9.0 ALTERNATIVES ANALYSIS

Executive Summary: The Basin Planners (BPs) developed and evaluated control technologies and sites which formed the basis for the development of Site Alternatives. From there, the BPs arrayed and sized viable Site Alternatives to formulate Basin Alternatives (described in Section 9.4). The Program Manager (PM) integrated the alternatives from all seven planning basins with complementary regional alternatives to form various system-wide alternatives. Each system-wide alternative (described in Section 9.5.2) represented a complete plan to control ALCOSAN and municipal CSOs and SSOs, to a selected level of control. As prescribed by the National CSO Policy[9-1], a range of CSO levels of control were evaluated, including alternatives targeting the Presumption and Demonstration Approach criteria. A range of SSO control levels were also considered, including the 2-year and 10-year level of control as indicated in ALCOSAN's Consent Decree (CD). As described throughout Section 9.5, a series of system-wide alternatives analyses were conducted that supported the decision making as to how ALCOSAN proposes to eliminate sanitary sewer overflows from the ALCOSAN system and to control combined sewer overflows in compliance with the Clean Water Act (CWA), consistent with the National CSO Policy[1].

ALCOSAN determined that the most cost effective means of complying with the CD and CSO Policy requirements is via the Demonstration Approach (Section 9.6.1). System-Wide Alternative 3f modified-10pct was shown to cost effectively achieve the ultimate goals of the elimination of SSOs and reduction of CSOs such that the attainment of water quality standards will not be precluded by remaining CSOs. This alternative is based on expanded treatment capacity at the Wood's Run WWTP, new regional conveyance, and several remote storage facilities. As System-Wide Alternative 3f modified-10pct was chosen as the Selected Plan, the technical feasibility of completing the plan by the 2026 CD implementation schedule was analyzed (Section 9.6.2). The analysis concluded that such an aggressive implementation schedule would likely overburden the contractor, labor and material resources available to do the work reliably and cost effectively, introducing unacceptable risk of cost inefficiencies and quality control concerns. In addition, ALCOSAN conducted an Affordability Assessment of the Selected Plan utilizing the methodology outlined in the 1997 USEPA guidance document[9-2] (Section 9.6.3). The analysis concluded that the Selected Plan, with an estimated planning level capital cost of approximately $3.6 billion in 2010 dollars, is cost prohibitive under a 2026 timeframe.

The CSO Control Policy includes provisions for the phased implementation of a long term control plan based upon the relative importance of adverse impacts upon water quality standards and on financial capability. Given that implementing a $3.6 billion program through 2026 would be unaffordable, raise serious financing questions, and risk cost inefficiencies and quality control concerns, ALCOSAN considered priority improvements and control strategies that could be realistically implemented by the CD established 2026 timeframe. Affordable 2026 alternatives were therefore developed as sub-sets of the Selected Plan, such that they could

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[9-1] EPA (U.S. Environmental Protection Agency). 1994. Combined Sewer Overflow (CSO) Control Policy. FRL-4732-7. Federal Register 59(75).

[9-2] Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development, EPA March 832-B-97-004

serve as an initial phase of improvements towards the longer term plan (Section 9.7). Analyses of these Affordable 2026 alternatives led to ALCOSAN's Recommended Plan for 2026, as presented in Section 10.

9.1 Regional Coordination & Integration Methodology

As described in Section 1, the approach taken by ALCOSAN in their wet weather planning process included dividing the ALCOSAN service area into seven planning basins to assure the appropriate level of municipal coordination, and attention to local conditions and priorities. Seven planning basin teams were procured to develop wet weather control alternatives and facilities plans for each of the planning basins. ALCOSAN obtained the services of a Basin Coordinator (BC) to provide the necessary inter-basin coordination and a Program Manager (PM) to provide technical leadership through guidance, standards, and progress meetings throughout the wet weather planning process.

As described in Section 8, the Basin Planners (BPs) developed and evaluated control technologies and sites which formed the basis for the development of site alternatives. From there, the BPs arrayed and sized viable site alternatives to formulate basin alternatives. As the BPs developed and refined basin alternatives for different levels of CSO and SSO control, the PM integrated the alternatives from all seven planning basins with complementary regional alternatives to form various system-wide alternatives. The PM then evaluated the system-wide impacts and recommended modifications to the basin alternatives to improve performance and reduce costs. This general process is illustrated in Figure 9-1.

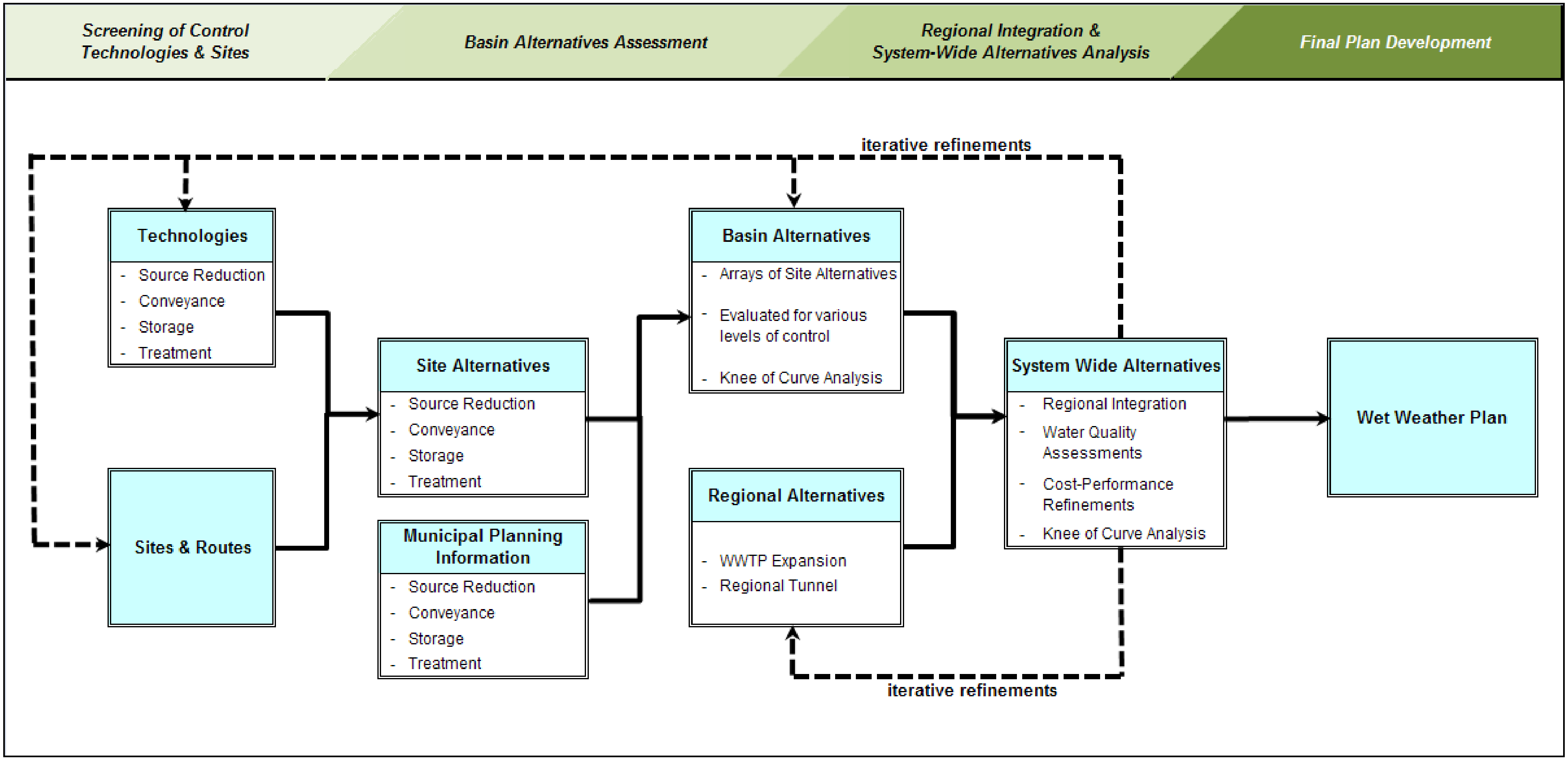
Throughout this entire process, standard guidance and protocols were established and utilized to support the efficient integration of numerous combinations of basin and regional control alternatives into seamless system-wide strategies. This section briefly describes the regional integration process, and summarizes the most significant guidance and protocols used throughout the process.

- Regional integration process
- Sensitive areas
- Cost estimating
- Hydrologic & hydraulic modeling
- Incorporation of municipal planning information

9.1.1 Regional Integration Process

Basin alternatives were analyzed by the BPs for various levels of CSO and SSO control. In parallel with this effort, the PM analyzed complementary regional alternatives that included new regional conveyance, storage, and treatment serving some or all planning basins. As the BPs identified and improved upon basin alternatives, the PM integrated the basin alternatives with complementary regional alternatives to form system-wide alternatives. Each system-wide alternative represented a complete plan to control ALCOSAN and municipal CSOs and SSOs, to a selected level of control.

Figure 9-1: Alternatives Development and Regional Integration Process



The PM then evaluated the system-wide impacts and recommended modifications to the basin alternatives to enhance water quality benefits and/or reduce regional implementation costs. Many technical, economic and regulatory compliance factors were considered collectively during this process, including:

- Municipal flow projections and planned overflow control improvements,
- Maximizing the benefit of existing conveyance and treatment plant infrastructure,
- Cost-benefit of alternative treatment plant expansion capacities,
- Dynamic simulations of hydraulic grade lines impacted by upstream and downstream basins and the treatment plant wet well elevation,
- Opportunities to consolidate planning basin facilities to improve performance, minimize operational complexity, and/or reduce costs,
- Consideration of a range of CSO and SSO control levels,
- Treatment performance,
- Consideration of sensitive areas, and
- Water quality benefits

These complex inter-related factors required a collaborative and iterative alternatives analysis process whereby municipal, basin, and regional control strategies were progressively integrated and refined to converge on cost-effective solutions for the region. The following sections 9.2, 9.3, 9.4, and 9.5 present the alternatives analysis results for the Wood's Run treatment plant, municipal controls, basin controls and integrated system-wide solutions, respectively. The iterative regional integration of these components led to identifying the most cost effective and preferred overflow control solutions considered in the development of this WWP.

9.1.2 Sensitive Areas

As another component of the Basin Alternatives development and analysis process, the BPs evaluated alternatives that provided a higher level of priority to sensitive areas as defined in the Consent Decree (CD). Appendix C of the ALCOSAN CD defines nine sensitive areas. These CD defined sensitive areas, previously listed on Table 5-10 and shown on Figure 5-6, include drinking water intakes (DWI), marinas, boat ramps, and parks along the Allegheny, Monongahela, and Ohio Rivers. This section provides a summary of the CD requirements pertaining to sensitive areas, and the guidance that was provided to basin planners in evaluating the control of CSO discharges directly impacting these sensitive areas.

The CD requires that the WWP include a proposal for addressing the sensitive areas listed in Appendix C, (Sensitive Areas), as well as any other sensitive areas identified by ALCOSAN in the WWP, in a manner that is consistent with EPA's Combined Sewer Overflow Policy. ALCOSAN has not identified any other sensitive areas in the WWP.

The CSO Policy states for sensitive areas:

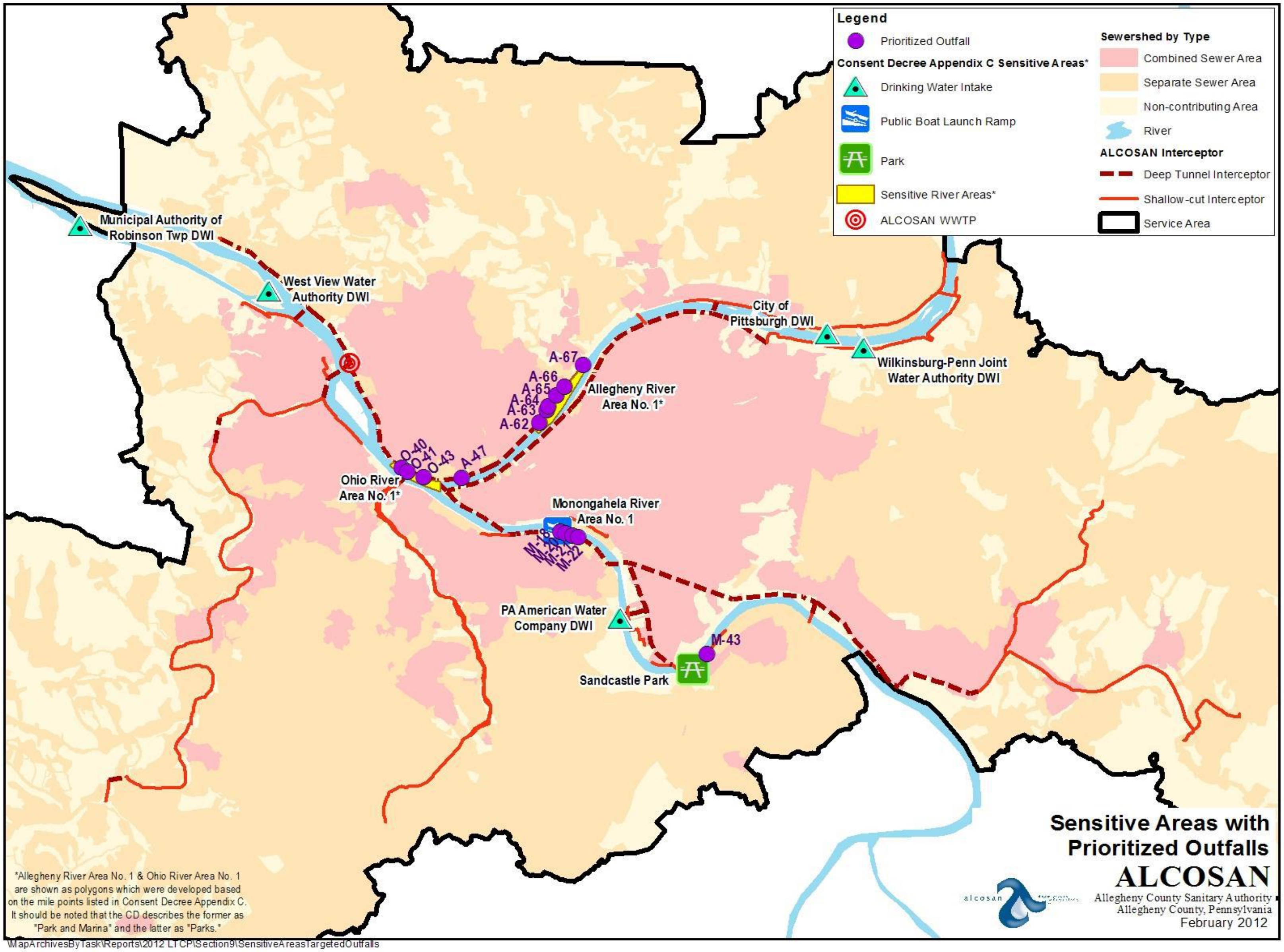
> *EPA expects a permittee's long-term CSO control plan to give the highest priority to controlling overflows to sensitive areas. For such areas, the long-term CSO control plan should:*
>
> - *Prohibit new or significantly increased overflows;*
> - *Eliminate or relocate overflows that discharge to sensitive areas wherever physically possible and economically achievable, except where elimination or relocation would provide less environmental protection than additional treatment; or*
> - *Where elimination or relocation is not physically possible and economically achievable, or would provide less environmental protection than additional treatment, provide the level of treatment for remaining overflows deemed necessary to meet WQS for full protection of existing and designated uses. In any event, the level of control should not be less than those described in Evaluation of Alternatives below; and*
> - *Where elimination or relocation has been proven not to be physically possible and economically achievable, permitting authorities should require, for each subsequent permit term, a reassessment based on new or improved techniques to eliminate or relocate, or on changed circumstances that influence economic achievability.*

In a manner consistent with the CSO Policy, higher priority was given to sensitive areas as part of the alternatives development and analysis process. Alternatives were evaluated to provide a higher level of control to CSOs that discharge directly to sensitive areas plus a fixed distance upstream on the same river bank. Table 9-1 lists theses CSOs which are also reflected on Figure 9-2.

Table 9-1: Targeted Outfalls for Higher Level of CSO Control

Planning Basin	Outfall
Lower Northern Allegheny	A-62
	A-63
	A-64
	A-65
	A-66
	A-67
Main Rivers	A-47
	M-18
	M-20
	M-21
	M-22
	O-40
	O-41
	O-43
Upper Monongahela River	M-43

Figure 9-2: Sensitive Areas with Targeted Outfalls



For basin alternatives in support of select system-wide alternatives targeting 4-6 overflows per year for all CSOs, the following alternatives were evaluated for providing a level of control of zero overflows in the typical year for outfalls directly impacting sensitive areas.

- Eliminate the targeted CSO discharges by sewer separation, which is an alternative which would have to be implemented by the municipalities.
- Relocate targeted CSO discharges to a point downstream of the sensitive area, but still provide control. Up to 6 overflows/year would be discharged downstream of the sensitive area, but flows in excess of typical year flows could still discharge via existing outfalls if complete re-location is not feasible.
- Eliminate the targeted CSO discharges by means of other feasible alternatives as may be proposed by the basin planners.

For basin alternatives in support of select system-wide alternatives targeting 13-15 overflows per year for all CSOs, outfalls directly impacting sensitive areas were analyzed to receive a higher level of control at 4-6 overflows per year.

Following this analysis, sensitive area controls were incorporated into evolving system-wide control strategies, leading up to and including the recommended regional plan. Sensitive areas alternatives analysis results are described in WWP Sections 9.4.3, 9.4.4 and 9.4.8 for the Lower Northern Allegheny, Main Rivers and Upper Monongahela basins respectively with a summary provided in Section 9.5.7.

9.1.3 Cost Estimating

In developing the WWP, ALCOSAN and its 83 customer municipalities worked together to develop coordinated wet weather overflow control planning solutions that addressed both local and regional concerns in the most cost effective manner possible. To support this effort and to encourage the use of a standardized approach across the service area, an Alternatives Costing Tool (ACT) was developed for use in estimating costs for CSO/SSO control alternatives for planning level cost comparisons. ALCOSAN, in a joint effort with the Philadelphia Water Department (PWD), developed the ACT. The tool was used for comparing costs of conceptual CSO/SSO control alternatives with an expected accuracy of +50% to -30% (AACE Class 4 Estimate[9-3]). This section provides a summary of the ACT and how it was used to facilitate the evaluation and comparison of wet weather control strategies.

Construction cost estimating data and approaches included in the ACT were provided through input from ALCOSAN, PWD, and the ALCOSAN wet weather planning team including the basin planning teams with additional national experience in CSO program implementation. In addition, cost curves developed from national CSO control programs as well as the United States Environmental Protection Agency (USEPA), industry organization reports such as WEFTEC, and cost data provided by other municipal agencies were used for comparative analysis in selecting ACT cost curves. These curves were developed based on actual

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[9-3] As defined in the source document for the cost estimate classification system titled "AACE International Recommended Practice No. 18R-97."

construction cost data, local adjustment factors, and other engineering judgment decisions. A key step in the tool development was validation of cost curves with bids or actual costs of various CSO control projects constructed throughout the United States in the last 15 years.

In addition to estimating capital costs for potential alternatives, the ACT allows the user to account for annual operation and maintenance (O&M) costs, periodic renewal/replacement costs, and other "non-construction" costs such as land acquisition, engineering, legal and administration. The ACT also provides three methods for making present worth life-cycle calculations for direct comparison of alternatives, and can account for cost inflation at future construction dates.

Key outputs from the ACT include:

- Current year capital cost
- Current year O&M costs
- Current year renewal/replacement costs
- Present worth based on capital costs and projected O&M and renewal/replacement costs
- Future years' O&M costs based on assumed inflation
- Total capital costs

Table 9-2 displays the control technologies which are included in the ACT.

Built in a similar fashion as the ACT, a separate cost estimating spreadsheet tool was developed specifically for estimating costs for conventional tunnels constructed with a tunnel boring machine (TBM). This tool is known as the ACT Tunnel Template and was issued with the intent of calculating costs of complete TBM construction, including related appurtenances (such as vortex structures, drop shafts, deaeration chambers, adits, ventilation shafts, etc.) that would be associated with a TBM-constructed tunnel. Cost estimate values generated in the ACT Tunnel Template were then input manually into the ACT so that total present worth calculations for TBM construction were calculated in the same manner as other technologies, thus providing an equitable comparison of cost.

ACT version 2.0 and the associated ACT Tunnel Template were used for determining planning levels costs for site alternatives and basin alternatives. Control alternatives were developed with conceptual level determinations of facility size, type, and configuration. This information was entered into the costing tool through standardized templates. The ACT is configured to allow the user to evaluate sizing and configuration alternatives. Assumptions and calculations were displayed in a step-wise manner in the ACT, while providing the user the ability to reference the source data.

Table 9-2: ACT Technology Summary

Source Controls:
Land-Based Stormwater Management (Green Infrastructure)
Private I/I Reduction
Municipal I/I Reduction
Storage:
Conventional Tunnel
Tank Storage
Conveyance:
Open Cut Pipe
Pump Station
Short-Bore Tunnel (Trenchless)
Sewer Separation
Treatment:
Retention Treatment Basin
Vortex Separation
High-Rate Clarification
Screening
Disinfection
Satellite Secondary / Advanced Treatment
Miscellaneous:
Miscellaneous

For the alternatives analysis process, the ACT was used for calculating the present worth values. Capital and O&M costs were expressed in current dollars. The current year value of the future stream of O&M payments are discounted back to the current year, as are renewal/replacement costs. This methodology is simplistic but obviates the complexities involved in predicting inflation rates and the mid-point of construction dates which are unknown in the alternatives analysis process. Key costing assumptions for the alternatives analysis were as follows:

- Costs were based on 2009 dollars using the December, 2009 ENR CCI index value of 8641, and the 2009 RS Means Location Factor of 99.6 for Pittsburgh.
- For simplification purposes in comparing alternatives, O&M and renewal/replacement costs were based on 2027 as the first year of operation with 2046 as the last year of the planning period (i.e. 20 years of operation).
- The default discount rate of 6 percent was used.

The Feasibility Study Working Group (FSWG) created a municipal cost subcommittee to review and provide comment on the ACT tool. Several municipal engineers, along with ALCOSAN, worked cooperatively to develop a set of review comments and recommendations. In response to these review comments and recommendations, ALCOSAN provided an updated version of the ACT (version 2.1) to the FSWG and customer municipalities for their use. Version 2.1 was the same as version 2.0 except for several updates requested by the FSWG Municipal Cost Subcommittee. The most noteworthy revisions to the tool were: 1) a new costing module was added for open cut conveyance pipe applications based upon local cost data from the municipalities and the Pittsburgh Water and Sewer Authority (PWSA) for open cut pipe installations; and 2) two additional Cured in Place Pipe (CIPP) unit cost options were added under the Municipal I/I reduction costing module to reflect data submitted for local municipal installations and PWSA installations respectively. This updated version was tailored to meet municipal needs, and was not used by ALCOSAN. Some of the municipal planning information submitted by ALCOSAN's customer municipalities made use of ACT version 2.1 in the costing and evaluation of municipal alternatives (as described in Section 9.3).

9.1.4 Hydrologic and Hydraulic Modeling

To ensure consistent evaluation of basin alternatives, a number of hydrologic and hydraulic (H&H) modeling standards were developed in addition to those described in the *Hydrologic and Hydraulic Modeling Plan*[9-4]. Several of the most pertinent modeling standards are summarized below.

Future Baseline Models for Alternative Evaluation: The baseline for evaluation of all wet weather alternatives were the H&H models of Future Baseline Conditions as described in Section 7.2. These future baseline models are a reflection of the projected flows in year 2046 in the ALCOSAN and municipal collection systems without any implementation of wet weather controls, as described further below.

The following items ***are*** included or assumed in the future baseline condition models:

- Projected changes in dry weather flows resulting from changes in projected population and sewershed area growth.
- Projected increases in wet weather flows due to planned development and redevelopment activities, as represented by sewershed area growth.
- Any projects (apart from WWP projects) by ALCOSAN, the customer municipalities, or other entities that already have been completed after 2008, are currently underway and have a scheduled completion date, or are in the planning stages with an estimated completion date before 2026. These projects were previously summarized in Table 7-6 and mapped in Figure 7-2.
- It was assumed that the existing municipal and ALCOSAN collection systems would be maintained and rehabilitated at a sufficient level to prevent increases in the rate of extraneous flow (GWI or RDII) conveyed to the ALCOSAN system.

[9-4] ALCOSAN Wet Weather Program, Hydrologic & Hydraulic Modeling Plan, August 2009

- It was assumed that the municipal collection systems would be inspected and cleaned at a frequency established in a comprehensive long-term maintenance plan to prevent significant deposits of solids and debris from accumulating.

- For the ALCOSAN deep tunnel interceptor system, a conservative assumption was made that the sediment accumulations along the deep tunnel system would be at the same levels and distribution as those used in validating the existing condition models.

The following ***are not*** included in the future baseline condition models:

- An increase in the treatment capacity of the Woods Run plant
- Municipal trunk sewer upgrades to increase conveyance capacities to the ALCOSAN system
- Wet weather control facilities or remedial activities documented in the WWP

Overflow Event Definition: For purposes of reporting overflow statistics derived from H&H model simulation results, the definition of an overflow event is as follows:

- For an individual outfall, multiple periods of overflow are considered one overflow event if the time between periods of overflow is no more than 24 hours.
- In general, for a particular Receiving Water or other receiving stream, multiple periods of overflow from one or more outfalls are considered one overflow event if the time between periods of overflow is no more than 24 hours without a discharge from any outfall.

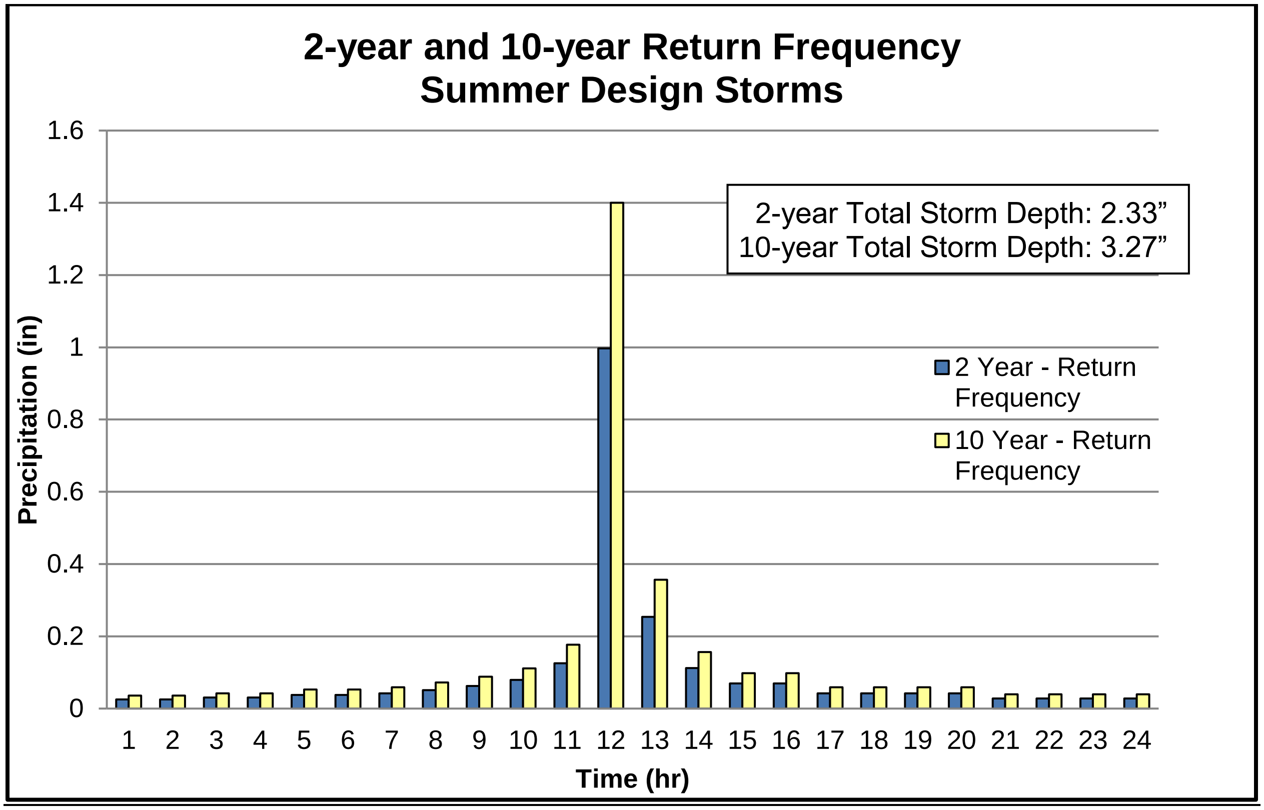
Basis for Sizing Facilities and Conveyance: The alternatives evaluation process involved sizing and evaluating facilities serving both combined and separate sanitary areas. For sizing conveyance and facilities in combined areas, continuous H&H model simulations were performed for the typical year to achieve the targeted level of CSO control, which ranged from zero to 20 overflows in the typical year. To establish the CSO levels of control that were analyzed, a knee-of-the-curve (KOC) analysis was performed at the basin level, and combined with regional costs to create a system-wide KOC. The BP KOC plots are described in Section 9.4 and the system-wide KOCs are presented in Sections 9.5.3 and 9.5.6. For sizing conveyance and facilities in separate sanitary areas, a design storm approach was utilized with the H&H models (for levels of control greater than the typical year). The levels of SSO control (elimination) evaluated ranged from the typical year up to a 10 year level of control. The following remainder of this section describes the design storm approach used for sizing conveyance and facility alternatives for the 2 and 10 year levels of control.

For sizing conveyance and facilities in separate sanitary areas for a given level of control, synthetic summer and winter design storms were developed and used in H&H model simulations to ensure conservative facility sizing. For each level of control analyzed, H&H model simulations were conducted for summer and winter design storms with the facilities for a given alternative in-place. These simulations were used to verify and/or adjust facility and conveyance sizing such that there were no SSO discharges, and no flooding in separate sanitary areas for the selected level of control.

SCS Type II Summer Design Storm: Single event synthetic design storms were developed based upon NOAA Atlas 14 volumes[9-5] and an SCS Type II distribution. The precipitation volumes presented in the atlas were based upon statistical analyses conducted on the historical precipitation record from the Pittsburgh WSCOM gage located near the Pittsburgh International Airport. A Soil Conservation Service (SCS) Type II distribution was applied to the synthetic design storm depths. The NOAA Atlas analysis results indicated that the 60 minute duration design storms typically associated with intense thunderstorm activity are most likely to occur during the months of June through August. The 24 hour design storms typically associated with large frontal systems are most likely to occur during the months of June through September.

The 2-year and 10-year summer design storms are shown in Figure 9-3. In modeling basin alternatives and system-wide alternatives, these 2- and 10-year summer design storms were applied to a typical summer dry weather period.

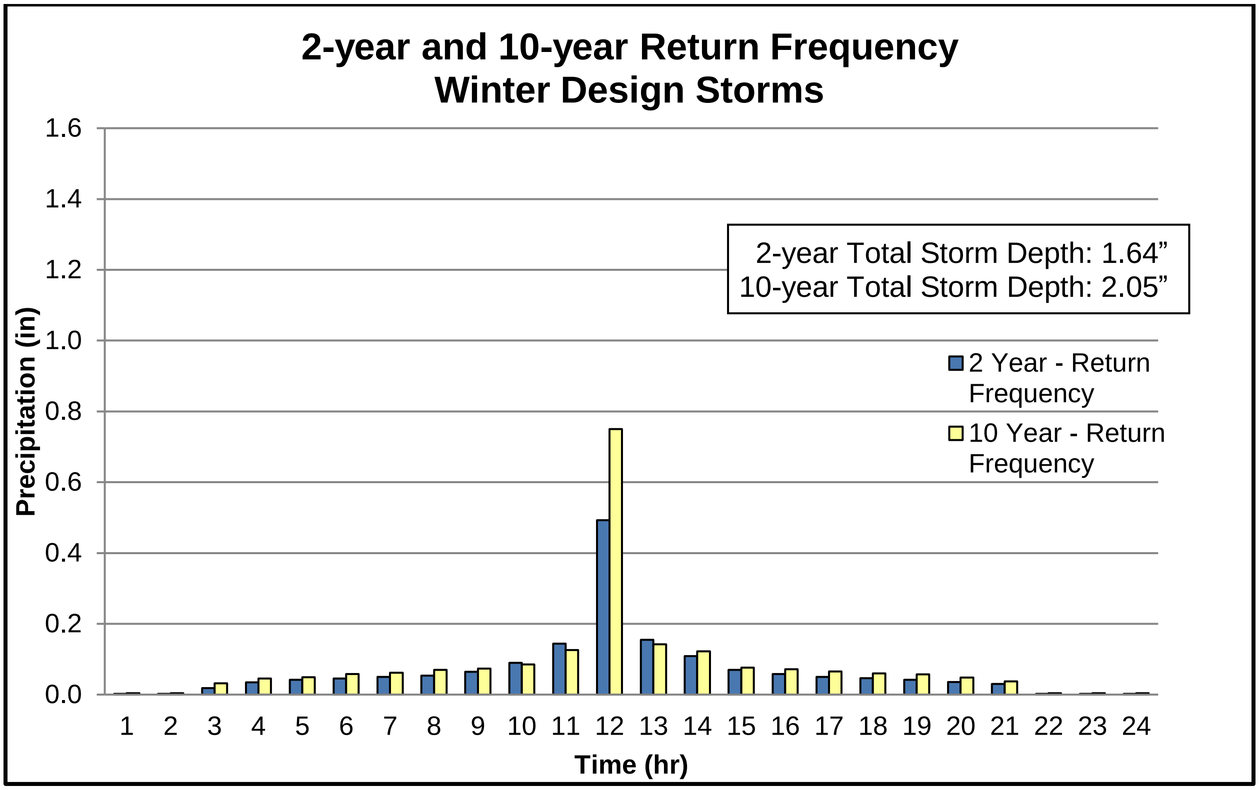
Figure 9-3: SCS Type II Summer Design Storms



9-5 Precipitation Frequency Atlas of the United States, NOAA Atlas 14, Volume 2, Version 3.0, NOAA, National Weather Service, Silver Spring, Maryland, 2006

Winter Design Storm: In the process of analyzing monitored flow data for developing their refined existing conditions models, some of the basin planners observed that peak flow from some sanitary sewershed areas was occurring during the winter season. Similar observations had been noted by some of the customer municipalities. This is attributed to the higher quantities of infiltration and inflow and the higher groundwater infiltration flow that can occur during winter conditions. To account for this observed condition, design storms specific to the winter season were developed by the 3 Rivers Wet Weather (3RWW) team. An analysis of the long-term gauge record at the Pittsburgh Airport was conducted to develop intensity-duration-frequency (I/D/F) curves. Symmetrically stacked rainfall distributions, in 15 minute time steps, were developed from the IDF analysis results for the 1, 2, 5, and 10 year return intervals. The 2-year and 10-year winter design storms are shown in Figure 9-4.

Figure 9-4: Winter Design Storms



In modeling system-wide alternatives, these 2- and 10-year winter design storms developed by the 3RWW team were applied to a typical winter dry weather period. To be conservative, all precipitation was treated as rainfall in all applications of the winter design storm regardless of the actual temperatures for the dry weather period selected. The general approach to H&H modeling is described in Section 4. Modeling specifics, such as the modeling approach relative to snowpack/snowmelt, can be found in ALCOSAN *Hydrologic & Hydraulic Modeling Plan*.

9.1.5 Incorporation of Municipal Planning Information

This section summarizes the general protocol used to incorporate municipal planning information into basin alternatives. Section 9.3 provides further details about the information requested and how it was incorporated in to the recommended regional plan.

In April of 2010, the validated H&H models for each planning basin and the associated H&H validation reports were made available by ALCOSAN to all customer municipalities. In response to a request from ALCOSAN, municipalities then provided preliminary flow estimates to ALCOSAN, which typically made use of the validated models or other H&H analysis tools developed by 3RWW. As this information was reviewed, the basin planners met with the municipalities to ensure that the basin planner model predictions for future municipal flows were in reasonable agreement with municipal projections. For some municipalities this was an iterative process involving multiple meetings and model revisions.

Early in the alternatives development process when municipal plans were unknown, all basin alternatives were developed based on the assumption that new municipal conveyance would be constructed where needed to convey all flows to ALCOSAN (i.e. no municipal overflows would remain). Later, ALCOSAN formally requested additional information from each municipality and authority regarding their anticipated control strategies. As this requested information was received, the latest understanding of each municipality's submitted planning information was incorporated into the sizing of basin alternatives, including their preferred municipal control strategy, if available. The incorporation of municipal planning information into the basin alternative evaluation and modeling followed the general guidelines below based on the information available at the time each basin alternative was evaluated:

1. The controls for each municipality were based on the best planning information available in formal written correspondence.

2. If a municipality had not yet provided the planning information or the information submitted was unclear and had not yet been reconciled, a "convey all flows" assumption continued to be used for each such municipality.

3. If a municipality provided a range of controls being considered or provided results for multiple levels of CSO and/or SSO control without indicating a preferred level of control, a 2-year level of control was assumed for SSOs, and a 4-6 overflows/year level of control was assumed for CSOs.

4. If a municipality provided detailed information about their proposed control strategy, any proposed sewers and storage facilities within the current model extents were added to the BP models. When information was not adequate or it was not feasible to add the proposed sewers and storage facilities to the BP models, the municipal planning information was represented in the models to the extent possible.

9.2 Woods Run WWTP and Satellite Treatment Alternatives Analysis

Since completing the *Comprehensive Sewage Facilities Plan* in 1996, prepared in compliance with the provisions of the Pennsylvania Sewage Facilities Act of 1965 (Act 537 Plan), ALCOSAN has maintained that maximizing flows to the Woods Run WWTP is a critical component to the ultimate success of a regional wet weather plan.

Following approval in 1999 of the Act 537 Plan by the Pennsylvania Department of Environmental Protection (DEP), the Allegheny County Health Department (ACHD) and the 83 service area communities, ALCOSAN was authorized to proceed with the first phase of a multi-phased Capital Improvements Program (CIP) at the Woods Run WWTP. Completion of the CIP Phase I construction projects in 2004 and more recently completed interim capital improvements through 2009 resulted in expansion of the full treatment capacity from 200 mgd to 250 mgd (effective Spring 2009). The capital improvements completed under Phase I also included the expansion of primary treatment and sodium hypochlorite storage facilities in anticipation of higher peak wet weather capacity to be implemented under Phase II of ALCOSAN's CIP. Refer to Section 3.1 for an overview of the existing WWTP and see Figure 9-5 for a current site plan.

Beginning in 2004 ALCOSAN launched efforts to reevaluate the initially proposed wet weather flow management strategy at the WWTP considering the passing of over ten years since the completion of the Act 537 Plan. In addition, execution of the ALCOSAN Consent Decree and further development of regional conveyance planning has influenced the objectives for WWTP expansion. The results of this preliminary evaluation were shared with EPA, DEP and ACHD in the *Draft Bypass Justification Report* (April 2010). This section provides an update of the WWTP alternatives analysis and bypass demonstration evaluation initially submitted in the *Draft Bypass Justification Report*.

This section also provides a summary of the consideration of satellite sewage treatment (SST) technology in each of the seven ALCOSAN Planning Basins (Section 9.2.6).

9.2.1 Wastewater Characteristics

Wastewater characteristics at the Woods Run WWTP are monitored by daily 24-hour composite and grab samples and analysis in the ALCOSAN Laboratory for chemical oxygen demand (COD), total suspended solids (TSS), volatile suspended solids (VSS), and ammonia nitrogen (NH_3-N), among other parameters. Plant influent biochemical oxygen demand (BOD) is derived from COD measurements then using a historical COD to BOD ratio of 2:1.

For the purpose of this analysis, daily plant monitoring data for a 36-month period from January 2004 through December 2006 were used to characterize the wastewater at the Woods Run WWTP. Primary influent and primary effluent pollutant characteristics were analyzed to facilitate evaluation of alternative scenarios for expansion of the WWTP for wet weather treatment.

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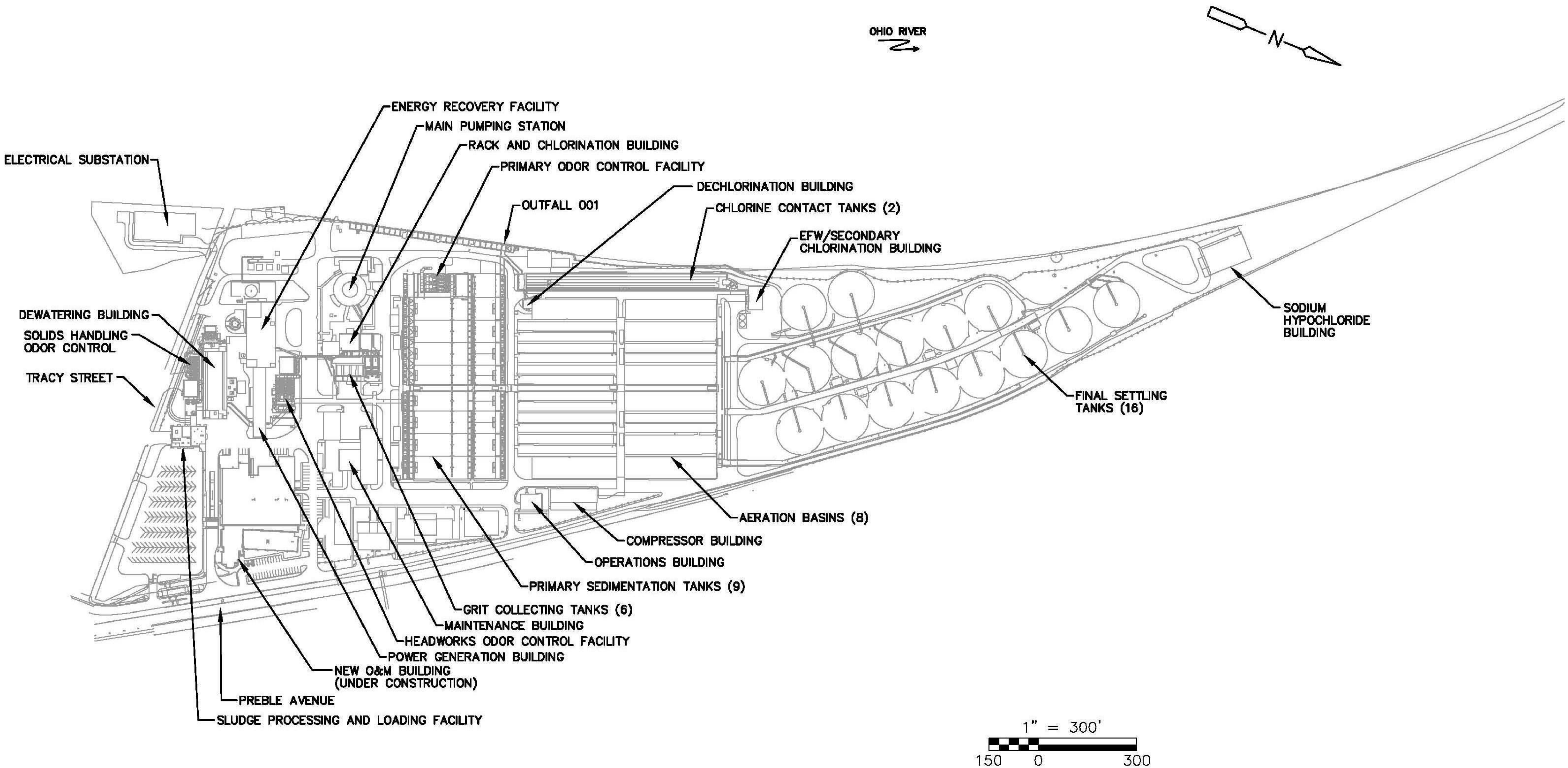
Figure 9-5: ALCOSAN Woods Run WWTP Site Plan



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Primary influent and primary effluent daily flows and loading data for the Woods Run WWTP for this time period are summarized in Table 9-3 and Table 9-4, respectively. Primary influent and primary effluent TSS, BOD and NH3-N concentrations are summarized in Table 9-5 and Table 9-6, respectively. Maximum month flows and loads (BOD and TSS) correspond to the 98th percentile value of the rolling 30-day average daily flow and load data, while maximum week flows and loads correspond to the 98th percentile value of the rolling 7-day (NH3-N) average of daily flow and load data. Maximum month and maximum week ammonia loadings are based on calendar months and weeks since primary effluent samples are typically tested 5 days/week for ammonia. Maximum day values correspond to the 98th percentile value of all daily flow and load data. The BOD data are based on daily COD testing of primary influent and primary effluent samples and the historical COD:BOD ratio of 2:1.

