

4.9.4 Existing Condition SSO Discharges from Municipal Outfalls

Table 4-25 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by the customer municipalities.

Annual Overflow Frequency: The table lists the annual overflow frequency for each individual municipal SSO outfall within the UA Planning Basin. The table and models indicate that one SSO outfall did not discharge at all under typical year precipitation and the most active outfall discharged up to 25 times per year.

Annual Overflow Duration: The table lists the annual overflow frequency for each individual municipal SSO outfall within the UA Planning Basin. The table and models indicate that one SSO outfall did not discharge at all during typical year precipitation conditions and the most active SSO outfall discharged 109 hours per year or 1.2 percent of the year. As a basis for comparison, there are approximately 220 hours during an average or typical year for which there is significant rainfall over the ALCOSAN service area.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal SSO outfall within the UA Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Upper Allegheny River basin, SSO outfalls owned and operated by the municipalities discharge an annual total of approximately 31 million gallons of SSO discharges into area receiving waters. The models indicated that one SSO outfall discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 30 million gallons throughout the year. The existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-25: Existing Condition, Typical Year Annual SSO Discharge Summary Municipal Outfalls within the Upper Allegheny River Planning Basin Area

SSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
OHM-211-OF	O'Hara Township	3	5	0.0380
MH-S32-OF	Shaler Township	25	109	30.1
MH-145-OF	Shaler Township	6	24	0.690
MH-75-OF	Shaler Township	0	0	0
MH-78-OF	Shaler Township	4	9	0.107

In addition to the municipal SSO outfalls listed in Table 4-25 above, the municipality of Penn Hills has an emergency overflow at each of their three flow equalization facilities, (Lincoln, Long Road, and Volk) that could discharge under emergency conditions or if the capacity of the facilities were to be exceeded. There also can be additional overflows from the other municipal pumping station emergency overflows located within the UA basin. There are also flooded manholes located along sanitary trunk sewers that can discharge under surcharge conditions.
In addition to the numerical summaries provided in Tables 4-22 through 4-25, graphical depictions of the model simulation results for the typical precipitation year within the Upper Allegheny River planning basin area are provided in Figures 4-43 through 4-45.
Figure 4-43 depicts the annual overflow frequency of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest number of activations during an average precipitation year. Outfalls with more than 70 activations per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 60 to 70 activations per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 30 to 59 activations per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 13 to 29 activations per year (averaging a little more than 1 to 2 overflows per month) were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 1 to 12 activations per year (averaging 1 or less overflows per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-44 depicts the annual overflow duration of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest total hours of discharge activity during an average precipitation year. Outfalls with more than 1000 hours of discharge activity per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 500 to 1000 hours of discharge per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 100 to 499 hours of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 25 to 99 hours of overflow discharge per year were placed into this category (outfalls were active less than 1.1 percent of the year). Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 0.25 to 24 hours of discharge per year (averaging 2 hours or less of overflow per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-45 depicts the annual overflow volume of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest volume of discharge activity during an average precipitation year. Outfalls discharging more than 200 million gallons per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls discharging 50 to 200 million gallons per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 10 to 49.9 million gallons of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow volume. Outfalls discharging 1.0 to 9.99 million gallons per year were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively low overflow volumes. Outfalls discharging less than 1.00 million gallons per year were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-43: Typical Year Overflow Frequency of CSO/SSO Outfalls within the Upper Allegheny River Planning Basin Area