Table 9-3: Primary Influent Flows and Loads, 2004 through 2006

Parameter	Flow (mgd)	BOD (lbs/day)	TSS (lbs/day)	NH_3-N (lbs/day)
Average Daily	191	156,694	224,167	10,303
Maximum Month	220	278,117	314,944	13,951
Maximum Week	224	281,460	366,248	16,061
Maximum Day	225	308,046	501,548	19,910

Table 9-4: Primary Effluent Flows and Loads, 2004 through 2006

Parameter	Flow (mgd)	BOD (lbs/day)	TSS (lbs/day)	NH_3-N (lbs/day)
Average Daily	191	79,018	66,925	9,332
Maximum Month	220	117,736	100,130	14,432
Maximum Week	224	130,900	126,830	16,675
Maximum Day	225	164,290	148,032	19,751

Table 9-5: Primary Influent Concentrations, 2004 through 2006

Parameter	BOD (mg/L)	TSS (mg/L)	NH_3-N (mg/L)
Average	96	142	6.7
Maximum Day (98^{th} percentile)	208	309	14.0

Table 9-6: Primary Effluent Concentrations, 2004 through 2006

Parameter	BOD (mg/L)	TSS (mg/L)	NH_3-N (mg/L)
Average Daily	50	42	6.1
Maximum Day (98th percentile)	105	100	14.4

Analysis of the three-year loadings data indicates the primary sedimentation tanks achieved removals of 50% BOD, 70% TSS and 9% Ammonia on average daily basis.

To evaluate the feasibility of high rate operation of the primary sedimentation tanks during wet weather a primary stress testing program was performed during 2005 and 2006 This full-scale stress testing program investigated the performance of the primary treatment process at surface overflow rates up to 3,100 gpd/ft²(limited by tank hydraulic capacity as explained in Section 9.2.2). The wastewater sampling and testing conducted as part of this stress testing also provided the opportunity to further characterize primary influent and primary effluent during dry and wet weather without the influence of co-settled waste activated sludge (WAS). Co-settling of WAS in the primary sedimentation tanks is the current operating practice, however, separate WAS thickening facilities are proposed for future wet weather operations at the WWTP. Table 9-7 summarizes the average primary influent and primary effluent TSS, BOD and ammonia concentrations during dry vs. wet weather.

Table 9-7: Average Daily TSS and BOD Concentrations During Primary Stress Testing

Weather Conditions	Primary Influent			Primary Effluent		
	BOD, mg/L	TSS, mg/L	NH_3-N, mg/L	BOD, mg/L	TSS, mg/L	NH_3-N, mg/L
Out of CSO (dry weather)	109	183	8.0	50	53	7.9
In CSO (wet weather)	90	153	5.5	46	50	5.9
Overall	104	174	7.2	49	53	7.3

The distinction between dry weather conditions (Out of CSO) and wet weather conditions (In CSO) shown in Table 9-7 is based on the occurrences of CSO events defined as days when the water level in the Main Pumping Station at the WWTP exceeds an elevation of 685 feet. Above this wet well level some CSO regulators in the regional conveyance system begin to overflow. The TSS, BOD and ammonia average characteristics of the primary influent exhibited some dilution in concentration during wet weather. Also noted was the primary effluent TSS and BOD concentrations remained approximately 50 mg/L during dry and wet weather. No ammonia removal was observed during the stress testing program. The average BOD removals during dry and wet weather were 50% and 44%, respectively. The average TSS removals during dry and wet weather were 68% and 61%, respectively. For further information on the primary stress testing program refer to the primary treatment description in Section 9.2.2 below.

9.2.2 Existing Treatment Processes Capacity for Wet Weather Treatment

This section summarizes current conditions of the existing Woods Run WWTP treatment process along with an assessment of capacity for proposed wet weather treatment. The current NPDES permit for the WWTP allows a daily discharge up to 250 mgd. The estimated peak flow treatment capacity of the WWTP is 275 mgd.

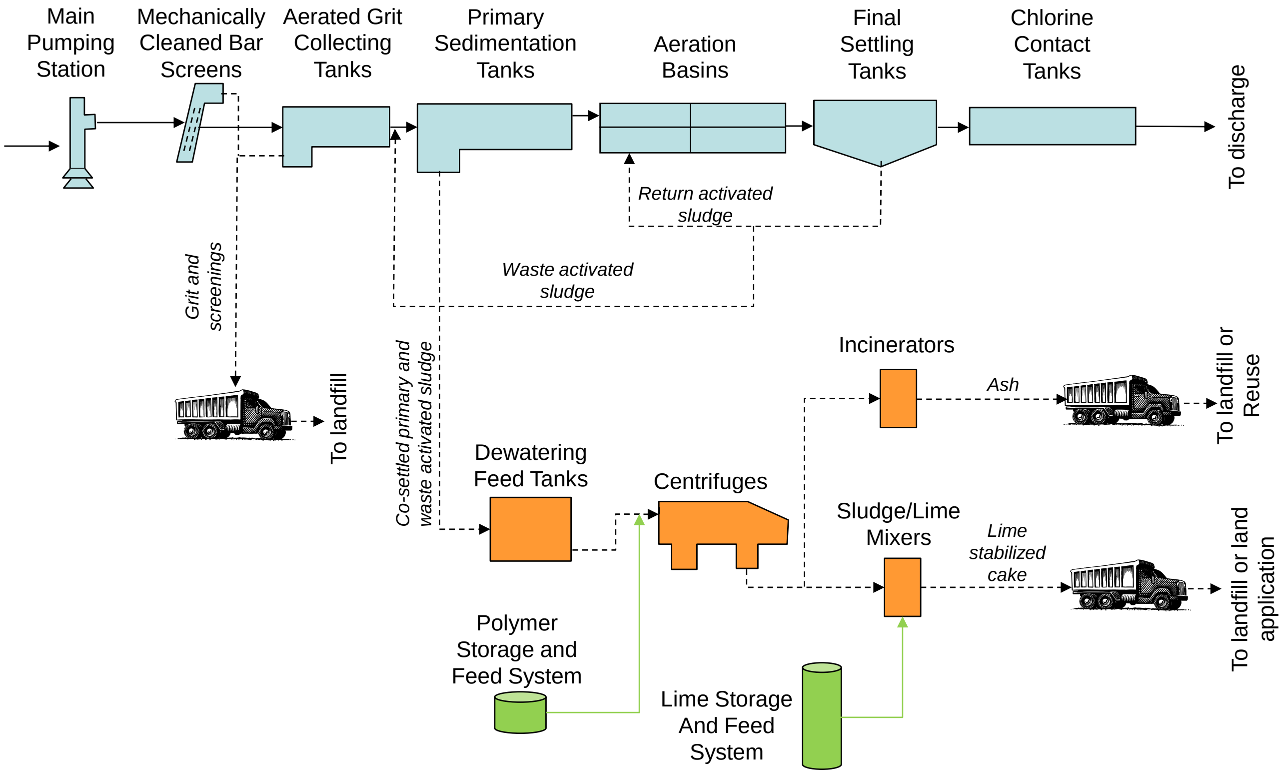
Appendix T (Bypass Demonstration) of the CD stipulates conditions for allowance of a bypass of all or any portion of the primary or secondary treatment process at the Sewage Treatment Plant. Among these conditions includes a demonstration that the secondary treatment portion in its current form is properly operated and maintained and that the Sewage Treatment Plant is designed to meet secondary limits for flows greater than the Peak Dry Weather Flow plus an amount of Wet Weather Flow equal to 25% of Peak Dry Weather Flow. ALCOSAN is in compliance with these requirements as follows:

- ALCOSAN's Consulting Engineer of Record (Chester Engineers) conducts quarterly and annual reviews of the WWTP operation and maintenance. The most recent annual report to ALCOSAN (December 2011) certified proper operation and maintenance of the wastewater treatment facilities and NPDES permit compliance was achieved throughout fiscal year 2011 (October 2010 through September 2011).

- The Peak Dry Weather Flow as defined in the CD is the annual average of the highest flow value for each day of Dry Weather Flow, in mgd. Based on a review of the flow records for the Woods Run WWTP between years 2003 and 2008, inclusive, the Peak Dry Weather Flow ranged from a low of 185 mgd in 2006 to a high of 216 mgd in 2007. Thus, the Peak Dry Weather Flow plus 25% for the same time period ranges from 231 mgd to 258 mgd. The current secondary treatment peak flow capacity of the Woods Run WWTP is approximately 275 mgd, which complies with the CD requirements.

Figure 9-6 shows the exiting wastewater and solids treatment processes which are further described below.

Figure 9-6: Woods Run WWTP Existing Process Flow Schematic



Main Pumping Station: The Main Pumping Station includes a 40-foot diameter wet well that is 102-feet deep and receives wastewater via three main interceptors (Upper Ohio, Lower Ohio and Chartiers Creek). There are six variable speed pumps located in the circular dry well around the outside perimeter of the wet well.

Early planning efforts during the preparation of the Act 537 Plan considered the potential to expand the total capacity (all six pumps) of the Main Pumping Station to 875 mgd through replacement of the existing pumps with larger pumps. Subsequent evaluation of the pumping station has lowered expectations for expansion of the existing pumping station for the following reasons:

- Concern for adverse hydraulic conditions in the wet well and pump intakes;
- Consideration of firm pumping capacity based on four of the six pumps in service;
- Expectations of lower wet well operating level necessary to maximize conveyance capacity to the plant.

ALCOSAN has proceeded with design of upgrades to the Main Pumping Station due to concern with potential failure of aging equipment. This design work has determined a maximum unit pumping capacity of 120 mgd can be achieved through replacement with a larger pump. This upgrade project will result in a firm capacity of 480 mgd for the Main Pumping Station.

Headworks: The headworks include the preliminary wastewater treatment processes of screenings removal and grit removal. In 2007 ALCOSAN completed construction of the Interim Grit and Screenings project that added two bar screens and two grit settling tanks to the WWTP's original four process trains. The primary objective of this project was to increase the redundancy and reliability of the preliminary treatment process and provide a firm capacity of 250 mgd with four of the six process trains in service. With five of the six process trains in service the peak flow capacity of 275 mgd can be achieved.

Wastewater pumped from the Main Pumping Station enters the Rack and Chlorination Building through an underground conduit where it is split between six bar screen channels. Each mechanically-cleaned bar screen has a stationary rack of steel bars spaced ¾ inches apart and is cleaned by a front-mounted multi-rake system. Screenings are conveyed via a belt conveyor to a roll-off, compacting dumpster in the adjacent Screenings Garage. Screenings are continuously weighed in the dumpster and transported for landfill disposal. After passing through the bar screen channels the wastewater enters a common effluent channel which functions to distribute flow between the in-service grit collecting tanks.

The aerated grit collecting tanks are sized to provide a hydraulic detention time of approximately three minutes at a peak flow of 250 mgd with four tanks in service. Grit removed from the tanks is conveyed via two belt conveyors to the adjacent Grit Garage and loaded into a tri-axle dump truck and transported for landfill disposal.

There are also provisions to add sodium hypochlorite in the raw sewage conduit between the Main Pumping Station and Rack and Chlorination Building. Referred to as the prechlorination application point, sodium hypochlorite was previously added for odor control prior to the construction of the Headworks and Primary Odor Control Facilities. ALCOSAN no longer uses prechlorination on a routine basis. Sodium Hypochlorite can also be added to the Main Pumping Station overflow structures (2) to provide some disinfection capability in the event of an emergency pumped overflow to the Ohio River.

The capacity of the headworks is limited by hydraulic controls. The weirs at the effluent end of the primary sedimentation tanks control the water surface elevation in the primary sedimentation tanks and in the headworks. ALCOSAN has developed a hydraulic model of the treatment plant that predicts with six or more primary sedimentation tanks in-service and with at least five of the six bar screens and grit collecting tanks process trains in-service the peak flow capacity through the headworks is approximately 275 mgd.

Primary Treatment: The primary treatment process includes nine rectangular primary sedimentation tanks arranged side-by-side and separated into five west-side tanks and four east-side tanks. Following preliminary treatment, the wastewater is conveyed via an underground conduit that splits flow between the east and west primary influent channels, which are aerated to keeps solids in suspension until entering the primary sedimentation tanks. Each primary sedimentation tank includes four longitudinal chain and flight sludge collecting mechanisms arranged in separate bays. A cross collection screw conveyor is located in a trough along the influent end of each tank which conveys settled sludge to a sump from where it is pumped to the Dewatering Feed Tanks. There are four primary sludge pumping stations with a total of 13 recessed impeller centrifugal pumps.

Waste activated sludge from the aeration basins is currently pumped to the primary influent channels and co-settled in the primary sedimentation tanks. Scum is removed from the primary sedimentation tanks using the chain and flight mechanisms and motor-operated tipping troughs. The collected scum is then pumped to the Dewatering Feed Tanks where it is blended with the co-settled sludge.

Effluent from the primary sedimentation tanks overflows v-notched weir troughs into a common aerated effluent channel. There are separate primary effluent pipes extending from the primary effluent channel to the influent channels of the eight aeration basins. Flow distribution between the aeration basins can be controlled using the flow meters and regulating valves in the primary effluent piping contained in underground Flow Regulating Chambers. The flow meters in these chambers are also used to monitor and report the total plant flow.

The primary sedimentation tanks are completely covered for odor control by cast-in-place concrete covers over most of the tank surface with buildings constructed over three areas where access is needed to operate the facilities (i.e., collector drives, scum troughs and effluent weirs). A two-stage counter-current odor control facility is located on top of the western-most sedimentation tank (Tank No. W-4) and in conjunction with a network of fiberglass ducts and make-up air units evacuates and treats foul air from under the tank covers and within the access buildings.

The physical design parameters of the primary sedimentation tanks are summarized in Table 9-8.

Table 9-8: Primary Sedimentation Tanks Physical Design Parameters

Tank No.	Length (feet)	Width (feet)	Side Water Depth (feet)	Surface Area (square feet)	Volume (million gallons)	Weir Length (feet)
W-4	280	70	15	19,600	2.2	252
W-3	280	67	15	18,760	2.1	244
W-2	280	67	15	18,760	2.1	244
W-1	280	67	15	18,760	2.1	244
W-0	280	61	14	17,080	1.8	212
E-0	280	61	14	17,080	1.8	212
E-1	280	67	15	18,760	2.1	244
E-2	280	67	15	18,760	2.1	244
E-3	280	67	15	18,760	2.1	244
Totals				166,320	18.4	2,140
Averages				18,480	2.0	238

Currently the primary treatment process is normally operated with six tanks in service which at a peak flow of 250 mgd results in an average surface overflow rate (SOR) of 2,250 gallons/day/ square foot (gpd/ ft^2). Although this SOR exceeds the DEP guideline (Maximum peak hourly

SOR of 1,500 gpd/ ft^2 in primary tanks that co-settle sludges) the ALCOSAN primary treatment process historically achieves excellent TSS and BOD removal rates averaging 70% and 50%, respectively.

The wet weather treatment concept proposed in the Act 537 Plan included high rate operation of the current nine primary sedimentation tanks at a peak SOR of 4,000 gpd/ ft^2 to achieve a total capacity of 600 mgd. In addition, the current practice of co-settling waste activate sludge would be changed through the addition of a separate WAS thickening process. During 2005 and 2006, full-scale primary stress testing was conducted to monitor performance of the primary treatment process under the proposed high rate operation and without WAS co-settling. It was determined by field testing that the approximate hydraulic capacity of each existing primary sedimentation tanks is 60 mgd, which results in a total primary treatment capacity of 540 mgd and firm capacity of 480 mgd (one tank out of service). The stress testing program also demonstrated acceptable primary treatment performance in terms of TSS and BOD removals at the 60 mgd /tank flow rate, which is equivalent to a SOR of approximately 3,100 gpd/ft^2 of surface area. For a full report of the stress testing program conducted at the ALCOSAN WWTP refer to Appendix A in Draft Bypass Justification Report (April 2010).

The addition of chemically-enhanced primary treatment (CEPT) in the primary sedimentation tanks is not considered necessary to achieve effective primary treatment up to the hydraulic capacity of the existing tanks and, if implemented, would increase operational complexity.

Secondary Treatment: The current secondary treatment facilities consist of eight aeration basins and 16 final settling tanks. The dimensions of the existing aeration basins, including six original basins and two newer basins constructed as part of the Phase I plant expansion, are shown in Table 9-9. The four-pass aeration basins are operated in a contact stabilization mode as follows: return activated sludge (RAS) is pumped to Pass 1 then flows to Pass 2, where it is combined with primary effluent (PE). Combined RAS and PE then flow through Passes 2, 3, and 4 for treatment and then through two aerated mixed liquor channels to the final settling tanks.

Table 9-9: Aeration Basin Dimensions

	Original Basins (EA-1, EA-2, EA-3, WA-1, WA-2, WA-3)				Newer Basins (EA-4, WA-4)			
	Pass 1	**Pass 2**	**Pass 3**	**Pass 4**	**Pass 1**	**Pass 2**	**Pass 3**	**Pass 4**
Unit Dimensions (ft)								
Length	279	300.67	300.67	279	279	255.67	255.67	279
Width	31.25	29	29	31.25	31.25	29	29	31.25
SWD	14.8	14.7	14.7	14.5	14.8	14.7	14.7	14.5
Volumes (million gallons)								
Each Pass	0.965	0.959	0.959	0.947	0.965	0.815	0.815	0.947
Each Basin	3.83, including Pass 1 2.86, excluding Pass 1				3.54, including Pass 1 2.58, excluding Pass 1			
Mixed-Liquor Channel Aerated Total Volume	1.2							
Total Aeration Volume, MG	31.2, including Pass 1 23.5, excluding Pass 1							

The design flows and loads used for the ALCOSAN Phase I CIP improvements to the aeration basins are shown in Table 9-10. BOD and total Kjeldahl nitrogen (TKN) loads are shown. Note that these flows and loads correspond to Phase II conditions reported in the 1996 Act 537 Plan. At maximum month flow, the design hydraulic retention time (HRT) in the aeration basins is 2.7 hours.

Table 9-10: Design Flows and Loads to Secondary Treatment Process

Parameter	Flow (mgd)	BOD Load (lbs/day)	TKN Load (lbs/day)
Average	241	165,473	30,150
Maximum Month	278	223,389	54,270
Maximum Week	290	248,210	57,285
Maximum Day	--	297,851	60,300

The design oxygen demand and airflow rates are shown in Table 9-11.

Table 9-11: Design Oxygen Demand and Airflow Rates

	Carbonaceous Oxygen Demand (lbs/day)	Nitrogenous Oxygen Demand (lbs/day)	Total Oxygen Demand (lbs/day)	Airflow (scfm)
Average	152,235	69,345	221,580	86,559
Maximum Month	205,518	124,821	330,339	136,410
Maximum Week	228,353	131,756	360,109	150,760
Maximum Day	274,023	138,690	412,713	176,709

The aeration system was designed to meet maximum day air requirements with all eight aeration basins in service.

There are sixteen, 141-ft diameter final settling tanks (FSTs), each with a side water depth (SWD) of 14.3 ft. Final settling tank design data are summarized in Table 9-12.

Table 9-12: Final Settling Tank Basis of Design Data

Parameter	Value
Number of Tanks	16
Tank Dimensions	
Diameter (ft)	141
Side Water Depth (ft)	14.3
Unit Area (ft^2)	15,615
Design Flows Wastewater (MGD)	
Average Daily Flow	241
Maximum Month ADF	278
Surface Overflow Rates (gpd/ ft^2), all tanks in service	
At Average Daily Flow	965
At Maximum Month ADF	1100
Surface Overflow Rates (gpd/ ft^2), one tank out of service	
At Average Daily Flow	1030
At Maximum Month ADF	1175
Solids Loading Rates (lb/day/ ft^2), all tanks in service MLSS = 2,340 mg/L and Return = 50%	
At Average Daily Flow	28.3
At Maximum Month ADF	43.2

There are four RAS pumping stations, each containing three RAS pumps with a capacity of 9,200 gpm at 34 feet of total dynamic head (TDH). At each RAS pump station; two of the three pumps are normally in service with one pump on standby. Total RAS pumping capacity, then, is 158 mgd, while firm capacity with one pump out of service at each RAS pumping station is 106 mgd.

Comparison of the actual BOD and ammonia loadings to the aeration basins (2004 to 2006) to design flows and loadings suggest the process has additional treatment capacity. However, the aeration system design was based on all eight tanks being in-service at the time of peak loading conditions. The secondary treatment theoretical capacity was evaluated based on (1) the mass required under aeration for nitrification at the design temperature and (2) the allowable mixed liquor suspended solids (MLSS) based on a solids-flux analysis of the final settling tanks. The results of the theoretical capacity analysis for the existing secondary treatment process are summarized in Table 9-13.

Table 9-13: Process Capacity of Existing Secondary Treatment Units: Results of Theoretical Capacity Analysis

BOD in Secondary Influent (mg/L)[a]	Estimated Capacity (mgd)		Aeration HRT at Total Capacity (hr)[c]	FST Overflow Rate at Total Capacity (gpd/ft^2)[c]	FST Solids Loading Rate at Total Capacity ($lbs/day/ft^2$)
	Firm[b]	Total			
64	295	335	2.2	1,340	40.2[c,d]

Abbreviations: BOD (Biochemical oxygen demand); HRT (Hydraulic retention time); FST (Final settling tank)

Notes:

a. BOD concentration at maximum month flow and maximum month loading (see Table 9-4).
b. Firm capacity corresponds to one larger aeration basin and two final settling tanks out of service.
c. Assumes all tanks (8 aeration and 16 FSTs) are in service.
d. Based on return ratio = 0.5 and MLSS = 2,400 mg/L.

One concern with the above analysis of theoretical capacity is it results in surface overflow rates at the final settling tanks above the 1,200 gpd/ft^2 maximum peak hourly rate recommended by DEP and also historically used for ALCOSAN design purposes. At the firm capacity of 295 mgd stated above it would be necessary to have all 16 final settling tanks in service in order keep the surface overflow rate less than 1,200 gpd/ft^2. This suggests that a total of 18 final settling tanks (two additional tanks) are needed to provide 295 mgd firm capacity.

Disinfection Process: The effluent disinfection process at ALCOSAN includes two, three-pass chlorine contact tanks that have total channel length of 1,910 feet, a channel width of 7.5 feet and side water depth of 14.5 feet. Sodium hypochlorite is introduced and mixed with secondary effluent flow in an aerated inlet channel from where it is split between the two chlorine contact tanks. Chemical addition is automatically paced through the plant-wide Distributed Control System (DCS) based on the plant flow rate. Effluent from the chlorine contact tanks combines in an effluent structure where it overflows weirs into an outlet trough and conduit leading to the plant outfall (No. 001). Defoaming chemicals can be added to the effluent prior to the outfall when necessary.

In early 2009 ALCOSAN completed construction of dechlorination facilities that modified the chlorine contact tanks to include a post aeration zone and a dechlorination zone. The last pass of each tank includes a post aeration zone wherein low pressure process air can be introduced through diffusers to raise the effluent dissolved oxygen (DO) concentration prior to discharge. The last 65 feet of channel length in each chlorine contact tank was modified to function as a dechlorination zone, wherein liquid sodium bisulfite is injected into the aerated mixing zone to reduce the effluent Total Residual Chlorine (TRC) concentration prior to discharge. These modifications were made to meet NPDES permit discharge limitations for DO and TRC following the plant capacity increase to 250 mgd.

Liquid sodium bisulfite is received by tanker truck and transferred to two, 3,000-gallon capacity fiberglass storage tanks located in the Dechlorination Facility building. This building also contains two chemical feed pumps that control the rate of sodium bisulfite addition. Chemical addition is automatically paced through the plant-wide Distributed Control System (DCS) based on the plant flow rate and effluent TRC concentration.

The current chlorination/dechlorination process has a peak flow capacity of 275 mgd based on the DEP-required 15 minutes detention time at peak flow for chlorine disinfection.

Solids Handling Facilities: Currently waste active sludge is co-settled in the primary sedimentation tanks and the settled solids are then pumped to one of the two dewatering feed tanks. Scum removed from the primary sedimentation tanks is also blended with co-settled sludge in the dewatering feed tanks. Sludge is pumped from the dewatering feed tanks at a concentration of 3 to 5 percent total solids to the dewatering centrifuges. A polymer solution is injected in the dewatering feed lines for sludge conditioning prior to entering the centrifuges. The dewatering centrifuges produce a sludge cake in excess of 30 percent total solids that is split between incineration and lime stabilization processes.

During the annual reporting period of October 2010 through September 2011 ALCOSAN disposed of approximately 39,000 dry tons of biosolids, of which 18,000 dry tons was lime stabilized then landfilled, and 7,000 dry tons was lime stabilized for beneficial reuse and 14,000 dry tons were incinerated producing approximately 6,000 tons of ash (reference: ALCOSAN 2011 Wasteload Management Report). The lime stabilized biosolids meet Class B beneficial reuse requirements and ALCOSAN is currently permitted in the State of Ohio for land application.

Each of the seven dewatering centrifuges has a throughput capacity of 4,200 lbs/hour (i.e., 50.4 dry tons/day) and the facilities were designed to meet a future peak weekly solids loading of 252 dry tons/day. There is space available for one additional centrifuge.

The two fluidized bed incinerators were each designed for a capacity of 86.3 dry tons/day (based on 81.3 dry tons/day of sludge and 5.0 dry tons/day scum).

The lime stabilization process was designed for a peak capacity of 100 dry tons solids/day and lime addition up to 30 percent by dry weight.

The addition of waste activated sludge thickening facilities was one component of ALCOSAN's Phase I CIP that was postponed until needed during Phase II (wet weather expansion). Co-settling of WAS in the primary sedimentation tanks can continue until that time when ALCOSAN is ready for high rate operation of the primary treatment process. Then, co-settling will no longer be the normal practice and WAS will be separately thickened prior to blending with primary sludge in the dewatering feed tanks. It is anticipated that a mechanical thickening process (gravity belt thickeners or centrifuges) will be used for future WAS thickening.

9.2.3 Wet Weather Flow Routing Scenarios

The potential concepts for future operation of the Woods Run WWTP assume that ALCOSAN will receive regulatory approval of the following operating conditions:

- High-rate operation of the primary sedimentation tanks
- Bypass of secondary treatment for peak wet weather flows entering the WWTP in excess of secondary treatment capacity. All flows bypassing secondary treatment receive preliminary and primary treatment followed by disinfection prior to discharge.

Four potential wet weather flow routing scenarios at the WWTP are summarized in Table 9-14. The estimated buffer storage noted in Table 9-14 indicates the estimated storage capacity necessary to contain a portion of the initial wet weather peak flow spike in excess of treatment capacity while transitioning into wet weather operating mode at the WWTP. The storage capacity is directly related to the estimated transition time to start-up wet weather treatment facilities.

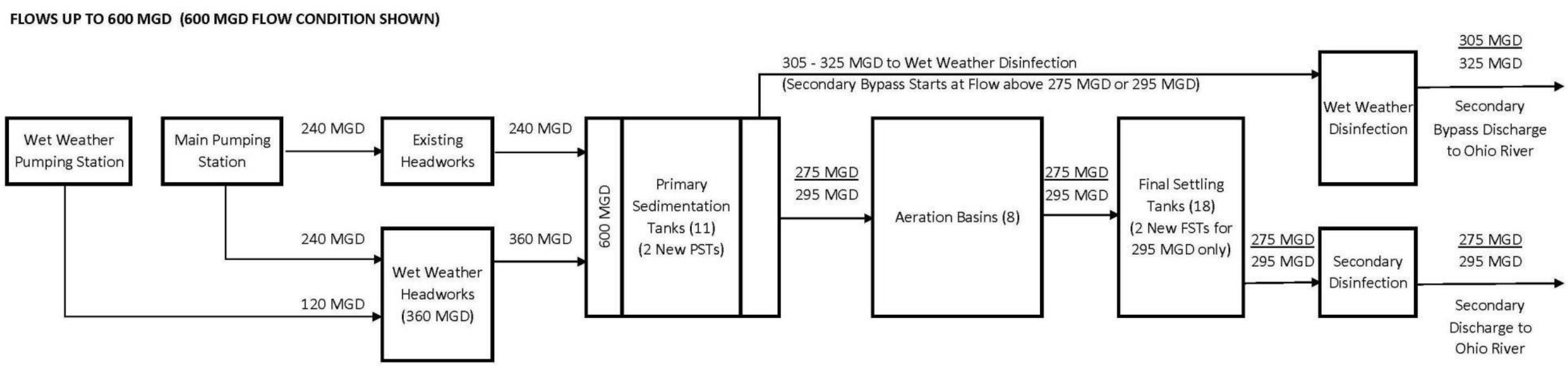
Table 9-14: Summary of Woods Run WWTP Wet Weather Expansion Scenarios

Scenario	Main Pump Station Capacity (mgd)	New Wet Weather Pump Station Capacity (mgd)	Primary Capacity (mgd)	Secondary Capacity (mgd)	High Rate Clarification (HRC) Capacity (mgd)	Core Flow Treatment Capacity (mgd)	Total Wet Weather Treatment Capacity (mgd)	Estimated Buffer Storage Capacity Required (MG)
A-1	400	200	600	275	-	275	600	9
A-2	400	200	600	295	-	295	600	9
A-3	480	120	600	275		275	600	9
A-4	480	120	600	295		295	600	9
B	420	-	420	295	125	420	420	18
C	480	-	480	295	-	295	480	0
D	480	-	480	295	125	420	480	18

Scenario A – Plant Expansion to 600 mgd with Conventional Bypass: Plant expansion Scenario A provides a peak wet weather treatment capacity at the Woods Run WWTP of 600 mgd. The four alternatives under Scenario A, referred to as A-1, A-2, A-3 and A-4 differ by the Main Pumping Station, Wet Weather Pumping Station and secondary treatment capacities, as shown in Table 9-14 above. ALCOSAN has decided to move forward with a Main Pumping Station upgrade project to provide 480 mgd pumping capacity, therefore, the A-1 and A-2 alternatives are included for comparison purposes only.

Figure 9-7 illustrates the wet weather process flow routing for alternatives A-3 and A-4. Dry weather flows and wet weather peak flows up to 480 mgd are received at the Main Pumping Station and then distributed between the existing plant headworks and new wet weather headworks. Dry weather flows can be routed through the existing headworks alone; or distributed between the existing and new wet weather headworks to keep them both operationally ready for wet weather. When peak flow exceeds the Main Pumping Station capacity, the new wet weather pumping station is started to provide an additional 120 mgd flow to the wet weather headworks.

Figure 9-7: Plant Expansion Scenario A Process Flow Diagram (Alternatives A-3 / A-4 shown)



All flows up to 600 mgd receive primary treatment and 275 mgd or 295 mgd go on to secondary treatment. Wet weather flows in excess of secondary treatment capacity, up to a maximum additional flow of 305 mgd or 325 mgd are routed around secondary treatment and receive disinfection prior to discharge.

Figure 9-8 illustrates a conceptual layout for the Scenario A wet weather flow routing alternatives which include the following process units:

Main Pumping Station: Existing pumping station is upgraded to provide a minimum firm pumping capacity of 480 mgd (A-3 and A-4).

Wet Weather Pumping Station: A wet weather pumping station is constructed to provide a minimum firm pumping capacity of 120 mgd (A-3 and A-4) so that combined with the Main Pumping Station upgrade the total influent pumping capacity is 600 mgd.

Wet Weather Headworks: New wet weather headworks are constructed with a minimum firm capacity of 360 mgd so that combined with the existing headworks operating at 240 mgd provides a firm preliminary treatment capacity of 600 mgd.

Primary Treatment: Two new primary sedimentation tanks are added to the existing nine tanks to provide a peak flow capacity of 600 mgd with 10 of 11 tanks in service, assuming high-rate operation is acceptable to the regulatory agencies.

Secondary Treatment: Two secondary treatment alternatives considered include the existing process capacity, estimated to be 275 mgd; or a 20 mgd expansion to 295 mgd capacity through the addition of two final settling tanks.

Disinfection: Disinfection of secondary effluent is achieved through a new ultraviolet (UV) disinfection process with a capacity of 275 mgd or 295 mgd, corresponding to the secondary treatment capacity, followed by post-aeration and discharge via a new plant outfall.

Wet Weather Disinfection: Primary effluent flow exceeding secondary treatment capacity is bypassed to the existing chlorine contact tanks modified for wet weather disinfection. The existing chlorination/dechlorination capacity may be modified and expanded from 275 mgd to 305 mgd or 325 mgd prior to post aeration and discharge at the existing outfall.

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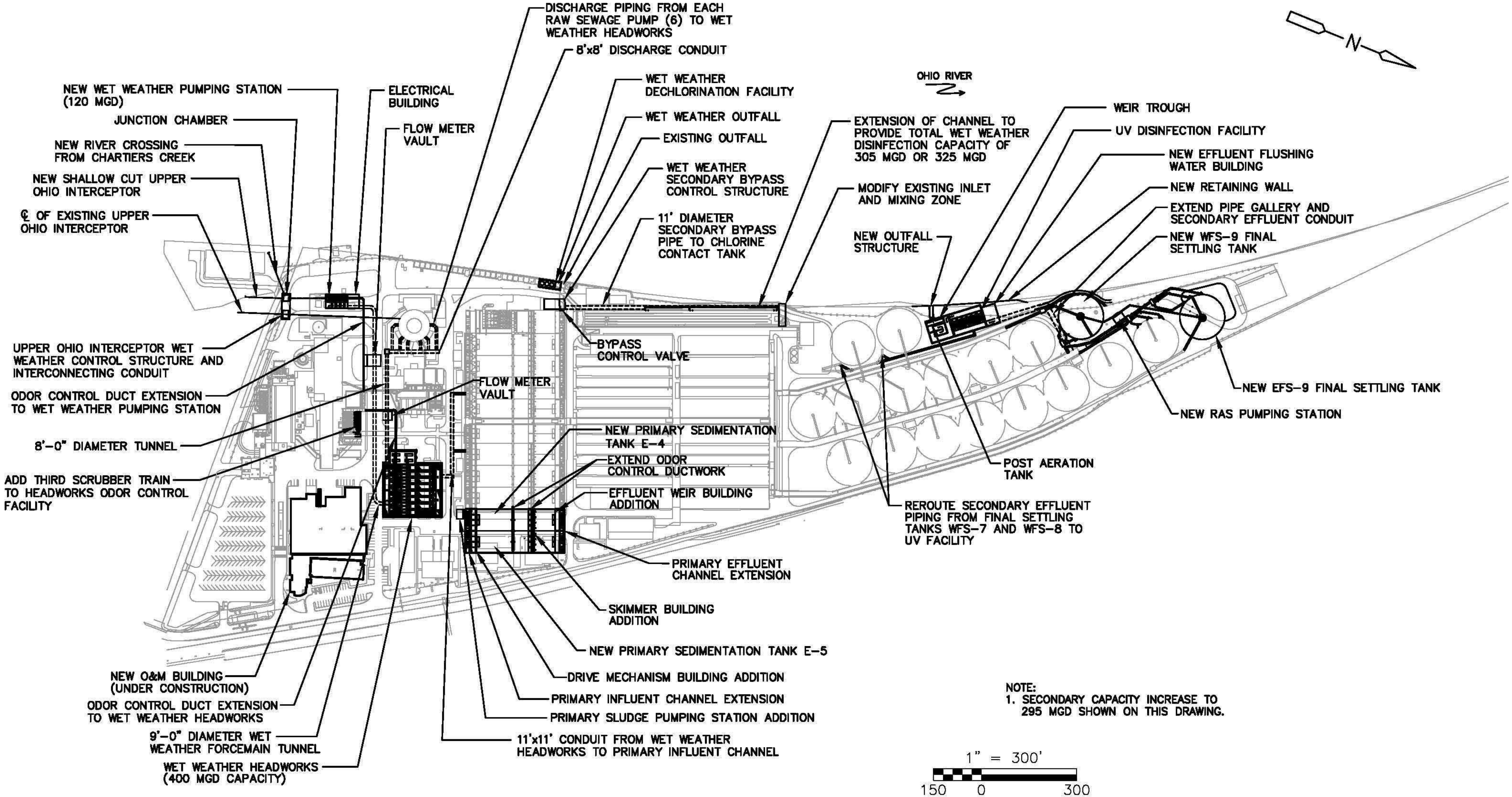
Figure 9-8: Plant Expansion Scenario A Conceptual Site Plan



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Scenario B – Plant Expansion to 420 mgd with HRC and Conventional Bypass: Plant expansion Scenario B provides a peak wet weather treatment capacity at the Woods Run WWTP of 420 mgd. Figure 9-9 illustrates wet weather process flow routing for Scenario B. Dry weather flows and wet weather peak flows up to 420 mgd are received at the existing Main Pumping Station and then distributed between the existing plant headworks and new wet weather headworks. There would be no Wet Weather Pumping Station under this scenario. Wet weather flows in excess of secondary treatment capacity (295 mgd) are diverted to the high rate clarification (HRC) process up to a maximum additional flow of 125 mgd (420 mgd total).

Figure 9-10 illustrates a conceptual layout for the Scenario B wet weather flow management alternative which includes the following process units:

Main Pumping Station: Existing pumping station is upgraded to provide a minimum firm pumping capacity of 420 mgd.

Wet Weather Headworks: New wet weather headworks are constructed with a minimum firm capacity of 220 mgd so that combined with the existing headworks operating at 200 mgd provides a firm preliminary treatment capacity of 420 mgd. For capital cost estimating purposes, a 295 mgd firm capacity for the new wet weather headworks is assumed in order to maximize preliminary treatment redundancy equal to the secondary treatment capacity.

Primary Treatment: The existing primary sedimentation tanks provide a firm peak flow capacity of 480 mgd with eight of the nine tanks in service, assuming high-rate operation (as demonstrated during stress testing described above) is acceptable to the regulatory agencies.

High Rate Clarification: This scenario includes the addition of a 125 mgd HRC process along the east-side of the primary sedimentation tanks. Wet weather flows exceeding the full treatment capacity of 295 mgd are diverted to the HRC process up to 125 mgd. For this scenario it is assumed that treated effluent from the HRC process would be combined with secondary effluent prior to disinfection.

Secondary Treatment: A 20 mgd secondary treatment expansion to 295 mgd capacity is achieved through the addition of two final settling tanks.

Disinfection: Final effluent disinfection for 420 mgd (295 mgd secondary effluent + 125 mgd HRC effluent) is achieved through a new UV disinfection facility.

Wet Weather Disinfection: No additional wet weather disinfection facilities are necessary for this scenario. The existing chlorine contact tanks and chlorination/dechlorination facilities would be available for potential future wet weather treatment under a phased expansion program, or as a back-up final effluent disinfection process.

Although Scenario B is feasible, this alternative will not receive further consideration as the EPA Region 3 has rejected the use of high rate clarification for Core Flow treatment as defined in the ALCOSAN Consent Decree.

Figure 9-9: Plant Expansion Scenario B Process Flow Diagram

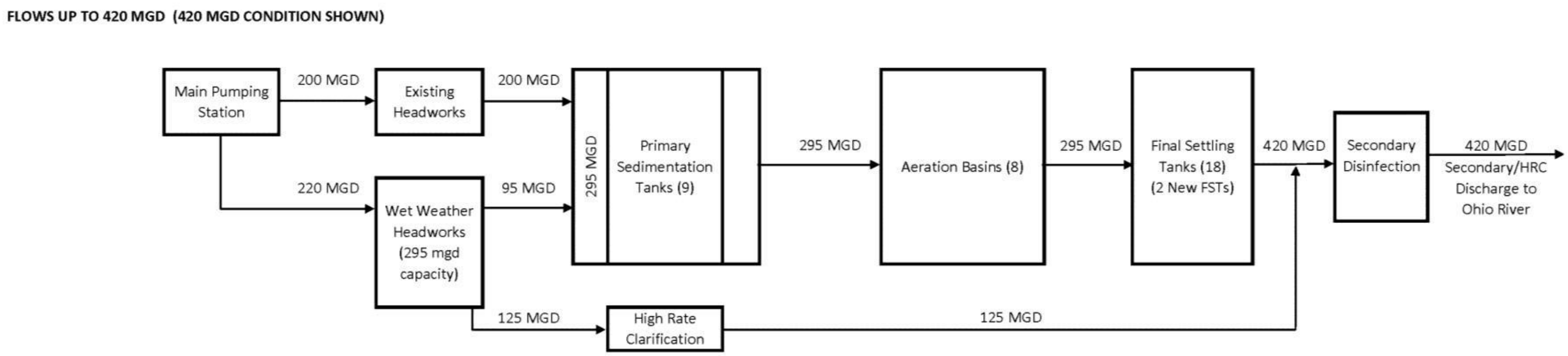
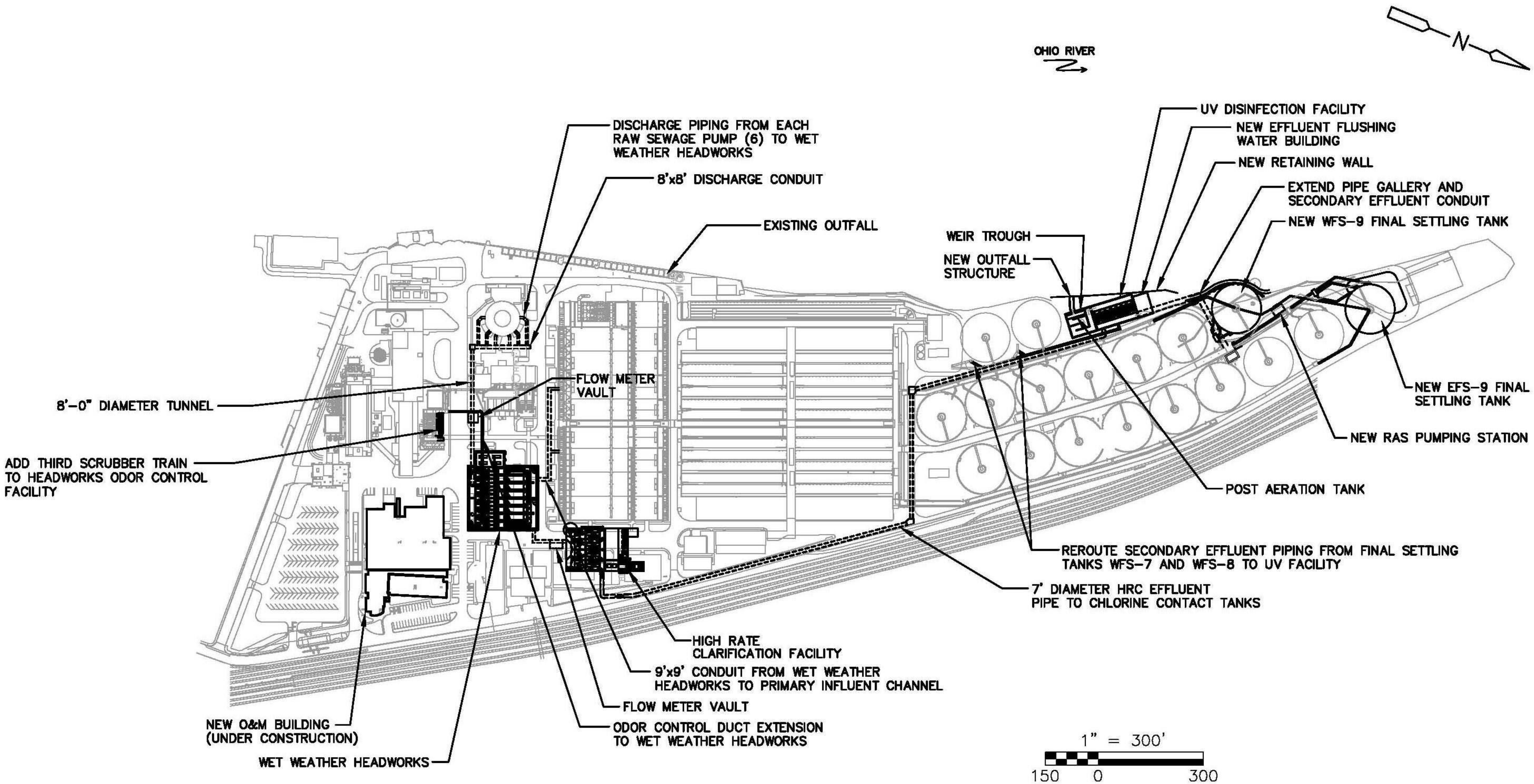


Figure 9-10: Plant Expansion Scenario B Conceptual Site Plan



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Scenario C – Plant Expansion to 480 mgd and Conventional Bypass: Plant expansion Scenario C provides a peak wet weather treatment capacity at the Woods Run WWTP of 480 mgd. Figure 9-11 illustrates wet weather process flow routing for Scenario C. Dry weather flows and wet weather peak flows up to 480 mgd are received at the existing Main Pumping Station and then distributed between the existing plant headworks and new wet weather headworks. There would be no Wet Weather Pumping Station under this scenario.

All flows up to 480 mgd receive primary treatment and 295 mgd go on to secondary treatment. Wet weather flows in excess of secondary treatment capacity, up to a maximum additional flow of 185 mgd, are routed around secondary treatment and receives disinfection prior to discharge.

Figure 9-12 illustrates a conceptual layout for the Scenario C wet weather flow management alternative which includes the following process units:

Main Pumping Station: Existing pumping station is upgraded to provide a minimum firm pumping capacity of 480 mgd.

Wet Weather Headworks: New wet weather headworks are constructed with a minimum firm capacity of 240 mgd so that combined with the existing headworks operating at 240 mgd provides a firm preliminary treatment capacity of 480 mgd. For capital cost estimating purposes, a 295 mgd firm capacity for the new wet weather headworks is assumed in order to maximize preliminary treatment redundancy equal to the secondary treatment capacity.

Primary Treatment: The existing primary sedimentation tanks provide a firm peak flow capacity of 480 mgd with eight of the nine tanks in service, assuming high-rate operation is acceptable to the regulatory agencies.

Secondary Treatment: A 20 mgd secondary treatment expansion to 295 mgd capacity is achieved through the addition of two final settling tanks.

Disinfection: Secondary effluent disinfection for 295 mgd is achieved through new UV disinfection facility, followed by post aeration and a new outfall.

Wet Weather Disinfection: The existing chlorine contact tanks and dechlorination process would be modified for wet weather disinfection so that primary effluent flow exceeding secondary treatment capacity when operating in a wet weather bypass would be diverted to the chlorine contact tanks. Initially, the wet weather disinfection capacity needed would be 185 mgd at a peak flow of 480 mgd. However, for planning purposes the critical infrastructure needed to disinfect an additional 120 mgd wet weather flow is included to allow for further plant wet weather capacity expansion to 600 mgd.

Figure 9-11: Plant Expansion Scenario C Process Flow Diagram

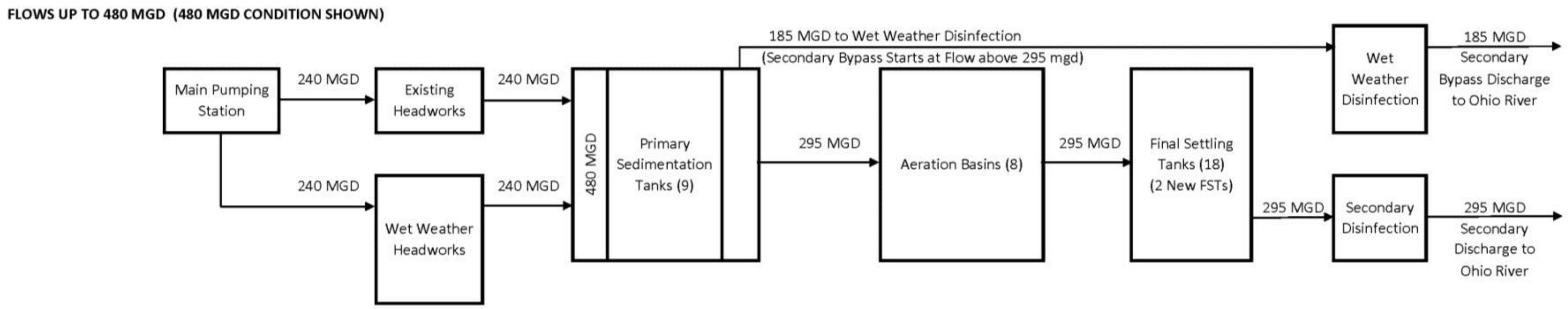
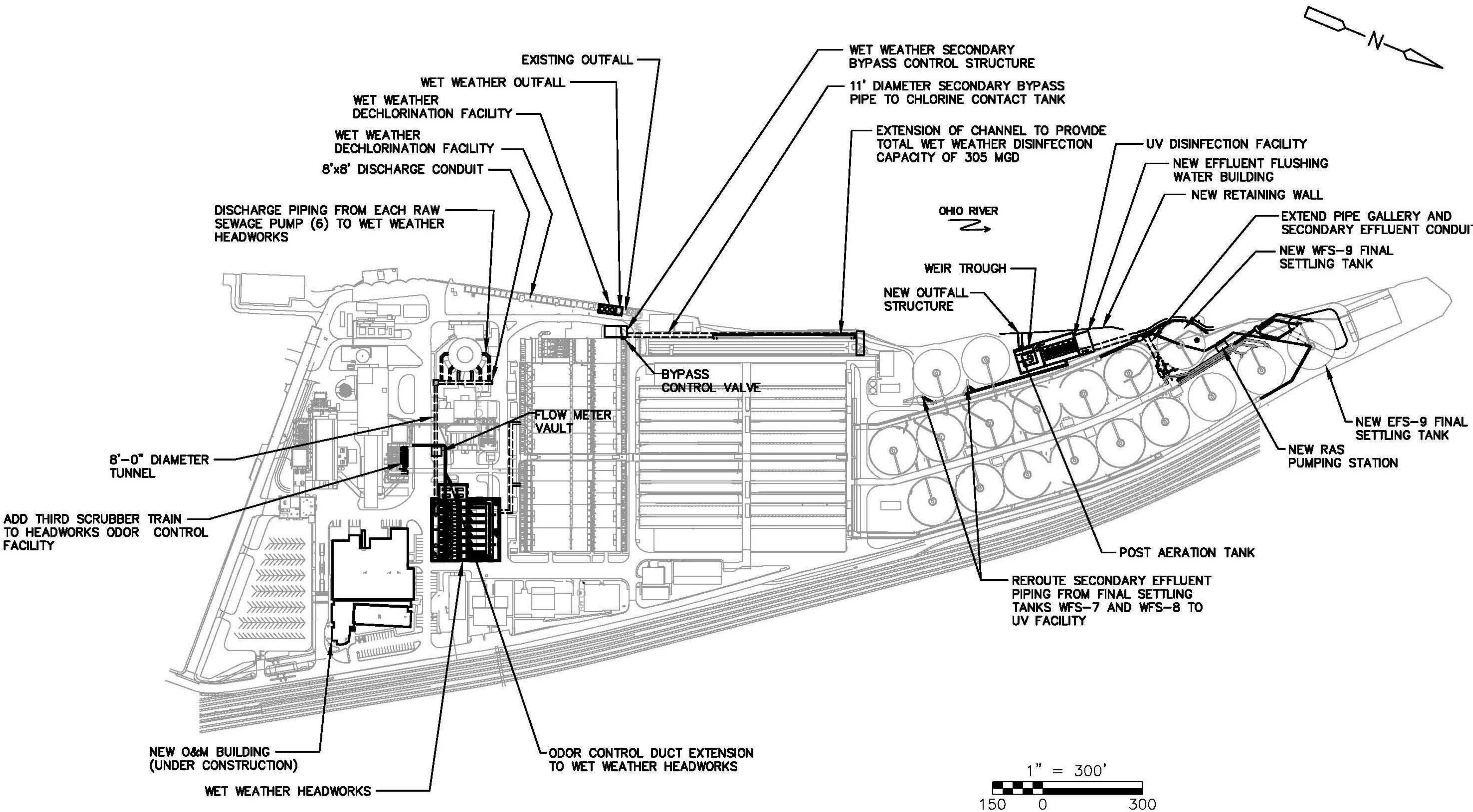


Figure 9-12: Plant Expansion Scenario C Conceptual Site Plan



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Scenario D – Plant Expansion to 480 mgd with HRC and Conventional Bypass: Plant expansion Scenario D provides a peak wet weather treatment capacity at the Woods Run WWTP of 480 mgd. Figure 9-13 illustrates wet weather process flow routing for Scenario D. Dry weather flows and wet weather peak flows up to 480 mgd are received at the existing Main Pumping Station and then distributed between the existing plant headworks and new wet weather headworks. There would be no Wet Weather Pumping Station under this scenario.

Wet weather flows in excess of secondary treatment capacity (295 mgd) are diverted to the high rate clarification (HRC) process up to a maximum additional flow of 125 mgd (420 mgd total). Above 420 mgd, up to 60 mgd of primary effluent bypasses secondary treatment to a wet weather disinfection process. Figure 9-14 illustrates a conceptual layout for the Scenario D wet weather flow management alternative which includes the following process units:

Main Pumping Station: Existing pumping station is upgraded to provide a minimum firm pumping capacity of 480 mgd.

Wet Weather Headworks: New wet weather headworks are constructed with a minimum firm capacity of 240 mgd so that combined with the existing headworks operating at 240 mgd provides a firm preliminary treatment capacity of 480 mgd. For capital cost estimating purposes, a 295 mgd firm capacity for the new wet weather headworks is assumed in order to maximize preliminary treatment redundancy equal to the secondary treatment capacity.

Primary Treatment: The existing primary sedimentation tanks provide a firm peak flow capacity of 355 mgd. Note, with eight of the nine tanks in service a peak flow capacity of 480 mgd is available, assuming high-rate operation is acceptable to the regulatory agencies.

High Rate Clarification: This scenario includes the addition of a 125 mgd HRC process along the east-side of the primary sedimentation tanks. Wet weather flows exceeding the full treatment capacity of 295 mgd are diverted to the HRC process up to 125 mgd. For this scenario it is assumed that treated effluent from the HRC process would be combined with secondary effluent prior to disinfection.

Secondary Treatment: A 20 mgd secondary treatment expansion to 295 mgd capacity is achieved through the addition of two final settling tanks.

Disinfection: Final effluent disinfection for 420 mgd (295 mgd secondary effluent + 125 mgd HRC effluent) is achieved through a new UV disinfection facility.

Wet Weather Disinfection: The existing chlorine contact tanks and dechlorination process would be modified for wet weather disinfection so that primary effluent flow exceeding secondary treatment plus HRC capacity would be diverted to the chlorine contact tanks. The wet weather disinfection capacity needed would be 60 mgd at a peak flow of 480 mgd.

Figure 9-13: Plant Expansion Scenario D Process Flow Diagram

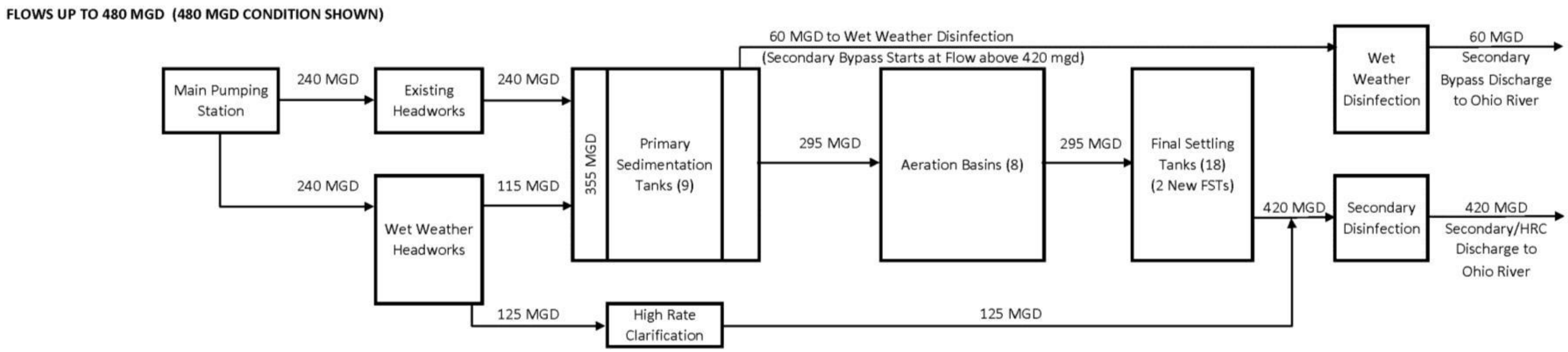
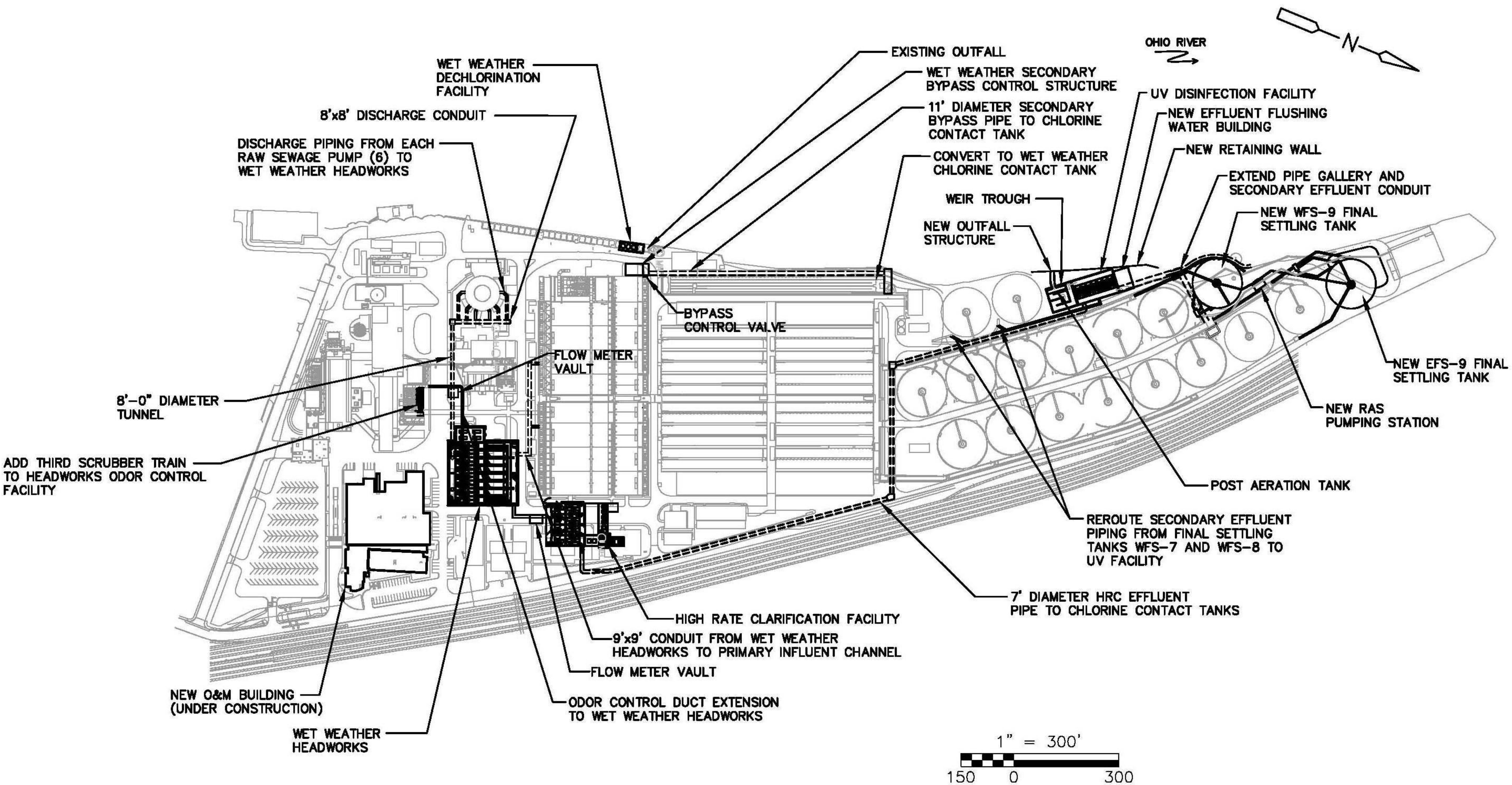


Figure 9-14. Plant Expansion Scenario D Conceptual Site Plan



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Plant Expansion Lifecycle Costs: The estimated life cycle costs including initial capital costs, annual O&M costs and the cost of future purchases for the WWTP plant expansion scenarios are listed below in Table 9-15.

Table 9-15. Summary of Estimated Lifecycle Costs for Woods Run WWTP Expansion Scenarios

Scenario	Estimated Lifecycle Costs ($ millions)[1]						
	Initial Capital Cost			Annualized Cost		PW of Future Purchases	Total Present Worth
	Wet Weather Pumping Station[2]	Wastewater Treatment	Total	Annual O&M Costs	PW of Annual Costs		
A-1	108	340	448	5.3	81	28	557
A-2	108	374	482	5.4	82	31	595
A-3	101	344	445	5.3	81	27	553
A-4	101	378	479	5.4	82	31	592
B	0	389	389	6.3	95	29	513
C	0	290	290	5.5	84	27	401
D	0	418	418	6.3	96	31	545

Preliminary evaluation of the plant expansion scenarios concluded that Scenarios A-3, A-4 and C are viable option for further consideration and integration into the regional wet weather plan. The other scenarios were eliminated for the following reasons:

- Scenarios A-1 and A-2 are no longer applicable since ALCOSAN is upgrading the Main Pumping Station capacity to 480 mgd, not 400 mgd as included in these scenarios

1 Life cycle cost estimates based on a planning period of 28 years assuming initiation of operation in 2018; federal discount rate of 4.875% (2008); and ENR CCI Pittsburgh Index (October 2008) of 7862.

2 The Wet Weather Pump Station estimated initial capital costs are based on a trench style that assumed the new conveyance to the new wet well would be no deeper than the incoming interceptors. If these WWTP expansion alternatives are coupled with regional improvements that involve a deeper regional conveyance system the Wet Weather Pumping Station cost will need to be replaced with the cost of a different type of deep tunnel pumping station.

- Scenarios B and D were eliminated as high rate clarification was included for Core Flow treatment; which has been rejected by EPA Region 3.

9.2.4 Secondary Treatment and Core Flow Requirements

The proposed facilities and other improvements which comprise the Wet Weather Plan must fulfill several requirements in regards to secondary treatment capacity.

- The facilities must be designed to capture and provide secondary treatment for a flow volume equivalent to all of the Sanitary Sewer System flow that is generated in the Regional Collection System. [9-3]
- If the WWP relies on the Demonstration Approach or the 85% Presumption Approach, the facilities must be designed to capture and provide secondary treatment to the volumetric equivalent of all Peak Dry Weather Combined Sewer System Flow generated from within the Regional Collection System.[9-4]
- If ALCOSAN proposes as part of its WWP to bypass all or any portion of the primary or secondary treatment processes at the sewage treatment plant, a secondary treatment requirement within Appendix T of the ALCOSAN CD would be invoked. ALCOSAN must demonstrate that Core Flow, as defined in Appendix T, will receive secondary treatment[9-5]

The CD also contains provisions that certain flow may be excluded from the volumes above which must receive secondary treatment if any one of the following three conditions would be met and the regulatory agencies approve the proposal .[9-4]

- ALCOSAN need not capture and provide treatment for sanitary sewer volume for which a customer municipality has committed to construct facilities to capture and treat.
- Secondly, ALCOSAN may exclude flow volume that a municipal trunk sewer cannot convey to ALCOSAN, if the municipality commits not to increase the conveyance capacity of the sewer system, and the municipality commits to use another control method to eliminate SSOs.
- Finally, ALCOSAN may exclude specific municipal flow volumes for which a detailed proposal is submitted to the regulatory agencies to exclude such flow.

These secondary treatment requirements were considered in the development of various system-wide alternatives that included expansion of the Woods Run WWTP capacity and/or construction of a new satellite sewage treatment plant. Preliminary estimates indicated that the required secondary treatment capacity could be up to 295 mgd, so all system-wide alternatives evaluated had a secondary treatment capacity of 295 mgd, or more. After the most preferred system-wide alternatives were identified, calculations were made to verify that the total

9-3 Paragraph 17(b)
9-4 Paragraph 18(a) & 18(b)(i)
9-5 Appendix T, Paragraph 1(g)
9-4 Paragraph 17(b), 18(a), 18(b) & 18(c)

secondary treatment capacity for each alternative was adequate to meet the volumetric requirements described above. These calculations are described in Section 9.5.6.3. Due to the unique nature of the Core Flow requirement mentioned above, the remainder of this section provides further background regarding the concept of Core Flow.

Under the CD definition in Appendix T, Core Flow has two components; a flow component from municipal combined sewer systems and a flow component from municipal separate sewer systems. The Core Flow component for the portions of the ALCOSAN service area served by combined sewer systems is 125 percent of the Peak Dry Weather Flow that is generated within the combined collection system and subsequently routed and conveyed to the ALCOSAN system. The Core Flow component for the portions of the ALCOSAN service area served by separate sewer systems is the peak flow (for both dry and wet weather conditions) that is generated within the separate sewer systems and subsequently routed and conveyed to the ALCOSAN system. Elsewhere in the CD, (such as paragraphs 17 and 19) it is recognized that flows from combined and separate sewershed areas are comingled within municipal and ALCOSAN systems. As noted above, the CD requires ALCOSAN to capture and provide treatment for a *flow volume equivalent* to all the sanitary sewer system flow routed and conveyed to ALCOSAN. It is assumed that this recognition, that has come to be known as the accounting principle, applies to Core Flow.

9.2.5 Bypass Demonstration

The ALCOSAN CD Appendix T stipulates “bypass demonstration” requirements to obtain approval for discharge of partially treated wastewater at the WWTP as part of the proposed Wet Weather Plan. Appendix T draws on the requirements of the NPDES bypass rule (40 CFR 122.141(m)), as well as the EPA Combined Sewer Overflow Policy (59 Federal Register 18688) and the DEP interim final Pennsylvania CSO Policy (September 2007).

The NPDES bypass rule has provisions to allow for intentional diversion of waste streams from any portion of treatment facility when it is necessary to perform maintenance to assure efficient operation. Bypasses for any other reason are prohibited, except when;

- A bypass is unavoidable to prevent loss of life, personal injury, or severe property damage,
- There are no feasible alternative to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime.

Both of these exceptions are applicable to ALCOSAN’s situation. In response to exception (A) above, once wastewater is received at the Main Pumping Station and pumped to the headworks, flow then passes through the rest of the plant by gravity. Attempts to pump peak flows in excess of approximately 275 mgd through the existing WWTP will cause flooding of process units resulting in reduced treatment performance and likely result in NPDES permit violations. Certain specific problem areas include the following:

- Flooding the grit collection tanks potentially resulting in overtopping the walls and causing a wastewater spill.
- Wash-out of activated sludge from the aeration basins and final settling tanks resulting in a loss of solids in the plant effluent.
- Flooding final settling tanks scum baffles causing a loss of floatables to the plant effluent and flooding scum collectors resulting in excessive recycle flow to the head of the plant.

In response to exception (B) above, and the stipulations of the CD Appendix T, the alternative control measures investigated in lieu of the proposed bypass include storage and pump-back and satellite treatment. The evaluation of alternatives summarized in this section concluded that implementing storage and pump-back in lieu of the proposed plant expansion requires excessively large storage facilities with unacceptably long pump-back durations and are, therefore, technically infeasible. In addition, the storage and pump-back facilities are considered financially infeasible since their estimated life cycle costs far exceed the comparable range of lifecycle costs for Woods Run WWTP expansion.

Satellite treatment facilities, in lieu of the proposed WWTP expansion, include a technical challenge to provide sufficient average daily flow to sustain biological treatment processes. In doing this, flow must be diverted from the Woods Run WWTP, thereby reducing its treatment capacity. The number of satellite treatment facilities and resulting diversion of average daily flow in lieu of the proposed 305 to 325 mgd maximum bypass reduces flow to the existing Woods Run WWTP to levels that significantly reduces capacity. In effect, wastewater treatment would be decentralized at a cost ranging from 2 to 3 times higher than the proposed plant expansion for wet weather treatment. Therefore, it was concluded that the satellite treatment alternatives are not technically or financially feasible alternatives to the proposed plant expansion strategies.

Storage and Pump-Back Facilities: The premise of storage and pump-back remedial measures is that wet weather flow in excess of the ALCOSAN WWTP secondary treatment capacity would be diverted to a new storage facility. Although wet weather overflow storage volume can be provided via storage tanks, surface storage basins, deep tunnels and other innovative means such as vertical shafts and street storage, most operating agencies with large storage volume requirements utilize deep tunnels. Therefore, it is assumed that the “storage” component of the storage and pump-back alternatives would be provided by deep tunnel systems.

Under a storage and pump-back scheme, as peak flows subside to the WWTP the stored wastewater would be pumped back to the WWTP to receive secondary treatment. The quantity of flow that would need to be diverted, then, depends on the secondary capacity of the WWTP. Two storage and pump-back alternatives were considered as follows:

- Alternative SPB-1: Storage and pump-back with 275 mgd secondary treatment capacity at the Woods Run WWTP.

- Alternative SPB-2: Storage and pump-back with 295 mgd secondary treatment capacity at the Woods Run WWTP.

Preliminary planning-level system-wide hydraulic and hydrologic (H&H) models were developed to quantify and characterize the total wet weather flow potentially reaching the WWTP. The general approach employed to model overflow storage and pump-back alternatives was to pump flows from the Woods Run WWTP Main Pumping Station wetwell to the plant headworks that are less than (or equal to) the plant capacity (either 275 or 295 mgd) and divert any excess flows from the wetwell to the storage facility. Pump-back from the storage facility was allowed only when the flow into the wetwell dropped below the treatment capacity at the WWTP. The amount of storage needed to satisfy this flow distribution without causing an overflow at the WWTP is the required storage.

To estimate the storage requirements for the two different plant capacities, it was assumed that four overflows per year would be allowed along the ALCOSAN interceptor system. Therefore, the fifth largest annual wet-weather event —based on the long-term precipitation record for the region—was used as the basis for modeling the storage requirements. Specifically, the period between April 1, 2004 and May 15, 2004 was used to model storage needs because this period contained a wet-weather event (on April 13, 2004) that was characterized by a total rainfall volume close to the median rainfall volume (1.16 inches) of the fifth largest wet-weather event for each of the 60 years in the period of record as well as relatively uniform rainfall distribution over the service area.

The results from the storage estimation analysis for each plant capacity are summarized below.

Alternative SPB-1: Under this alternative, the secondary treatment capacity at the WWTP is assumed to be 275 mgd and all the flow reaching the wetwell that is less than or equal to this value would be pumped to the WWTP. Flows in excess of 275 mgd were assumed to be diverted to storage during the modeling. As long as the flows into the wetwell exceed 275 mgd, they would be diverted to storage and allowed to accumulate there. Once the flows into the wetwell drop below 275 mgd, the pumps in the storage facility would be turned on and pump at a variable rate to utilize all the available capacity in the WWTP up to a maximum of 275 mgd (combined pump-back and incoming flow).

In order to capture all simulated wet weather flows conveyed to the WWTP for the modeled storm event (April 13, 2004), a storage capacity of 102 million cubic feet (765 million gallons) would be necessary. The maximum pump-back rate would be approximately 125 mgd, but it would require over 98 days to drain the storage facility during the simulation due to a series of significant back-to-back storm events prior to and following the April 13 storm. Analysis of the utilization of this storage unit suggests that during the period between January 2004 and March 2005 this storage facility would have been empty 28 percent of the time. It is apparent from this analysis that limiting the plant capacity to 275 mgd would result in the inability to drain a storage facility between a pattern of back-to-back storms and a highly excessive detention time in the storage facility.

Typically, SSO/CSO tunnel storage facilities are designed to pump back stored flows within 48 hours of the storm event to avoid significant solids deposition and odor problems associated with long pump back times. Pump back times of several months under Alternative SPB-1 are clearly technically not feasible.

Alternative SPB-2: Under this alternative, the secondary treatment capacity at the WWTP is assumed to be 295 mgd and all the flow reaching the wetwell that is less than or equal to this value would be pumped to the WWTP. Therefore, flows in excess of 295 mgd were assumed to be diverted to storage during the modeling. As long as the flows into the wetwell exceed 295 mgd, they would be diverted to storage and allowed to accumulate there. Once the flows into the wetwell drop below 295 mgd, the pumps in the storage facility would be turned on and pump at a variable rate to utilize all the available capacity in the WWTP up to a maximum of 295 mgd (combined pump-back and incoming flow).

In order to capture all simulated wet weather flows conveyed to the WWTP for the modeled storm event (April 13, 2004), a storage capacity of 73.5 million cubic feet (550 million gallons) would be necessary. The maximum pump-back rate would be approximately 135 mgd, but it would require close to 18 days to drain the storage facility during the simulation due to a series of significant back-to-back storm events. As noted above for Alternative SPB-1, tunnel pump back times should not exceed 48 hours to avoid significant solids deposition and odor problems associated with long pump back times. Pump back times in excess of two weeks under Alternative SPB-2 are technically not feasible.

Analysis of the utilization of this storage model suggests that during the period between January 2004 and March 2005 this storage facility would have been empty 44 percent of the time. It was also estimated that during this time a period of 28 days was required to empty the storage facility between early September and early October 2004.

Although technically not feasible, the cost of storage and pump back facilities were estimated to assess financial feasibility. The conceptual design of storage and pump-back facilities presented herein is not intended to represent the final system improvements for ALCOSAN's Wet Weather Plan. Rather, they were developed to determine feasibility and estimate the cost of storage and pump-back facilities as an off-site alternative to the proposed wet weather flow management strategy at the WWTP.

Figure 9-15 illustrates a conceptual layout of storage tunnels shown as green lines on the figure. The twin-tunnel alignment along the north shore of the Ohio River and Allegheny River was selected to provide sufficient storage capacity using 30-foot diameter tunnels; to remain within the ALCOSAN service area; and to be capable of filling from a diversion at the Woods Run WWTP; and be self-draining via a dewatering pumping station located at the WWTP. The physical design parameters of the storage tunnels alternatives are summarized in Table 9-16.

Figure 9-15: Bypass Demonstration – Conceptual Layout of Deep Storage Tunnel for Storage and Pump-Back Alternatives

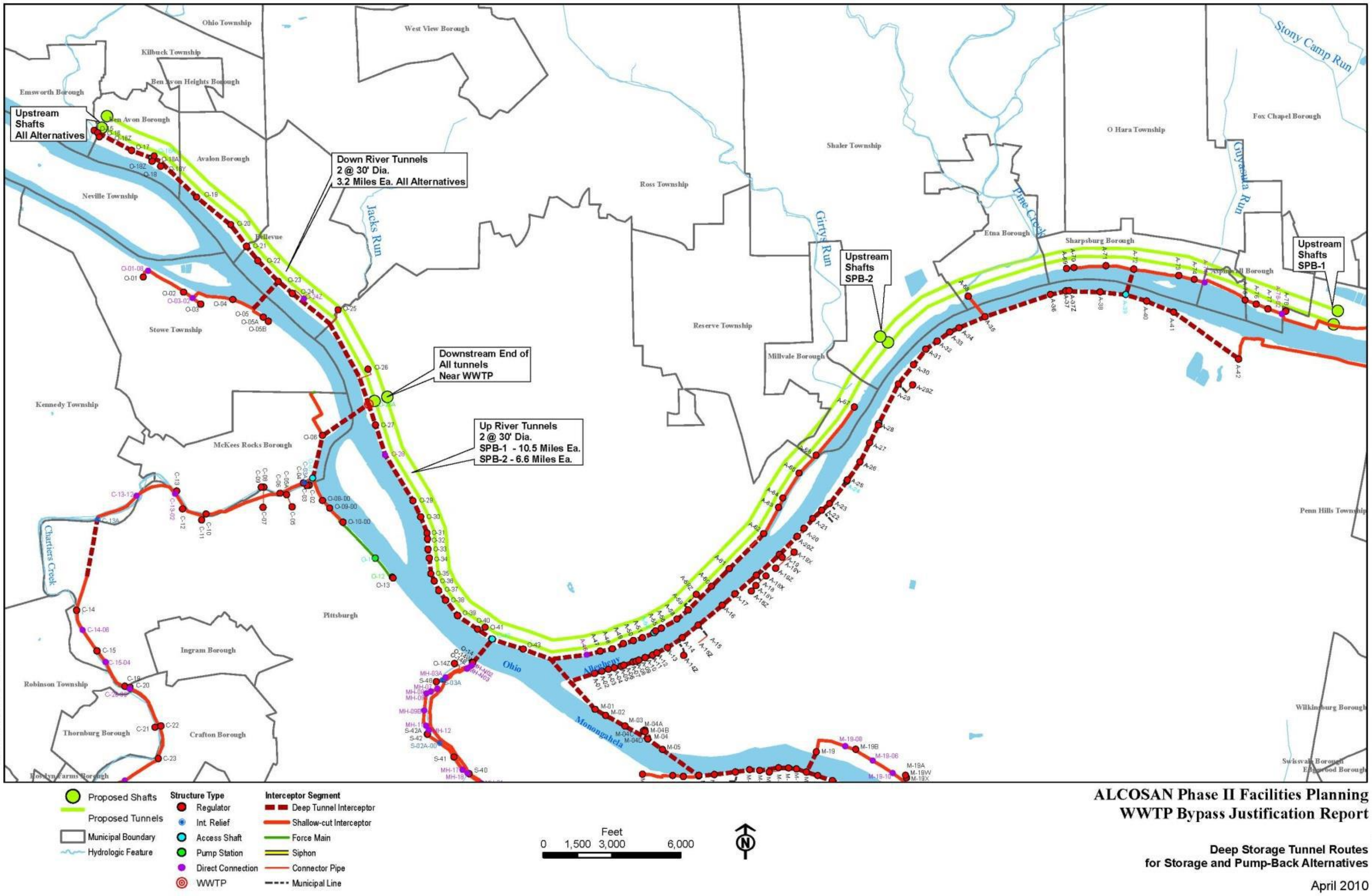


Table 9-16: Summary of Storage and Pump-Back Alternatives Conceptual Design

Parameter	Units	Storage and Pump-Back Alternative	
		SPB-1	SPB-2
Design Capacities			
WWTP Capacity	mgd	275	295
Required Storage Volume	MG	765	550
Tunnel Dewatering Capacity	mgd	125	135
Tunnels Downriver of WWTP			
Diameter	Feet	30	30
Length – Each	Feet	17,000	17,000
Total Vertical Fall at 0.1% Slope	Feet	17	17
Total Length	Feet	34,000	34,000
Total Storage Volume Provided	MG	180	180
Tunnels Upriver of WWTP			
Diameter	Feet	30	30
Length – Each	Feet	55,340	35,010
Total Vertical Fall at 0.1% Slope	Feet	55	35
Total Length	Feet	110,680	70,020
Total Storage Volume Provided	MG	585	370
Total Tunnel Length & Volume			
Total Length	Feet	144,680	104,020
Total Length	Miles	27.4	19.7
Total Storage Volume Provided	MG	765	550

The capacity analysis of the existing Main Pumping Station concluded that the maximum recommended upgrade of the Main Pumping Station is 480 mgd, based on concerns with the wet well hydraulics and firm capacity of the pumping station. Therefore, in order to bring more than 480 mgd of wet weather flow to the WWTP, several conveyance system improvements were identified for the analysis of expansion alternatives.

Since the storage and pump-back alternatives assume the diversion of flow into storage occurs at the WWTP, it is necessary to include the conveyance system improvements. The conveyance system improvements identified are summarized below

- **Chartiers Creek Interceptor Tunnel and River Crossing:** Construct a 12-foot diameter parallel interceptor tunnel and river crossing. The tunnel would extend approximately 5,000 linear feet (lf) from the Chartiers-Ohio Junction Chamber (O-07) to the WWTP. This tunnel would have a capacity of 415 mgd and an initial capital cost of $44 million.
- **Lower Ohio Interceptor Tunnel and River Crossing:** Construct an 8-foot diameter parallel interceptor tunnel and river crossing. The tunnel would extend approximately 7,000 lf from the Freemont River crossing (O-05) to the WWTP. This tunnel would have a capacity of 135 mgd and an initial capital cost of $40 million
- **Shallow-cut Upper Ohio Interceptor:** Construct a 5-foot diameter shallow-cut interceptor from Westhall Street (O-27) to the WWTP. This interceptor would have a capacity of 70 mgd and an initial capital cost of $2 million.
- **Interconnecting Conduit to Existing Upper Ohio Interceptor:** Construct a control structure and interconnecting conduit from the 10.5-feet diameter Upper Ohio Interceptor to the new junction chamber for the storage tunnels. This interconnection would have a capacity of 250 mgd and an initial cost of $14 million.

The combined initial capital costs for the conveyance system improvements described above is $100 million.

Capital costs for the deep tunnels and dewatering pump station were estimated using the Alternatives Costing Tool (ACT) prepared for ALCOSAN's wet weather program. The dewatering pump station cost (including the shaft cost) is based on the Sanks cost curve[9-6] that has been adjusted based on costs of several planned or actual deep pump stations. Because the curve is based on a national reference, the costs were adjusted over time using the national ENR CCI value for October, 2008 (ENR CCI = 8623), and adjusted for location based on the RS Means overall Location Factor for Pittsburgh (98.7).

The tunnel costs were developed assuming the required storage is provided in a series of 30-foot diameter deep tunnels located completely in sound rock. Costs are provided for both pre-cast segmental and cast-in-place linings as there is not yet sufficient information to determine which approach is most appropriate for this project.

Table 9-17 provides a summary of the estimated capital cost range for each storage and pump back alternative. The "Low Range" of capital costs shown in Table 9-17 is based on using a cast-in-place (CIP) tunnel lining system and the "High Range" is based on a pre-cast segmental lining system. More geotechnical investigations would be necessary to determine which tunnel lining system is most suitable for the Pittsburgh region and actual tunnel alignment. The pre-cast lining system is a one-pass installation method that is more suitable for poor soil/rock conditions and where groundwater is difficult to control. The CIP lining system is a two-pass

[9-6] Jones, G., Basserman, B., Sanks, R., Tchobanoglous, G., Pumping Station Design (Third Edition 2006).

construction method where the tunnel is excavated and then an interior concrete lining is cast-in-place. The CIP lining system costs less than pre-cast segmental linings, but it is best suited for sound rock conditions with little groundwater intrusion. Therefore, the capital costs for the storage tunnel alternatives are expressed as a range that covers the potential construction costs for varying site conditions and construction methods.

Table 9-17: Summary of Storage and Pump-Back Alternatives Estimated Capital Costs

Alternative	Storage Capacity (MG)	Dewatering Pump Station Capacity (mgd)	Estimated Capital Cost, $ millions		
			Low Range	High Range	Equipment Replacement
SPB-1	765	125	$2,300	$3,200	$4
SPB-2	550	135	$1,700	$2,400	$5

The O&M costs developed for the storage and pump-back alternatives include materials, labor, and energy costs associated with tunnel and dewatering pump station operation. O&M costs are based on the following.

- Tunnel operating statistics obtained from model simulations of the storage and pump-back alternatives
- Tunnel length
- Average ALCOSAN labor rates for maintenance and operations staff
- An electricity cost of $0.09/kWh
- Pump station capacity

The annual O&M costs and equivalent present worth over the 28-year planning period for the storage and pump-back alternative are summarized in Table 9-18.

Table 9-18. Storage and Pump-Back Alternatives Estimated Annual O&M Costs

Item	Estimated Annual O&M Costs ($1,000s)	
Alternative	SPB-1	SPB-2
Labor – Operations	$510	$380
Labor – Maintenance	$560	$470
Electricity	$630	$530
Materials	$110	$110
Total Annual O&M Cost	**$1,810**	**$1,500**
Present Worth	$27 million	$23 million

Alternative SPB-1 requires no additions to the existing plant process units, but does include the on-site capital improvements listed below to support the storage tunnels dewatering pump station.

- *Odor Control:* The existing Headworks Odor Control Facility would be expanded by the addition of a third scrubber train to provide odor control for the tunnel junction chamber and dewatering pump station.

- *On-site Conveyance:* The capital cost to construct a force main between the storage tunnel dewatering pump station and the existing Main Pumping Station is included in on-site capital improvements for this alternative.

The estimated initial capital cost for the improvements to the WWTP for Alternative SPB-1 is $7.4 million.

Alternative SPB-2 includes expansion of the WWTP secondary treatment capacity by 20 mgd from 275 mgd to 295 mgd including the capital improvements listed below.

- *Odor Control:* The existing Headworks Odor Control Facility would be expanded by the addition of a third scrubber train to provide odor control for the tunnel junction chamber and dewatering pump station.

- *Existing Plant Headworks:* For this analysis it is assumed that the existing screenings and grit removal facilities are adequate for a plant capacity of 295 mgd with five of the six process trains (bar screen followed by a grit collecting tank) in-service.

- *Primary Treatment:* The existing primary sedimentation tanks have sufficient available capacity to operate at 295 mgd.

- *Secondary Treatment:* The expansion of secondary treatment capacity by 20 mgd includes the addition of two final settling tanks and one Return Activated Sludge (RAS) pumping station.

- *Secondary Disinfection:* For this analysis it is assumed the expansion of the existing chlorine contact tank capacity from 275 mgd to 295 mgd is feasible.

- *On-Site Conveyance:* The capital cost to construct a force main between the storage tunnel dewatering pump station and the existing Main Pumping Station is included in on-site capital improvements for this alternative.

The estimated initial capital cost for the improvements to the WWTP for Alternative SPB-2 is $48 million.

The storage and pump-back alternatives each relate to a specific treatment capacity at the Woods Run WWTP. Table 9-19 provides a summary of the estimated annual O&M costs at the WWTP for the increase in plant treatment capacity and the treatment of stored flows.