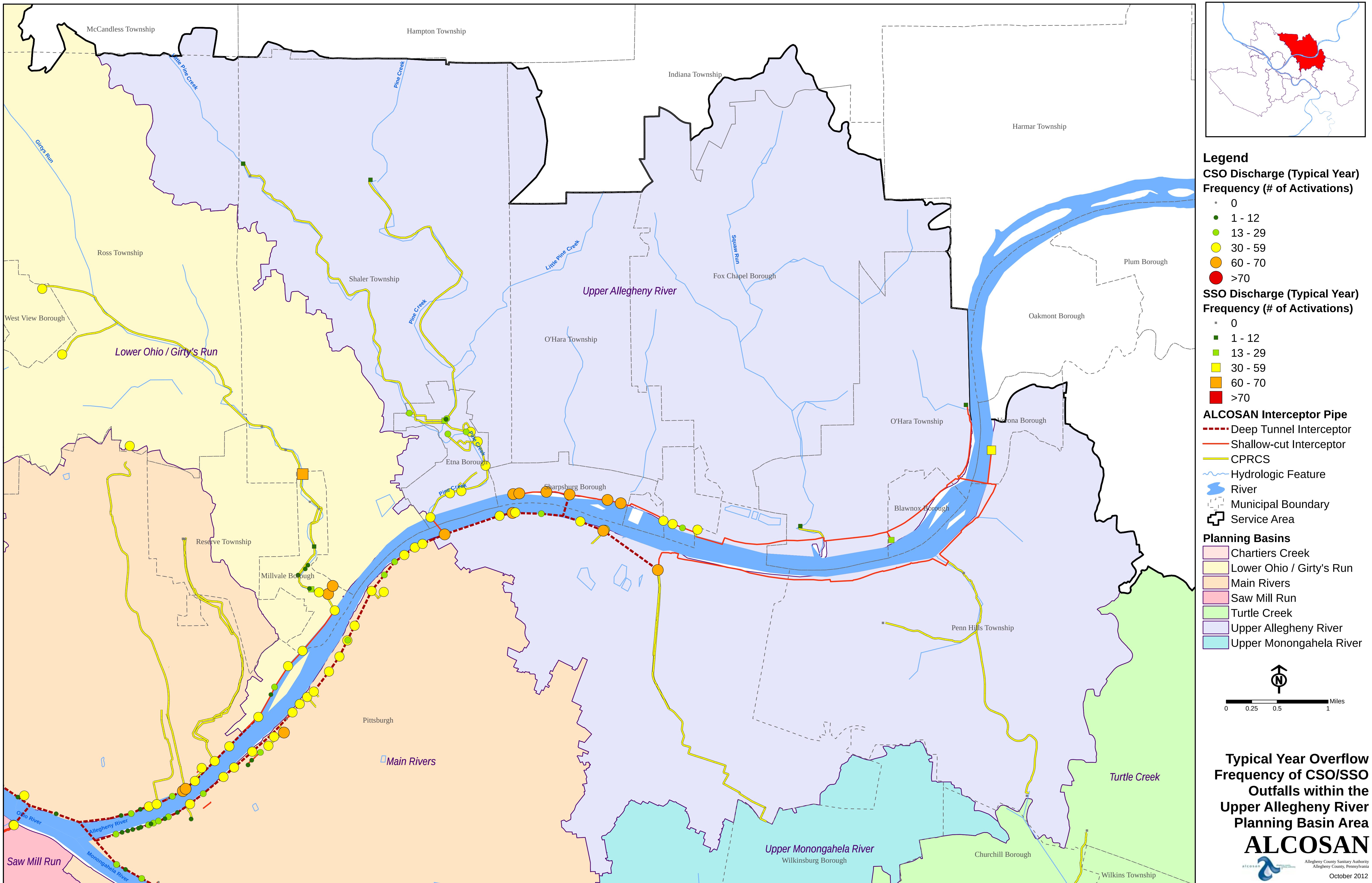


Figure 4-44: Typical Year Overflow Duration of CSO/SSO Outfalls within the Upper Allegheny River Planning Basin Area