Table 9-19: Estimated Annual O&M Costs at the Woods Run WWTP for Storage and Pump-Back Alternatives SPB-1 and SPB-2

Item	Estimated WWTP Annual O&M Costs ($1,000s)	
Alternative	SPB-1	SPB-2
Labor – Operations	$72	$68
Labor – Maintenance	$46	$42
Electricity	$748	$788
Chemicals	$1,350	$1,350
Materials	$9	$9
Residuals	$984	$984
Total Annual O&M Cost	**$3,209**	**$3,241**
Present Worth	$48.5 million	$48.9 million

The two storage and pump-back alternatives differ by the treatment capacity provided at the Woods Run WWTP and the resulting storage facilities needed to store off-line and pump-back the wet weather flow reaching the WWTP (with some conveyance system improvements) from the fifth largest annual storm event in the ALCOSAN service area as selected by review of the historical rainfall records and as simulated by the ALCOSAN hydrologic and hydraulic models. Table 9-20 provides a present worth cost summary of the storage and pump-back alternatives.

Table 9-20: Summary of Storage and Pump-Back Alternatives Present Worth

Parameter	Storage and Pump-Back Alternative Present Worth ($ millions)	
	SPB-1	SPB-2
Design Data Summary		
WWTP Capacity, mgd	275	295
Storage Tunnel Capacity, MG	765	550
Dewatering Pump Station Capacity, mgd	125	135
Capital Costs		
Storage and Dewatering – High Range	$3,200	$2,400
Storage and Dewatering – Low Range	$2,300	$1,700
Conveyance System Improvements	$100	$100
WWTP Improvements	$7	$48
Present Worth of Annual Costs		
Storage and Dewatering	$27	$23
WWTP Improvements	$49	$49
Present Worth of Future Renewal and Replacement Capital Costs		
Storage and Dewatering	$4	$5
WWTP Improvements	$0	$1
Total Present Worth – High Range	**$3,387**	**$2,626**
Total Present Worth – Low Range	**$2,487**	**$1,929**

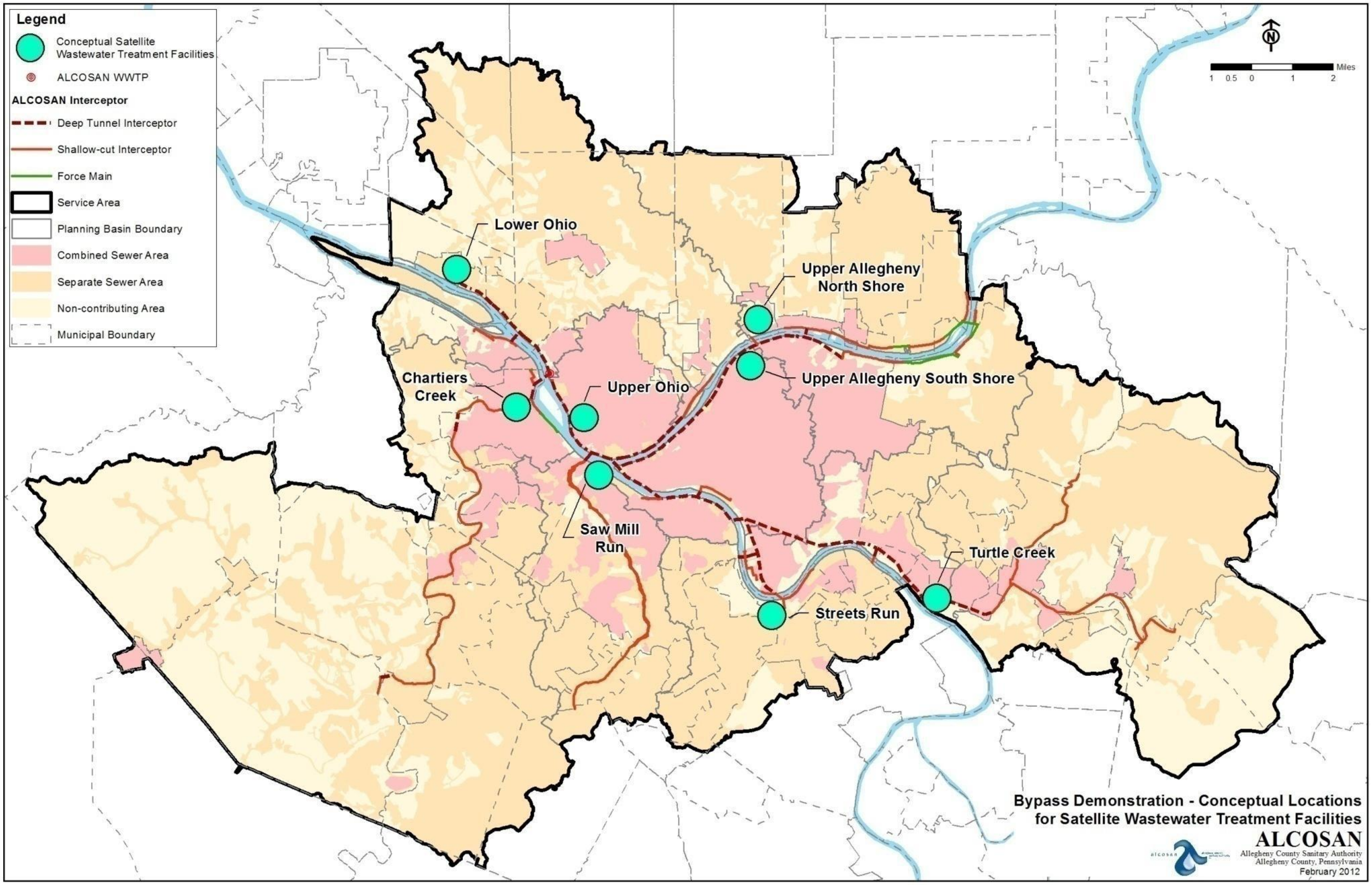
Satellite Treatment Facilities: The premise of satellite treatment remedial measures is to provide secondary treatment at satellite wastewater treatment facilities in lieu of the proposed wet weather flow management strategies at the Woods Run WWTP. The satellite treatment capacity needed to avoid bypass of secondary treatment at the Woods Run WWTP is directly related to the wet weather flow routing scenario as shown in Table 9-21.

Table 9-21: Summary of Wet Weather Bypass by Plant Expansion Scenario

Scenario	Total Wet Weather Treatment Capacity (mgd)	Secondary Capacity (mgd)	Peak Rate of Wet Weather Secondary Treatment Bypass (mgd)
A-1	600	275	325
A-2	600	295	305
A-3	600	275	325
A-4	600	295	305
B	420	295	125
C	480	295	185
D	480	295	185

Potential sizes and locations of satellite treatment facilities were identified by performing hydrologic and hydraulic simulations of the ALCOSAN collection system using rainfall records from 2001 through 2004 to determine average and peak wet weather flows delivered to different points in the interceptors. These simulations were performed with the same model used for the storage and pump-back analysis described above. Historic flow monitoring records were also used for investigating potential sites at locations not specifically identified in the models. Eight sites were identified as potential locations for satellite treatment facilities as shown on Figure 9-16 including: Chartiers Creek, Saw Mill Run, Turtle Creek, Upper Allegheny North Shore and South Shore, Upper Ohio, Streets Run and Lowries Run.

Figure 9-16: Bypass Demonstration – Conceptual Locations for Satellite Wastewater Treatment Facilities



It should be noted that the identification of potential satellite treatment locations was not based on the feasibility of procuring the land required for the treatment facilities, or likelihood of local approval, but rather on the ability to convey flows to the treatment facilities and provide sufficient land area to construct the facilities.

The Chartiers Creek site is a triangular parcel located on the west shore of the Ohio River near Brunot Island. The site is 25 acres and bordered on the north by Robb Road, on the east by River Road and the Ohio River, on the south by River Road and Chartiers Creek and on the west by railroad tracks. Flow to a Chartiers Creek satellite treatment facility could be diverted from the vortex and junction chamber O-07.

The Turtle Creek site is a rectangular parcel located on the north shore of the Monongahela River near the Thomson Steel Works, across the river from Kennywood Park. The site is 15 acres and is bordered on the northeast by railroad tracks, on the southeast by 11th Street, on the southwest by the Monongahela River, and on the northwest by Seventh Street. Flow to a Turtle Creek satellite treatment facility could be diverted from the deep-tunnel interceptor, downstream of regulator structure M-60.

The Upper Allegheny – South Shore site is a rectangular parcel located on the south shore of the Allegheny River downstream of the 62nd Street Bridge. The site is 13 acres and is bordered on the north by the Allegheny River, on the east by 57th Street, on the south by railroad tracks, and on the west by a privately-owned parcel. Flow to the Upper Allegheny satellite treatment facility could be diverted from the deep-tunnel interceptor, close to regulator structure A-35.

The Upper Ohio site is a collection of parcels located along the east shore of the Ohio River between the Woods Run WWTP and the West End Bridge. The overall site is 39 acres and is currently owned by a number of private, commercial, and governmental parties. The site is bordered on the north by Branchport Street to the east by Metropolitan Street, to the south by North Avenue, and to the west by railroad tracks and the Ohio River. Preble Avenue bisects the site. Flow to an Upper Ohio satellite treatment facility could be diverted from the deep-tunnel interceptor, downstream of regulator structure O-38.

The Saw Mill Run site is a collection of parcels located along the west shore of the Ohio River near the West End Bridge. The overall site is 14 acres and is currently owned by a number of private, commercial, railroad and government parties. The site is bordered on the north by the West End Bridge, to the south by the entrance to the Duquesne Incline and Station Square properties, to the east by the Ohio River and to the west by Carson Street. Flow to a Saw Mill Run satellite treatment facility would be diverted from the 48-inch diameter interceptor just upstream of regulator structure O-14 and the river crossing.

The Streets Run site is vacant property located along the south shore of the Monongahela River near the Glenwood Bridge. The site is approximately 23 acres and bordered on the north by the Monongahela River, to the south and west by railroad tracks and to the east by Sandcastle. Flow to the Streets Run satellite treatment facility would be diverted from the 96-inch Homestead Trunk Sewer and 33-inch Streets Run Trunk Sewer just upstream of the river crossing drop shaft structure A-42A.

The Upper Allegheny – North Shore site is a rectangular parcel located on the north shore of the Allegheny River near the 62nd Street Bridge. The site is approximately 12 acres and includes four privately-owned and developed commercial properties. It is bordered on the north by Pine Creek and Route 28, on the east by private property, on the south by railroad tracks and the Allegheny River, and on the west by Pine Creek. Flow to the Upper Allegheny – North Shore satellite treatment facility would be diverted from the shallow cut interceptor, close to regulator structure A-68.

The Lowries Run site is a collection of parcels located along the north shore of the Ohio River near the Emsworth Lock and Dam. The overall site is approximately 8 acres including several privately-owned residential, commercial and light manufacturing properties. The site is bordered on the north by Route 65, to the south by railroad tracks and the Ohio River, to the east by Lowries Run and to the west by abutting privately-owned properties. Flow to a Lowries Run satellite treatment facility would be diverted from the 24-inch Lowries Run interceptor and 12-inch sewer from Emsworth upstream of the Lower Ohio Interceptor near regulator structure O-15.

Based on review of flow records, conveyance system models and existing site conditions the average daily and peak wet weather flow capacities of the eight potential satellite treatment sites are summarized in Table 9-22.

In order to develop satellite treatment facility alternatives, it is necessary to make several planning-level assumptions as to the level of treatment required and the treatment processes used. For this analysis, the following wastewater treatment assumptions were made.

- Since the satellite facilities are located along the main rivers it was assumed they would have NPDES discharge limitations similar to those at the Woods Run WWTP
- Primary treatment followed by secondary treatment using an activated sludge process would be provided for the two larger (Chartiers Creek and Upper Ohio) facilities (i.e., average daily flow greater than 20 mgd)
- Secondary treatment for the smaller satellite treatment facilities (average daily flow = 20 mgd, or less) would be provided using a sequencing batch reactor process without primary treatment
- UV disinfection would be used at all facilities
- Sludge thickening, dewatering and lime stabilization solids handling processes would be provided at all but the Upper Ohio site
- At the Upper Ohio site, sludge would be pumped to the Woods Run WWTP solids handling process due to its close proximity

Table 9-22: Potential Satellite Treatment Plant Locations and Treatment Capacities

Facility Name/Location	Nearest ALCOSAN Interceptor Structure	Average Daily Flow (mgd)	Peak Wet Weather Flow (mgd)
Chartiers Creek	O-07	40	120
Saw Mill Run	O-14	10	40
Turtle Creek	M-60	17	68
Upper Allegheny – South Shore	A-35	20	80
Upper Ohio	O-38	73	217
Streets Run	M-42A	10	40
Upper Allegheny – North Shore	A-68	5	20
Lowries Run	O-15	5	15
Totals		**180**	**600**

For planning purposes, it was assumed the satellite treatment facilities would be comprised of the following major unit processes:

- Influent pumping station
- Mechanical bar screens
- Aerated grit chambers
- Primary clarifiers (Chartiers Creek and Upper Ohio sites only)
- Aeration tanks and secondary clarifiers (Chartiers Creek and Upper Ohio sites) or sequencing batch reactors (Saw Mill Run, Streets Run, Turtle Creek, Lowries Run and Upper Allegheny sites)
- UV disinfection
- Cascade post-aeration
- Sludge holding tanks and sludge pumping station (Upper Ohio site only)
- Onsite sludge processing, including gravity belt thickeners for waste activated sludge thickening, centrifuge dewatering and lime stabilization (Chartiers Creek, Saw Mill Run, Streets Run, Turtle Creek, Lowries Run and both Upper Allegheny sites)

- Odor control for headworks, primary treatment (where provided) and solids handling facilities using two-stage chemical scrubbers (similar to Woods Run WWTP). Certain areas may require additional odor control provisions due to location in sensitive areas; however, the need for higher levels of odor control was not evaluated in this analysis.

Conceptual design criteria for each unit process are described in detail below. Most of the design criteria are based on requirements published in the 1997 DEP *Domestic Wastewater Facilities Manual*. Many of these design criteria are similar to what is outlined in the *Recommended Standards for Wastewater Facilities* 2004 edition (generally referred to as the "10 State Standards").

Note that a peaking factor (for peak-wet-weather-to-average flow) of 3.0 is used for sizing the Chartiers Creek and Upper Ohio satellite facilities. This peaking factor, which is higher than what is typically used for design of secondary treatment facilities, assumes that the biological process would be operated in conventional plug-flow mode during average flows and contact stabilization/step-feed mode during peak wet-weather flows. Preliminary analyses suggest that making this conversion could potentially increase the plant's capacity during wet weather flows to three times its average dry weather capacity.

The Upper Allegheny, Turtle Creek, Saw Mill Run, Streets Run and Lowries Run satellite facilities were sized using a peaking factor of 4.0 which is at the high end of the peak flow range for an SBR facility. A peaking factor of 3.0 was used for the Lowries Run SBR facility based on the flow monitoring records in the Lowries Run interceptor.

The cost evaluation for satellite treatment was based on a present worth analysis including estimated capital costs for initial construction; the present worth of future renewal and replacement capital costs and the present worth of annual operation and maintenance cost over the planning period of 2018 through 2046.

The capital costs for the satellite treatment alternatives include the sum of the estimated construction costs and the estimated non-construction costs. Preliminary quantity takeoffs were made for the following items:

- Buildings (on a square foot basis)
- Process tankage, channels, and major structures (quantity takeoff of site work and concrete)
- Major equipment (e.g., unit rates based on vendor planning quotes for pumps, screens, grit handling equipment, conveying equipment etc.)
- Property values based on Allegheny County assessment records
- Demolition of existing structures (on a square foot basis)

Unit costs and allowances for the planning-level construction cost estimates were developed for this project. The capital costs of alternatives are expressed in base year 2008 US dollars. For the purposes of present worth calculations, capital costs are not inflated to the anticipated mid-point of construction. Each non-construction cost is calculated as a percentage of the estimated construction cost. Estimated capital costs are shown in Table 9-23A.

Table 9-23A: Summary of Satellite Treatment Estimated Capital Costs

Plant Names	Design Flows, mgd		Estimated Capital Costs, $ millions	
	Average Daily	Peak Wet Weather	Treatment Plant	PW of Future Renewal and Replacement
Chartiers Creek	40	120	$508	$17
Turtle Creek	17	68	$250	$14
Upper Allegheny – South Shore	20	80	$289	$16
Upper Ohio	73	217	$697	$17
Saw Mill Run	10	40	$214	$12
Streets Run	10	40	$193	$12
Upper Allegheny – North Shore	5	20	$144	$9
Lowries Run	5	15	$141	$9

The O&M costs developed for the satellite treatment alternatives include materials, labor, electricity, and chemical costs associated with building use and equipment operation for all liquid treatment and solids handling processes. Residual disposal costs are also estimated for landfill disposal of screenings and grit and for landfill or land application of stabilized biosolids as currently conducted at the Woods Run WWTP.

Unit costs for satellite treatment plant O&M estimates are:

- Maintenance and operations staff: average ALCOSAN labor rates;
- Electricity: $0.09/kWh;
- Caustic for odor control: $0.40/lb; sodium hypochlorite for odor control: $0.66/lb;
- Maintenance materials cost: 20 percent of maintenance labor costs.

The annual O&M costs and equivalent present worth over the 28-year planning period for the satellite treatment alternatives are summarized in Table 9-23B.

Table 9-23B: Summary of Satellite Treatment Facilities Present Worth

Satellite Plant	Design Data Summary		Satellite Treatment Present Worth ($ millions)			
	Average Daily Flow, mgd	Peak Capacity, mgd	Initial Capital Cost	PW of Annual Costs	PW of Future Renewal & Replacement	Total Present Worth
Chartiers Creek	40	120	$508	$119	$17	$644
Turtle Creek	17	68	$250	$59	$14	$323
Upper Allegheny South Shore	20	80	$289	$66	$16	$371
Upper Ohio	73	217	$697	$211	$17	$925
Saw Mill Run	10	40	$214	$38	$12	$264
Streets Run	10	40	$193	$39	$12	$244
Upper Allegheny North Shore	5	20	$144	$29	$9	$182
Lowries Run	5	15	$141	$29	$9	$179

Plant Expansion Scenarios A-1 to A-4 includes maximum secondary treatment bypass of 305- to 325- mgd at the Woods Run WWTP. In lieu of this wet weather bypass there are four possible combinations of satellite facilities to provide a total peak flow capacity of 305- to 325-mgd as shown in Table 9-24. These combinations of satellite treatment facilities, referred to a Scenario SST-600, result in estimated PW lifecycle costs ranging from $1.4- to $1.6-billion. The satellite treatment alternatives are approximately three times the Scenario A lifecycle PW cost range of $550 to $590 million.

Table 9-24: Scenario SST-600 Combinations of Satellite Treatment Facilities and Present Worth Costs

Satellite Plant Combinations*	Design Data Summary		Satellite Treatment Present Worth ($ millions)			
	Average Daily Flow mgd	Peak Capacity mgd	Initial Capital Cost	PW of Annual Costs	PW of Future Purchases	Total Present Worth
UO, TC, & UANS	95	305	$1,091	$299	$40	$1,430
UO, UASS & LR	98	312	$1,127	$306	$42	$1,475
UO, UASS & UANS	98	312	$1,130	$306	$42	$1,478
CC & UO	113	337	$1,205	$330	$34	$1,569
UO, UASS, UANS, & LR	103	332	$1,271	$335	$51	$1,657

*CC = Chartiers Creek, TC = Turtle Creek, UASS=Upper Allegheny South Shore, UO=Upper Ohio, SMR=Saw Mill Run, SR=Streets Run, UANS=Upper Allegheny North Shore, LR=Lowries Run

Plant Expansion Scenario B includes a maximum secondary treatment bypass of 125 mgd at the Woods Run WWTP. This is approximately equal to the peak flow capacity of the Chartiers Creek conceptual satellite treatment plant (120 mgd). The estimated PW lifecycle cost of the Chartiers Creek satellite plant is $644 million compared to the Scenario B estimated PW lifecycle cost of $513 million. However, since the use of high-rate clarification for core flow treatment at the Woods Run WWTP was rejected by the EPA, this comparison is academic and not considered a feasible wet weather flow management strategy for ALCOSAN.

Plant Expansion Scenarios C and D include a maximum secondary treatment bypass of 185-mgd at the Woods Run WWTP. Scenario D is not considered a feasible wet weather flow management strategy for the same reasons noted above for Scenario B regarding EPA rejection of high-rate clarification. In lieu of the Scenario C wet weather bypass, the four lowest-cost possible combinations of satellite facilities to provide a total peak flow capacity of 185-mgd are shown in Table 9-25. These combinations of satellite treatment facilities, referred to as SST-480, result in PW lifecycle costs ranging from $925- to $967-million. The satellite treatment alternatives are more than double the Scenario C lifecycle PW cost of $401 million.

Table 9-25: Scenario SST- 480 Combinations of Satellite Treatment Facilities and Present Worth Costs

Satellite Plant Combinations*	Design Data Summary		Satellite Treatment Present Worth ($ millions)			
	Average Daily Flow mgd	Peak Capacity mgd	Initial Capital Cost	PW of Annual Costs	PW of Future Purchases	Total Present Worth
UO	73	217	$697	$211	$17	$925
TC, UASS & SR	47	188	$732	$164	$42	$938
TC, UASS & SMR	47	188	$753	$163	$42	$958
CC & TC	57	188	$758	$178	$31	$967

*CC = Chartiers Creek, TC = Turtle Creek, UASS=Upper Allegheny South Shore, UO=Upper Ohio, SMR=Saw Mill Run, SR=Streets Run, UANS=Upper Allegheny North Shore, LR=Lowries Run

Bypass Justification: The planning efforts conducted to evaluate the technical and financial feasibility of providing full treatment in lieu of the proposed bypass of partially-treated wet weather flows at the Woods Run WWTP included extensive use of the ALCOSAN H&H models. These models were used to simulate and quantify estimated wet weather flows to the Woods Run WWTP achieved through maximum use of the existing regional conveyance systems. Conceptual designs were developed for deep tunnel storage and pump-back facilities which included consideration of historical rainfall records including critical time periods with back-to-back storm events. Through use of the H&H models and flow monitoring records strategic sites for potential satellite treatment facilities were identified based on the distribution of wastewater flow in the collection system. Basic design criteria and costing tools were developed to provide a consistent and comparable method of conceptually sizing facilities and estimating capital and annual costs for numerous planning alternatives.

Through the concept development efforts, it became apparent that storage and pump-back facilities needed to eliminate the proposed bypass of partially-treated wet weather flow at the WWTP are technically not feasible. They are extremely large and require excessively long pump-back time periods for full treatment. Even at an expanded full-treatment capacity of 295 mgd at the WWTP (Scenario SPB-2) the storage tunnel dewatering time approaches one month for the targeted design storm event. Typically, the holding/dewatering time for storage facilities is no more than one to two days in order to reduce the potential for wastewater to turn septic or to settle-out suspended solids in the storage facility. Septic wastewater pumped from a storage facility can have a significant impact on the operation of a WWTP as well as emission of foul odors. In addition, excessive settlement of solids in the storage facility can generate operational challenges associated with cleaning, maintaining full storage capacity and control of odors from the storage facility.

Satellite treatment facilities in lieu of the proposed WWTP expansion scenarios inherently include a technical challenge to provide sufficient average daily flow to sustain biological treatment processes. In doing this, flow must be diverted from the Woods Run WWTP, thereby reducing its treatment capacity. For example, Satellite Treatment Scenario SST-600 requires diversion of approximately 100 mgd of average daily flow from the Woods Run WWTP to eliminate the wet weather secondary bypass of 305 mgd to 325 mgd of wet weather flow under plant expansion Scenarios A-3 and A-4. This diversion of average daily flow from the WWTP would severely limit the capacity of the existing facility. Satellite Treatment Scenario SST-480 requires diversion of between 47 mgd to 73 mgd of average daily flow from the WWTP to eliminate a wet weather secondary bypass of 185 mgd under plant expansion Scenario C. This diversion of average daily flow from the WWTP reduces capacity of the existing facility, but is potentially feasible. However, plant expansion Scenario C limits the wet weather treatment capacity at the WWTP to 480 mgd which increases the magnitude of regional conveyance improvements necessary to compensate for the reduced capacity at the WWTP.

The financial feasibility of providing storage and pump back or satellite treatment in lieu of the plant expansion scenarios was also evaluated. Table 9-26 provides a comparative summary of the estimated life cycle present worth costs of the viable plant expansion scenarios with the storage and pump back and satellite treatment alternatives.

Table 9-26: Summary of WWTP Expansion, Storage and Pump Back and Satellite Treatment Alternatives Present Worth Costs

Alternative	Life Cycle Present Worth Cost ($ millions)			
	Initial Capital Cost	PW of Annual Costs	PW of Future Purchases	Total Present Worth
Plant Expansion Scenario A-3	$445	$81	$27	$553
Plant Expansion Scenario A-4	$479	$82	$31	$592
Plant Expansion Scenario C	$290	$84	$27	$401
Storage and Pump Back Scenario SPB-1	$2,407 - $3,307	$76	$4	$2,487 - $3,387
Storage and Pump Back Scenario SPB-2	$1,848 - $2,348	$72	$4	$1,929 - $2,626
Satellite Treatment Scenario SST-600	$1,091 - $1,271	$299 - $335	$40 - $51	$1,430 - $1,657
Satellite Treatment Scenario SST-480	$697 - $758	$211 - $178	$17 - $31	$925 - 967

A comparison of the life cycle present worth costs indicates that the storage and pump-back alternatives are three to five times more costly than comparable plant expansion alternatives. Similarly, the present worth costs of satellite treatment scenarios exhibits two to three times higher cost than the plant expansion alternatives.

This life cycle cost comparison clearly demonstrates the significantly higher cost for either alternative to the proposed plant expansion scenarios, but taken by itself does not demonstrate financial infeasibility. However, when put in the context of the overall wet weather plan as presented in Section 11 of the WWP, it is demonstrated that a plant expansion (or alternative to secondary bypass) with present worth costs in excess of approximately $600 million is financially not feasible.

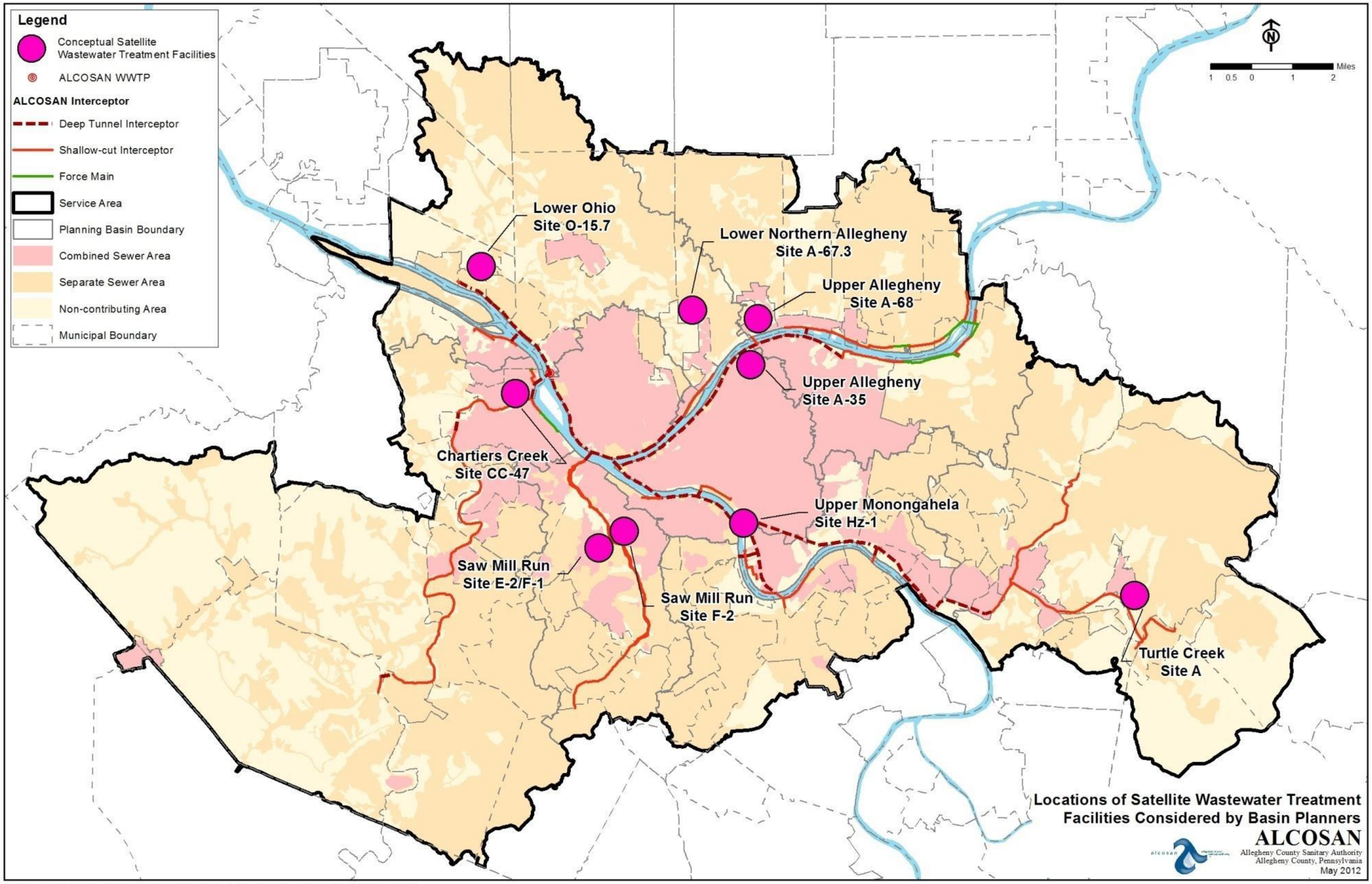
9.2.6 Satellite Sewage Treatment Plant Alternatives

Satellite sewage treatment (SST) plants were considered as one alternative for treatment of SSOs and CSOs, in lieu of partial treatment at the Woods Run WWTP as summarized in Section 9.2.5. A preliminary evaluation of potential SST plants included the conceptual design and cost estimating for eight SST plants ranging in size from 5 mgd to 73 mgd annual average daily flow (ADF) located along the main rivers (see Section 9.2.5). Through this evaluation, it was determined that SST plants include a technical challenge to provide sufficient ADF to sustain biological treatment processes. In doing this, flow must be diverted from the Woods Run WWTP, thereby reducing its ADF and peak treatment capacity. In effect, wastewater treatment would be decentralized at a higher cost than the proposed plant expansion for wet weather treatment.

Following the preliminary evaluation, each of the ALCOSAN Basin Planners reviewed the sites presented in the preliminary evaluation and analyzed the potential of an SST alternative within their respective planning basin. The process for analyzing the viability of SST plants as a basin alternative varied slightly for each of the seven basins. However, it was common to screen the technology in the Basin Planner prepared *Screening of Controls and Sites* reports, which provided basic considerations of the technical and financial feasibility of carrying forward an SST control technology through the basin planning process. The analyses also included assessing the available land, set back requirements, access, site difficulties, permitting requirements and prior cost estimates from the preliminary evaluation. The PM provided standard guidance for evaluation of the SST technology.

The SST sites considered by the Basin Planners are shown on Figure 9-17. In many cases, SST was eliminated as a viable technology for concerns over technical limitations and/or cost effectiveness. However, there were cases where SST was considered for further evaluation. A summary of SST consideration in each planning basin follows.

Figure 9-17: Locations for Satellite Wastewater Treatment Facilities Considered by the Basin Planners



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Chartiers Creek Planning Basin: The implementation of SST in the upper reaches of the Chartiers Creek Planning basin was not considered feasible due to siting limitations, and because discharges to Chartiers Creek would have permit limits based on effluent dominated streams that require more costly advanced treatment technologies. SST was considered among the RBS alternatives for the Chartiers Creek Planning Basin at a site referred to as CC-47 McKees Rock East. This site is at the outlet of the Chartiers Creek interceptor system near ALCOSAN structure O-07-00. A 40 mgd SST facility was considered for this site with a peak wet weather treatment capacity of 120 mgd. This facility would provide secondary treatment prior to discharge in the Ohio River. Five RBS alternatives were evaluated for this SST site which varied by the combination with other control technologies (i.e., treatment, storage and conveyance). One element that each alternative had in common was the Chartiers Creek interceptor system would be disconnected from the Woods Run WWTP and directed to the new SST facility. Wet weather flows in excess of the SST facility capacity would be handled through other CSO treatment, storage and relief sewer facilities up to the associated control levels.

Lower Ohio River – Girty's Run (LOGR) Planning Basin: The upper (northern) portion of the basin has hilly terrain restricting the siting of large treatment facilities. The lower portions of the basin along the Allegheny and Ohio Rivers have flatter areas more suited for treatment facilities, however, the current land use for railroads, major roads and highways limits the available space. Although no SST facilities are recommended in the LOGR Basin; two sites were evaluated for SST including Site O-15.7 in Ohio Township and Site A-67.3 in Millvale Borough as summarized below.

SST was evaluated at Site O-15.7 for the 2-year storm control level for sanitary sewers at the BBS boundary condition. This alternative would convey dry and wet weather flow from the O-15 trunk sewer upstream of Emsworth Borough to Site O-15.7. It was anticipated that the placement of a SST facility at this location would eliminate the need for controls at the O-15-00 outfall and reduce the size of the controls for the other outfalls along the LON. It was determined that overflows would still occur at the O-15-00 structure and the remaining outfalls along the LON were not impacted by removing these flows from the existing ALCOSAN system. This alternative was not carried into the Basin Alternative analysis due to the high cost of the SST; a control facility still being required for control of O-15 overflows; and there was no benefit to sizing of other overflow control facilities along the LON.

In the tributary area to CSO A-67 a storage tank was evaluated for consolidation flow grouping CF11 for the 0, 1, 4, 7, and 20 overflows per year CSO control levels to determine the impact of the size of the facility required at A-67. This consolidation conveys flow from all GRJSA CSOs and SSOs upstream of and including the Millvale SSO to Site A-67.3. A hydraulic assessment determined that if wet weather flows were directed into a storage tank at Site A-67.3 that the overflows at A-67 were not reduced compared to the baseline condition. To further evaluate this option, a simulated bulk head was placed at the Millvale Borough border and all upstream flow was directed to a satellite treatment facility. The resulting overflows at A-67 were then compared to the baseline overflows at A-67. Under this scenario, the overflows at A-67 were not significantly different than the baseline condition. Since an upstream facility at Site A-67.3 would not result in reduced facility size for the control of A-67, a facility at Site A-67.3 was not carried forward into the Basin Alternative analysis.

The potential site for a SST facility in the LOGR planning basin identified in the bypass demonstration (Section 9.2.5) near the Emsworth Lock and Dam was not consider by the LOGR basin planners since much of the property is currently in use and would not be readily available. In addition, the municipalities provided input as to preferred alternate sites for SST.

Main Rivers Planning Basin: SST was not considered feasible in the MR Planning Basin due to siting issuing along the redeveloping river banks and the proximity to the Woods Run WWTP. Nearly all of the flows in the MR basin are from combined sewers within an urban area which is not conducive to siting and operation of SST facilities. There are only two SSOs in the MR Basin, both located in Reserve Township, that are not particularly active based on flow monitoring and modeling efforts. In addition, the limited flow from these SSOs makes SST a less viable control technology.

Saw Mill Run Planning Basin: SST was considered in the SMR Planning Basin as an alternative to off-line storage in the Flow Source CF08 area. This area is located in the central portion of the SMR Basin; wherein, the average daily flows and wet weather flows were suitable for consideration of a 20 mgd SST with a peak capacity of 80 mgd. Two sites were evaluated for SST location referred to as E-2/F-1 and F-2.

The E-2/F-1 site potentially had the available space, however, the location on a hillside well above the parallel sewers and significant operational, implementation and public issues resulted in elimination of this alternative from further consideration. The F-2 site was determined to have insufficient space for SST.

The potential site for an SST facility in the SMR planning basin identified in the bypass demonstration (Section 9.2.5) near the West End Bridge was not considered an appropriate control technology by the SMR basin planners due to excessive cost compared to storage or conveyance alternatives.

Turtle Creek Planning Basin: An SST facility located at Site A and serving the consolidated sewershed areas CF04, CF05 and CF06 was considered the only practical SST site in the TC Basin. Site A is located on park property in Monroeville along the border with Pitcairn, between Turtle Creek and Broadway Boulevard. Since a SST plant at this site would discharge to Turtle Creek, advanced treatment levels would be required. Combined with the need for flow equalization and influent pumping, the SST alternative resulted in present worth costs nearly three times the cost of comparable consolidation and storage alternatives. Therefore, SST was not recommended for this site.

Other sites in the TC Basin were rejected for SST application due to sites being too small to accommodate a complete secondary treatment plant; the high cost for new wet weather conveyance to the downstream sites (i.e., Site B and Site 5); or being located in areas where the ADF was insufficient to accommodate a secondary treatment facility.

Upper Allegheny River Planning Basin: SST was considered in the UA Basin for two types of application, including (1) secondary treatment of dry weather sanitary sewer flows and overflows at SSO locations for SSO control, or (2) secondary treatment of dry weather flows and a portion of wet weather flows at key locations as a means of providing additional core flow capacity on a system-wide basis. An SST was not considered feasible for the SSO areas A-45, A-82 and A-85 because of their remote location, low flows and overall costs compared to that of other alternatives. Two locations were considered potentially feasible for SST near ALCOSAN Structures A-35 and A-68.

The A-35 site is located along the south shore of the Allegheny River near 57th Street. A 20 mgd ADF with peak flow treatment capacity of 80 mgd would provide treatment to all wet weather flows (sanitary and combined) at this location for up to LOC of about 2 to 3 overflows per year. Since the land around this site is not readily available, a SST facility was not considered for further evaluations.

The A-68 site is located on the north shore of the Allegheny River, west of the 62nd Street Bridge between Route 28, Pine Creek and the railroad tracks along the river. The tributary sanitary and combined sewer areas could support a 5 mgd (ADF) SST facility. However, the wet weather flows far exceed the maximum potential peak treatment capacity of 20 mgd for this SST facility considering a peaking factor of four times ADF. In order to achieve even the lowest LOC, additional storage or treatment facilities would be necessary in addition to SST at this site. For example, to achieve a LOC of 4 – 6 overflows/year would require an 80 mgd RTB in addition to the SST plant. The combined cost for SST and RTB exceed the cost of an alternative with a 100 mgd RTB alone by over $100 million. Given the limited system-wide benefits of a small SST facility at this location and the high cost, SST was not considered for further evaluation.

Upper Monongahela River Planning Basin: The most promising case for the implementation of a SST plant was at the site of the former LTV Steel property in Hazelwood (identified as Site Alternative Hz-1 by the UM Basin Planner). A new pump station would be built to intercept the deep tunnel interceptor and pump all flow to a new SST plant, effectively splitting the Upper Mon and Turtle Creek planning basins from the rest of the ALCOSAN system. The preliminary sizing indicated that the proposed SST would need 45 mgd ADF and 125 mgd peak flow capacities to treat all flows conveyed by the existing deep tunnel interceptor from the Upper Mon and Turtle Creek planning basins. A conceptual site layout determined that more than 20 acres would be required unless high-rate processes are used. As part of the system-wide alternative analysis process, this regional conveyance plus SST alternative was retained for evaluation as System-Wide Alternative 3c.

SST was also considered for three other CSO consolidation site alternatives (Hazelwood, Streets Run and Mon Valley). However, cost analyses of these three SST alternatives resulted in excess of $500 million higher present worth value than comparable retention treatment basins and were eliminated from further consideration.

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9.3 Municipal Planning Information

9.3.1 Introduction

Part VI, Section N of the ALCOSAN Consent Decree describes the required cooperation between ALCOSAN and its customer municipalities and details the processes by which ALCOSAN was to solicit information from and provide information to the municipalities. The CD also requires ALCOSAN to solicit comments on the draft WWP and provide public participation opportunities on the proposed Plan. ALCOSAN coordinated closely with its customer municipalities in the development of appropriate wet weather control facilities. These public participation and municipal coordination activities are discussed extensively in Section 2 of the WWP. Selected municipal coordination activities relating to development of wet weather control strategies are summarized in this subsection.

In conjunction with ALCOSAN's federal Consent Decree, most municipalities have entered into a Consent Order Agreement (COA) or Administrative Consent Order (ACO) issued respectively by the PaDEP for combined sewer systems and municipal collection systems outside of Allegheny County and by the ACHD for sanitary systems within Allegheny County. Most of the customer municipalities were required to participate and cooperate with ALCOSAN in establishing the quantity and rate of wastewater to be conveyed to the ALCOSAN system through the planning period. The municipalities provided their responses to ALCOSAN, and most included the requested preliminary planning information including preliminary flow information at each point of connection (POC) and proposed municipal improvements and costs to control and/or convey flows.

The municipal orders require the development of municipal Feasibility Studies for the elimination of SSOs and the control of CSOs from municipal sewer systems. These studies are due to PaDEP or ACHD six months after the submittal of ALCOSAN's Wet Weather Plan. Due to the complexity of working with the municipal planning information received through 2011, ALCOSAN distributed a letter in the Fall of 2011 requesting that selected municipalities cooperate to submit the Draft Feasibility Studies by POC (instead of by municipality) at 48 complex, multi-municipal POCs. (These Draft Feasibility Studies were received by ALCOSAN in July, 2012, as discussed in Section 9.3.5.) ALCOSAN coordinated with the municipalities and municipal authorities during the development of the Wet Weather Plan, allowing the integration of the respective ALCOSAN controls with preliminary municipal control strategies.

9.3.2 Information Requested by ALCOSAN

During the concurrent development of ALCOSAN and municipal wet weather control strategies, ALCOSAN first requested preliminary flow estimates and control strategies from each municipality by early 2010. After extensive review of this preliminary information and coordination with the municipalities, the following additional planning information was requested from each customer municipality and authority within the ALCOSAN service area by the fall of 2010:

- Flow estimates, including any updates from the preliminary flow estimates
- Proposed modifications to the municipal systems (if any) needed to deliver such flows

- Alternatives under consideration for flow delivery, if proposed modifications are not available

The following specific information was requested for proposed modifications to the existing system and for alternatives under consideration for controlling CSO and SSO discharges:

- The level of CSO/SSO control provided
- The capital costs, operation and maintenance (O&M) costs, and renewal and replacement (R&R) costs associated with new municipal improvements and facilities
- For the existing municipal collection system, the O&M and R&R costs for new or expanded programs and practices that are implemented as a means to reduce the frequency, duration and volume of CSO and SSO discharges.
- The basis for the cost estimates (ALCOSAN Alternatives Costing Tool or other methodology)

At a minimum, the proposed municipal O&M and R&R costs for the existing collection systems were expected to include new programs needed to support the key ALCOSAN H&H modeling assumption described in Section 7: that inflow and infiltration (I/I) in the existing system will not increase during the 2046 planning period.

9.3.3 Municipal Responses

The municipal responses to the ALCOSAN data requests were reviewed by the ALCOSAN basin planner teams to assess the completeness and reliability of the provided municipal documentation and to identify any control strategies that may have been proposed by a municipality. The basin planners followed through by placing phone calls, distributing e-mails, and conducting follow-up meetings with the municipalities to ask questions and ascertain the municipal intent. In some cases, even after the follow-through coordination was completed, information from a particular municipality was still incomplete, was judged to be unreliable, or a preferred control strategy could not be clearly identified. In these cases, the basin planner assumed a control strategy (including the proposed technologies and facility locations and sizes), assumed a level of control and the associated costs, and/or identified areas within the existing municipal sewer system that had adequate hydraulic capacity to convey peak wet weather flow to the ALCOSAN system and where no capital improvements or control facilities were required.

The following information was summarized for each POC to the ALCOSAN system and for each municipality within that POC. The summary distinguished between separate sanitary sewer improvements and combined sewer improvements so that SSO and CSO control costs could be tabulated separately.

- The name of the POC sewershed and name of each municipality contributing flow;
- The proposed technology to be utilized within the POC if control facilities are needed;

- A notice from the Borough or Authority Engineer that no capital improvements are required within the POC sewershed if the existing sewer system was adequate;
- The level of CSO/SSO controls provided by the preferred control strategies;
- The projected, O&M and renewal and replacement cost associated with the POC for the new municipal improvements and facilities, including any new costs for the existing municipal collection system if associated with limiting extraneous flow and controlling CSO and SSO discharges.
- The basis for the capital and/or present worth cost estimates (ALCOSAN Alternatives Costing Tool or other methodology)
- Whether the proposed control alternative and costs were provided by the municipality or if assumptions were used by the basin planner due to unreliable or incomplete information.

The municipality-identified or basin planner-assumed preliminary municipal control strategies as of the spring of 2011 are shown in Figures 9-19 through 9-25. A figure is provided for each planning basin. Many municipalities indicated the capacity of their existing system is adequate to convey predicted flows through 2046. Of the remaining municipalities that have indicated the need for improvements, the great majority of the municipal control strategies reflect new conveyance for sending more flow to the ALCOSAN system for treatment. However, the strategies also employ other approaches including tank storage, sewer separation, sewer system optimization, stream removal, pump station upgrades, inflow/infiltration removal, and storm water removal. Preliminary municipal cost estimates provided to ALCOSAN for these control strategies indicate a total municipal capital cost of $530 million based on the best information available at this time.

Additional information on these preferred and/or assumed preliminary municipal control strategies as of the spring of 2011 are provided in Table 9-27 through Table 9-34. An individual table is provided for each planning basin. These comprehensive tables indicate for each point of connection, the tributary municipalities, any upstream regulator structures and outfalls along the municipal collection system, how the flow will be managed and maintained, and for CSOs the proposed level of control. Some updates to this information were received in July, 2012, in the Draft Feasibility Studies as described in Section 9.3.5.

Appendix S and V of the ALCOSAN Consent Decree require that the WWP include certain information for each POC upon implementation of the Wet Weather Plan, based on input from each customer municipality. This information includes the total service population and forecasts of the total flow that each POC will contribute to the conveyance and treatment system after implementation of the WWP. This information is included in WWP Appendix B. The forecasts of total flow for each POC were determined using a typical year model simulation with future baseline (2046) flow conditions plus all assumed or preferred municipal control strategies incorporated. The simulations were conducted assuming a free discharge condition at the model system boundaries and outfalls. The annual volume of flow contributed at each POC was divided by 365 in order to report the flow at each POC in gallons/day, as required by the CD.

Most of the municipalities within the ALCOSAN service area own, operate, and maintain their respective combined or sanitary sewer collection systems. However, 22 of the 83 customer municipalities have sewer or water and sewer authorities. A list of the municipal wastewater authorities within the ALCOSAN service area is provided in Section 6 of the WWP. There are a variety of alternative institutional arrangements between these authorities and their respective municipalities. Some authorities own, operate, and maintain the collection sewer systems on behalf of the municipality. Some operate and maintain the sewers, and others have lease management agreements with their respective municipalities. When the regulatory agencies issued Consent Order and Agreements (COAs) and Administrative Consent Orders (ACOs) for a series of required sewer system activities, they were issued jointly to both the municipalities and the municipal authorities. Therefore, 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 collection systems, regulator structures, and CSO/SSO outfalls.

Figure 9-19: Chartiers Creek Municipal Planning Information

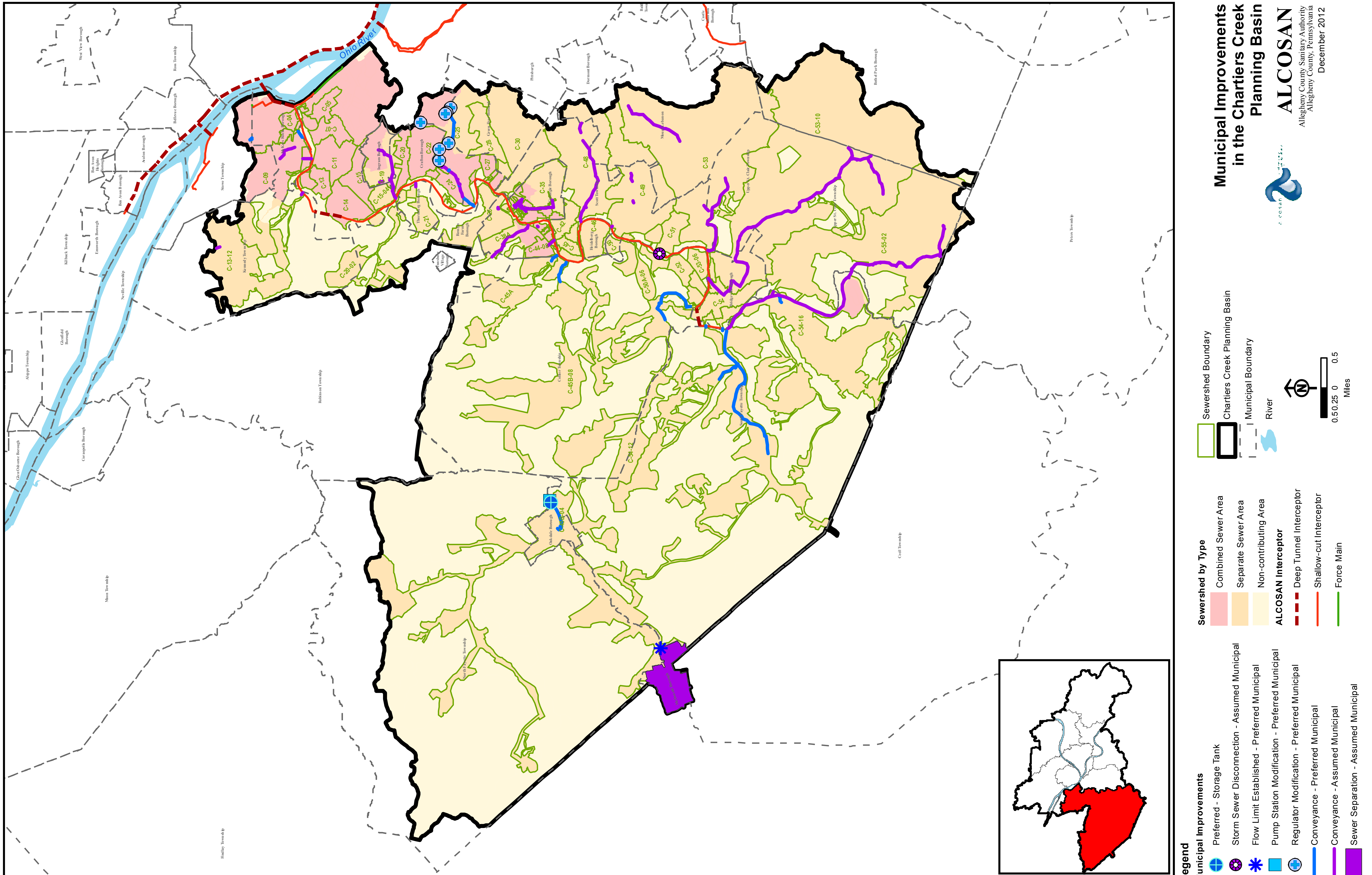

Figure 9-20: Lower Ohio / Girty's Run Planning Basin Municipal Improvements

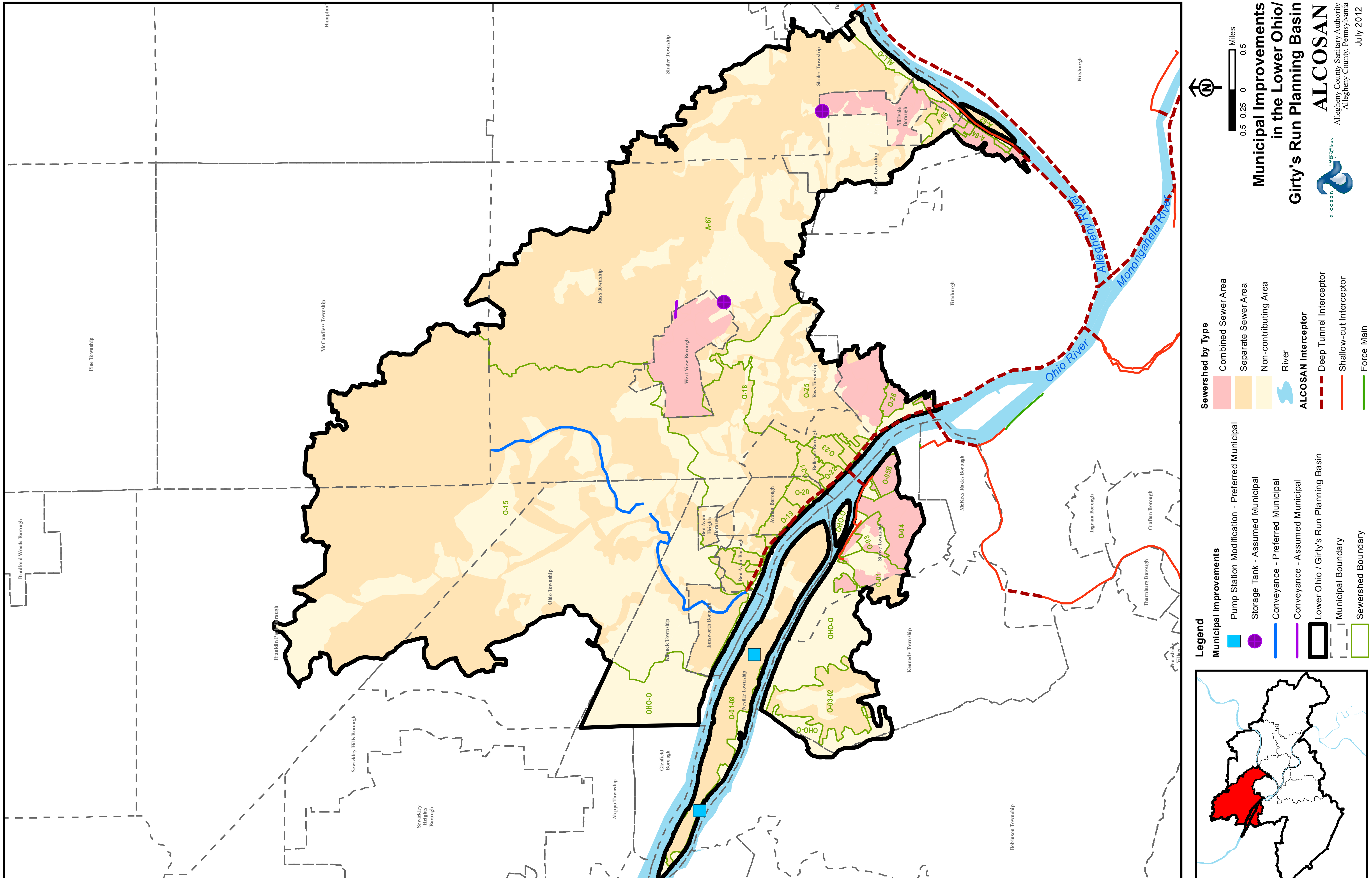

Figure 9-21: Main Rivers Planning Basin Municipal Alternatives

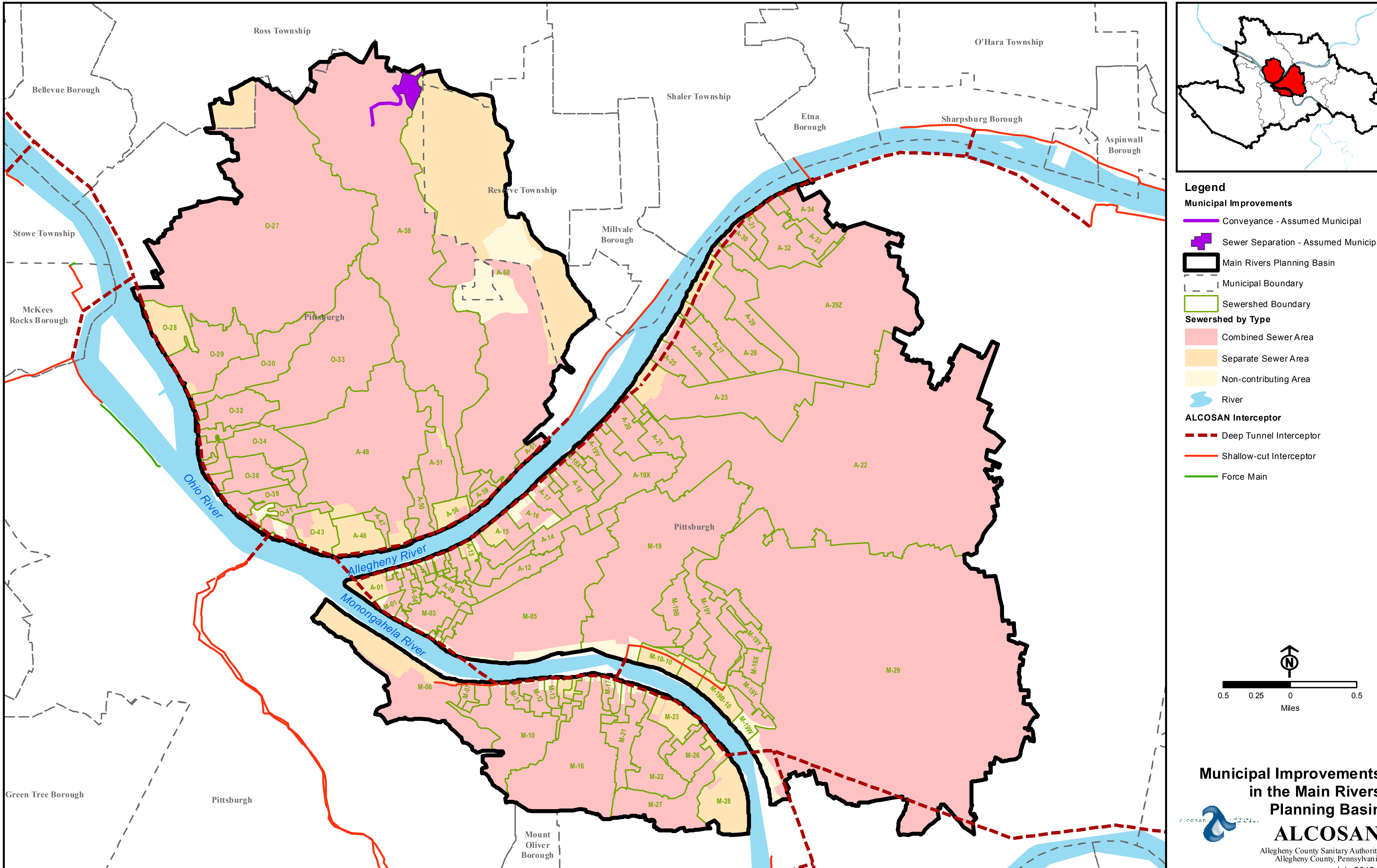

Figure 9-22: Saw Mill Run Planning Basin Municipal Improvements

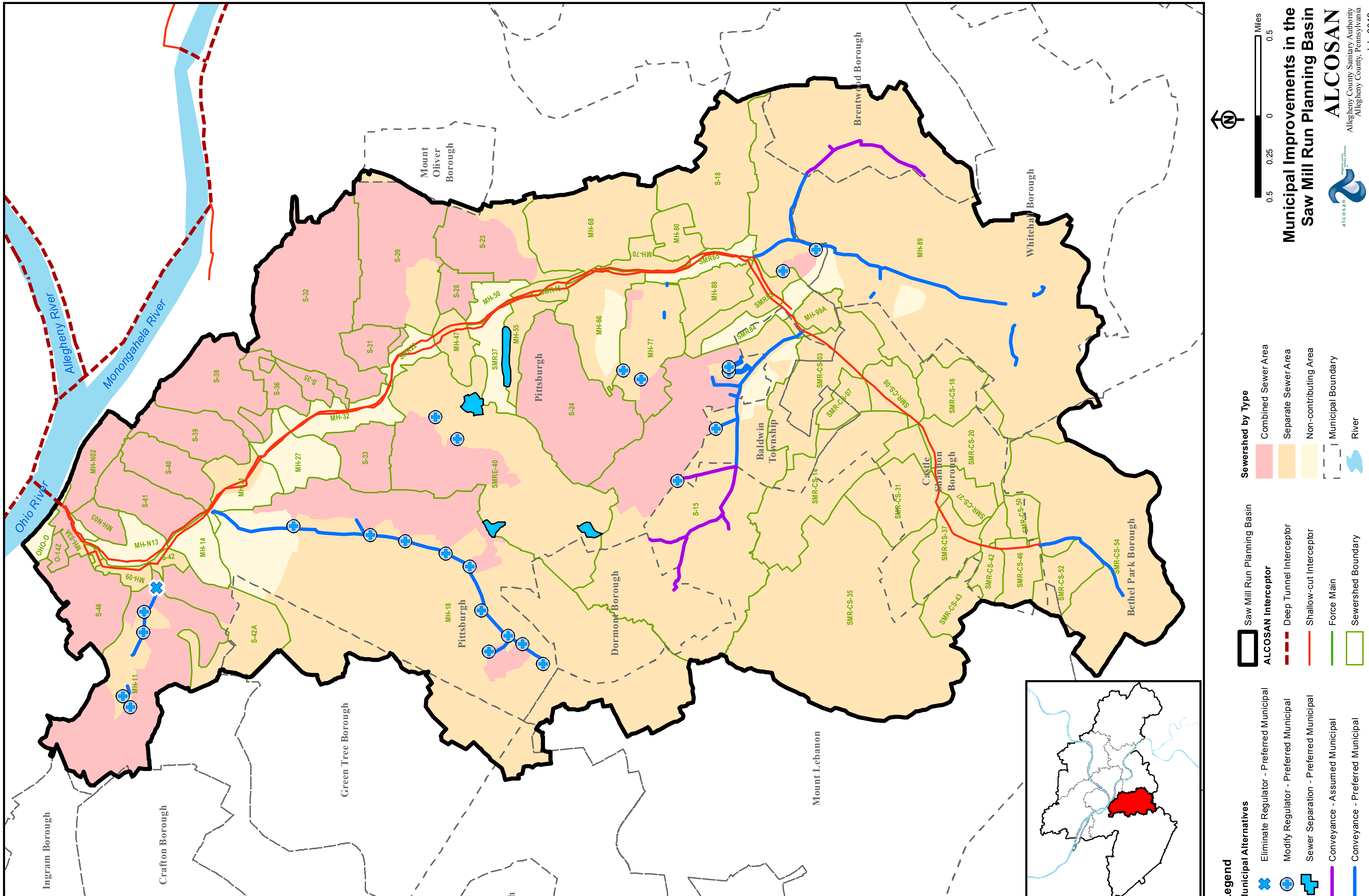

Figure 9-23: Turtle Creek Planning Basin Municipal Alternatives

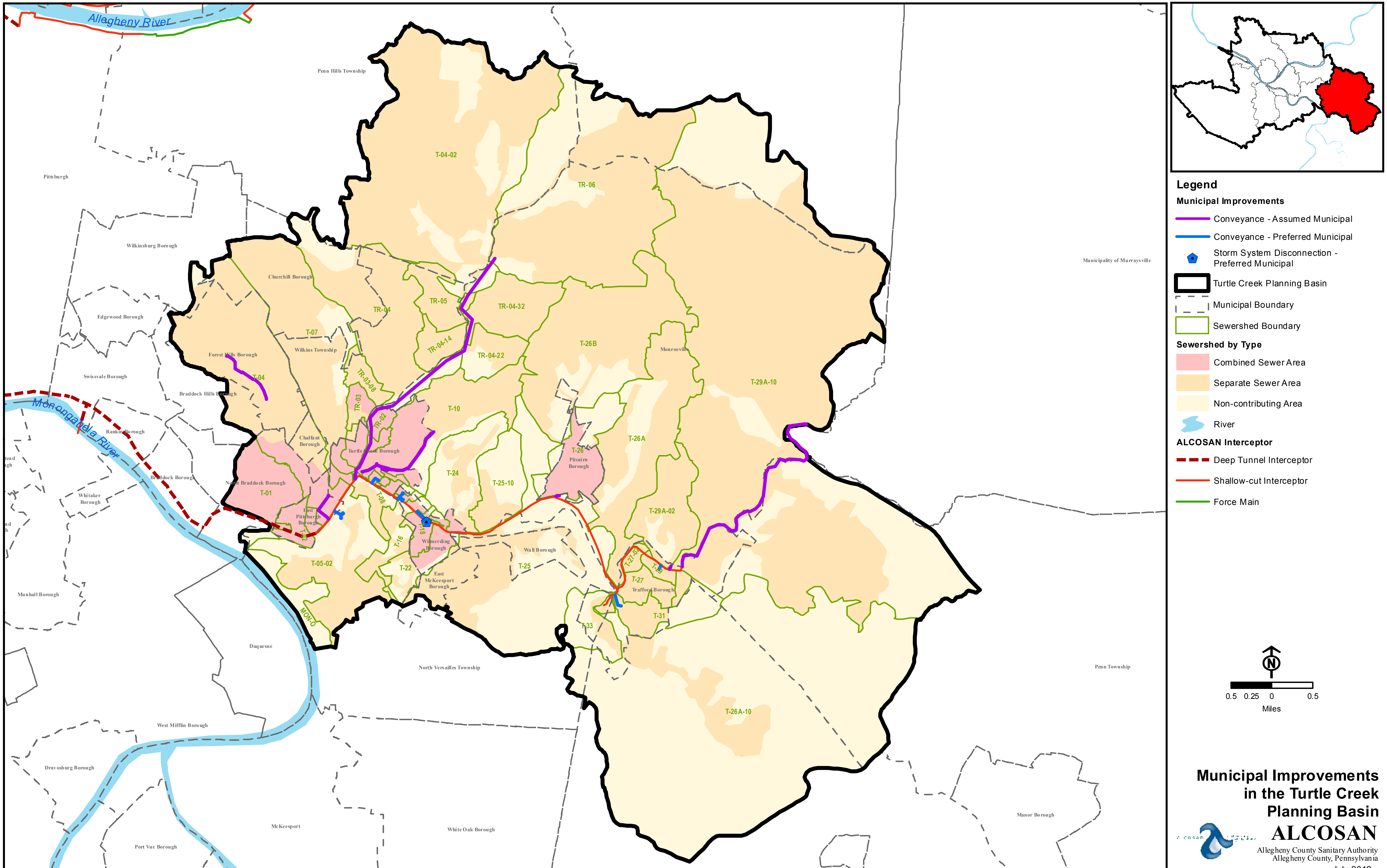

Figure 9-24: Upper Allegheny River Planning Basin Municipal Improvements

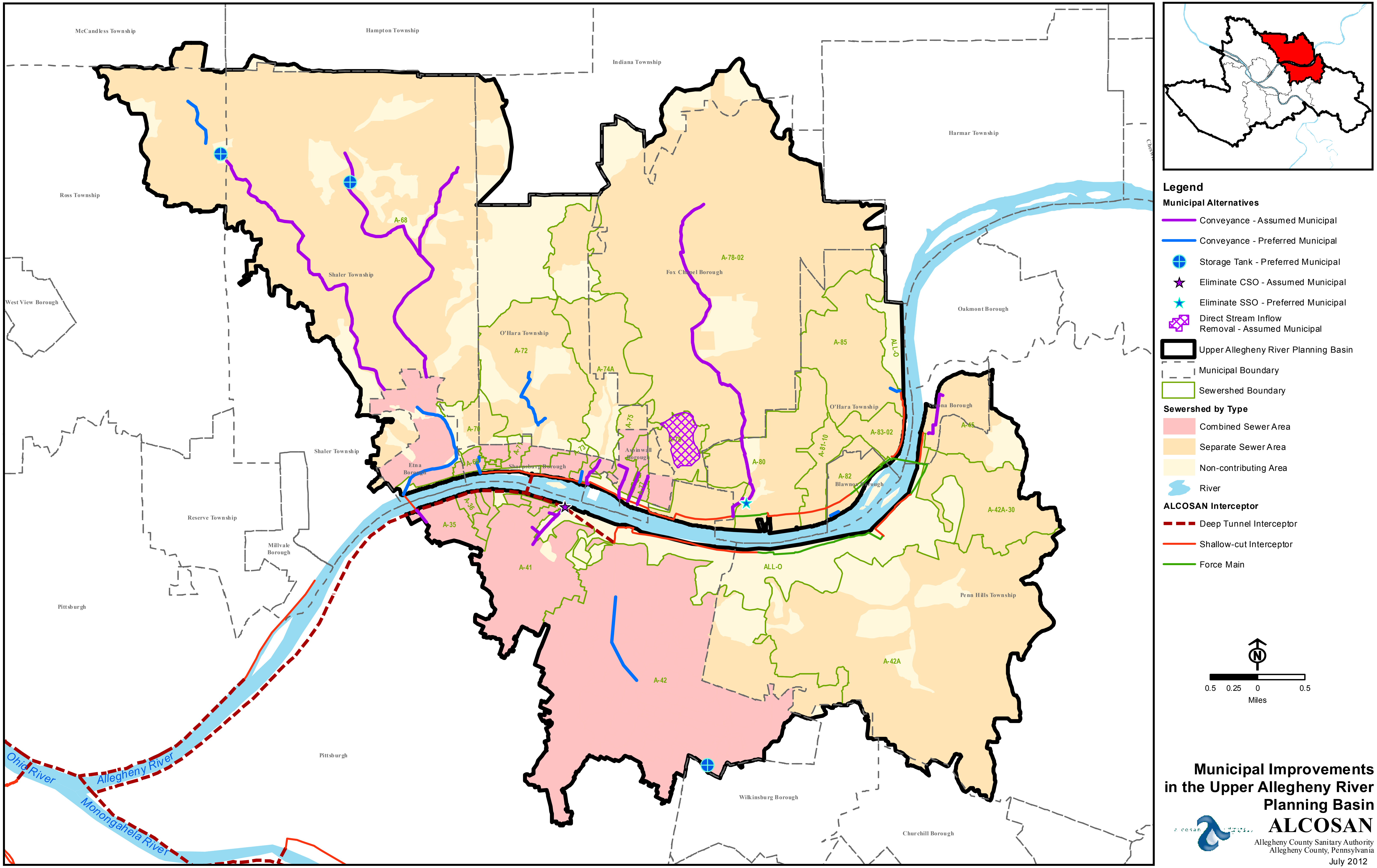

Figure 9-25: Upper Monongahela River Planning Basin Municipal Alternatives

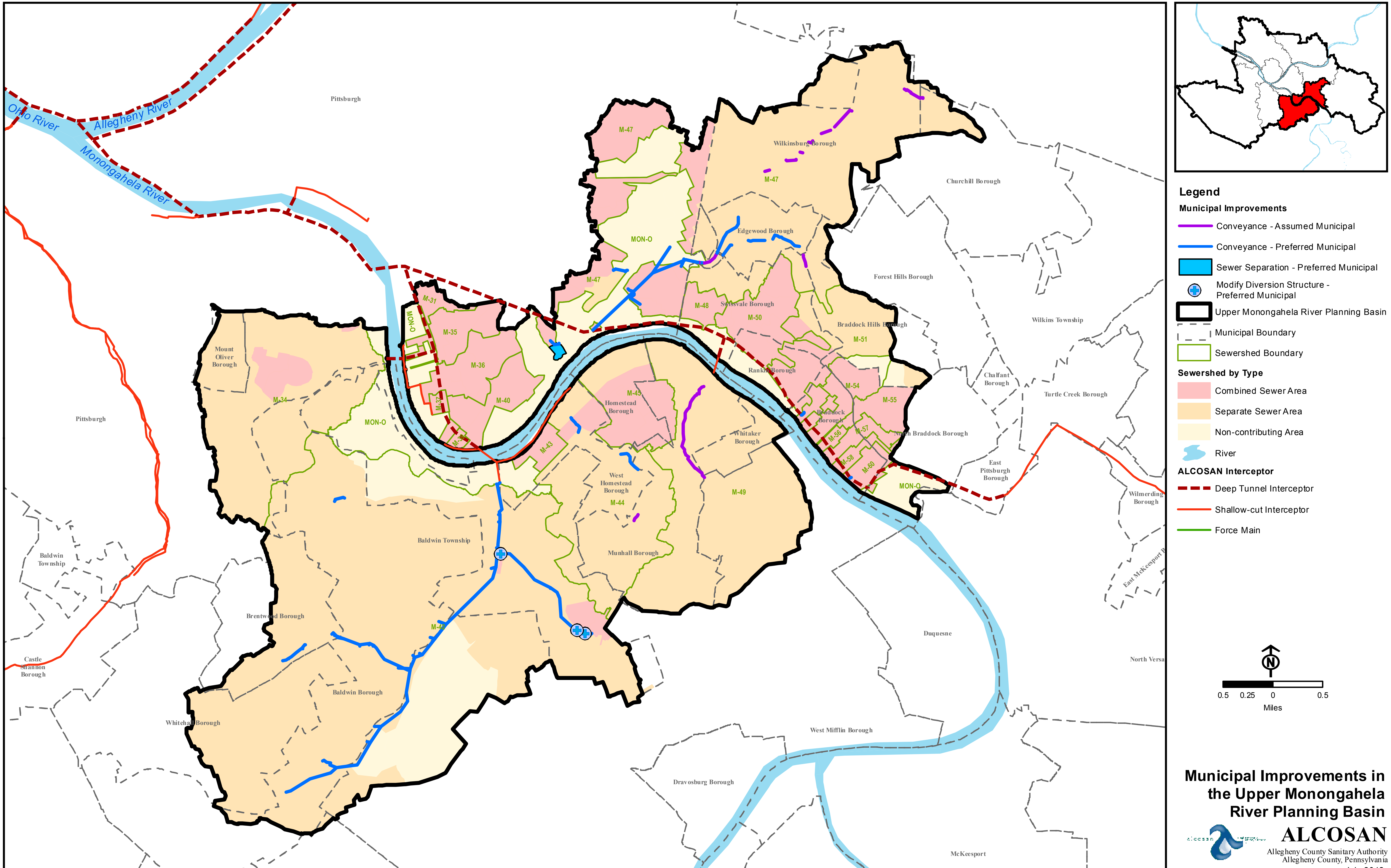

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Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-02	City of Pittsburgh / Pittsburgh Sewer & Water Authority (COP / PWSA)	This POC has been eliminated since the 2013 submission of the Wet Weather Plan.					
C-03	COP / PWSA	Use existing system					
C-04	McKees Rocks	Use existing system					
C-05	COP / PWSA	Use existing system					
C-05A	COP / PWSA	Use existing system					
C-06	McKees Rocks	Use existing system					
C-07	COP / PWSA	Use existing system[1]					
C-08	McKees Rocks	Use existing system					
C-09	Kennedy				Use existing system		
	McKees Rocks	Parallel relief sewer[2]		4			
	Stowe	Use existing system					
C-10	McKees Rocks	Conveyance					
C-11	COP / PWSA	Use existing system					
C-12	COP / PWSA	Use existing system					
C-13	McKees Rocks	Use existing system[2]	MKR-1	4			
C-13-02	COP / PWSA	Use existing system	ADC07RC13A	4			
C-13-06	COP / PWSA				Use existing system		
C-13-12	Kennedy				Conveyance		
C-13A-02	COP / PWSA	Use existing system					
C-13A-04	COP / PWSA				Use existing system		
C-14	COP / PWSA	This POC has been eliminated since the 2013 submission of the Wet Weather Plan.					
C-14-06	COP / PWSA				Use existing system		

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-15	Ingram	Use existing system					
	COP / PWSA	Use existing system					
C-15-04	COP / PWSA	Replacement Sewer					
C-19	Crafton				Parallel relief sewer		
	Ingram	Parallel relief sewer					
	COP / PWSA				Use existing system		
C-20	Crafton	Use existing system					
	COP / PWSA	Use existing system					
C-20-02	Kennedy				Use existing system		
	Robinson / MATR				Use existing system		
	Private Ownership				Use existing system		
C-21	Thornburg				Use existing system		
C-22	Crafton	Use existing system					
C-23	Crafton	Use existing system					
C-23-08	Crafton	Use existing system					
C-23-14	Crafton	Use existing system					
C-24	Crafton	Parallel relief sewer					
C-25	Green Tree				Use existing system		
	Crafton				Use existing system		
	COP / PWSA	Replacement sewers and regulator modifications	CSO-039E001 CSO-039J001 CSO-039K001 CSO-068H001 CSO-068H002	4			

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-26	Carnegie				Use existing system		
	Rosslyn Farms				Use existing system		
C-26A	COP / PWSA	Use existing system					
C-27	COP / PWSA	Use existing system					
C-28	Green Tree				Use existing system		
	COP / PWSA	Use existing system					
C-29	Green Tree				Use existing system		
	COP / PWSA	Use existing system					
C-30	Green Tree				Use existing system		
	Scott				Use existing system	W-2D[6]	10 year
C-31	Carnegie	Use existing system					
C-33	Carnegie				Use existing system		
C-34	Carnegie				Use existing system		
C-34A	Carnegie	Conveyance[3]					
C-35	Carnegie	Parallel relief sewer			Parallel relief sewer		
C-36	Carnegie				Use existing system		
C-37	Carnegie	Use existing system					
C-38	Carnegie				Use existing system		
C-38A	Carnegie				Parallel relief sewer and replacement sewer		
	Robinson / MATR				Parallel relief sewer		
C-38B	Carnegie	Parallel relief sewer					
C-39	Carnegie	POC is abandoned					
C-40[3]	Carnegie	This POC has been eliminated since the 2013 submission of the Wet Weather Plan.					

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-41	Carnegie	Use existing system					
C-42	Scott				Use existing system		
C-43	Carnegie	Use existing system					
C-44	Carnegie	Use existing system					
C-44-08	Carnegie	Parallel relief sewer	812-48A 2000-774	4			
C-44-12	Private Ownership				Use existing system		
C-45	Scott				Use existing system		
C-45A	Carnegie				Use existing system		
	Collier / Collier Twp Municipal Authority (CTMA)[4]				Sewer Replacement		
	Robinson/ MATR				Use existing system		

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-45B-04	South Fayette / Municipal Authority of the Township of South Fayette (MATSF)				Oakdale Pump Station capacity increased, relief sewers, storage tank, and flow limited from McDonald		
	McDonald / McDonald Borough Sewer Authority (MBSA)	Complete sewer separation[7]	B4_MCD0008 A1_MCD0002-3 A2_MCD0082 A3_MCD0104 A4_MCD0097 B13_MCD0048 B14_MCD0044 B16_MCD0063 B17_MCD0058 B18_MCD0067 B2_MCD0004 B3_MCD0006 B6_MCD0107 B7_MCD0101 B8_MCD0094 B9_MCD0095	4			
	North Fayette				Use existing system		
	Oakdale / Oakdale Borough Authority (OBA)				Covered under Municipal Authority of the Township of South Fayette (MATSF) submittal.		

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-45B-08	Collier / (CTMA)[4]				Pipe upsizing	RR-SI	2 year
C-46	Heidelberg				Use existing system		
C-47	Scott				Use existing system		
C-48	Carnegie				Use existing system		
	Mt. Lebanon				Conveyance		
	Scott				Parallel relief sewer	H-11[8] H-30-1 H-30-2 H-30-2C	2-10 year
C-49	Mt. Lebanon				Use existing system		
	Scott				Parallel relief sewer and replacement sewer		
C-50	Collier / CTMA[4]				Use existing system		
	Scott				Use existing system		
C-50A	Scott				Use existing system		
C-50A-06	Collier / CTMA[4]				Use existing system	KH-47A	2 year

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-50A-12	Collier / CTMA[4]				Use existing system	KH-1	2 year
C-50B	Scott				Use existing system		
C-51	Scott				Disconnect Storm Sewer		
C-52	Collier / CTMA[4]				Use existing system		
C-53	Bethel Park / Bethel Park Municipal Authority (BPMA)				Use existing system		
	Castle Shannon				Use existing system		
	Mt. Lebanon				Conveyance		
	Scott				Parallel relief sewer		
	Upper St. Clair				Conveyance		
C-53-06	Private Ownership				Use existing system		
C-53-08	Bridgeville				Use existing system		
C-53-10	Bethel Park / BPMA				Parallel relief sewer and replacement sewers	1D41	10 year
	Bridgeville				Parallel relief sewer and replacement sewers	2000-57	2-10 year
	Upper St. Clair				Parallel relief sewer and replacement sewers	950-1733 950-2213 950-4785[5]	2-10 year
C-54	Bridgeville				Use Existing System		

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
C-54-06	Collier / CTMA[4]				Use existing system	DCKH	2 year
C-54-07	Collier / CTMA[4]				Use existing system		
C-54-12	Collier / CTMA[4]				Sewer replacement		
	South Fayette / MATSF				Upsize Pipes		
C-54-16	Cecil				Use existing system		
	South Fayette / MATSF				Parallel relief sewers, replacement sewers, and add siphon crossings		10 year
C-54-18	Bridgeville Borough				Use existing system		
C-54-20	South Fayette / MATSF				Use existing system		
C-55	Bridgeville				Use existing system		
C-55-02	Bethel Park / BPMA				Use existing system		
	Peters				Use existing system		
	Upper St. Clair				Conveyance	950-4750 950-4382	2-10 year
O-06	McKees Rocks	Replacement sewer	MKR-2 MKR-3	4			
	Stowe	Use existing system					
O-08	COP / PWSA	Use existing system					

Table 9-27: Chartiers Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
O-09	COP / PWSA	This POC has been eliminated since the 2013 submission of the Wet Weather Plan.					
O-10	COP / PWSA	This POC has been eliminated since the 2013 submission of the Wet Weather Plan.					
O-11	COP/PWSA	This POC has been eliminated since the 2013 submission of the Wet Weather Plan.					
O-13	COP/PWSA	Use existing system					

Black Text: Preferred municipal planning information
Red Text: PB assumed municipal planning information

[1] Sheraden Park stream inflow considered part of baseline conditions

[2] Deweyville and Pine Hollow stream removals considered part of baseline conditions

[3] Wabash stream inflow removal considered part of baseline conditions

[4] Collier Township owns and operates the sewer system tributary to POC C-50. The Collier Township Municipal Authority owns and operates the remaining sewer systems tributary to its other POCs with ALCOSAN

[5] Jointly permitted by Bridgeville & Upper St. Clair

[6] The Scott Township Feasibility Study Report (July 2013) indicates CCTV has shown this is not a constructed overflow. ALCOSAN will confirm.

[7] 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.

[8] 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.

Table 9-28: Lower Ohio – Girty's Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-62	City of Pittsburgh / Pittsburgh Water and Sewer Authority (COP / PWSA)	Use existing system			Use existing system		
A-63	(COP / PWSA)	POC eliminated by Route 28 project.					
A-64	(COP / PWSA)	Use existing system					
A-65	(COP / PWSA)	Use existing system					
A-66	(COP / PWSA)	POC eliminated by Route 28 project. Flows redirected to A-65 and A-66-02.					
	Reserve	POC eliminated by Route 28 project. Flows redirected to A-65.			POC eliminated by Route 28 project. Flows redirected to A-65.		
	Millvale	POC eliminated by Route 28 project. All flow removed by Route 28 project.					