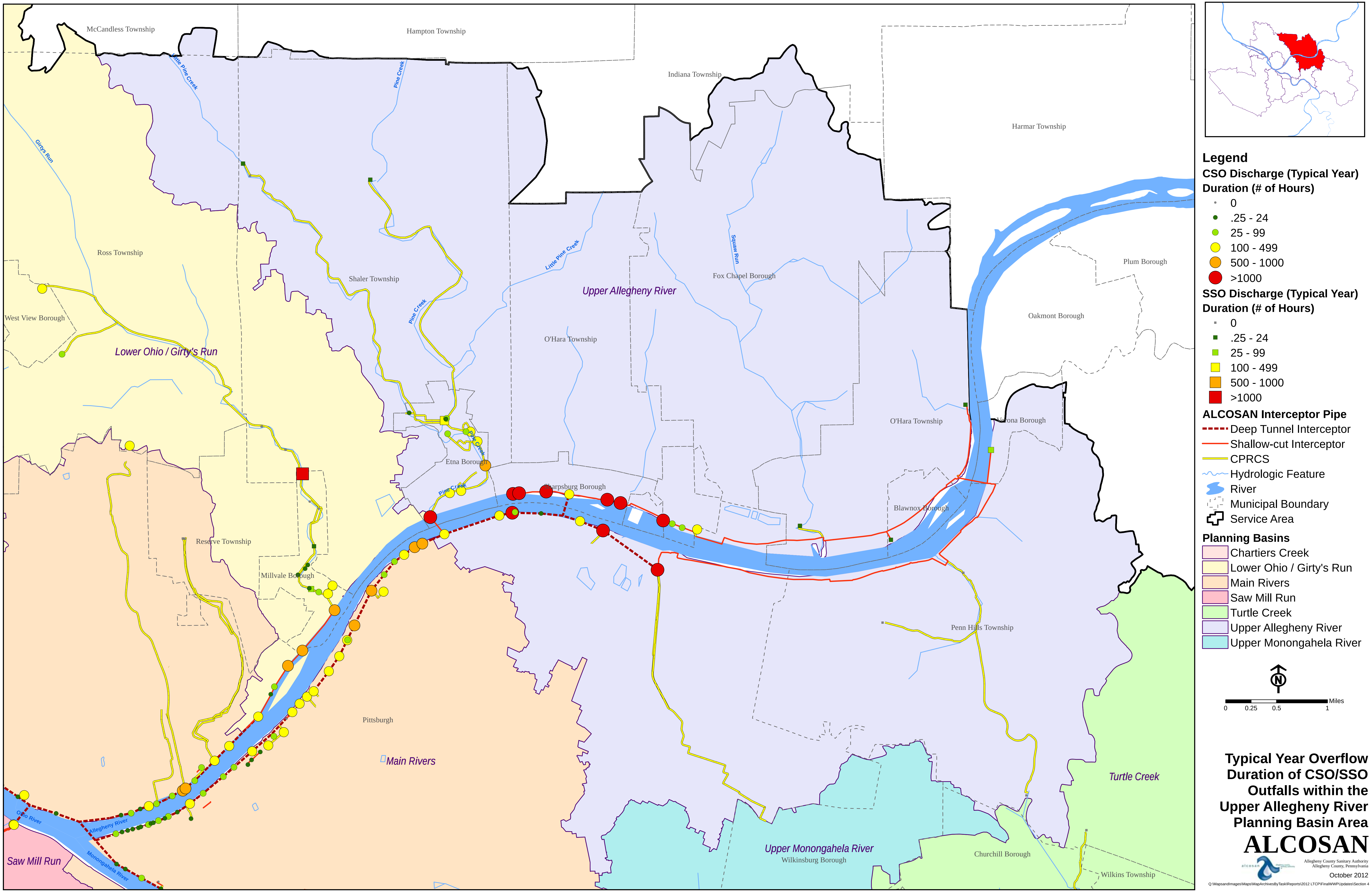
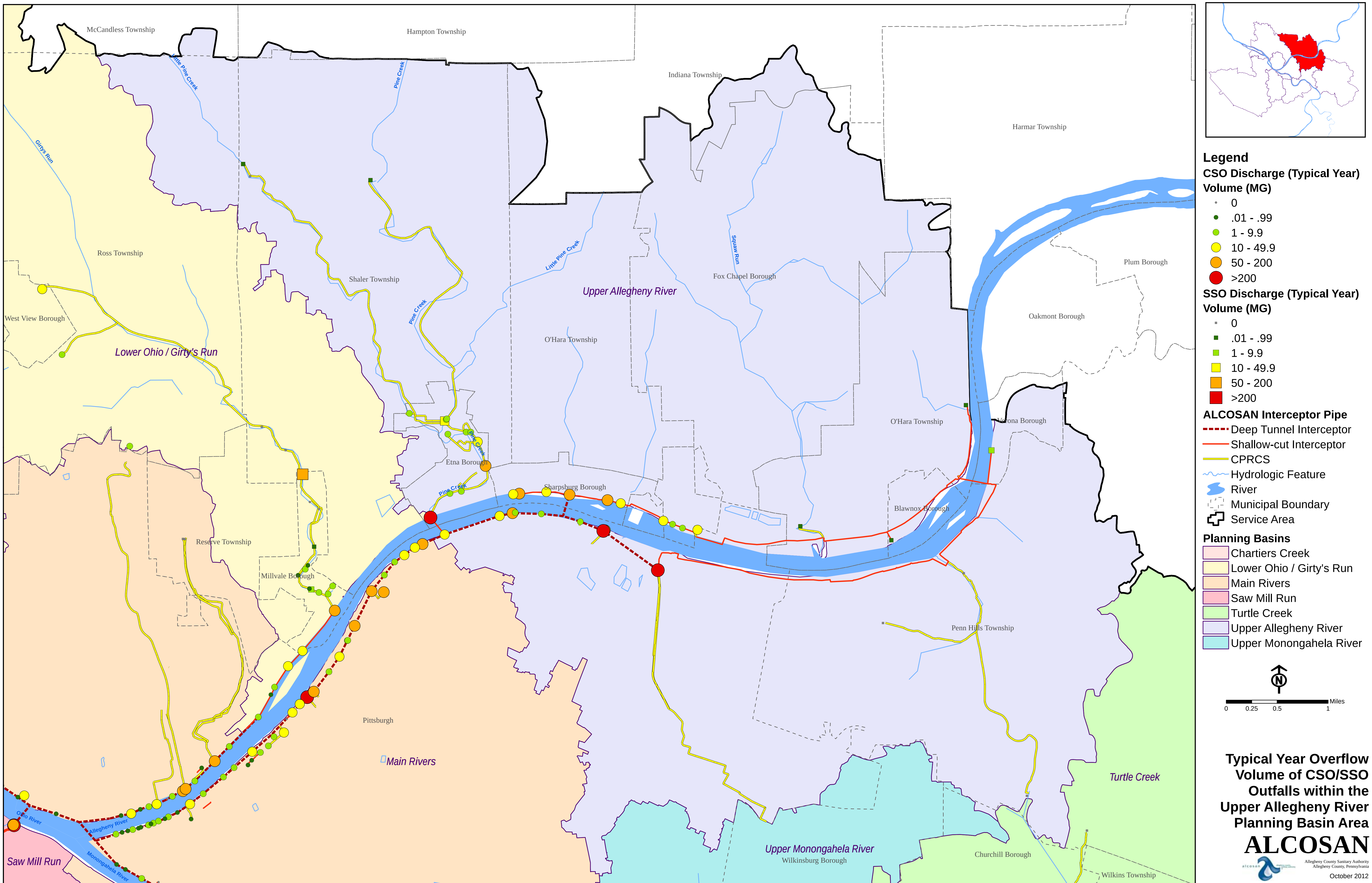


Figure 4-45: Typical Year Overflow Volume of CSO/SSO Outfalls within the Upper Allegheny River Planning Basin Area



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

4.10 Characterization of the Upper Monongahela River Planning Basin

The adjusted and refined typical year precipitation dataset values were applied to the validated H&H model to quantify and characterize dry and wet weather flows that were generated within each of the municipal collection systems that comprise the Upper Monongahela (UM) River Planning Basin area. The model simulations conveyed the flows to the respective point of connection with the ALCOSAN system and through regulating structures where they exist, diverting flow into the ALCOSAN interceptor system and discharging any remaining wet weather flow to CSO or SSO outfalls. The model summed and tabulated CSO and SSO discharges and conveyed and routed the diverted flow to the Woods Run Wastewater Treatment Plant.

To support the development and assessment of alternative measures to the control wet weather CSO and SSO discharges, and to identify an optimal control facility configuration for the Wet Weather Plan, the adjusted and refined typical year precipitation dataset was then applied to the existing condition validated model to generate baseline condition statistics on the annual frequency, duration and volume of overflows. This section provides a summary description of the H&H Characterization of existing conditions within the Upper Monongahela River basin and corresponding CSO and SSO discharges in tabular and graphical formats.

Tables 4-26 through 4-28 provide concise regional summaries of the existing condition annual frequency, duration and volume of CSO and SSO discharges and establish a baseline from which to evaluate the performance of the alternative control measures. The table information was obtained from typical year model simulation results. The table information includes overflow statistics for each individual outfall structure within the Upper Monongahela River Planning Basin.

4.10.1 Existing Condition CSO Discharges from ALCOSAN Outfalls

Table 4-26 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by ALCOSAN.

Annual Overflow Frequency: The table lists the annual overflow frequency, determined by the validated existing condition H&H models, for each individual ALCOSAN CSO outfall within the UM Planning Basin. The table and models indicate that under typical year precipitation conditions, the least active outfall discharges 1 time per year and the most active outfalls discharge up to 65 times per year. Reported overflow frequencies were calculated utilizing a standardized 24-hour inter-event time and a 0.0646 million gallons/day minimum threshold value. These calculated annual overflow frequencies could be compared to rainfall frequency. During a year with average or typical precipitation, there are approximately 94 significant storms over the ALCOSAN service area. This was determined from an analysis of the long-term precipitation record at the Pittsburgh International Airport to find the median value of significant precipitation events over a year.

Annual Overflow Duration: The table lists the annual overflow duration for each individual ALCOSAN CSO outfall within the UM Planning Basin. The table and models indicate that during typical year precipitation conditions, the least active outfall discharged less than one hour per year and the most active CSO outfall discharged up to 1,673 hours per year or 19 percent of the total year. The calculated annual overflow discharge durations could be compared to the annual duration that the Woods Run wastewater treatment plant (WWTP) operates at its peak capacity. The model simulations indicated that during a year with typical year precipitation conditions, the plant would operate at its peak capacity of 250 million gallons per day for approximately 1,400 hours. Therefore, the WWTP was likely operating at full capacity when most of the CSO discharges were occurring.

Annual Overflow Volume: The table lists the annual overflow volume for each individual ALCOSAN CSO outfall within the UM Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Upper Monongahela River planning basin area, CSO outfalls owned and operated by ALCOSAN discharge an annual total of approximately 1.9 billion gallons of CSO discharges into area receiving waters. The models indicated that under typical year precipitation conditions, the least active outfall discharged a total of 4.4 thousand gallons per year and the most active individual outfall discharged a total of 750 million gallons throughout the year.

The calculated annual overflow discharge volumes could be compared to the annual volume of wastewater flow that is treated at the Woods Run treatment plant. The H&H models indicated that during a year with average or typical rainfall over the ALCOSAN service area, the current interceptor system and WWTP capacity (250 MGD) would provide treatment for approximately 77 billion gallons of wastewater from the customer municipalities.

Table 4-26: Existing Condition, Typical Year Annual CSO Discharge Summary
ALCOSAN Outfalls within the Upper Monongahela River Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
M-31-OF	ALCOSAN	34	78	3.58
M-31Z-OF	ALCOSAN	1	0.5	0.00444
M-32-OF	ALCOSAN	This outfall has been closed		
M-33-OF	ALCOSAN	1	0.25	0.000787
M-34-OF	ALCOSAN	58	654	131
M-35-OF	ALCOSAN	64	839	49.2
M-36-OF	ALCOSAN	63	364	31.9
M-37-OF	ALCOSAN	22	25	0.793

Table 4-26: Existing Condition, Typical Year Annual CSO Discharge Summary ALCOSAN Outfalls within the Upper Monongahela River Planning Basin Area

CSO Outfall	Owner	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
M-38-OF	ALCOSAN	16	17	1.08
M-39-OF	ALCOSAN	54	273	4.62
M-40-OF	ALCOSAN	57	308	42.9
M-42-OF	ALCOSAN	62	1057	151
M-43-OF	ALCOSAN	62	441	17.7
M-44-OF	ALCOSAN	60	1673	230
M-45-OF	ALCOSAN	57	224	49.3
M-47-OF	ALCOSAN	65	507	226
M-48-OF	ALCOSAN	45	87	15.7
M-49-OF	ALCOSAN	61	911	44.6
M-50-OF	ALCOSAN	51	106	30.6
M-51-OF	ALCOSAN	61	319	41.8
M-52-OF	ALCOSAN	58	139	11.0
M-53-OF	ALCOSAN	32	77	2.80
M-54-OF	ALCOSAN	33	126	27.4
M-55-OF	ALCOSAN	50	118	27.7
M-56-OF	ALCOSAN	19	40	2.82
M-57-OF	ALCOSAN	57	232	14.8
M-58-OF	ALCOSAN	32	60	4.44
M-59-DT-IRO	ALCOSAN	58	1244	750
M-60-OF	ALCOSAN	60	209	10.4
M-61-OF	ALCOSAN	2	6	0.430

4.10.2 Existing Condition CSO Discharges from Municipal Outfalls

Table 4-27 provides a summary of the existing condition annual frequency, duration and volume of CSO discharges from outfall structures owned and operated by the customer municipalities or their designated municipal authorities. A list of the municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP. Because of the complex variety of institutional arrangements between authorities and their respective municipalities, in the WWP both are indicated as "owners" in the narrative and summary tables regarding the CSO/SSO outfalls.