Table 9-28: Lower Ohio – Girty's Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-66-02	COP / PWSA	This new direct connection POC was created by the A-66 work per the Route 28 project. Flows accounted for with A-65 for WWP.					
A-67	Girty's Run Joint Sewer Authority[1]	Storage tank	ML-CSO#1-OF ML-CSO#2-OF ML-CSO#3-OF ML-CSO#4-OF ML-CSO#5-OF ML-CSO#6-OF ML-CSO#7-OF ML-CSO#8-OF ML-CSO-#9-OF	2	Storage tank	• MH.37-IRO-OF (Greenhill SSO) • MH.25-IRO-OF (Millvale SSO) • MH.07-IRO-OF (Baeurlein St SSO) • MH.I-IRO-OF (Hayes SSO) • UT-OF • LT-OF	2 year
	West View / Municipal Authority of West View (MAWV)	Storage tank	• WV-CSO#1-OF (CSO-1 Cemetery Lane)	4			
		Conveyance	• WV-CSO#2-OF (CSO-2 Cresson Ave)	0			
O-01	Stowe	Use existing system					
	Kennedy				Use existing system		
O-01-08	Neville				Rehab 2 Existing Pump Stations	Neville_SSO-3-OF	
O-02	Stowe	Use existing system					2 year
O-03	Stowe	Use existing system					
O-03-02	Kennedy				Use existing system		
O-04	Stowe	Use existing system					
O-05A	Stowe	Use existing system					
O-05B	Stowe	Use existing system					

Table 9-28: Lower Ohio – Girty's Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
O-15	Lowries Run Joint Operating Committee				Upsize pipes, new parallel conveyance	• Lowries Run MH 59	2 year
	Emsworth				Use existing system (O-15-EMS)		
	Emsworth				Use existing system (O-15-EMSPS)		
O-16	Ben Avon				Use existing system		
	Emsworth				Use existing system		
	Kilbuck				Use existing system		
O-16Z	Ben Avon				Use existing system		
	Kilbuck				Use existing system		
O-17	Ben Avon				Use existing system		
O-18	Bellevue				Use existing system		
	Avalon				Use existing system		
	Ben Avon				Use existing system		
	Ben Avon Heights				Use existing system		
	Kilbuck				Use existing system		
	Ross				Use existing system		
	West View / MAWV				Use existing system		
O-18Y	Ben Avon				Use existing system		
O-18Z	Ben Avon				Use existing system		

Table 9-28: Lower Ohio – Girty's Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
O-19	Avalon				Use existing system		
O-20	Avalon				Use existing system		
O-21	Avalon				Use existing system		
	Bellevue				Use existing system		
O-22	Bellevue				Use existing system		
O-23	Bellevue				Use existing system		
O-24	Bellevue				Use existing system		
O-25	Bellevue				Use existing system		
	Ross				Use existing system with I/I reduction[2]		
	COP / PWSA	Use existing system					
O-26	COP / PWSA	Use existing system					
O-26A	ALCOSAN	Use existing system					

Black text: Preferred municipal planning information
Red text: BP assumed municipal planning information

[1] Girty's Run Joint Sewer Authority encompasses McCandless, Millvale, Reserve, Ross, Shaler, and West View

[2] Mapping extent of I/I reduction is not currently available

Table 9-29: Main Rivers Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-01	City of Pittsburgh / Pittsburgh Water and Sewer Authority (COP / PWSA)	Use Existing System					
A-02	COP / PWSA	Use Existing System					
A-03	COP / PWSA	Use Existing System					
A-04	COP / PWSA	Use Existing System					
A-05	COP / PWSA	Use Existing System					
A-06	COP / PWSA	Use Existing System					
A-07	COP / PWSA	Use Existing System					
A-08	COP / PWSA	Use Existing System					
A-09	COP / PWSA	Use Existing System					
A-10	COP / PWSA	Use Existing System					
A-11	COP / PWSA	Use Existing System					
A-12	COP / PWSA	Use Existing System					
A-13	COP / PWSA	Use Existing System					
A-14	COP / PWSA	Use Existing System					
A-14Z	COP / PWSA	Use Existing System					
A-15	COP / PWSA	Use Existing System					
A-16	COP / PWSA	Use Existing System					
A-17	COP / PWSA	Use Existing System					
A-18	COP / PWSA	Use Existing System					
A-18X	COP / PWSA	Use Existing System					
A-18Y	COP / PWSA	Use Existing System					
A-18Z	COP / PWSA	Use Existing System					

Table 9-29: Main Rivers Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-19X	COP / PWSA	Use Existing System					
A-19Y	COP / PWSA	Use Existing System					
A-19Z	COP / PWSA	Use Existing System					
A-20	COP / PWSA	Use Existing System					
A-20Z	COP / PWSA	Use Existing System					
A-21	COP / PWSA	Use Existing System					
A-22	COP / PWSA	Use Existing System					
A-23	COP / PWSA	Use Existing System					
A-25	COP / PWSA	Use Existing System					
A-26	COP / PWSA	Use Existing System					
A-27	COP / PWSA	Use Existing System					
A-27Z	COP / PWSA	Use Existing System					
A-28	COP / PWSA	Use Existing System					
A-29	COP / PWSA	Use Existing System					
A-29Z	COP / PWSA	Use Existing System					
A-30	COP / PWSA	Use Existing System					
A-31	COP / PWSA	Use Existing System					
A-32	COP / PWSA	Use Existing System					
A-33	COP / PWSA	Use Existing System					
A-34	COP / PWSA	Use Existing System					
A-46	COP / PWSA				Use Existing System		
A-47	COP / PWSA	Use Existing System					
A-48	COP / PWSA	Use Existing System					
A-49	COP / PWSA	Use Existing System					
A-50	COP / PWSA	Use Existing System					
A-51	COP / PWSA	Use Existing System					
A-55	COP / PWSA	Use Existing System					

Table 9-29: Main Rivers Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-56	COP / PWSA	Use Existing System					
A-58	COP / PWSA	Sewer separation & Conveyance	OF009E001 OF163G001	0			
A-59	COP / PWSA	Use Existing System					
A-59Z	COP / PWSA	Use Existing System					
A-60	COP / PWSA	Use Existing System					
	Reserve	Use Existing System			Use Existing System	B-122A-OF F-101-OF	10 year
	Ross	Use existing system			Use Existing System		
A-61	COP / PWSA	Use Existing System					
M-01	COP / PWSA	Use Existing System					
M-02	COP / PWSA	Use Existing System					
M-03	COP / PWSA	Use Existing System					
M-04	COP / PWSA	Use Existing System					
M-04A	COP / PWSA	Use Existing System					
M-04B	COP / PWSA	Use Existing System					
M-04D	COP / PWSA	Use Existing System					
M-05	COP / PWSA	Use Existing System					
M-06	COP / PWSA	Use Existing System					
M-07	COP / PWSA	Use Existing System					
M-08	COP / PWSA	Use Existing System					
M-10	COP / PWSA	Use Existing System					
M-11	COP / PWSA	Use Existing System					
M-12	COP / PWSA	Use Existing System					
M-12Z	COP / PWSA	Use Existing System					
M-13	COP / PWSA	Use Existing System					
M-14	COP / PWSA	Use Existing System					

Table 9-29: Main Rivers Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
M-15	COP / PWSA	Use Existing System					
M-15Z	COP / PWSA	Use Existing System					
M-16	COP / PWSA	Use Existing System					
M-17	COP / PWSA	Use Existing System					
M-18	COP / PWSA	Use Existing System					
M-19	COP / PWSA	Use Existing System					
M-19-10	COP / PWSA	Use Existing System					
M-19B	COP / PWSA	Use Existing System					
M-19B-06	COP / PWSA				Use Existing System		
M-19B-10	COP / PWSA				Use Existing System		
M-19W	COP / PWSA	Use Existing System					
M-19X	COP / PWSA	Use Existing System					
M-19Y	COP / PWSA	Use Existing System					
M-20	COP / PWSA	Use Existing System					
M-21	COP / PWSA	Use Existing System					
M-22	COP / PWSA	Use Existing System					
M-23	COP / PWSA	Use Existing System					
M-24	COP / PWSA	Use Existing System					
M-26	COP / PWSA	Use Existing System					
M-27	COP / PWSA	Use Existing System					
M-28	COP / PWSA	Use Existing System					
M-29	COP / PWSA	Use Existing System					
O-27	COP / PWSA	Use Existing System					
	Ross				Use Existing System		
O-28	COP / PWSA				Use Existing System		
O-29	COP / PWSA	Use Existing System					
O-30	COP / PWSA	Use Existing System					

Table 9-29: Main Rivers Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
O-31	COP / PWSA	Use Existing System					
O-32	COP / PWSA	Use Existing System					
O-33	COP / PWSA	Use Existing System					
O-34	COP / PWSA	Use Existing System					
O-35	COP / PWSA	Use Existing System					
O-36	COP / PWSA	Use Existing System					
O-37	COP / PWSA	Use Existing System					
O-38	COP / PWSA	Use Existing System					
O-39	COP / PWSA	Use Existing System					
O-40	COP / PWSA	Use Existing System					
O-41	COP / PWSA	Use Existing System					
O-43	COP / PWSA	Use Existing System					

Black text: Preferred municipal planning information
Red text: BP assumed municipal planning information

Table 9-30: Saw Mill Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
MH-03A	City of Pittsburgh / Pittsburgh Water and Sewer Authority (COP / PWSA)	Use existing system			Use existing system		
MH-08	COP / PWSA				Use existing system		
MH-09B	COP / PWSA				Use existing system		
MH-11	Crafton	Use Existing System					
	COP / PWSA	Eliminate one regulator, modifications to four regulators, and parallel relief sewers	CSO019M001[1]	4	Parallel relief sewers		
MH-18	Dormont				Use existing system		
	Green Tree				Use existing system		
	Mount Lebanon				Use existing system		
	COP / PWSA	Modifications to 10 regulators and relief sewer	CSO016A001 CSO16A002 CSO035A001 CSO035E001 CSO035J001 CSO036R001	4	Relief sewer		
	Scott				Use existing system		
MH-21	COP / PWSA				Use existing system		
MH-47	COP / PWSA				Use existing system		
MH-55	COP / PWSA	Sewer Separation	CSO034R001	4	Use Existing System		
MH-66	COP / PWSA				Use existing system		
MH-68	COP / PWSA				Use existing system		
MH-70	COP / PWSA				Use existing system		

Table 9-30: Saw Mill Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
MH-77	COP / PWSA	Modifications to two regulators and relief sewers	CSO095E001	4	Relief sewers		
MH-80	COP / PWSA		CSO095J001	4	Use existing system		
MH-88	COP / PWSA				Use existing system		
MH-89	Brentwood				Upsize Pipes		
	Castle Shannon				Use existing system		
	COP / PWSA	Modifications to two regulators and relief sewers	CSO138K001 CSO138P001 CSO138E001	4			
	Whitehall				Relief Sewers		
MH-99A	COP / PWSA				Use existing system		
MH-N02	COP / PWSA	Use existing system					
MH-N03	COP / PWSA	Use existing system					
O-14Z	COP / PWSA	Use existing system					
S-15	Baldwin				Relief Sewer		
	Dormont				Use existing system		
	Mount Lebanon				Increased conveyance capacity		
	COP / PWSA	Modifications to four regulators and relief sewers	CSO097L001 CSO139A001 CSO139B001 CSO139B002 CSO139B003 CSO139F001 S1500POCL01A-OF	4	Relief sewers		
S-16LC	COP / PWSA				Use existing system		
S-18	COP / PWSA				Use existing system		

Table 9-30: Saw Mill Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
S-23	COP / PWSA	Use existing system	CSO060A001	4	Use existing system		
	Mount Oliver				Use existing system		
S-24	COP / PWSA	Use existing system					
S-28	COP / PWSA	Use existing system					
S-29	COP / PWSA	Use existing system			Use existing system		
	Mount Oliver				Use existing system		
S-30	COP / PWSA	Use existing system					
S-31	COP / PWSA	Use existing system					
SMRE-40	Dormont				Use existing system		
	COP / PWSA	Modifications to two regulators, sewer separation, and parallel relief sewers	CSO015P001	4			
S-32	COP / PWSA	Use existing system					
S-33	COP / PWSA	Use existing system					
S-34	COP / PWSA	Use existing system					
S-35	COP / PWSA	Use existing system					
S-36	COP / PWSA	Use existing system					
S-37	COP / PWSA	Use existing system					
S-38	COP / PWSA	Use existing system					
S-39	COP / PWSA	Use existing system					
S-40	COP / PWSA	Use existing system					
S-41	COP / PWSA	Use existing system					
S-42	COP / PWSA	Use existing system					
S-42A	Green Tree				Use existing system		
	COP / PWSA	Use existing system		4	Use existing system		
S-46	COP / PWSA	Use existing system					

Table 9-30: Saw Mill Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
SMRE-61 (SMR45)	COP / PWSA				Use existing system		
SMR83	COP / PWSA				Use existing system		
SMR-CS-02	Baldwin Township				Use existing system		
	Castle Shannon				Use existing system		
SMR-CS-03	Castle Shannon				Use existing system		
SMR-CS-06	Baldwin Township				Use existing system		
	Castle Shannon				Use existing system		
SMR-CS-08	Castle Shannon				Use existing system		
SMR-CS-14	Baldwin Township				Use existing system		
	Castle Shannon				Use existing system		
	Mount Lebanon				Use existing system		
SMR-CS-16	Castle Shannon				Use existing system		
SMR-CS-20	Castle Shannon				Use existing system		
SMR-CS-27	Castle Shannon				Use existing system		
SMR-CS-31	Castle Shannon				Use existing system		
	Mount Lebanon				Use existing system		
SMR-CS-33	Castle Shannon				Use existing system		
SMR-CS-34	Castle Shannon				Use existing system		
	Mount Lebanon				Use existing system		
SMR-CS-37	Castle Shannon				Use existing system		
SMR-CS-39A	Castle Shannon				Use existing system		
SMR-CS-42	Castle Shannon				Use existing system	CS-MLSSO[2]	2-10 year
	Mount Lebanon				Use existing system		
SMR-CS-43	Castle Shannon				Use existing system		
SMR-CS-46	Castle Shannon				Use existing system		
SMR-CS-50	Castle Shannon				Use existing system		

Table 9-30: Saw Mill Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
SMR-CS-52	Bethel Park / BPMA				Use existing system		
	Castle Shannon				Use existing system		
	Mount Lebanon				Use existing system		
SMR-CS-54	Bethel Park / BPMA				Upsize Trunk Sewer	3B1001OF 3B1002OF	10 year
	Castle Shannon				Use existing system		

Black text: Preferred municipal planning information
Red text: BP assumed municipal planning information

[1] Joint permit with ALCOSAN for S-42A-OF/CSO019M001

[2] Ownership of this outfall is in question

Table 9-31: Turtle Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
T-01	East Pittsburgh	Use existing system					
	North Braddock	Use existing system					
T-02	East Pittsburgh	Use existing system					
T-03	East Pittsburgh	Use existing system					
T-04	Braddock Hills				Use existing system		
	Chalfant				Use existing system		
	Churchill				Use existing system		
	East Pittsburgh	Relief sewers					
	Forest Hills				Relief sewers		
	North Braddock	Use existing system			Use existing system		
	Turtle Creek	Use existing system					
	Wilkins				Use existing system		
	Wilkinsburg				Use existing system		
T-04-02	Penn Hills				Use existing system		
T-05-02	North Versailles / NVTA				Conveyance	T-05-OF	2 year
T-07	Churchill				Use existing system		
	Turtle Creek	Use existing system					
	Wilkins				Use existing system		

Table 9-31: Turtle Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

<table>
<tr><th rowspan="2">ALCOSAN Point of Connection</th><th rowspan="2">Municipality/ Authority</th><th colspan="3">Combined Sewer System</th><th colspan="3">Separate Sewer System</th></tr>
<tr><th>How Will Flows Be Managed/ Maintained?</th><th>Existing Municipal CSOs</th><th>Future Overflow Frequency in Typical Year</th><th>How Will Flows Be Managed/ Maintained?</th><th>Existing Municipal SSOs</th><th>SSO Level of Control</th></tr>
<tr><td>T-08</td><td>North Versaille/ NVTA s</td><td></td><td></td><td></td><td>Use existing system</td><td></td><td></td></tr>
<tr><td rowspan="6">T-09
(see detailed Table 9-32 below)</td><td>Churchill</td><td></td><td></td><td></td><td>Use existing system</td><td></td><td></td></tr>
<tr><td>Monroeville / Monroeville Municipal Authority (MMA)</td><td></td><td></td><td></td><td>Conveyance</td><td>MH-2363-OF</td><td></td></tr>
<tr><td>Penn Hills</td><td></td><td></td><td></td><td>Use existing system</td><td></td><td></td></tr>
<tr><td>Plum / Plum Borough Municipal Authority (PBMA)</td><td></td><td></td><td></td><td>Use existing system</td><td></td><td></td></tr>
<tr><td>Turtle Creek</td><td>Conveyance</td><td>T-MH-075-OF
GI-12-OF</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Wilkins</td><td>Conveyance</td><td>TR-03A-OF</td><td>0</td><td>Conveyance</td><td></td><td></td></tr>
<tr><td rowspan="2">T-10</td><td>Monroeville / Monroeville Municipal Authority (MMA)</td><td></td><td></td><td></td><td>Conveyance</td><td></td><td></td></tr>
<tr><td>Turtle Creek</td><td>Relief sewers</td><td>T-10C-OF
(TC-01)</td><td>0</td><td></td><td></td><td></td></tr>
<tr><td>T-11</td><td>Turtle Creek</td><td>Use existing system</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>T-12</td><td>Turtle Creek</td><td>Relief sewers</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>T-13</td><td>Turtle Creek</td><td>Use existing system</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>T-14</td><td>Turtle Creek</td><td>Use existing system</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>T-15</td><td>Wilmerding</td><td>Relief sewers</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Table 9-31: Turtle Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
T-16	North Versailles / NVTA				Use existing system		
T-16-02	Wilmerding				Use existing system		
T-16A	Wilmerding	Relief Sewers					
T-17	Wilmerding	Use existing system					
T-18	Wilmerding	Disconnection of storm system[2]	T-18-OF_ST[2]	0			
T-19	Wilmerding	Relief sewers					
T-21	Wilmerding	Use existing system					
T-22	North Versailles / NVTA				Use existing system		
	Wilmerding				Use existing system		
T-23	Wilmerding	Use existing system					
T-24	Monroeville / MMA				Use existing system		
	Wilmerding	Use existing system					
T-25	East McKeesport				Use existing system		
	North Versailles / NVTA				Use existing system		
	Wall				Use existing system		
T-25-10	Monroeville / MMA				Use existing system		
T-26	Pitcairn	Use existing system					
T-26A	Monroeville / MMA				Use existing system		

Table 9-31: Turtle Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
T-26A-10	North Huntingdon/ North Huntingdon Twp Municipal Authority (NHTMA) / Western Westmoreland Municipal Authority (WWMA)				Use existing system		
	Trafford				Use existing system		
T-26B	Monroeville / MMSA				Conveyance		
T-27	Trafford				Use existing system		
T-27-02	Trafford				Use existing system		
T-27-12	Trafford	This direct connection POC was included with POC T-27-02 for development of the WWP.					
T-29	Trafford				Relief Sewers		
T-29A-02	Monroeville / MMA				Conveyance		
T-29A-08	Trafford				Use existing system		

Table 9-31: Turtle Creek Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
T-29A-10	Monroeville / MMA				Conveyance and I/I Removal[1] (T-29A-10A)	T-29A-10-M1-OF	2 year
	Penn Township/ Penn Township Sewage Authority (PTSA)				Use existing system (T-29A-10A)		
	Plum / Plum Borough Municipal Authority				Use existing system (T-29A-10A)		
	Trafford				Use existing system (T-29A-10B)	T-29A-10B-OF	2 year
T-31	Trafford				Relief Sewers		
T-32	Trafford				Use existing system		
T-33	Trafford				Use existing system		

Black text: Preferred municipal planning information
Red text: BP assumed municipal planning information
[1] Mapping extent of I/I removal is not currently available
[2] This project was confirmed to be complete which eliminated this overflow.

Table 9-32: Thompson Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipal Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
			How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
T-09	TR-01	Turtle Creek						
	TR-01-06z	Turtle Creek						
		Wilkins		T-MH-075-OF GI-12-OF				
	TR-01-16	Turtle Creek						
	TR-02	Turtle Creek						
	TR-02-04	Wilkins		CSO No. 1				
	TR-03	Wilkins						
	TR-03-08	Chuchill						
		Wilkins						
	TR-04	Churchill						
		Penn Hills						
		Wilkins						
	TR-04-14	Monroeville / MMA						
		Wilkins						
	TR-04-22	Monroeville / MMA						
	TR-04-32	Monroeville / MMA						
		Wilkins						
	TR-05	Monroeville / MMA						

Table 9-32: Thompson Run Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipal Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
			How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
		Penn Hills						
		Wilkins						
	TR-05-04	Monroeville / MMA						
		Wilkins						
	TR-06	Monroeville / MMA						
		Penn Hills						
		Plum / PBMA						

Black text: Preferred municipal planning information
Red text: BP assumed municipal planning information

Table 9-33: Upper Allegheny River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-35	Pittsburgh/ Pittsburgh Water and Sewer Authority (COP / PWSA)	Upsize Pipes					
A-36	COP/ PWSA	Use existing system					
A-37	COP/ PWSA	Use existing system					
A-37Z	COP/ PWSA	Use existing system					
A-38	COP/ PWSA	Use existing system					
A-40	COP/ PWSA	Use existing system					
A-41	COP/ PWSA	Eliminate CSO and pipe upsizing	121H001-OF	0			
A-42	Penn Hills				Use existing system		
	COP/ PWSA	Underground Storage Tanks and relief sewers	177K001-OF (CSO128K001)[1]	4			
	Wilkinsburg				Use existing system		
A-42-02	COP/ PWSA	Use existing system					
A-42A	Penn Hills				Use existing system		
A-42A-30	Penn Hills				Use existing system		
A-44-02	Verona				Use existing system		
A-45	Penn Hills				Use existing system		
	Verona				Parallel relief sewer		

Table 9-33: Upper Allegheny River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-68	Etna	Parallel relief sewer	CSO-1A-OF CSO-1-OF CSO-2-OF CSO-3-OF CSO-4-OF CSO-5-OF CSO-7-OF CSO-8-OF MH-C108-OF MH-M7-OF	4	Parallel relief sewer		
	Hampton				Use existing system		
	Indiana Twp / Deer Creek Drainage Basin Authority				Use existing system		
	McCandless				Use existing system		
	O'Hara				Use existing system		
	Ross Twp				Sewer Replacement		
	Shaler				Storage facilities and sewer replacement	MH-S32-OF (Ross/Shaler) MH-145-OF (Butler Plank) MH-75-OF (Autumnwood) MH-78-OF (Hodil)	2 year
A-69	Sharpsburg	Conveyance					
	Private Ownership	Use existing system					

Table 9-33: Upper Allegheny River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-70	O'Hara				Use existing system		
	Sharpsburg	Use existing system					
	Shaler				Use existing system		
A-71	Sharpsburg	Use existing system					
A-72	O'Hara				Parallel relief sewer		
	Sharpsburg	Use existing system					
A-73	Sharpsburg	Use existing system					
A-74	Sharpsburg	Parallel relief sewer and sewer replacement					
A-74A	Sharpsburg				Pipe upsizing		
	Fox Chapel / Fox Chapel Sanitary Authority (FCSA)				Use existing system		
	O'Hara				Use existing system		
A-75	Aspinwall	Parallel relief sewer					
	Fox Chapel / FCSA				Use existing system		
	O'Hara				Use existing system		
	Sharpsburg	Use existing system					
A-76	Aspinwall	Parallel relief sewer					
A-77	Aspinwall	Parallel relief sewer					

Table 9-33: Upper Allegheny River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
A-78	Aspinwall	Use existing system[2]					
	Fox Chapel / FCSA				Use existing system		
	O'Hara				Use existing system		
A-78-02	Fox Chapel / FCSA				Parallel relief sewer		
	Indiana Twp / Deer Creek Drainage Basin Authority				Use existing system		
	O'Hara				Use existing system		
A-78-14	COP / PWSA				Use existing system		
A-80	O'Hara				SSO elimination	OHM-211	10 year
A-81-10	O'Hara				Use existing system		
A-82	Blawnox				Pipe upsizing		
	O'Hara				Use existing system		
A-83-02	O'Hara				Use existing system		
A-84-08	O'Hara				Use existing system		
A-85	O'Hara				Parallel relief sewer		

Black text: Preferred municipal planning information
Red text: BP assumed municipal planning information

[1] Regulator is located in A-42 sewershed but discharges to Upper Monongahela River (Nine Mile Run) during wet weather

[2] Stream inflow removal considered part of baseline conditions

Table 9-34: Upper Monongahela River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
M-31	City of Pittsburgh/ Pittsburgh Water and Sewer Authority (COP / PWSA)	Use existing system					
M-31Z	COP / PWSA	Use existing system					
M-32	COP / PWSA	Use existing system					
M-33	COP / PWSA	Use existing system					
M-34	Baldwin				Use existing system		
	Mt. Oliver				Use existing system		
	COP / PWSA	Use existing system	CSO_030N001 CSO_032N001 CSO_032P001	4			
M-35	COP / PWSA	Use existing system					
M-36	COP / PWSA	Use existing system					
M-37	COP / PWSA	Use existing system					
M-38	COP / PWSA	Use existing system					
M-39	COP / PWSA	Use existing system					
M-40	COP / PWSA	Use existing system					
M-42	Baldwin				Parallel relief sewers		10
	Brentwood				Parallel relief sewers	Baldwin-Brentwood	
	COP / PWSA	Diversion Structure Modifications and Relief Sewers	CSO_134A001 CSO_184E001 CSO_185H001	4			
	Pleasant Hills				Use existing system		
	West Mifflin				Use existing system		

Table 9-34: Upper Monongahela River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
	Whitehall				Use existing system		
M-43	West Homestead	Use existing system					
M-44	Munhall / Munhall Sanitary Municipal Authority (MSMA)				Upsize pipes		
	COP/PWSA				Use existing system		
	West Homestead	Conveyance	• M4400_-OSC-M-02OF • M4400_-OSC-M-04OF • WestRun-CulvertRelief	0			
M-44-02	Homestead				Use existing system		
M-45	Homestead	Use existing system			Use existing system		
	Munhall / MSMA				Use existing system		
M-47	Braddock Hills	Use existing system			Use existing system		
	Churchill				Use existing system		
	Edgewood				Parallel relief sewers	• Edgewood MH-20 SSO • Edgewood-Allenby SSO	2
	Penn Hills				Use existing system		
	COP/ PWSA	Parallel relief sewers and Sewer Separation	CSO_089D001 (LBs_1111646) CSO128R002	4			
	Swissvale				Parallel relief sewers		2

Table 9-34: Upper Monongahela River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
	Wilkinsburg				Parallel relief sewers	Koenig Field SSO (W-844.7_Out)	2
M-48	Swissvale	Use existing system					
M-49	Munhall / MSMA		MH_02OF[2] MH_04OF[2] MH_12OF[2] MH_14OF[2]	0	Relief Sewer	Unpermitted_OF-A Unpermitted_OF-B Unpermitted_OF-C Unpermitted_OF-D	2
	West Mifflin / West Mifflin Sanitary Sewer Authority				Use existing system		
	Whitaker / MSMA				Use existing system		
M-50	Rankin	Use existing system					
	Swissvale	Use existing system			Use existing system		
M-51	Braddock	Use existing system				TasseyHollow _SSO[1]	2
	Braddock Hills				Use existing system		
	Rankin	Use existing system					
	Swissvale	Use existing system			Use existing system		
M-52	Braddock	Relief sewer					
M-53	Braddock	Use existing system					
M-54	Braddock	Use existing system					
	North Braddock	Use existing system					
M-55	Braddock	Use existing system					
	Braddock Hills				Use existing system		
	North Braddock	Use existing system					

Table 9-34: Upper Monongahela River Basin – Preferred/Assumed Flow Management Approach at each ALCOSAN POC

ALCOSAN Point of Connection	Municipality/ Authority	Combined Sewer System			Separate Sewer System		
		How Will Flows Be Managed/ Maintained?	Existing Municipal CSOs	Future Overflow Frequency in Typical Year	How Will Flows Be Managed/ Maintained?	Existing Municipal SSOs	SSO Level of Control
M-56	Braddock	Use existing system					
M-57	Braddock	Use existing system					
	North Braddock	Use existing system					
M-58	Braddock	Use existing system					
	North Braddock	Use existing system					
M-60	Braddock	Relief sewer					
	North Braddock	Use existing system					
M-61	Private Ownership	Use existing system			Use existing system		

Black text: Preferred municipal planning information
Red text: BP assumed municipal planning information
[1] Owner of this outfall is undetermined

[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.

There is a trend towards implementing green infrastructure and other source control measures which reduce overflows by controlling the amount of stormwater that enters the sewer system. Therefore, municipalities were polled to determine the extent to which they plan to incorporate green control measures into their wet weather solutions. Municipal responses to ALCOSAN data requests indicated a number of municipalities are considering green solutions. A list of these potential projects is provided in Table 9-35.

9.3.4 Integration of Preliminary Municipal Control Strategies into the WWP

The predicted hydraulic impacts of the preliminary municipal control strategies for each POC sewershed area, as described in Section 9.3, were integrated into the ALCOSAN WWP. Wherever applicable and whenever sufficient information was provided, the proposed municipal projects were incorporated into the ALCOSAN hydrologic and hydraulic models. Where no improvements were required and the existing sewer systems had adequate capacity, the model representation of the existing system was unchanged. The resulting models were used to generate future condition dry and wet weather flows into the ALCOSAN system for final model simulations of the WWP.

The municipal cost information was incorporated into and reflected in the regional affordability analysis. The intent for obtaining the requested municipal cost information was to provide ALCOSAN with a rough estimate of the capital, incremental (new) O&M and R&R costs that would be incurred by the municipalities as they implement their respective municipal wet weather control strategies (conveyance, local storage, source reduction, etc.).

9.3.5 Ongoing Coordination after Submission of WWP

The final municipal feasibility studies are due to the regulatory agencies six months following submittal of the ALCOSAN WWP. Therefore, the municipal planning information submitted to ALCOSAN by the customer municipalities to develop this WWP has not been finalized and may be subject to modification. Regardless, the municipal planning information represents the best available information at the time of submission, compiled as a part of an evolving, iterative and collaborative planning process. The submitted information provides the results of the municipal hydraulic capacity studies and identifies which municipal sewershed collection systems are believed to have sufficient capacity to convey peak wet weather flow to ALCOSAN (i.e. control projects are not required). For the municipal sewershed areas where enhanced wet weather control was deemed necessary, the submitted information indicated the preferred control technology and the estimated size and location of the control facility at the time of submission.

The municipal costing information requested by ALCOSAN was intended to provide ALCOSAN with a rough estimate of the incremental municipal capital, O&M and, R&R costs that the municipalities would incur in implementing their respective wet weather control strategies. The incremental O&M and R&R costs are limited to new or expanded programs and practices to reduce CSOs and SSOs, and to ensure that I/I in the existing system does not increase during the planning period.

Table 9-35: Potential Municipal Green Infrastructure / Source Control Projects

Basin	Municipality	POC	Project Description
Chartiers Creek	McDonald	C-45B-04	Sewer separation is on-going throughout the municipality to remove stormwater from the combined system and to control CSOs.
	North Fayette Township	C-45B-04	Proposing to reduce wet weather flows by using sewer repairs to reduce high levels of inflow and infiltration.
	City of Pittsburgh / Pittsburgh Water and Sewer Authority (COP / PWSA)	O-9, O-10, O-11	Source controls included in East Carson Street Widening Project.
Lower Ohio / Girty's Run	West View Borough	A-67	Green infrastructure will be considered for the areas of Frankfort Avenue, Standard Avenue, portions of Center Avenue, the roof of the Municipal Complex and the roofs of the Municipal Authority administrative offices.
Main Rivers	COP / PWSA	A-58	Sewer separation of the area tributary to CSO DC163L001.
	Reserve Township	A-60	Source flow reduction and conveyance.
Saw Mill Run	COP / PWSA	MH-55	Sewer separation of the area tributary to PWSA diversion chamber DC034R001.
	COP / PWSA	SMRE-40	Sewer separation of the area tributary to PWSA diversion chambers DC034N001, DC035P001, DC062C001 and DC062K002.
Turtle Creek	N/A	N/A	None.
Upper Allegheny	Etna	A-68	Municipality is piloting, testing and evaluating green infrastructure in their downtown district to supplement the selected municipal control
	Shaler	A-68	Source reduction through I/I will be used to supplement the selected municipal control for this POC.
	Ross Township	A-68	Source reduction through I/I will be used to supplement the selected municipal control for this POC.

Table 9-35: Potential Municipal Green Infrastructure / Source Control Projects

Basin	Municipality	POC	Project Description
Upper Allegheny	Aspinwall	A-78	Green infrastructure may be considered in conjunction with the Delafield Stream removal project. Municipality has proposed I/I removal via the lining of approximately 370-ft of pipe.
	Fox Chapel	A-78-02	Source reduction through I/I will be used to supplement the selected municipal control for this POC.
Upper Monongahela	N/A	N/A	None.
All Applicable Basins	COP / PWSA	Not Available	Best management practices (BMPs) source controls will continue to be implemented as part of PWSA's Nine Minimum Control Measures. The City and PWSA implement sewer use ordinances and storm water management regulations that restrict discharges to the sewer system and require development activities to use green infrastructure solutions and low impact development practices.

The ALCOSAN customer municipalities are not required to submit a Feasibility Study to the agencies until six months after ALCOSAN submits its WWP. Therefore, the municipal alternatives described in this WWP do not constitute official municipal plans and may be modified by the municipalities. Material changes to the municipal control strategies that have been incorporated into this WWP could be of a sufficient magnitude to require a modification of the ALCOSAN WWP.

Due to the complexity of working with the municipal planning information received through 2011, ALCOSAN issued a request in the Fall of 2011 that selected municipalities cooperate to submit Draft Feasibility Studies to ALCOSAN by POC (instead of by municipality) for each of 48 complex, multi-municipal POCs. These complex POC sewersheds selected for additional coordination are depicted in Table 9-36 and Figure 9-26.

For the 48 complex POCs, ALCOSAN also requested that each draft Study be submitted with a Resolution from the governing bodies of the participating municipalities. The Resolution was to acknowledge the joint effort of the participating municipalities and authorize the release of the Study to ALCOSAN for planning and review purposes. The Resolution would not constitute adoption or final approval of the Study. However, it would acknowledge concurrence by the municipalities in the planning efforts to date. The Resolution was requested to be submitted with the draft Feasibility Study by July 31, 2012.

ALCOSAN received the Draft Feasibility Studies in July, 2012 as expected. While these studies provided some updates to the estimated costs of municipal improvements, most of the changes were either fairly minor, or did not warrant an update to ALCOSAN's estimate since a preferred alternative was still not identified. Therefore, $530 million still remains a reasonable estimate of the total capital cost of municipal improvements.

The Draft Feasibility Studies also affirmed or updated the municipal flow management strategies which are summarized in Table 9-27 through 9-34. However, many of the studies still presented multiple alternatives being considered without identifying a preferred alternative. In addition, a number of the studies were not clear on whether or not the flow management strategy was changing. The only definitive changes to the flow management strategies shown in these tables are for the points of connections described below. The definitive changes identified are not expected to have a significant impact on the sizes or costs of the ALCOSAN facilities and conveyances reflected in the Selected Plan or the Recommended 2026 Plan:

- C-45B-04 – The lead alternative identified in letters from two municipalities and one sewer authority includes the following improvements: construction of conveyance and a new pump station to convey some flows for treatment at the Moon Township Municipal Authority; construction of a storage basin, increasing capacity at the Oakdale pump station, and construction of a parallel relief interceptor for flows to be conveyed to ALCOSAN for treatment; I/I reduction in North Fayette Township; and sewer separation in McDonald Borough. The previously received information on proposed improvements was reported in Table 9-27. The primary change in the flow strategy is the proposal to send a portion of flow to the Moon Township Municipal Authority for treatment.

- T-04 – The alternative which served as the cost basis for several of the community resolutions associated with this study includes new conveyance and a storage tank. Previously received information reported in Table 9-31 indicated that only conveyance was proposed.
- T-09 (Thompson Run) – The preferred alternative now includes conveyance and a storage tank. Previously received information reported in Table 9-31 indicated that only conveyance was proposed.
- T-29A-10 – The study indicates the control strategy includes conveyance and a storage tank. Previously received information reported in Table 9-31 indicated that only conveyance and I/I removal were proposed.
- A-42A & A-42A-30 - The preferred alternative includes conveyance improvements in several problem areas, removal of a diversion structure that diverts flow to an existing equalization storage tank, and elimination of a pump station. Previously received information reported in Table 9-33 indicated that flows could be managed with the existing system.
- M-47 (Nine Mile Run) - The preferred alternative now includes conveyance and a storage tank. Previously received information reported in Table 9-34 indicated that conveyance and sewer separation were proposed.

Table 9-36: List of Designated Complex POCs

ALCOSAN POC	Watershed	Tributary Municipalities
CHARTIERS CREEK BASIN		
C-25	Bells Run	Crafton
		Green Tree
		Pittsburgh
C-45B-04	Robinson Run	McDonald
		North Fayette
		Oakdale
		South Fayette
C-48	Georges Run	Mt. Lebanon
		Scott
C-49	Scrubgrass Run	Mt. Lebanon
		Scott
C-53	Painters Run	Bethel Park
		Mt. Lebanon
		Scott
		Upper St. Clair
C-53-10	McLaughlin Run	Bethel Park
		Bridgeville
		Upper St. Clair

Table 9-36: List of Designated Complex POCs

ALCOSAN POC	Watershed	Tributary Municipalities
C-54-12	Thoms Run	Collier
		South Fayette
C-55-02	Brush Run	Bethel Park
		Peters
		Upper St. Clair
LOWER OHIO / GIRTY'S RUN BASIN		
A-67	Girty's Run	McCandless (GRJSA)
		Millvale (GRJSA)
		Reserve (GRJSA)
		Ross (GRJSA)
		Shaler (GRJSA)
		West View
O-15	Lowries Run	Franklin Park (MTSA)
		Kilbuck (MTSA)
		McCandless (MTSA)
		Ohio (MTSA)
		Ross (MTSA)
		West View (MTSA)
MAIN RIVERS BASIN		
A-22	Unnamed Watershed	Pittsburgh
A-23	Unnamed Watershed	Pittsburgh
A-58	Unnamed Watershed	Pittsburgh & PennDOT (Not a multi-municipality POC but a 3rd party is involved)
A-60	Unnamed Watershed	Pittsburgh
		Reserve
M-5	Unnamed Watershed	Pittsburgh
M-19	Unnamed Watershed	Pittsburgh
M-29	Unnamed Watershed	Pittsburgh
O-27	Unnamed Watershed	Pittsburgh
		Ross
SAW MILL RUN BASIN		
MH-11	McCartney Run	Crafton
		Pittsburgh
MH-18	Little Saw Mill Run	Dormont
		Green Tree
		Mt. Lebanon
		Pittsburgh
		Scott

Table 9-36: List of Designated Complex POCs

ALCOSAN POC	Watershed	Tributary Municipalities
MH-89	Weyman Run	Brentwood
		Castle Shannon
		Pittsburgh
		Whitehall
S-15	McDonoughs Run	Baldwin Twp.
		Dormont
		Mt. Lebanon
		Pittsburgh
S-42A	Unnamed Watershed	Green Tree
		Pittsburgh
SMRE-40	Plummers Run	Dormont
		Pittsburgh
SMR-CS-34	Unnamed Watershed	Castle Shannon
		Mt. Lebanon
SMR-CS-54	Unnamed Watershed	Bethel Park
THOMPSON RUN / TURTLE CREEK BASIN		
T-04	Unnamed Watershed	Braddock Hills
		Chalfant
		Churchill
		East Pittsburgh
		Forest Hills
		North Braddock
		Turtle Creek
		Wilkins
		Wilkinsburg
T-04-02	Unnamed Watershed	Penn Hills
T-09 (TR)	Unnamed Watershed	Churchill
		Monroeville
		Turtle Creek
		Wilkins
T-10	Unnamed Watershed	Monroeville
		Turtle Creek
T-18	Unnamed Watershed	North Versailles
		Wilmerding

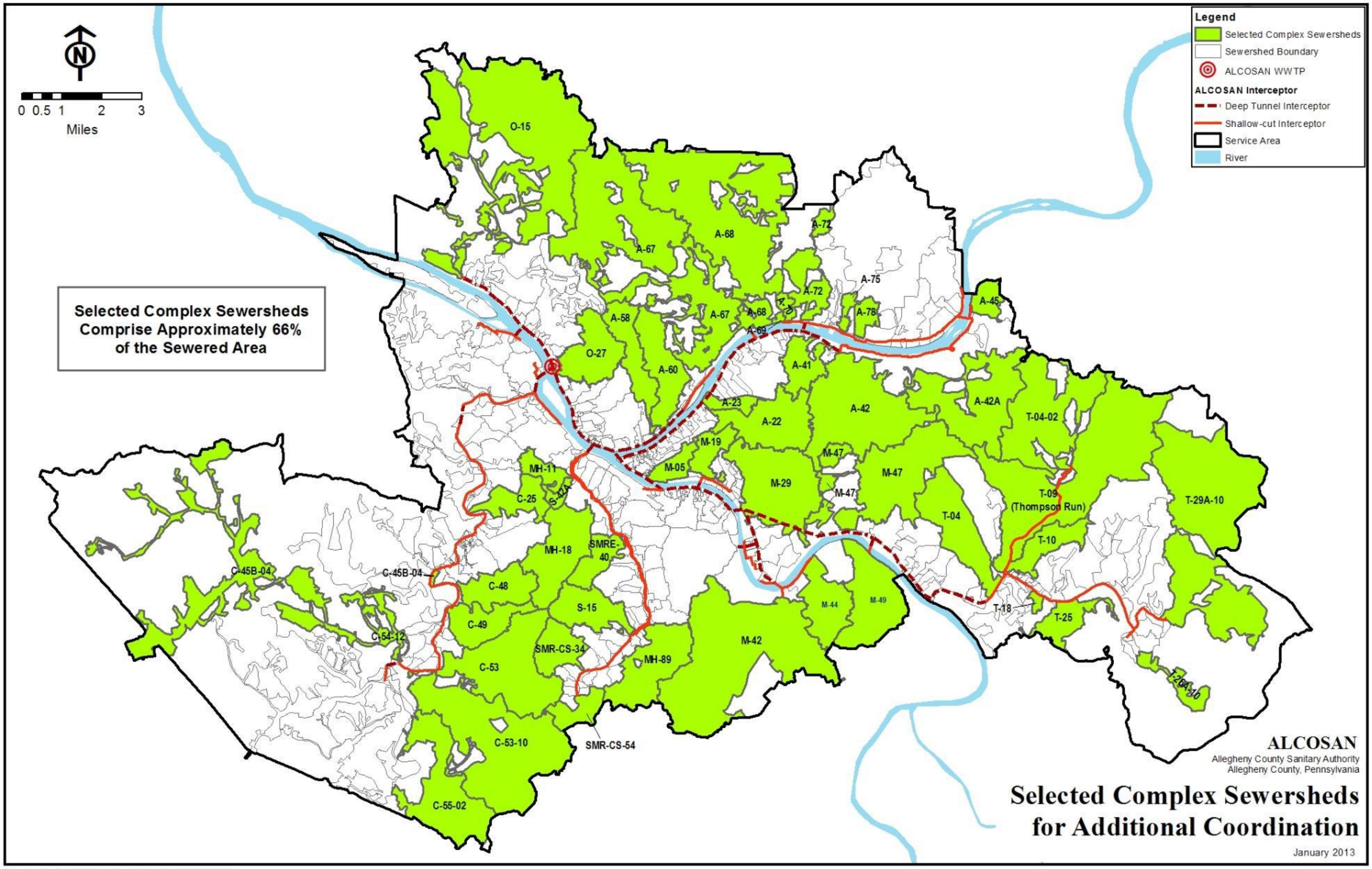
Table 9-36: List of Designated Complex POCs

ALCOSAN POC	Watershed	Tributary Municipalities
T-25	Unnamed Watershed	East McKeesport
		North Versailles
		Wall
T-26A-10	Unnamed Watershed	North Huntingdon
		Penn
		WWMA
T-29A-10	Unnamed Watershed	Monroeville
		Penn
		Plum
		Trafford
UPPER ALLEGHENY BASIN		
A-41	Heth's Run	Pittsburgh
A-42	Negley Run	Penn Hills
		Pittsburgh
A-42A	Unnamed Watershed	Penn Hills
A-45	Unnamed Watershed	Penn Hills
		Verona
A-68	Pine Creek	Etna
		Indiana
		McCandless
		Ross
		Shaler
A-69	Unnamed Watershed	Etna
		O' Hara
		Sharpsburg
A-70	Unnamed Watershed	O' Hara
		Shaler
		Sharpsburg
A-72	Unnamed Watershed	O' Hara
		Sharpsburg
A-75	Unnamed Watershed	Aspinwall
		Fox Chapel
		O' Hara
A-78	Unnamed Watershed	Aspinwall
		Fox Chapel
		O' Hara

Table 9-36: List of Designated Complex POCs

ALCOSAN POC	Watershed	Tributary Municipalities
UPPER MONONGAHELA BASIN		
M-42	Streets Run	Baldwin Boro
		Brentwood
		Pittsburgh
		Pleasant Hills
		West Mifflin
		Whitehall
M-44	West Run	Munhall
		Pittsburgh
		West Homestead
M-47	Nine Mile Run	Churchill
		Edgewood
		Penn Hills
		Pittsburgh
		Swissvale
		Wilkinsburg
M-49	Homestead Run	Munhall
		West Mifflin
		Whitaker

Figure 9-26: Locations of Selected Complex Sewersheds for Additional Coordination



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9.4 Basin Alternatives Analysis

A basin alternative is defined as a control alternative made up of an array of one or more site alternatives, intended to provide a unique level of CSO and SSO control applicable to an entire planning basin. The process for the development and evaluation of basin alternatives started with the results of the site alternative evaluation. As described in Section 8, the Basin Planners (BPs) determined feasible control technologies in their respective planning basins, reviewed sites and routes, and defined and screened site alternatives. In developing basin alternatives, the BPs arrayed and sized viable site alternatives into basin alternatives. After undergoing a screening process, select alternatives were carried forward for more detailed analysis to determine the preferred basin alternatives for each of the ALCOSAN planning basins. That additional analysis included refining conveyance and facility sizing with H&H models to achieve the targeted levels of CSO and SSO control, preparing cost estimates, preparing cost-performance plots and performing a ranking of the top basin alternatives to evaluate economic and non-economic factors.

This section presents the basin alternative analysis results for each of the seven planning basins in the ALCOSAN service area. Section 9.4.1 provides a description of specific guidance and tools that were utilized in evaluating basin alternatives. Sections 9.4.2 through 9.4.8 present the basin-specific results for each of the planning basins.

9.4.1 Introduction

The Program Manager (PM) and ALCOSAN developed technical tools, guidance, and assumptions to be used by the BPs to ensure an acceptable degree of consistency between the individual basin planning efforts regarding the evaluation of basin alternatives. This guidance included the standard guidance and protocols described in Section 9.1, plus some additional guidance unique to the basin alternatives evaluation process. While specific details on the approaches utilized varied somewhat between the planning basins to meet basin-specific needs, this sub-section provides a general description of the additional guidance for the basin alternatives evaluation process.