Annual Overflow Frequency: The table lists the annual overflow frequency for each individual municipal CSO outfall within the UM Planning Basin. The table and models indicated that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfalls discharge up to 66 times per year. As a basis for comparison, during a year with average or typical precipitation there are approximately 94 storms over the ALCOSAN service area.

Annual Overflow Duration: The table lists the annual overflow duration for each individual municipal CSO outfall within the UM Planning Basin. The table and models indicate that some CSO outfalls did not discharge at all under typical year precipitation conditions and the most active outfall discharged up to 203 hours per year or 2.3 percent of the total year. As a basis for comparison, there are approximately 220 hours during an average or typical year for which there is significant rainfall over the ALCOSAN service area.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal CSO outfall within the UM Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Upper Monongahela River basin, municipal CSO outfalls discharge an annual total of approximately 31.5 million gallons of CSO discharges into area receiving waters. The models indicated that under typical year precipitation conditions, the least active outfall discharged no volume at all and the most active individual outfall discharged a total of 17.6 million gallons throughout the year. As a basis for comparison, the existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-27: Existing Condition, Typical Year Annual CSO Discharge Summary Municipal Outfalls within the Upper Monongahela River Planning Basin Area

CSO Outfall	Owner[1]	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
MH_02OF [2]	Munhall Borough / Munhall Sanitary Sewer Municipal Authority (Munhall / MSSMA)	2	7	0.204

Table 4-27: Existing Condition, Typical Year Annual CSO Discharge Summary Municipal Outfalls within the Upper Monongahela River Planning Basin Area

CSO Outfall	Owner(1)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
MH_04OF (2)	Munhall / MSSMA	0	0	0
MH_12OF (2)	Munhall / MSSMA	1	5	0.0652
MH_14OF (2)	Munhall / MSSMA	1	5	0.0655
CSO_030N001	City of Pittsburgh/ Pittsburgh Water and Sewer Authority (Pittsburgh / PWSA)	0	0	0
CSO_032N001	Pittsburgh / PWSA	12	8	0.179
CSO_032P001	Pittsburgh / PWSA	0	0	0
CSO_134A001	Pittsburgh / PWSA	17	20	0.597
CSO_184E001	Pittsburgh / PWSA	0	0	0
CSO_185H001	Pittsburgh / PWSA	60	89	2.05
CSO128R002	Pittsburgh / PWSA	26	57	17.6
LBs_1111646 (OF089D001)	Pittsburgh / PWSA	13	20	1.27
M4400_-OSC-M-02OF	West Homestead	25	32	1.02
M4400_-OSC-M-08OF	West Homestead	66	203	8.41

Note(1): In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.
Note(2): The Munhall Sanitary Sewer Municipal Authority Source Flow Reduction Study (Dec 2017) indicates this outfall has been reclassified from a CSO to an SSO, and that outfall MH_04OF (now referred to as SSO 004) has been permanently sealed. ALCOSAN will confirm.

4.10.3 Existing Condition SSO Discharges from ALCOSAN Outfalls

Within the Upper Monongahela River planning basin, there are no SSO regulator structures or outfalls that are owned or operated by ALCOSAN and hence, no SSO discharge summary table or narrative for ALCOSAN outfalls.

4.10.4 Existing Condition SSO Discharges from Municipal Outfalls

Table 4-28 provides a summary of the existing condition annual frequency, duration and volume of SSO discharges from outfall structures owned and operated by the customer municipalities or their associated municipal authority.
Annual Overflow Frequency: The table lists the annual overflow frequency for each individual municipal SSO outfall within the UM Planning Basin. The models indicated that some SSO outfalls did not discharge at all under typical year precipitation and the most active outfalls discharge up to 59 times per year. There are approximately 94 storms over the ALCOSAN service area during a year with average or typical precipitation.

Annual Overflow Duration: The table lists the annual overflow frequency for each individual municipal SSO outfall within the UM Planning Basin. The models indicated that some SSO outfalls did not discharge at all during typical year precipitation conditions and the most active SSO outfall discharged 681 hours per year or 7.8 percent of the year. There are approximately 220 hours during an average or typical year for which there is significant rainfall over the ALCOSAN service area.

Annual Overflow Volume: The table lists the annual overflow volume for each individual municipal SSO outfall within the UM Planning Basin. During a year with average or typical rainfall over the service area, the model simulations indicate that within the Upper Monongahela River basin, municipal SSO outfalls discharge an annual total of approximately 65.3 million gallons of SSO discharges into area receiving waters. The table and models indicate that some SSO outfalls discharged no volume at all under typical year precipitation conditions and the most active individual outfall discharged a total of 57.1 million gallons throughout the year. The existing ALCOSAN WWTP would treat approximately 77 billion gallons of wastewater during a year with average or typical precipitation.