Basin Alternatives Evaluation: The goal of the basin alternatives analysis phase of the WWP development process was to identify the best (based upon economic and non-economic criteria) approaches to achieving specified CSO control levels while concurrently eliminating SSOs to specified design storm levels. This needed to be accomplished all within the context of basin boundary conditions influenced by various inter-basin and system-wide control alternatives including Woods Run Treatment Plant improvements. The general process for fulfilling this goal is summarized below.

- Array and size site alternatives into feasible basin alternatives
- Conduct screening of basin alternatives to determine a 'short list' of alternatives to undergo further analysis
- Analyze alternatives that were carried forward using H&H models to achieve targeted levels of control
- Develop present worth cost estimates for the most promising basin alternatives and prepare cost / performance curves

- Using a basin alternative ranking process, recommend the most effective basin alternative for each level of control, compatible with each basin boundary condition

Basin alternative development and analysis followed a two phase process that involved multiple stages over the course of the WWP development. At each stage, costing and performance data were developed and evaluated. Analyses were performed to compare alternatives and converge on the most effective solutions for each planning basin.

The first phase of the basin alternative evaluation process had the ALCOSAN BPs frame the development of basin alternatives within the context of two broad control strategies:

- Basin Based Strategy (BBS): peak wet weather flow from the planning basin would be limited to the hydraulic capacity of the existing interceptor conveyance system; no additional regional conveyance facilities would extend to the planning basins. The existing deep and shallow-cut tunnel and interceptor system would remain as the sole regional conveyance system. The Woods Run WWTP would have expanded secondary treatment capacity and expanded wet weather treatment capacity.

- Regional Based Strategy (RBS): peak wet weather flow from each planning basin would not be limited and the amount of conveyance to a new regional conveyance system would be maximized. This new regional conveyance would supplement the existing interceptor conveyance in order to deliver the peak flow to the ALCOSAN treatment plant. The Woods Run WWTP would have expanded secondary treatment capacity and expanded wet weather treatment capacity.

In general, due to the constraints of the existing system hydraulic capacity, alternatives developed as part of the BBS resulted in numerous remote wet weather storage and/or treatment facilities within each planning basin. In contrast, due to the added regional conveyance, alternatives developed under the RBS resulted in few to no remote wet weather storage and/or treatment facilities within each planning basin. These two broad control strategies effectively bracketed the range of control options for each basin, and collectively provided a suite of basin alternatives that could be integrated in various combinations to establish and initiate analysis of system-wide alternatives. This approach supported the initial independent analysis and selection of basin alternatives that comprised the first phase of the basin alternatives evaluation process.

The BBS and RBS basin alternatives were developed in support of the knee-of-the-curve analyses and were ranked against each other to determine the most preferred (or recommended) alternative at each level of CSO and SSO control analyzed. These initial alternatives assumed all municipal flows were conveyed to ALCOSAN, meaning that there were no CSO or SSO discharges from the municipal collection systems. Due to this assumption and the fact that these alternatives were developed independent of system-wide alternatives, municipal and regional facilities were not included in the costing estimates. The BBS and RBS alternatives analyzed, and the ALCOSAN and municipal CSO and SSO control levels evaluated, are shown on Table 9-37. The BBS and RBS alternatives were then compiled to formulate System-wide Alternatives 1 and 2, respectively. The ten BBS and RBS basin alternatives that were provided to the PM were evaluated at a 2-year design storm SSO control level, although some BPs conducted evaluations for other levels of SSO control.

Table 9-37: Summary of Basin Alternatives Evaluated

	System-Wide Alternative	Description	ALCOSAN CSO Control Level (Overflows / Year)	ALCOSAN SSO Elimination up to X-Year Design Storm	Municipal CSO Control Level (Overflows / Year)	Municipal SSO Elimination up to X-Year Design Storm	Municipal Flows Assumption
Basin-Based Alternatives	5	85% Capture by Receiving Stream w/ Remote CSO Treatment & Storage	85% Capture	2-Year	0	2-Year	Convey all flows to ALCOSAN
	1	Basin-Based Control Strategy	0	2-Year	0	2-Year	Convey all flows to ALCOSAN
			1 to 3		0		
			4 to 6		0		
			7 to12		0		
			13 to 20		0		
Regional-Based Alternatives	2	Regional-Based Control Strategy	0	2-Year	0	2-Year	Convey all flows to ALCOSAN
			1 to 3		0		
			4 to 6		0		
			7 to12		0		
			13 to 20		0		
	4	Complete Sewer Separation and SSO Storage/Conveyance	0	2-Year	0	2-Year	Convey all flows to ALCOSAN
Additional Alternatives in Support of Regional Integration	8a	Regional Tunnel from WWTP to A-42 and M-29 w/ 12' TBM and Upper Mon. Remote CSO Treatment and	13 to 15 (1)	2-Year	Varies by Municipality	Varies by Municipality	Limited Municipal Planning Information Incorporated
	3f	Regional Tunnel w/ Remote CSO Treatment and Storage (Tunnel from WWTP to A-42 and M-51)	4 to 6	2-Year	Varies by Municipality	Varies by Municipality	Limited Municipal Planning Information Incorporated
	3h	Same as Alt. 3f except 10-year SSO control level	4 to 6	10-Year	Varies by Municipality	Varies by Municipality	Limited Municipal Planning Information Incorporated
	3i	Same as Alt. 3f except Typical Year SSO control level	4 to 6	Typical Year	Varies by Municipality	Varies by Municipality	Limited Municipal Planning Information Incorporated
	3f-modified	Same as Alt. 3f Except Higher Level of CSO Control for Targeted Outfalls in Sensitive Areas	4 to 6 (2)	2-Year	Varies by Municipality	Varies by Municipality	Latest Municipal Planning Information Incorporated

(1) Except 4 to 6 overflows in the typical year for targeted outfalls which directly impact sensitive areas
(2) Except 0 overflows in the typical year for targeted outfalls which directly impact sensitive areas

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An additional alternative that was evaluated under the BBS control strategy was to identify the most cost-effective means to achieve 85% capture by receiving stream, using a subset of controls that comprise the preferred BBS alternative in each planning basin. Preliminary basin planner percent capture estimates were used to estimate the annual untreated overflow volume which equates to 85% capture by receiving stream. This alternative also assumed all municipal flows were conveyed to ALCOSAN. The 85% capture basin alternatives were compiled to formulate System-Wide Alternative 5.

An additional alternative that was evaluated under the RBS control strategy was to control all CSOs via complete sewer separation. This alternative also assumed all municipal flows were conveyed to ALCOSAN. The sewer separation basin alternatives were compiled to formulate System-Wide Alternative 4.

A listing and description of the BBS and RBS basin alternatives that were evaluated by the BPs are provided in Sections 9.4.2 through 9.4.8. Also included are the associated cost estimates and performance statistics associated with these alternatives.

The second phase of the basin alternative evaluation process was the development of additional alternatives derived from the regional integration process (as described in Section 9.1.1). These alternatives served different objectives than the BBS and RBS alternatives and were developed in support of converging on the most effective system-wide alternatives (as described in Section 9.5).

Unlike the BBS and RBS alternatives, modeling and analysis of these basin alternatives were to reflect incorporation of municipal planning information that included the BP's latest understanding of each municipality's submitted planning information, including their preferred municipal control strategy (if available). Due to the evolving nature of the municipal plans, as summarized in Sections 9.1 and 9.3, the level of municipal planning information included varied as the basin alternative evaluation process progressed. For information that was received, the hydraulic impacts of the preliminary municipal control strategies were integrated into the hydrologic and hydraulic models and managed/controlled future condition flows discharging into the ALCOSAN system were generated.

The cost and performance differences for various levels of SSO control were evaluated using System-wide Alternatives 3f, 3h and 3i. The performance target for Alternative 3f was a 2–year level of SSO control. Alternatives 3h and 3i represented variations of Alternative 3f with the primary difference being that facility sizes and costs were updated to control ALCOSAN SSO discharges to a 10-year and typical year level of control, respectively. The ALCOSAN CSO performance target for all three alternatives was 4-6 overflows per year, consistent with one of the Presumption Approach criterion that is presumed to meet the water-quality based requirements of the Clean Water Act. There was no difference in municipal controls for these three alternatives as they assumed that all flows would be conveyed to ALCOSAN. The SSO control analysis is described in Section 9.5.5. The analysis demonstrates why the 2-year level of control was selected.

The additional alternatives that were analyzed in support of regional integration, and the ALCOSAN and municipal CSO and SSO control levels at which they were evaluated, are shown on Table 9-37. The latest municipal planning information as described in Section 9.3.3 was incorporated in the last alternative listed in this table (Alt. 3f-modified). The associated cost estimates and performance statistics associated with these alternatives are presented in Sections 9.4.2 through 9.4.8. Descriptions of the system-wide alternatives that these basin alternatives supported are provided in Section 9.5.

Knee-of-the-Curve Analysis: In evaluating wet weather control strategies, feasible basin alternatives needed to be evaluated based on their performance versus cost to ensure that the most cost effective alternatives for each targeted performance criteria were identified. To accomplish this, cost estimates were developed and plotted against the corresponding performance levels for knee-of-the-curve (KOC) assessments. The relationships between the performance of the basin alternatives, and the cost of those alternatives, were developed and evaluated to identify the level of control at which the increment of pollution reduction achieved in the receiving water diminishes compared to the incremental increased costs, as prescribed by EPA's CSO Control Policy[9-7].

Each of the points on the KOC plots were determined by two values: a performance value (annual untreated overflow volume) resulting from an H&H model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). Note that municipal and regional conveyance costs were not included in the capital cost estimates used for basin level KOC analysis. The annual untreated overflow volumes represented the resulting basin-wide ALCOSAN and municipal untreated overflow volume based on future (2046) conditions with the basin alternatives implemented. For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represented a continuous relationship between performance and cost. The inflection point of this connected line is referred to as the knee-of-the-curve.

Formal KOC plots were developed for the most preferred basin alternatives identified by the ALCOSAN BPs for the control strategies and CSO/SSO control levels shown on Table 9-37. In addition, included on these plots were points for additional alternatives that were developed and evaluated by the BPs as part of the regional integration process. The resulting KOC plots for each of the ALCOSAN planning basins are provided in Sections 9.4.2 through 9.4.8.

Basin Alternative Ranking: While the KOC analyses discussed in the prior section allow for the evaluation of arguably the two most important criteria (cost and performance) for each of the basin alternatives, they do not account for other considerations such as public factors, operational impacts, and implementation concerns. As a result, the Basin Alternatives Ranking and Assessment Tool (BARAT) was developed by the PM to account for these factors and assist the BPs in identifying their most preferred basin alternatives for the control strategies and CSO/SSO control levels evaluated. Table 9-38 shows a listing of economic and non-economic factors evaluated. The tool was developed to provide the following:

- A consistent method to be used in the ranking and evaluation of basin alternatives

[9-7] Environmental Protection Agency. *Combined Sewer Overflow (CSO) Control Policy; Notice* (1994). Federal Register / Vol. 59, No. 75 / Tuesday, April 19, 1994 / Notices

- An evaluation of non-economic and performance related criteria associated with the basin alternatives
- A user-friendly method to keep the levels of effort and data generation efficient and consistent amongst the seven ALCOSAN planning basins

The BARAT was derived from the Site Alternatives Screening Method (as described in Section 8) that was developed to assist the BPs in narrowing the field of potential site alternatives that would undergo detailed cost estimating and H&H model runs to evaluate control alternative performance. The method was based on a qualitative evaluation of various screening categories such as cost, performance, operation, implementation, and public acceptance. The method allowed for the assignment of grades to each site alternative with those receiving higher grades to receive additional evaluation.

The primary difference between the Site Alternative Screening Method and the BARAT is the approach applied in evaluating the various criteria. The Site Alternative Screening Method was based entirely on a qualitative approach in evaluating the various categories. The BARAT incorporates more detailed information (cost estimates, model results, etc.) and employs a quantitative evaluation of many of the criteria. Both tools use a combination of standardized answers and the user's best professional judgment.

The BARAT includes a Basin Alternative Evaluation Form that was to be completed for basin alternatives that were evaluated, with the information logged directly into a database. Using this data, the tool then employs a series of computations to score the various criteria. The overall scoring assigned to a basin alternative is based upon a potential maximum total score of 100 points. The scoring assigned by the tool allows for direct comparisons between basin alternatives that were evaluated under the same control strategy and CSO/SSO performance level.

The weightings assigned to each scoring category were derived from those used in the Site Alternative Screening Method. Input on those weighting factors was solicited from each of the seven Basin Planning Committees, the Customer Municipality Advisory Committee, and the Regional Stakeholders Group. The weighting factors were finalized by incorporating recommendations made by ALCOSAN department representatives. A comparison of the assigned weightings used in the Site Alternative Screening Method and those assigned to the BARAT can be found on Table 9-38.

The BPs were to use the BARAT in ranking BBS and RBS alternatives. For each of the individual basin-based and regional-based control strategies, the tool was to be used to rank the top (up to 5) basin alternatives for each control level analyzed. The basin alternative ranking results are included in Sections 9.4.2 through 9.4.8 for each of the respective ALCOSAN planning basins.

Table 9-38: Scoring Comparison: Site Alternative Screening vs. Basin Alternative Ranking

Category		Criteria	Criteria Weighting: Site Alternative Screening (%)	Criteria Weighting: Basin Alternative Ranking (Points)	Screening/Ranking Method: Site Alternative Screening	Screening/Ranking Method: Basin Alternative Ranking
Economic Factors	1	Total Present Worth	25%	30	Qualitative	Quantitative
	2	Predictability of Cost	5%		Qualitative	
Public Factors	3	Community Disruption	2%	2	Qualitative	Qualitative
	4	Potential for Nuisances (odor, noise, aesthetic)	6%	6	Qualitative	Qualitative
	5	Multiple Benefit Opportunities	6%	6	Qualitative	Qualitative
	6	Environmental Justice	6%	6	Qualitative	Qualitative
Water Quality, Public Heath and Environmental Impacts	7	Untreated Overflow Volume Reduction	5%	5	Qualitative	Quantitative
	8	Bacteria Discharge Reduction	5%	5	Qualitative	Quantitative
	9	Floatables Capture	3%	1.5	Qualitative	Quantitative
	10	Suspended Solids Reduction		1.5		Quantitative
	11	BOD Control	3%	3	Qualitative	Quantitative
	12	Nutrient Control	3%	3	Qualitative	Quantitative
	13	Control of Discharge to Sensitive Areas	4%	4	Qualitative	Qualitative
	14	Impact to Slopes, Shoreline, Wildlife	2%	2	Qualitative	Qualitative
Operation Impacts	15	Ease of Operation	4%	4	Qualitative	Quantitative
	16	Ease of Maintenance	4%	4	Qualitative	Quantitative
	17	Reliability/Redundancy	4%	4	Qualitative	Quantitative
	18	O&M Consistency with Existing Practices	3%	3	Qualitative	Quantitative
Implementation Impacts	19	Constructability	4%	4	Qualitative	Qualitative
	20	Ability to Expand Capacity	3%	3	Qualitative	Qualitative
	21	Land Acquisition	3%	3	Qualitative	Qualitative
		TOTAL	**100%**	**100**		

9.4.2 Chartiers Creek Planning Basin

This section summarizes the development, evaluation, and results of the basin alternatives analyzed for the Chartiers Creek (CC) planning basin. The overall development and evaluation process used by CC and the other six basin planners was described in Section 9.4.1. As such, this section primarily focuses on results of the basin alternatives evaluation and any features or methods that were unique to the CC planning basin.

Basin Alternatives Evaluation: A total of 52 basin alternatives were evaluated including 24 under the basin-based control strategy (BBS) and 28 under the regional-based control strategy (RBS). The BBS assumed that additional regional conveyance beyond the existing interceptor system would not be available. The RBS assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Table 9-39 provides a summary of the basin alternatives that were evaluated. Included are the control technologies associated with the alternatives (conveyance, storage, treatment, deep tunnel, sewer separation, and secondary WWTP), the CSO and SSO control levels, and capital cost estimates for the basin alternatives evaluated.

As basin alternatives evolved, a number of facilities that were included early in the screening evaluation process were eliminated or changed. This screening process reduced the number of potential basin alternatives. Next, several iterations of the basin screening were performed. For example, initially Basin Alternatives CC_BA01 to CC_BA05 were selected as the preferred BBS alternatives and Basin Alternatives CC_BA06 to CC_BA10 were selected as the preferred RBS alternatives for the five levels of CSO control that were evaluated. Subsequently, the alternatives were further evaluated to examine the feasibility of reducing the number of sanitary storage basins. This evaluation was driven by concerns with the availability of two of the sites and the general desire to reduce the number of facilities for long-term operational viability. The updated evaluation identified feasible variations of the original most preferred basin alternatives, BBS alternatives CC_BA26 to CC_BA30 and CC_BA31 to CC_BA35, and RBS alternatives CC_BA36 to CC_BA40 and CC_BA41 to CC_BA45.

In later versions of alternatives development, the presence of a regional tunnel to which wet weather flows could be discharged significantly increased the amount of flow transport that was assumed. This condition resulted in removal of most of the wet weather facilities that were originally envisioned in the earlier basin based and regional based alternatives.

Basin Alternative Ranking: To assist in determining the most preferred basin alternatives for various CSO control levels analyzed, select BBS and RBS basin alternatives were ranked using the Basin Alternative Ranking and Assessment Tool (BARAT), as described in Section 9.4.1. Figure 9-27 and 9-28 provide summaries of the ranking results for alternatives analyzed under the BBS and RBS, respectively. Basin alternatives CC_BA26 through CC_BA30 were identified as the top ranked BBS alternatives for the various levels of control that were evaluated. CC_BA36 through CC_BA40 were determined to be the top ranked RBS alternatives.

Knee of the Curve Analysis: Figure 9-29 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional based alternatives, as well as for additional alternatives that were evaluated in support of regional integration.

Each of these points was determined by two values: a performance value (untreated overflow volume) resulting from a model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after the predicted future growth has occurred and the basin alternative has been implemented. For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represents a continuous relationship between performance and cost. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

Summary of Preferred BBS and RBS Basin Alternatives: Table 9-40 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-40, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. Shown in parentheses is the system-wide alternative that the basin alternative supports as well as the CSO level of control that they were evaluated at. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended to the planning basin. All flows will be conveyed to the Woods Run wastewater treatment plant (WWTP) via the existing deep tunnel interceptor and crossing under the Ohio River.

CC_BA24 (Alt. 5 - 85% Capture): Basin Alternative CC_BA24 incorporates storage and conveyance at sites CC-09 Hickman Street North, CC-13a AK Steel, and CC-26 Heidelberg Park in the sanitary portion of the basin, and conveyance and a retention/ treatment basin (RTB) treatment at site CC-47 McKees Rocks East in the combined portion. No storage or treatment is required at site CC-34 Duncan Properties for this option due to the lower level of overflow control required, 85% capture of overflows. Instead, wet weather flows are conveyed downstream via the relief conveyance sewer. Relief sewer conveyance is used from the downstream end of the existing interceptor near structure O-07-00 up to manhole C-54-06 near the upstream end. This relief sewer also helps to convey CSO flows to the various facilities in the combined portions of the system. Additional consolidation sewers convey flows to relief sewers, and to and from storage and treatment facilities.

Table 9-39: Chartiers Creek – Summary of Basin Alternatives Evaluated

Basin Alternative	BBS or RBS	Components of Alternative																	Control Technology						Control Level		Cost
		Location of Parallel Relief	CC09 San Basin	CC13 San Basin	CC26 San Basin	Bednar Tunnel C5502 to C53	Bednar Tunnel C5310 to C53	CC34 Mixed Basin	CC34 RTB	CC38 Mixed Basin	CC38 RTB	CC47 Mixed Basin	CC47 RTB	CC47 HRC	CC47 SST	Corliss Deep Tunnel	Carson Street Sewer	LOGRPB Excess WWF	Conveyance	Storage	Treatment	Sewer Separation	Deep Tunnel	Secondary WWTP	CSO (OF/yr)	SSO (yr)	Current Year Capital Cost ($M)
CC_BA01	BBS	O-07-00 to C-54-06	X	X	X				X				X			X			X	X	X				0	2	$769.40
CC_BA02	BBS	O-07-00 to C-54-06	X	X	X				X				X			X			X	X	X				1-3	2	$747.00
CC_BA03	BBS	O-07-00 to C-54-06	X	X	X			X					X			X			X	X	X				4-6	2	$742.10
CC_BA03-RS	BBS	O-07-00 to C-54-06	X	X	X			X					X			X			X	X	X				4-6	2	$742.10
CC_BA04	BBS	O-07-00 to C-54-06	X	X	X								X			X			X	X	X				7-12	2	$686.40
CC_BA05	BBS	O-07-00 to C-54-06	X	X	X								X			X			X	X	X				13-20	2	$665.20
CC_BA06	RBS	O-07-00 to C-54-06	X	X	X				X				X			X			X	X	X				0	2	$516.40
CC_BA07	RBS	O-07-00 to C-54-06	X	X	X				X				X			X			X	X	X				1-3	2	$466.80
CC_BA08	RBS	O-07-00 to C-54-06	X	X	X			X					X			X			X	X					4-6	2	$474.90
CC_BA09	RBS	O-07-00 to C-54-06	X	X	X								X			X			X	X					7-12	2	$463.50
CC_BA10	RBS	O-07-00 to C-54-06	X	X	X								X			X			X	X					13-20	2	$463.50
CC_BA11	BBS	O-07-00 to C-54-06		X	X		X		X					X		X			X	X	X				0	2	$815.20
CC_BA12	BBS	O-07-00 to C-54-06		X	X		X		X					X		X			X	X	X				1-3	2	$730.10
CC_BA13	BBS	O-07-00 to C-54-06		X	X		X	X						X		X			X	X	X				4-6	2	$671.70
CC_BA14	BBS	O-07-00 to C-54-06		X	X		X	X						X		X			X	X	X				7-12	2	$625.00
CC_BA15	BBS	O-07-00 to C-54-06		X	X		X							X		X			X	X	X				13-20	2	$570.00
CC_BA16	RBS	O-07-00 to C-54-06	X	X	X				X						X	X			X	X	X			X	0	2	$947.50
CC_BA17	RBS	O-07-00 to C-54-06	X	X	X				X						X	X			X	X	X			X	1-3	2	$924.50
CC_BA18	RBS	O-07-00 to C-54-06	X	X	X			X							X	X			X	X	X			X	4-6	2	$862.70
CC_BA19	RBS	O-07-00 to C-54-06	X	X	X			X							X	X			X	X	X			X	7-12	2	$838.10
CC_BA20	RBS	O-07-00 to C-54-06	X	X	X										X	X			X	X	X			X	13-20	2	$822.30
CC_BA21(1)	BBS	O-07-00 to C-54-06														X			X				X		4-6	2	$758.10
CC_BA22	BBS	O-07-00 to C-54-06	X	X	X														X	X		X			0	N/A	$996.37
CC_BA23	RBS	O-07-00 to C-54-06	X	X	X														X	X		X			0	N/A	$896.60
CC_BA26	BBS	O-07-00 to C-54-06	X						X				X				X		X	X	X				0	2	$759.28
CC_BA27	BBS	O-07-00 to C-54-06	X						X				X				X		X	X	X				1-3	2	$743.97
CC_BA28	BBS	O-07-00 to C-54-06	X					X					X				X		X	X	X				4-6	2	$689.29
CC_BA29	BBS	O-07-00 to C-54-06	X										X				X		X	X	X				7-12	2	$666.52
CC_BA30	BBS	O-07-00 to C-54-06	X										X				X		X	X	X				13-20	2	$645.28
CC_BA31	BBS	O-07-00 to C-54-06	X				X		X				X						X	X	X				0	2	$768.70
CC_BA32	BBS	O-07-00 to C-54-06	X				X		X				X						X	X	X				1-3	2	$755.40
CC_BA33	BBS	O-07-00 to C-54-06	X				X	X					X						X	X	X				4-6	2	$699.30

Table 9-39: Chartiers Creek – Summary of Basin Alternatives Evaluated

Basin Alternative	BBS or RBS	Components of Alternative																	Control Technology						Control Level		Cost
		Location of Parallel Relief	CC09 San Basin	CC13 San Basin	CC26 San Basin	Bednar Tunnel C5502 to C53	Bednar Tunnel C5310 to C53	CC34 Mixed Basin	CC34 RTB	CC38 Mixed Basin	CC38 RTB	CC47 Mixed Basin	CC47 RTB	CC47 HRC	CC47 SST	Corliss Deep Tunnel	Carson Street Sewer	LOGRPB Excess WWF	Conveyance	Storage	Treatment	Sewer Separation	Deep Tunnel	Secondary WWTP	CSO (OF/yr)	SSO (yr)	Current Year Capital Cost ($M)
CC_BA34	BBS	O-07-00 to C-54-06	X				X						X						X	X	X				7-12	2	$677.90
CC_BA35	BBS	O-07-00 to C-54-06	X				X						X						X	X	X				13-20	2	$656.70
CC_BA36	RBS	O-07-00 to C-54-06	X						X								X	X	X	X	X				0	2	$494.79
CC_BA37	RBS	O-07-00 to C-54-06	X						X								X	X	X	X	X				1-3	2	$461.42
CC_BA38	RBS	O-07-00 to C-54-06	X					X									X	X	X	X					4-6	2	$455.87
CC_BA39	RBS	O-07-00 to C-54-06	X														X	X	X	X					7-12	2	$443.55
CC_BA40	RBS	O-07-00 to C-54-06	X														X	X	X	X					13-20	2	$443.55
CC_BA41	RBS	O-07-00 to C-54-06	X				X		X										X	X	X				0	2	$506.30
CC_BA42	RBS	O-07-00 to C-54-06	X				X		X										X	X	X				1-3	2	$472.90
CC_BA43	RBS	O-07-00 to C-54-06	X				X	X											X	X					4-6	2	$465.90
CC_BA44	RBS	O-07-00 to C-54-06	X				X												X	X					7-12	2	$455.00
CC_BA45	RBS	O-07-00 to C-54-06	X				X												X	X					13-20	2	$455.00
CC_BA24[(2)] (Alt 5)	BBS	O-07-00 to C-54-14	X	X	X								X						X	X	X				85% Capture	2	$790.00
CC_BA03f[(2)]	RBS	O-07-00 to C-54-14, C-54-16 to C-55-02						X									X	X	X	X					4-6	2	$429.05
CC_BA03f-Deep Tunnel[(2)(3)]	RBS	O-07-00 to C-54-14, C-54-16 to C-55-02						X									X	X	X	X			X		4-6	2	$535.80
CC_BA08a[(2)]	RBS	O-07-00 to C-54-14, C-54-16 to C-55-02															X	X	X						13-15	2	$390.70
CC_BA03f-Modified[(2)]	RBS	O-07-00 to C-54-14, C-54-16 to C-55-02						X									X	X	X	X			X		4-6	2	$464.75

[(1)] Deep tunnel from near upstream end to downstream end of existing interceptor.
[(2)] System-Wide Basin Alternative.
[(3)] Variation of CC_BA03f that incorporates deep tunnel from near existing ALCOSAN regulator C-14-00 to drop shaft for regional tunnel near existing ALCOSAN regulator O-06-00.

Figure 9-27: Chartiers Creek BBS Basin Alternative Ranking Results

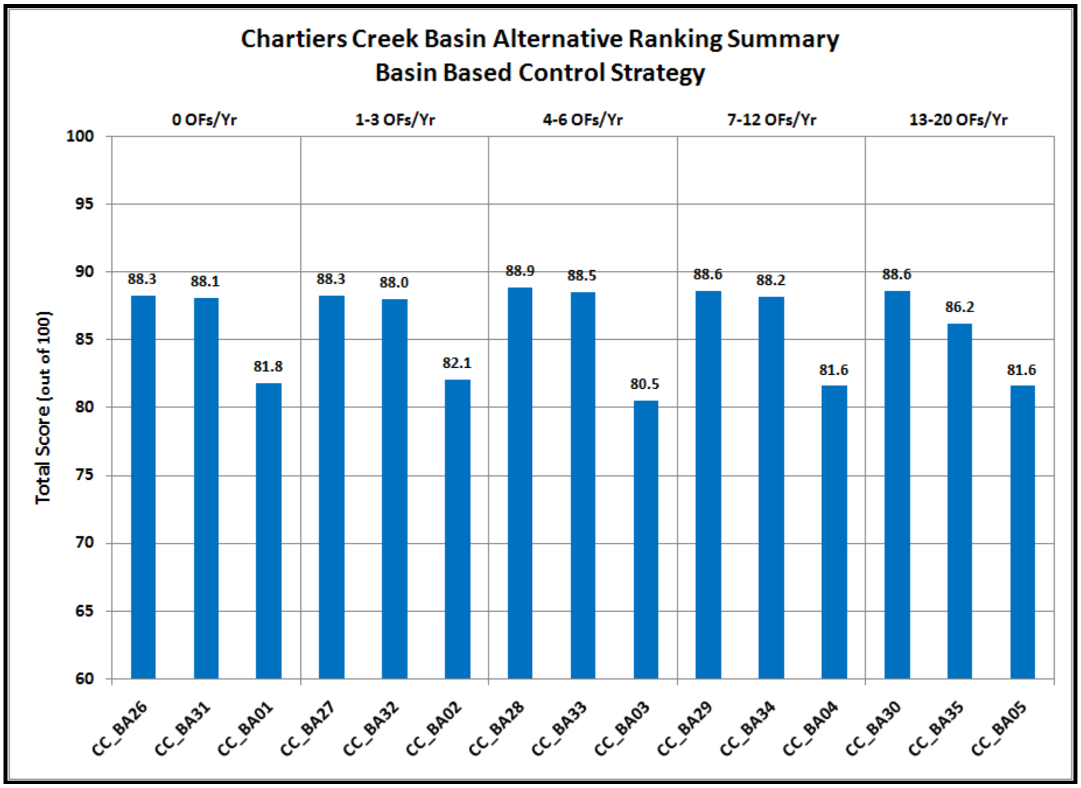


Figure 9-28: Chartiers Creek RBS Basin Alternative Ranking Results

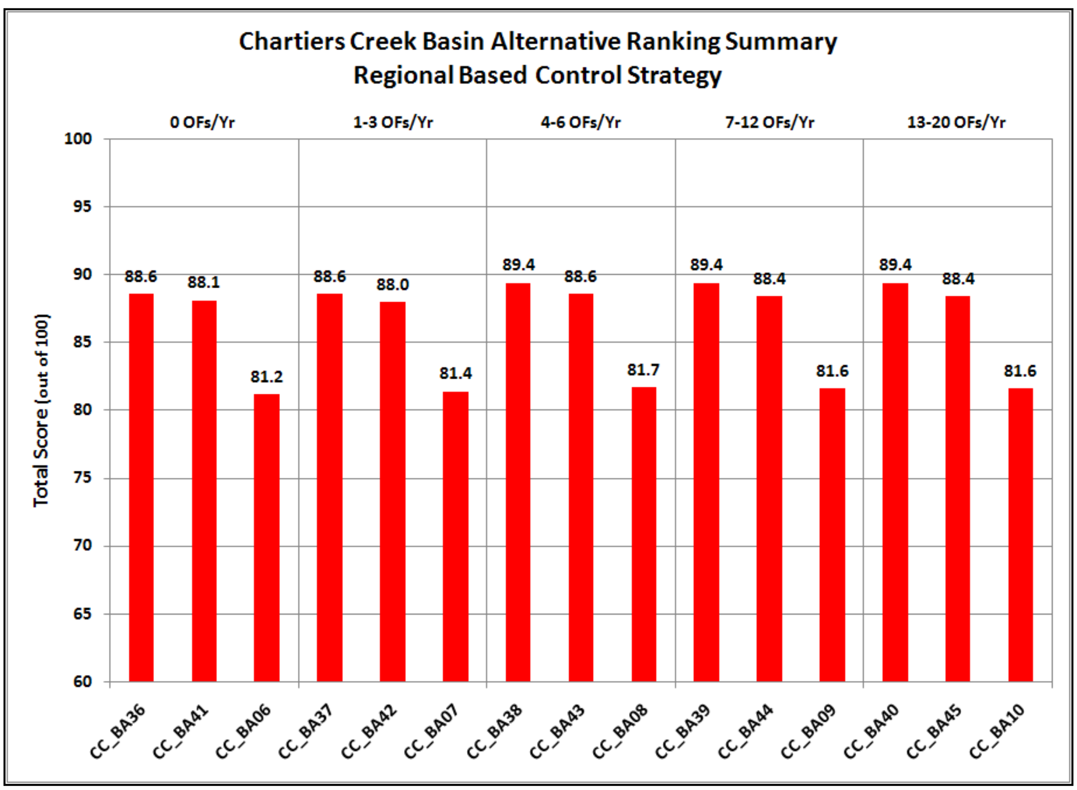


Figure 9-29: Chartiers Creek Knee-of-the-Curve Analysis

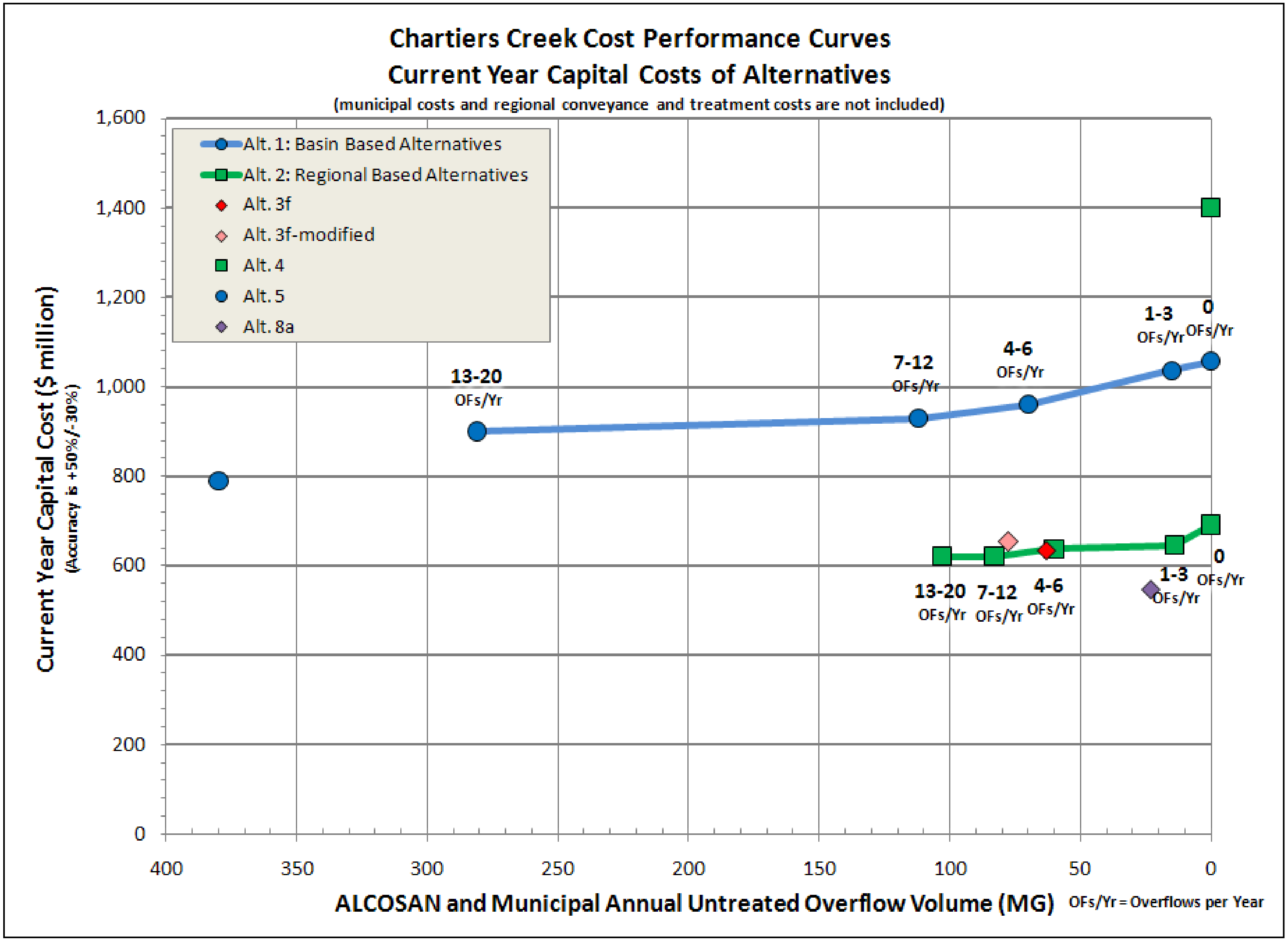


Table 9-40: Chartiers Creek Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
CC_BA24	5	380	85% capture	2-year	790
CC_BA30	1	281	13-20	2-year	900
CC_BA29		112	7-12	2-year	929
CC_BA28		70	4-6	2-year	961
CC_BA27		15	1-3	2-year	1,036
CC_BA26		0	0	2-year	1,057
Regional Based Control Strategy					
CC_BA40	2	103	13-20	2-year	621
CC_BA39		83	7-12	2-year	621
CC_BA38		60	4-6	2-year	638
CC_BA37		14	1-3	2-year	646
CC_BA36		0	0	2-year	692
CC_BA22	4 (1)	0	0	2-year	1,403
Additional Alternatives in Support of Regional Integration					
CC_BA08a	8a	23	13-15	2-year	548
CC_BA03f	3f	63	4-6	2-year	634
CC_BA03f-Modified	3f-Modified	78	4-6	2-year	655

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs

<u>CC_BA26 (Alt. 1 – 0 overflows/year) and BA27 (Alt. 1 – 1 to 3 overflows/year):</u> Basin Alternatives CC_BA26 and CC_BA27 incorporate conveyance and a storage basin at site CC-09 Hickman Street North in the separate sanitary portion of the basin and conveyance and RTB treatment at CC-34 Duncan Properties and CC-47 McKees Rocks East sites in the combined portion. RTB, as a control technology, is implemented at the Duncan Properties site for these options due to the higher levels of overflow to be controlled and being a more cost-effective option.

Storage basins for CSO areas are not feasible for the large flow volumes created at these control levels due to space constraints. Relief sewer conveyance is required from manhole C-54-06 near the upstream end of the system to the downstream end of the existing interceptor near structure O-07-00. This relief sewer also helps to convey CSO flows to the two facilities in combined portions of the system. Additional consolidation sewers convey flows to relief sewers, and to and from storage and treatment facilities.

CC_BA28 (Alt 1 - 4 to 6 overflows/year): Basin Alternative CC_BA28 incorporates conveyance and a storage basin at site CC-09 Hickman Street North in the sanitary portion of the basin. Conveyance, a storage basin at site CC-34 Duncan Properties, and a RTB treatment facility at site CC-47 McKees Rocks East are used in the combined portion. Relief sewer conveyance is required from manhole C-54-06, near the upstream end of the system, to the downstream end of the existing interceptor, near structure O-07-00. This relief sewer also helps to convey CSO flows to the two facilities in combined portions of the system. Additional consolidation sewers convey flows to relief sewers, and to and from storage and treatment facilities.

CC_BA29 (Alt. 1 – 7 to 12 overflows/year) and CC_BA30 (Alt. 1 – 13 to 20 overflows/year): Basin Alternatives CC_BA29 and CC_BA30 incorporate conveyance and a storage basin at site CC-09 Hickman Street North in the separate sanitary portion of the basin. Conveyance, a pumped interceptor relief point at the Duncan Properties site, and a RTB treatment facility at site CC-47 McKees Rocks East are used in the combined portion. Relief sewer conveyance is used from the downstream end of the existing interceptor, near structure O-07-00, up to manhole C-54-06, near the upstream end. This relief sewer also helps to convey CSO flows to the two facilities in combined portions of the system. Additional consolidation sewers convey flows to relief sewers, and to and from storage and treatment facilities.

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new regional tunnel and a new crossing under the Ohio River will be constructed, and that the regional tunnel and river crossing can take as much flow as needed from the CC planning basin.

CC_BA36 (Alt. 2 – 0 overflows/year) and CC_BA37 (Alt. 2 – 1 to 3 overflows/year): Basin Alternatives CC_BA36 and CC_BA37 incorporate conveyance and a storage basin at site CC-09 Hickman Street North in the separate sanitary portion of the basin and conveyance and RTB treatment at site CC-34 Duncan Properties in the combined portion. RTB, as a control technology, is implemented at the Duncan site for these options due to the higher levels of overflow to be controlled and being a more cost-effective option. Storage basins sized to handle the associated large flow volumes created by the control levels are not feasible due to space constraints. Relief sewer conveyance is used from the downstream end of the existing interceptor, near structure O-07-00, up to manhole C-54-06, near the upstream end. This relief sewer also helps to convey CSO flows to the Duncan Properties site RTB facility in the combined portion of the system. Additional consolidation sewers convey flows to relief sewers, and to and from storage and treatment facilities. This alternative is used in conjunction with the proposed new regional tunnel near regulator O-06-00 such that no control facility is required at the downstream end of the Chartiers Creek interceptor system.

CC_BA38 (Alt. 2 – 4 to 6 overflows/year): Basin Alternative CC_BA38 incorporates conveyance and two storage basins, one at the upstream end of the basin at site CC-09 Hickman Street North, and one in the lower portion of the basin at site CC-34 Duncan Properties. Relief sewer conveyance is used from the downstream end of the existing interceptor, near structure O-07-00, up to manhole C-54-06, near the upstream end. This relief sewer also conveys flow to the Duncan Properties site storage facility in the combined portion of the system. Additional consolidation sewers convey flows to relief sewers and to and from storage and treatment facilities. This alternative is used in conjunction with the proposed new regional tunnel such that no control facility is required at the downstream end of the Chartiers Creek interceptor system.

CC_BA39 (Alt. 2 – 7 to 12 overflows/year) and CC_BA40 (Alt. 2 – 13 to 20 overflows/year): Basin Alternatives CC_BA39 and CC_BA40 incorporate conveyance and a single storage basin at site CC-09 Hickman Street North in the separate sanitary portion of the basin. Conveyance and a pumped interceptor relief point at the Duncan Properties site are used in the combined portion. Relief sewer conveyance is used from the downstream end of the existing interceptor, near structure O-07-00, up to manhole C-54-06, near the upstream end. This relief sewer also helps to convey CSO flows to the proposed new regional tunnel at the downstream end of the system near regulator O-06-00. Additional consolidation sewers convey flows to relief sewers, and to and from storage and treatment facilities. This alternative is used in conjunction with the proposed new regional tunnel such that no facility is required at the downstream end of the Chartiers Creek interceptor system.

CC_BA22 (Alt. 4 – Sewer Separation): Basin-wide Basin Alternative CC_BA22 uses storage and conveyance at CC-09 Hickman Street North, CC-13a AK Steel, and CC-26 Heidelberg Park in the separate sanitary portion of the basin, and conveyance and full sewer separation in the combined sewer area. Sewer separation includes private I/I removal on all residential and commercial properties via new lateral construction.

***Summary of Additional Basin Alternatives in Support of Regional Integration*:** Table 9-40 provides details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-40, these basin alternatives reflected evolving municipal planning information, and levels of CSO and SSO control which varied by municipality.