Table 4-28: Existing Condition, Typical Year Annual SSO Discharge Summary Municipal Outfalls within the Upper Monongahela River Planning Basin Area

SSO Outfall	Owner(1)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
Baldwin-Brentwood	Brentwood	7	14	0.180
Edgewood-MH20 SSO	Edgewood	23	48	2.21
Edgewood-Allenby SSO	Edgewood	3	3	0.0400
Unpermitted_OF-A	Munhall Borough / Munhall Sanitary Sewer Municipal Authority (Munhall / MSSMA)	0	0	0
Unpermitted_OF-B	Munhall / MSSMA	1	4	0.0884

Table 4-28: Existing Condition, Typical Year Annual SSO Discharge Summary Municipal Outfalls within the Upper Monongahela River Planning Basin Area

SSO Outfall	Owner(1)	Annual Overflow Frequency (number of activations)	Annual Overflow Duration (hours per year)	Annual Overflow Volume (million gallons)
Unpermitted_OF-C	Munhall / MSSMA	0	0	0
Unpermitted_OF-D	Munhall / MSSMA	59	681	57.1
TasseyHollow_SSO	Undetermined	0	0	0
Koenig Field SSO	Wilkinsburg	12	36	5.67

Note(1): In communities where municipal authorities exist, both the municipality and authority are indicated as "owners." Actual institutional arrangements for owning, operating and maintaining the sewer systems vary among individual communities.

In addition to the municipal SSO outfalls listed in Table 4-28 above, there are emergency overflows at 4 municipal pump stations that could discharge under emergency conditions. There is an emergency overflow at the Collins Road pump station that is owned and operated by Churchill Borough. There is an emergency overflow at the Pittsburgh Water and Sewer Authority (PWSA) Mifflin Road and Rodger Street pump stations. There is also an emergency overflow at the Wilkinsburg Borough Fairmont Road pumping station. It should be noted that there are flooded manholes located along sanitary trunk sewers that can discharge under surcharge conditions.

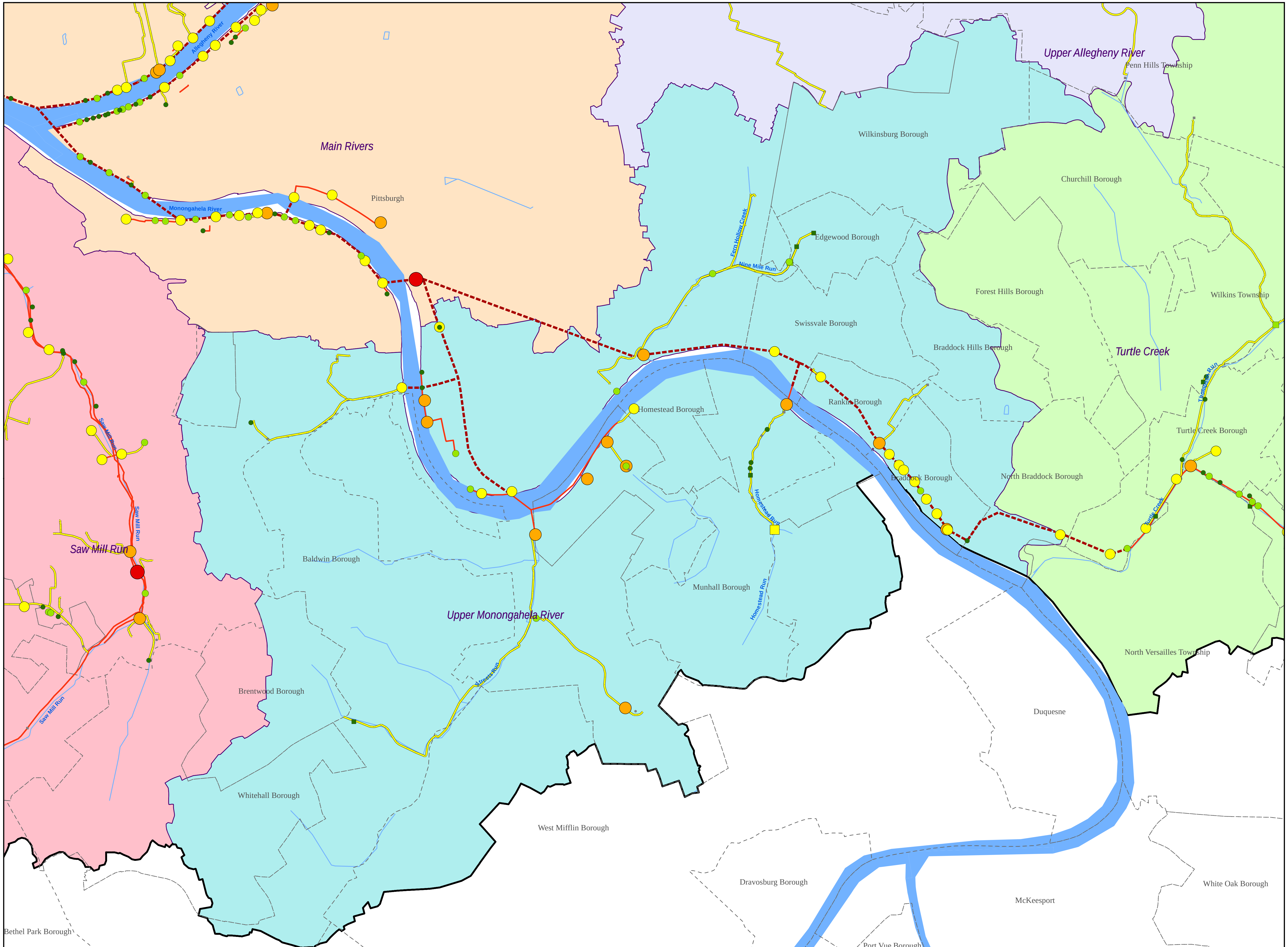
In addition to the numerical summaries provided in Tables 4-26 through 4-28, graphical depictions of the model simulation results for the typical precipitation year within the Upper Monongahela River planning basin area are provided in Figures 4-46 through 4-48.

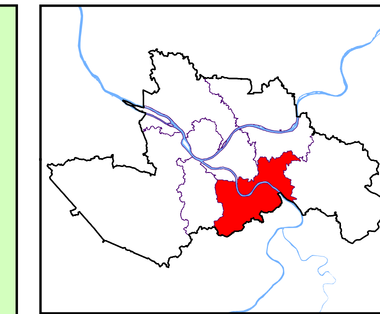
Figure 4-46 depicts the annual overflow frequency of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest number of activations during an average precipitation year. Outfalls with more than 70 activations per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 60 to 70 activations per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 30 to 59 activations per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 13 to 29 activations per year (averaging a little more than 1 to 2 overflows per month) were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 1 to 12 activations per year (averaging 1 or less overflows per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-47 depicts the annual overflow duration of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest total hours of discharge activity during an average precipitation year. Outfalls with more than 1000 hours of discharge activity per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls with 500 to 1000 hours of discharge per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 100 to 499 hours of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow activity. Outfalls with 25 to 99 hours of overflow discharge per year were placed into this category (outfalls were active less than 1.1 percent of the year). Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively infrequent annual overflow activity. Outfalls with 0.25 to 24 hours of discharge per year (averaging 2 hours or less of overflow per month) were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-48 depicts the annual overflow volume of CSO and SSO discharges from the ALCOSAN and municipal collection systems. Red circles and squares, respectively, are used to show the locations of the CSO and SSO outfalls with the greatest volume of discharge activity during an average precipitation year. Outfalls discharging more than 200 million gallons per year were placed into this category. Orange circles and squares are used to depict CSO and SSO outfalls discharging 50 to 200 million gallons per year. Yellow circles and squares are used to depict CSO and SSO outfall locations with 10 to 49.9 million gallons of discharge per year. Light green circles and squares are used to show the locations of CSO and SSO outfalls with relatively moderate annual overflow volume. Outfalls discharging 1.0 to 9.99 million gallons per year were placed into this category. Dark green circles and squares are used to show the locations of CSO and SSO outfalls with relatively low overflow volumes. Outfalls discharging less than 1.00 million gallons per year were placed into this category. CSO and SSO outfalls with no discharge activity during the typical year are depicted with grey circles and squares.

Figure 4-46: Typical Year Overflow Frequency of CSO/SSO Outfalls within the Upper Monongahela River Planning Basin





Typical Year Overflow Frequency of CSO/SSO Outfalls within the Upper Monongahela River Planning Basin Area

ALCOSAN

Allegheny County Sanitary Authority
Allegheny County, Pennsylvania

October 2012

Figure 4-47: Typical Year Overflow Duration of CSO/SSO Outfalls within the Upper Monongahela River Planning Basin Area

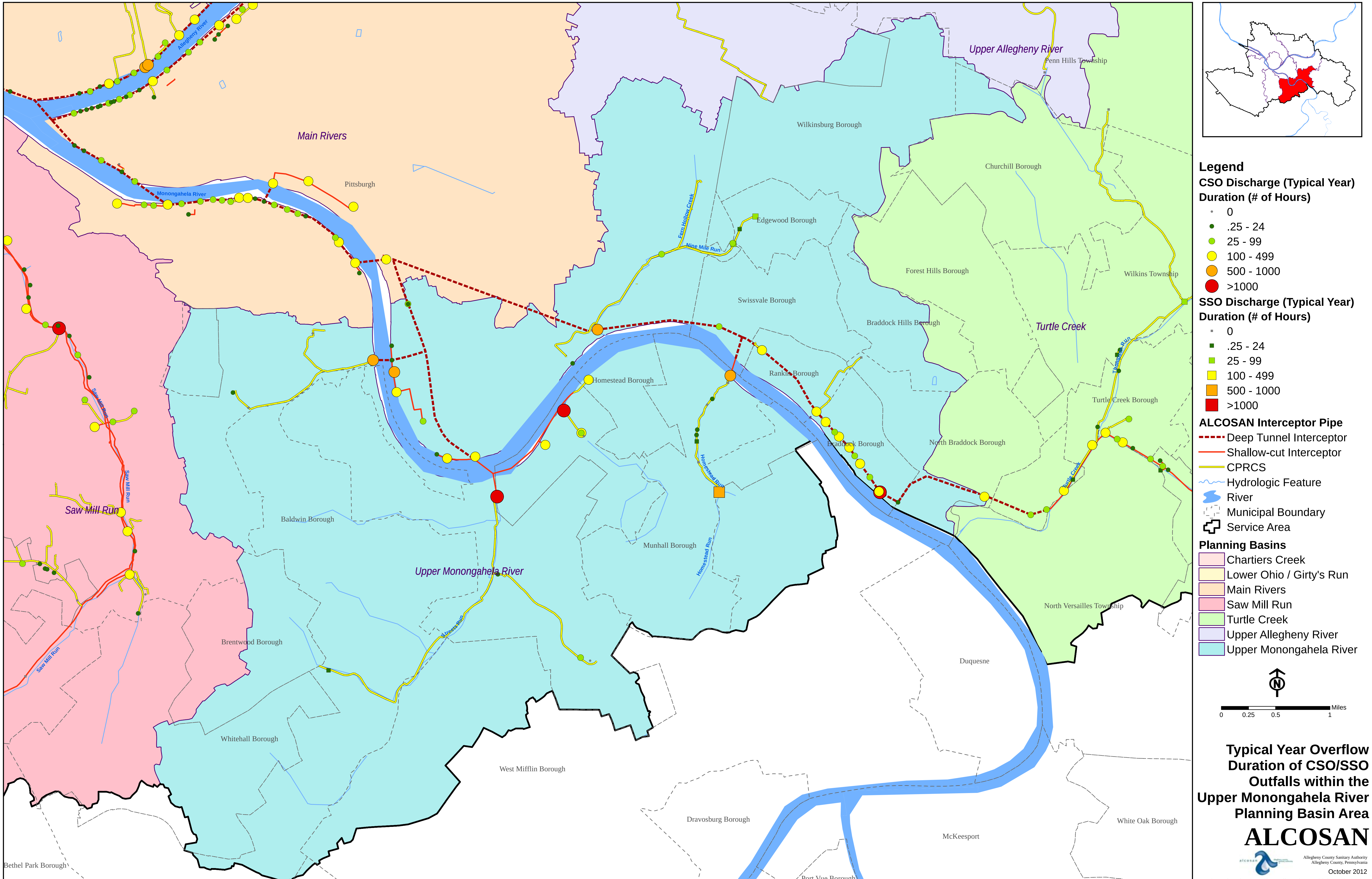
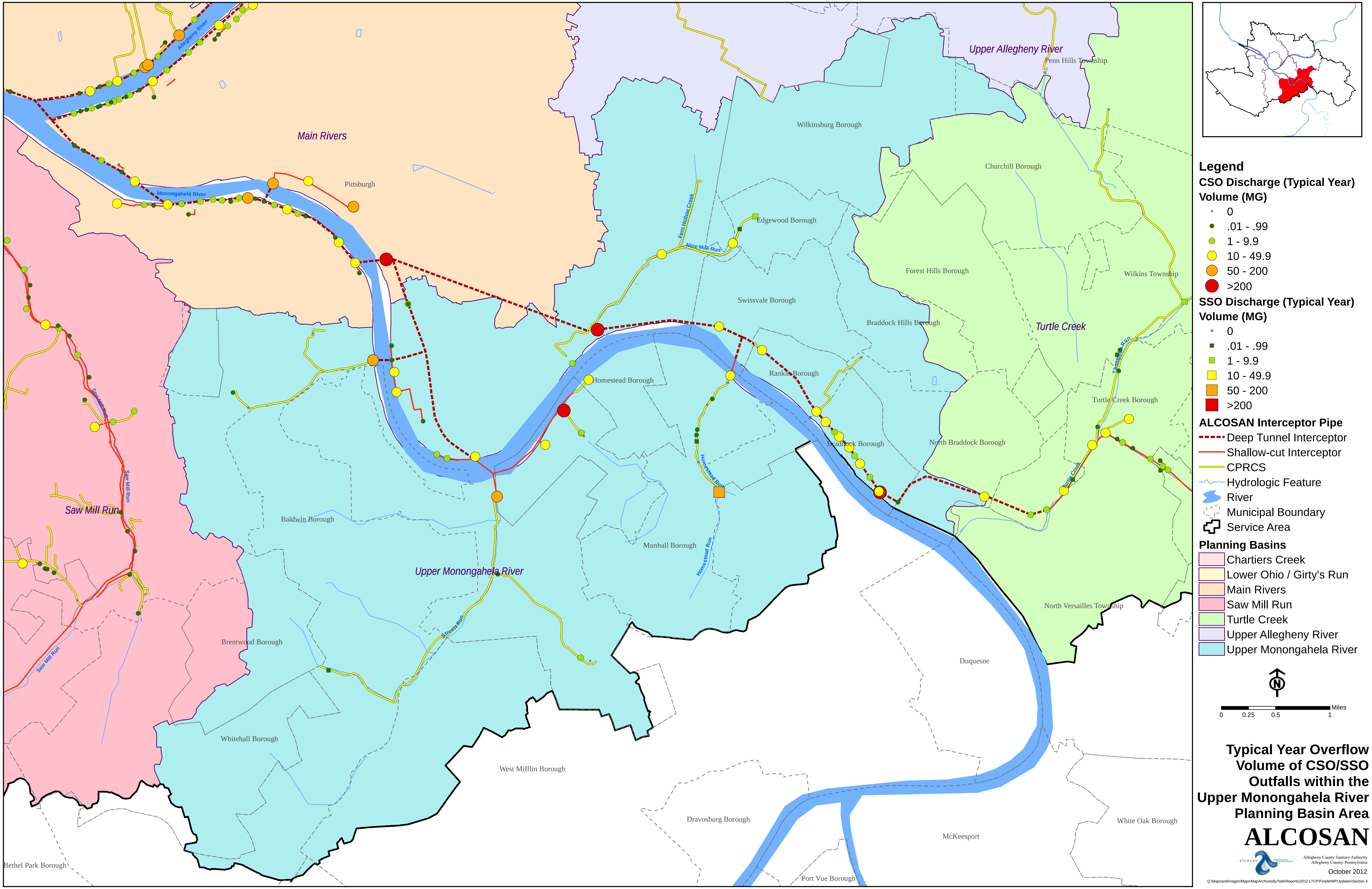


Figure 4-48: Typical Year Overflow Volume of CSO/SSO Outfalls within the Upper Monongahela River Planning Basin Area



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