The following provides brief summary descriptions of these alternatives. Shown in parentheses is the system-wide alternative that the basin alternative supports as well as the CSO level of control that they were evaluated at. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

CC_BA03f (Alt. 3f – 4 to 6 overflows/year): System-Wide Basin Alternative CC_BA03 incorporates conveyance and a single storage basin at the CC-34 Duncan properties site. Relief sewer conveyance is used from the downstream end of the existing interceptor, near structure O-07-00, up to manhole C-55-02, near the upstream end (excluding the Bridgeville Tunnel). This alternative is used in conjunction with the proposed new regional tunnel such that no control facility is required at the downstream end of the Chartiers Creek interceptor system. Alternative 3f assumes a free discharge at the regional tunnel.

CC_ BA03f-Modified (Alt. 3f-Modified – 4 to 6 overflows/year): System-Wide Basin Alternative CC_BA03- The same basic alternative is used for both Alternative 3f and 3f_Modified, with no significant physical difference between the two. Facility sizes between Alternative 3f and Alternative 3f Modified are the same. The principal difference between the two alternatives is the change in downstream boundary condition. Since Alternative 3f assumed a free discharge under all conditions, no backwater impacts on the existing or relief interceptor were addressed in that alternative. The lack of a free discharge under some conditions required the implementation of various hydraulic controls to isolate portions of the downstream Chartiers Creek tributary area from potential backwater impacts. This also resulted in some changes to regulators and impacted the amount of resultant overflow during the typical year. Differences in costs between 3f and 3f-Modified relate predominately to these hydraulic modifications and refinement of costs as the definition of the alternative was refined. In addition, a cost component included in the CC alternative in 3f was transferred to part of the System-Wide Alternative in 3f-Modified.

<u>CC_BA08A (Alt. 8a – 13 to 15 overflows/year):</u> This alternative was targeted to achieve a goal of 13-15 overflows/year for CSO control. The 2-year level of SSO control was used. Top ranked regional basin Alternative 3f-Modified was used as the starting point for development of this alternative. The higher number of overflows allowed in this alternative eliminated the need for the storage basin at the CC-34 Duncan Properties site. Alternative 8a consists of relief sewer conveyance from ALCOSAN manhole C-55-02 (excluding the Bridgeville Tunnel), near the upstream end of the CC basin, to structure O-07-00 at the downstream end. The relief sewer would provide the additional capacity required to convey all flows to the WWTP via the existing and proposed regional tunnel crossings. Excess wet weather flows would enter the regional tunnel via a new drop shaft near structure O-07-00 and ALCOSAN regulator O-06-00 for conveyance to the WWTP when capacity of the existing tunnel is exceeded. The required levels of CSO and SSO control were met through conveyance alone.

Section 9.5 describes the integration of these basin alternatives into system-wide alternatives. The section describes the system-wide alternative development process and provides descriptions of the system-wide alternatives that were evaluated.

9.4.3 Lower Ohio – Girty's Run Planning Basin

This section summarizes the development, evaluation, and results of the basin alternatives analyzed for the Lower Ohio – Girty's Run (LOGR) planning basin. The overall development and evaluation process used by LOGR and the other six basin planners was described in Section 9.4.1. As such, this section primarily focuses on results of the basin alternatives evaluation and any features or methods that were unique to the LOGR planning basin.

The LOGR planning basin consists of two sub-basin areas: (1) the Lower Northern Allegheny (LNA) sub-basin and the Lower Ohio (LO) sub-basin. Because both sub-basins were modeled and analyzed separately, the results for the two sub-basins will be presented under separate sequential headings.

Basin Alternatives Evaluation (LNA): A total of 38 LNA basin alternatives were evaluated including 23 under the basin-based control strategy (BBS) and 15 under the regional-based control strategy (RBS). The BBS assumed that additional regional conveyance beyond the existing interceptor system would not be available. The RBS assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Table 9-41 provides a summary of the basin alternatives that were evaluated. Included are the control strategy, the control technologies associated with the alternatives, and the CSO and SSO levels of control. There are no ALCOSAN SSOs in the LNA sub-basin, and the CSO levels of control are reported as the number of allowable overflows per year with typical precipitation.

A key component of this screening included constructability reviews that were conducted along the storage/conveyance corridors to identify obstacles above and beyond "normal" construction issues that would need to be accounted for and considered. At the end of the screening process, a total of 23 basin alternatives were carried forward under the BBS control strategy, and a total of 15 basin alternatives were carried forward under the RBS control strategy. Each alternative, that was carried forward was formally ranked using the Basin Alternative Ranking and Assessment Tool (BARAT), as described below.

Basin Alternative Ranking (LNA): To assist in determining the most preferred basin alternatives for various CSO control levels analyzed, all of the BBS and RBS basin alternatives were ranked using the BARAT, as described in Section 9.4.1. Figures 9-30 and 9-31 provide summaries of the ranking results for alternatives analyzed under the BBS and RBS, respectively. Basin alternatives LNA_BA25 through LNA_BA28 were identified as the top ranked BBS alternatives for the various levels of control that were evaluated. LNA_BA30 was actually the 2nd ranked alternative in BARAT slightly behind LNA_BA69. The only difference between the two sets of alternatives was the length of the consolidation sewer in the Allegheny River backchannel. It was determined from a constructability perspective, that once the consolidation sewer was being constructed in the backchannel it would be easier to stay in the backchannel. This constructability consideration was not accounted for in the BARAT. Therefore LNA_BA30 was selected as the 1st preferred alternative over LNA_BA69.

LNA_BA77 through LNA_BA82 were determined to be the top ranked RBS alternatives. The BP selected this group of alternatives as the 1st preferred alternatives even though each alternative was not necessarily the top-ranked at each control level. When viewed across all control levels, this group was most consistently one of the highest ranked. In addition, it was top ranked for the 1-3 and 4-6 overflows per year control levels. For the 0 overflows per year control level LNA_BA77 was selected over LNA_BA31 due to the elevated risks with constructing an interceptor under the Allegheny River as part of LNA_BA31 which were not fully accounted for in the BARAT. For control levels 7-12 and 13-20 overflows per year LNA_BA80 and LNA_BA82 were selected over LNA_BA48 and LNA_BA50 to be consistent with the other control levels. The only difference between the two sets of alternatives was the length of the consolidation sewer in the Allegheny River backchannel. It was determined from a constructability perspective, that once the consolidation sewer was being constructed in the backchannel it would be easier to stay in the backchannel. This constructability consideration was not accounted for in the BARAT.

Table 9-41: Lower Northern Allegheny – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO*
LNA_BA25	Basin-Based	CF10	RTB (conveyance in back channel throughout)	0 OFs / Year	--
LNA_BA26	Basin-Based	CF10	RTB (conveyance in back channel throughout)	1 to 3 OFs / Year	--
LNA_BA27	Basin-Based	CF10	RTB (conveyance in back channel throughout)	4 to 6 OFs / Year	--
LNA_BA28	Basin-Based	CF10	RTB (conveyance in back channel throughout)	7 to 12 OFs / Year	--
LNA_BA30	Basin-Based	CF10	RTB (conveyance in back channel throughout)	20 OFs / Year	--
LNA_BA31	Regional-Based	CF17	Conveyance	0 OFs / Year	--
		CF16	Conveyance		
LNA_BA32	Regional-Based	CF17	Conveyance	1 to 3 OFs / Year	--
		CF16	Conveyance		
LNA_BA33	Regional-Based	CF17	Conveyance	4 to 6 OFs / Year	--
		CF16	Conveyance		
LNA_BA34	Regional-Based	CF17	Conveyance	7 to 12 OFs / Year	--
		CF16	Conveyance		
LNA_BA36	Regional-Based	CF17	Conveyance	20 OFs / Year	--
		CF16	Conveyance		
LNA_BA37	Basin-Based	CF10	RTB	4 to 6 OFs / Year (reduced sediment)	--

Table 9-41: Lower Northern Allegheny – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO*
LNA_BA38	Basin-Based	CF17	RTB	0 OFs / Year	--
		CF16	RTB		
LNA_BA39	Basin-Based	CF17	RTB	1 to 3 OFs / Year	--
		CF16	RTB		
LNA_BA40	Basin-Based	CF17	Underground Tank	4 to 6 OFs / Year	--
		CF16	RTB		
LNA_BA41	Basin-Based	CF17	Underground Tank	7 to 12 OFs / Year	--
		CF16	RTB		
LNA_BA43	Basin-Based	CF17	Underground Tank	20 OFs / Year	--
		CF16	Underground Tank		
LNA_BA44	Basin-Based	CF10	Sewer Separation	0 OFs / Year	--
LNA_BA45	Regional-Based	CF10	Conveyance to main Rivers A-59 (conveyance part way in back channel)	0 OFs / Year	--
LNA_BA46	Regional-Based	CF10	Conveyance to main Rivers A-59 (conveyance part way in back channel)	1 to 3 OFs / Year	--
LNA_BA47	Regional-Based	CF10	Conveyance to main Rivers A-59 (conveyance part way in back channel)	4 to 6 OFs / Year	--
LNA_BA48	Regional-Based	CF10	Conveyance to main Rivers A-59 (conveyance part way in back channel)	7 to 12 OFs / Year	--
LNA_BA50	Regional-Based	CF10	Conveyance to main Rivers A-59 (conveyance part way in back channel)	20 OFs / Year	--

Table 9-41: Lower Northern Allegheny – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO*
LNA_BA51	Basin-Based	CF10	Tunnel	0 OFs / Year	--
LNA_BA52	Basin-Based	CF10	Tunnel	1 to 3 OFs / Year	--
LNA_BA53	Basin-Based	CF10	Tunnel	4 to 6 OFs / Year	--
LNA_BA54	Basin-Based	CF10	Tunnel	7 to 12 OFs / Year	--
LNA_BA56	Basin-Based	CF10	Tunnel	20 OFs / Year	--
LNA_BA86	Basin-Based	CF17	Underground Tank	4 to 6 OFs / Year (Reduced Sediment)	--
		CF16	RTB		
LNA_BA64	Basin-Based	CF10	RTB (conveyance part way in back channel)	0 OFs / Year	--
LNA_BA65	Basin-Based	CF10	RTB (conveyance part way in back channel)	1 to 3 OFs / Year	--
LNA_BA66	Basin-Based	CF10	RTB (conveyance part way in back channel)	4 to 6 OFs / Year	--
LNA_BA67	Basin-Based	CF10	RTB (conveyance part way in back channel)	7 to 12 OFs / Year	--
LNA_BA69	Basin-Based	CF10	RTB (conveyance part way in back channel)	20 OFs / Year	--
LNA_BA77	Regional-Based	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	0 OFs / Year	--
LNA_BA78	Regional-Based	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	1 to 3 OFs / Year	--
LNA_BA79	Regional-Based	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	4 to 6 OFs / Year	--

Table 9-41: Lower Northern Allegheny – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO*
LNA_BA80	Regional-Based	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	7 to 12 OFs / Year	--
LNA_BA82	Regional-Based	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	20 OFs/Year	--
LNA_BA76	Alternative 3f	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	4 to 6 OFs/Year	--
LNA_BA83	Complete Sewer Separation for Targeted CSO outfalls near Sensitive Areas	CF10	Sewer Separation	4 to 6 OFs/Year	--
		A-67	Underground Tank	--	02
LNA_BA84	Relocation of Targeted CSO Outfalls Near Sensitive Areas	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	4 to 6 OFs/Year	--
LNA_BA85	Alternative 8a	CF10	Conveyance to Main Rivers A-59 (conveyance in backchannel throughout)	13 to 20 OFs/Year	--
LNA_BA87	Alternative 3f-modified	CF10	Conveyance to Main Rivers A-60 (conveyance in backchannel throughout)	4 to 6 OFs/Year	--

* Note: There are no ALCOSAN SSOs in the LNA sub-basin

Figure 9-30: Lower Northern Allegheny BBS Basin Alternative Ranking Results

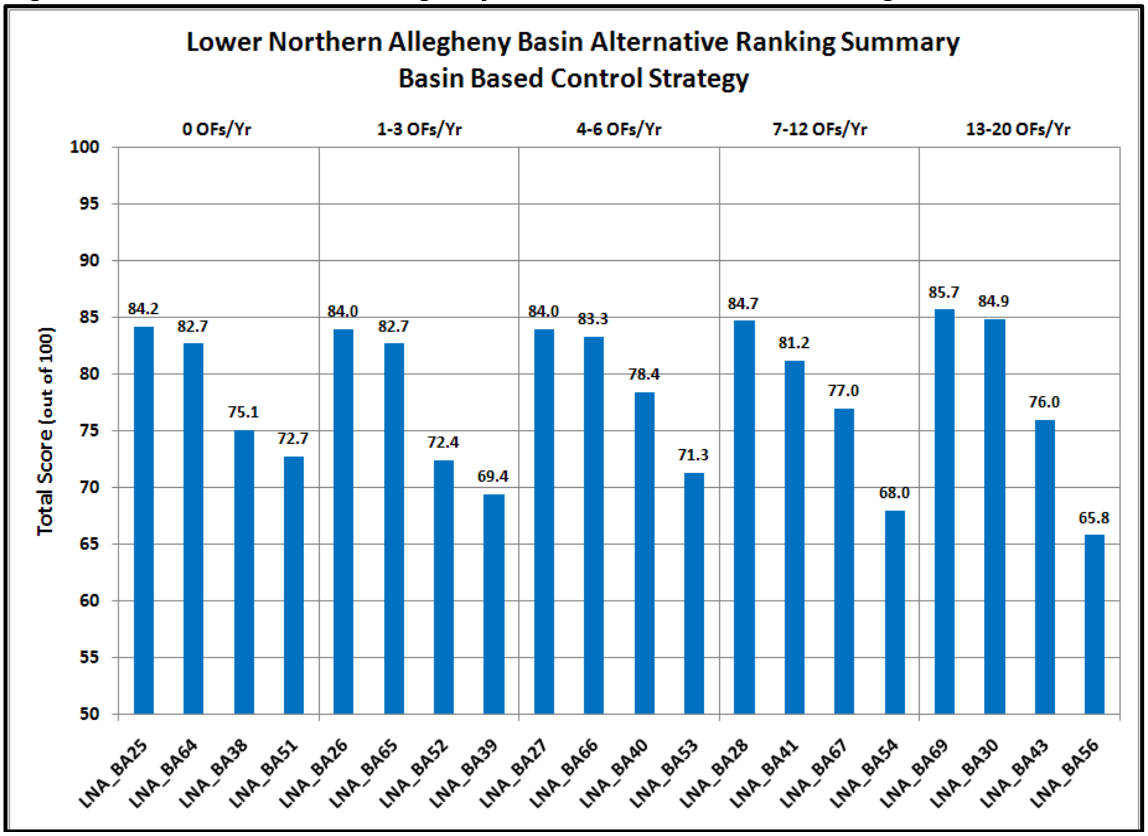
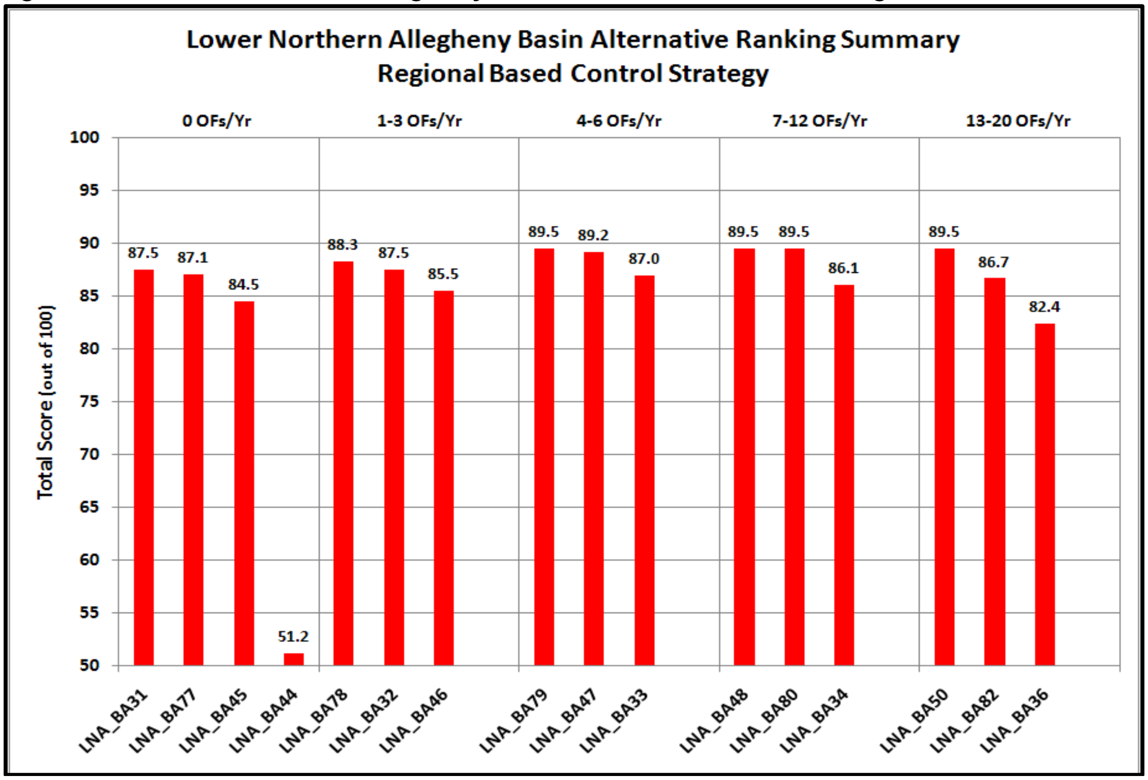


Figure 9-31: Lower Northern Allegheny RBS Basin Alternative Ranking Results



Knee of the Curve Analysis (LNA): Figure 9-32 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional-based alternatives, as well as for additional alternatives that were evaluated in support of regional integration. Each of these points was determined by two values: a performance value (annual untreated overflow volume) resulting from a model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after predicted future growth has occurred and the basin alternative has been implemented. For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represents a continuous relationship between performance and cost.

Summary of Preferred BBS and RBS Basin Alternatives (LNA): Table 9-42 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. In addition, included are the other mandatory basin alternatives of complete sewer separation of combined sewered areas and 85% capture by receiving stream. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended to the planning basin. All flows will have to be conveyed to the WWTP via the existing Lower Northern Allegheny deep tunnel interceptor.

<u>LNA_BA25 through LNA_BA30 (Alt. 1 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year):</u> The LNA preferred BBS basin alternatives are LNA_BA25 through LNA_BA30. For each control level, the basin alternative is comprised of a retention/treatment basin (RTB) facility at Site A-62.1 for the control of the CF10 consolidated outfalls. The conveyance sewer that would transport the overflows to Site A-62.1 would start at a new diversion structure at the A-67 point of connection in Millvale Park to pick up the A-67-00 overflows.

Figure 9-32: Lower Northern Allegheny Knee-of-the-Curve Analysis

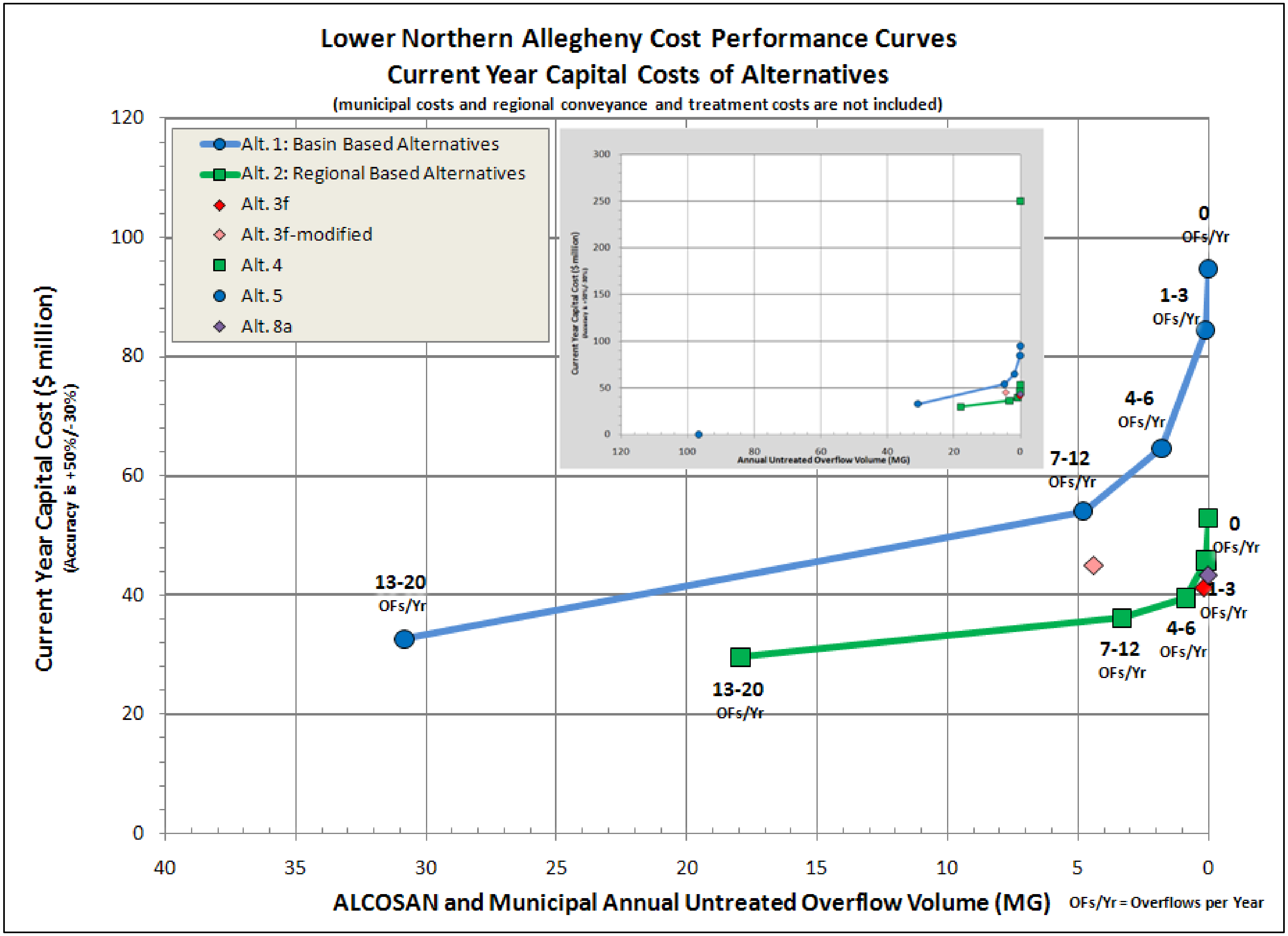


Table 9-42: Lower Northern Allegheny Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
LNA_BA57	5	97	85% capture	2-year	0
LNA_BA30	1	31	13-20	2-year	33
LNA_BA28		5	7-12	2-year	54
LNA_BA27		2	4-6	2-year	65
LNA_BA26		0	1-3	2-year	85
LNA_BA25		0	0	2-year	95
Regional Based Control Strategy					
LNA_BA81	2	18	13-20	2-year	30
LNA_BA79		3	7-12	2-year	36
LNA_BA78		1	4-6	2-year	39
LNA_BA77		0	1-3	2-year	46
LNA_BA76		0	0	2-year	53
LNA_BA44	4 (1)	0	0	2-year	250
Additional Alternatives in Support of Regional Integration					
LNA_BA85	8a	0	13-15 (2)	2-year	43
LNA_BA76	3f	0	4-6 (3)	2-year	41
LNA_BA87	3f-Modified	4	4-6 (4)	2-year	45

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs alone were cost prohibitive.
(2) Targeted outfalls directly upstream of sensitive areas were controlled to 4-6 overflows/year
(3) Targeted outfalls directly upstream of sensitive areas were controlled to 4-6 overflows/year, but the incremental cost to achieve relocation or elimination was also evaluated.
(4) Targeted outfalls upstream of sensitve areas were relocated based on recommended approach per Alt. 3f.

The conveyance system would be installed with open cut methods along the Allegheny River Back Channel, parallel to the existing shallow cut interceptor, and would be connected to the new diversion structures for A-67-00, A-65-00, and A-64-00 with short pipe segments. When the conveyance alignment is near the existing A-63-00 diversion structure, the conveyance alignment would turn inland to convey flow to the facility at Site A-62.1. This alignment was selected in order to avoid conflict with the relocated railroad lines and the newly constructed elevated bike trail that lie parallel to the river between A-64-00 and A-65-00. The A-62-00 overflows would be conveyed from a new diversion chamber near the intersection of River Avenue and the driveway for Bay Valley Foods to the facility at Site A-62.1.

The CF10 RTB facility would be less expensive than the CF16 and CF17 facilities over the range of control levels. Besides the cost, the selection was based on a number of factors. One such factor is that there are a number of sensitive areas identified in the ALCOSAN CD between Sites A-62.1 and A-66.4. By consolidating the flows into the downstream site, Site A-62.1, the facility would be located downstream of these sensitive areas. It would also reduce the number of facilities that ALCOSAN would be required to maintain within a very small geographic area. If the construction of the consolidation sewer line in the backchannel of the Allegheny River would become infeasible from a permitting perspective, the second preferred alternatives would be LNA_BA38 through LNA_BA43.

<u>LNA_BA57 (Alt. 5 - 85% Capture):</u> Within the LNA planning basin, 94% of the combined flows are captured under future baseline conditions (WWTP at 480 mgd) assuming the upstream municipal CSOs and SSOs within the A-67 sewershed are transported down to the A-67 point of connection (POC). There are also no ALCOSAN SSOs within the LNA Planning Basin. Therefore, no alternatives were required to bring the LNA planning basin to an 85% capture control level. While the 85% capture criteria are met under these conditions, overflows would occur under this alternative.

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new regional tunnel would be constructed along the Allegheny River, and that this regional tunnel would take as much flow as needed from the Lower Northern Allegheny planning basin.

<u>LNA_BA77 through LNA_BA82 (Alt. 2 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year):</u> The preferred regional-based alternative for the LNA is conveyance of the CF10 consolidation flows to the drop shaft location for the proposed Main Rivers Basin tunnel. The CF10 conveyance sewer would start at the A-67 POC, run southwest to A-62-00 and then continue along the river to the connection at the Main Rivers proposed drop shaft location, which would lie just past the 16^{th} Street Bridge. The alignment would follow the Allegheny River Back Channel (parallel to the existing interceptor) between A-67-00 and A-62-00. At A-62-00, the conveyance pipe would turn inland and follow the existing bike trail until just past the 16^{th} Street Bridge where the conveyance tunnel would make a 45 degree turn under River Avenue and connect to the Main Rivers tunnel drop shaft. The conveyance pipe would be constructed with open cut methods along the back channel and would require the use of cofferdams at either end of the back channel during construction. Due to the depth of pipe required between A-62-00 and the Main Rivers site, microtunneling methods would be used.

LNA_BA44 (Alt. 4 – Sewer Separation): The LNA sewer separation alternative (LNA_BA44) includes the separation of all combined areas within the LNA sewershed. This includes the entirety of the A-62, A-64 and A-65 sewersheds, and portions of the A-67 sewershed (including the West View and Girty's Run CSOs). The sewer separation alternative assumes that the alternative will eliminate the CSOs associated with the tributary combined areas. In the A-67 sewershed, since it is a mixed use sewershed, additional controls beyond the sewer separation would be required to control the excess flows at A-67-00. Because the A-67 sewershed would continue to have excess separate sanitary flows, this sewer separation alternative also includes an SSO storage tank. This tank was sized for the 2-year design storm and would be located at Site A-66.4. It is assumed that the municipalities would provide conveyance of the municipal SSO overflows down to the A-67 POC.

Summary of Additional Basin Alternatives in Support of Regional Integration (LNA):
Table 9-42 provides details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. These basin alternatives reflected evolving municipal planning information, and levels of CSO and SSO control which varied by municipality. All of these additional alternatives considered higher levels of control for targeted outfalls in sensitive areas, but they are not included in the Alternative 3f costs reported.

The following provides brief summary descriptions of these alternatives. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

LNA_BA76 (Alt. 3f – 4-6 overflows/year): The LOGR BP selected the top-ranked regional-based Basin Alternative for the LNA sub-basin (conveyance of the CF10 consolidation to the nearest regional tunnel drop shaft near the A-59 POC). LNA_BA76, with the 3f boundary conditions, was selected as the preferred LNA regional-based Basin Alternative for the targeted level of control of 4-6 overflows per year. All conveyance was to be sized to convey the typical year peak flow (0 overflows per year control level).

The CF10 conveyance sewer would start at the A-67 POC, run southwest to A-62-00 and then continue along the river to the connection at the proposed drop shaft location for the regional tunnel near A-59-00, which would lie just past the 16th Street Bridge. The alignment would follow the Allegheny River Back Channel (parallel to the existing interceptor) between A-67-00 and A-62-00. At A-62-00, the conveyance pipe would turn inland and follow the existing bike trail until just past the 16th Street Bridge where the conveyance tunnel would make a 45 degree turn under River Avenue and connects to the proposed tunnel drop shaft. The conveyance pipe would be constructed with open cut methods along the back channel and would require the use of cofferdams at either end of the back channel during construction. Due to the depth of pipe required between A-62-00 and the Main Rivers site, microtunneling methods would be used.

LNA_BA87 (Alt. 3f-Mod – 4-6 overflows/year): Alternative 3f served as the basis for Alternative 3f - modified. The same conceptual layout was utilized and resized based on the model results when the Alternative 3f- modified boundary condition was applied. Alternative 3f - modified, as described below, is named LNA_BA87 and was selected as the preferred basin alternative for the targeted level of control of 4 to 6 overflows per year. However, because this alternative is comprised only of consolidation sewers and is in a sensitive area, the alternative was sized for the 0 overflows per year control level.

The key components of Alternative LNA_BA87 include an overflow structure on the proposed Alternative 3f - modified consolidation line approximately 1,000 feet downstream of A-62-00, adding a cross-connection (diversion structure) between the existing interceptor and the new consolidation sewer at A-62-02, and adding flap gates at the existing A-62-00 drop shaft. Even with these additions, a small amount of manhole flooding is still predicted to occur at a number of manholes along the existing interceptor. The manhole flooding could be addressed by utilizing locking manhole covers.

The consolidation pipe would be constructed with open cut methods from A-67-00 to A-62-00 in the Allegheny River back channel in order to avoid the infrastructure congestion primarily between A-65-00 and A-64-00. At A-62-00, the pipe will turn inland and be constructed on land with microtunnel methods from A-62-00 to the proposed regional tunnel at the proposed drop shaft location near the A-60 POC. The consolidation sewer constructed between A-67-00 and A-65-00 (3,775 linear feet) would be a 78-inch diameter pipe. The pipe between A-65-00 and A-62-02 (2,900 linear feet) would be an 84-inch diameter pipe. The remainder of the pipe from A-62-02 to A-60 (3,380 linear feet) would be a 90-inch pipe. A large diversion chamber will be constructed at A-62-02 between the existing interceptor and the proposed consolidation pipe to alleviate manhole flooding at this location. There will also be short segments of pipe connecting the new diversion chambers at A-65-00, A-64-00 and A-62-00 and the proposed consolidation pipe. A 66-inch diameter overflow pipe will convey overflows to the Allegheny River from the proposed diversion chamber that would be located approximately 1,000 feet downstream from the LNA sensitive areas.

LNA_BA85 (Alt. 8a – 13-15 overflows/year): Based on the direction provided by the PM, the LOGR BP selected the top-ranked regional-based basin alternative for the LNA sub-basin (conveyance of the CF10 consolidation to the nearest regional tunnel drop shaft near the A-59 POC). LNA_BA85 with the 8a boundary conditions was selected as the preferred LNA regional-based basin alternative for the targeted level of control of 13 to 15 overflows per year. However, all conveyance for the 8a alternatives was to be sized to convey the typical year peak flow rates (0 overflows per year control level) because the A-62-00, A-64-00, A-65-00 and A-67-00 structures overflow to sensitive areas. This alternative is configured the same as the Alternative 3f alternative. As such, the conveyance would be constructed through the back channel between the A-67-00 and A-62-00 outfalls with open cut methods. The conveyance alignment would be constructed on land with microtunnel methods between A-62-00 and the A-59-00 drop shaft.

Section 9.5 describes the integration of these basin alternatives into system-wide alternatives. The section describes the system-wide alternative development process and provides descriptions of the system-wide alternatives that were evaluated.

Summary of Alternatives to Address Targeted CSO Outfalls near Sensitive Areas (LNA):
As described in Section 9.1, guidance was provided to the basin planners to evaluate alternatives for varying levels of enhanced control to Consent Decree defined sensitive areas. For basin alternatives in support of select system-wide alternatives targeting 4-6 overflows per year for all CSOs, the basin planners evaluated alternatives for providing a CSO level of control of zero overflows in the typical year for outfalls directly impacting sensitive areas. There were two primary alternatives that were evaluated for CSOs tributary to sensitive areas. First, elimination of the CSOs was evaluated via full sewer separation. Additionally, the relocation of the outfalls downstream of the sensitive area was also evaluated. The details of these two alternatives are provided on Table 9-42 and are described below.

There are six targeted CSOs within the LNA planning basin that that discharge directly to sensitive areas or a fixed distance upstream of the sensitive area that are listed below. There are 9 additional targeted outfalls that directly impact sensitive areas in the Main Rivers and Upper Monongahela planning basins.

- A-62-00
- A-63-00
- A-64-00
- A-65-00
- A-66-00
- A-67-00

It should be noted that the A-63-00 and A-66-00 CSO overflows will be eliminated during the construction of the Route 28 Improvement Project. The elimination of these outfalls is represented in the Future Baseline model and therefore were not considered as part of the alternatives developed herein.

Complete Sewer Separation for Targeted CSO Outfalls Near Sensitive Areas

A sewer separation alternative LNA_BA83, was developed and a cost estimate prepared. This alternative would essentially be a municipal control alternative. The LNA sewer separation includes the separation of all combined areas within the LNA sewershed. This includes the entirety of the A-62, A-64 and A-65 sewersheds, and portions of the A-67 sewershed (including the West View and Girty's Run CSOs in Millvale). The sewer separation alternative assumes that the alternative will eliminate the CSOs that are tributary to the combined area. However, in the A-67 sewershed, since it is a mixed use sewershed additional controls beyond the sewer separation would be required to control the excess flows at A-67-00.

Because the A-67 sewershed would continue to have excess separate sanitary flows after a sewer separation program, this sewer separation alternative also includes an SSO storage tank to control the excess flows. This tank was sized for the 2-year design storm and would be located at Site A-66.4. It is assumed that the municipalities would provide conveyance of the municipal SSO overflows down to the A-67 POC. The cost estimate includes the cost of conveying the SSO overflows from the A-67 POC to the storage facility at Site A-66.4. The conveyance pipe would be constructed with microtunneling methods through Millvale Park.

Implementation of this alternative would result in no overflows during the typical year.

LNA_BA83 would cost $361 million while the cost to implement LNA_BA76 would be $41.5. Therefore, the additional cost to implement LNA_BA83 over LNA_BA76 would be $319 million.

Relocation of Targeted CSO Outfalls Near Sensitive Areas

The overflows within the LNA Planning Basin are extremely sensitive to the downstream boundary conditions. Using Alternative 3f as a starting point, two scenarios were evaluated. The first assumed a free discharge condition for the new consolidation sewer contained in Alternative 3f. The second scenario included applying the existing interceptor boundary condition to the downstream end of the Alternative 3f consolidation sewer.

Under the free discharge scenario, Alternative 3f effectively eliminates all overflows upstream of the identified sensitive area without any further improvements to the system. However, when the Alternative 3f boundary condition is applied to the consolidation sewer within Alternative 3f, overflows occur at A-62-00, A-65-00, and A-67-00 as well as some manhole flooding at a number of manholes along the existing interceptor. To address these overflows alternative LNA_BA84 was developed.

The key components of Alternative LNA_BA84 include a new overflow structure on the proposed Alternative 3f consolidation line approximately 1,000 feet downstream of A-62-00, raising the weirs of the A-62-00 (by 4 feet), A-65-00 (by 4 feet), and A-67-00 (by 1 foot) diversion structures, adding a cross-connection between the existing interceptor and the new consolidation sewer at A-62-02, and adding flap gates at each connection to the new consolidation line. Even with these additions, a small amount of manhole flooding still occurs at a number of manholes along the existing interceptor. The manhole flooding can be addressed by locking the manholes down.

It should be noted that the maximum predicted hydraulic gradelines in the LNA system are impacted by both the downstream interceptor and Allegheny River elevations. During the most significant events during the typical year, the Allegheny River boundary condition is higher than the Alternative 3f existing interceptor boundary. It was due to these boundary conditions that required the weirs at A-62-00, A-65-00, and A-67-00 to be raised in order to relocate the overflows to the new relief sewer 1,000 feet downstream of A-62-00. A detailed hydraulic analysis of raising these weirs would need to be evaluated to determine if there would be any adverse impacts on the local systems. If the hydraulic analysis indicates an adverse impact on the local system, an alternative approach would be to pump the overflows at the new relief sewer to eliminate the impact of the river boundary condition.

Based on this analysis, there are three approaches for relocating the overflows from upstream of the sensitive area. First, the gradeline in the regional tunnel can be controlled in a way that would always provide the LNA planning basin a free discharge outlet into the regional tunnel. If this is not cost effective or feasible, an alternative would be alternative LNA_BA84 which provides a new overflow on the consolidation line approximately 1,000 feet downstream of A-62-00. If this alternative is determined to have an adverse impact on the local systems, a wet weather pump station can be located at the new overflow on the consolidation line so that the hydraulic gradeline can be controlled by this relief elevation instead of the Allegheny River elevation.

LNA_BA84 would cost $43.1 million while the cost to implement LNA_BA76 would be $41.5. Therefore, the additional cost to implement LNA_BA84 over LNA_BA76 would be $1.62 million.

A slight variation of LNA_BA84 is recommended for incorporation into the Alternative 3f-modified alternative, LNA_BA76. This alternative would include all the aspects of LNA_BA84 except for the raising of the weirs at A-62-00, A-65-00, and A-67-00. The new outfall should only be activated during periods when the regional tunnel design is exceeded. During events when the regional tunnel is full and the Allegheny River level is elevated, the existing outfalls at A-67, A-65, A-64, and A-62 will activate to prevent upstream flooding (expected to be approximately 1 time in the typical year).

Basin Alternatives Evaluation (LO): For the LO basin alternatives, the naming convention adhered to the following naming protocol since these alternatives were made up of both Lower Ohio – North (LON) and Lower Ohio – South (LOS) basin alternatives: LON"_BA""XX"-LOS"_BA""XX". LON basin alternatives included control alternatives that were on the north shore of the Ohio River while LOS alternatives were associated with the south shore.

A total of 48 LO basin alternatives were evaluated including 38 under the basin-based control strategy (BBS) and 10 under the regional-based control strategy (RBS). The BBS assumed that additional regional conveyance beyond the existing interceptor system would not be available. The RBS assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Table 9-43 provides a summary of the basin alternatives that were evaluated. Included are the control strategy, the control technologies associated with the alternatives, and the CSO and SSO levels of control. The CSO levels of control are reported as the number of allowable overflows per year with typical precipitation. The SSO levels of control are reported as a design storm recurrence interval in years.

As basin alternatives evolved, a number of facilities that were included early in the screening evaluation process were eliminated or changed resulting in the need for new site alternatives and basin alternatives. Several iterations of a basin alternative screening process were performed to reduce the number of basin alternatives to those most viable. A key component of this screening included constructability reviews that were conducted along the storage/conveyance corridors to identify obstacles above and beyond "normal" construction issues that would need to be accounted for and considered. At the end of the screening process, a total of 31 basin alternatives were carried forward under the BBS control strategy, and a total of 10 basin alternatives were carried forward under the RBS control strategy. Each of these alternatives was then formally ranked using the Basin Alternative Ranking and Assessment Tool (BARAT), as described below.

Table 9-43: Lower Ohio – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO
LON_BA15-LOS_BA19	Basin-Based	CF02	RTB	0 OFs / Year	--
		CF14	RTB	0 OFs / Year	--
		CF07	Tunnel	--	02
LON_BA15-LOS_BA20	Basin-Based	CF02	RTB	1 to 3 OFs / Year	--
		CF14	RTB	1 to 3 OFs / Year	--
		CF07	Tunnel	--	02
LON_BA15-LOS_BA21	Basin-Based	CF02	RTB	4 to 6 OFs / Year	--
		CF14	Tank	4 to 6 OFs / Year	--
		CF07	Tunnel	--	02
LON_BA15-LOS_BA22	Basin-Based	CF02	RTB	7 to 12 OFs / Year	--
		CF14	Tank	7 to 12 OFs / Year	--
		CF07	Tunnel	--	02
LON_BA15-LOS_BA24	Basin-Based	CF02	Tank	20 OFs / Year	--
		CF14	Tank	20 OFs / Year	--
		CF07	Tunnel	--	02
LON_BA16-LOS_BA25	Regional-Based	CF18	Conveyance	0 OFs / Year	02
LON_BA17-LOS_BA26	Regional-Based	CF18	Conveyance	1 to 3 OFs / Year	02
LON_BA18-LOS_BA27	Regional-Based	CF18	Conveyance	4 to 6 OFs / Year	02
LON_BA19-LOS_BA28	Regional-Based	CF18	Conveyance	7 to 12 OFs / Year	02
LON_BA21-LOS_BA30	Regional-Based	CF18	Conveyance	20 OFs / Year	02

Table 9-43: Lower Ohio – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO
LON_BA13-LOS_BA56	Basin-Based	CF03, CF22, CF06, O-18	Underground Tank	--	02
		CF02	Screening & Disinfection	0 OFs / Year	--
		CF14	Screening & Disinfection		
LON_BA13-LOS_BA57	Basin-Based	CF03, CF22, CF06, O-18	Underground Tank	--	02
		CF02	Screening & Disinfection	1 to 3 OFs / Year	--
		CF14	Screening & Disinfection		
LON_BA13-LOS_BA58	Basin-Based	CF03, CF22, CF06, O-18	Underground Tank	--	02
		CF02	Screening & Disinfection	4 to 6 OFs / Year	--
		CF14	RTB		
LON_BA13-LOS_BA59	Basin-Based	CF03, CF22, CF06, O-18	Underground Tank	--	02
		CF02	Screening & Disinfection	7 to 12 OFs / Year	--
		CF14	RTB		
LON_BA13-LOS_BA61	Basin-Based	CF03, CF22, CF06, O-18	Underground Tank	--	02
		CF02	RTB	20 OFs / Year	--
		CF14	RTB		
LON_BA14-LOS_BA44	Regional-Based	CF07	LON Conveyance	--	02
		CF08	LOS Conveyance	0 OFs / Year	--
LON_BA14-LOS_BA45	Regional-Based	CF07	LON Conveyance	--	02
		CF08	LOS Conveyance	1 to 3 OFs / Year	--

Table 9-43: Lower Ohio – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO
LON_BA14-LOS_BA46	Regional-Based	CF07	LON Conveyance	--	02
		CF08	LOS Conveyance	4 to 6 OFs / Year	--
LON_BA14-LOS_BA47	Regional-Based	CF07	LON Conveyance	--	02
		CF08	LOS Conveyance	7 to 12 OFs / Year	--
LON_BA14-LOS_BA49	Regional-Based	CF07	LON Conveyance	--	02
		CF08	LOS Conveyance	20 OFs / Year	--
LO_BA203	Basin-Based	CF18	Storage Tunnel	0 OFs / Year	02
LO_BA204	Basin-Based	CF18	Storage Tunnel	1 to 3 OFs / Year	02
LO_BA205	Basin-Based	CF18	Storage Tunnel	4 to 6 OFs / Year	02
LO_BA206	Basin-Based	CF18	Storage Tunnel	7 to 12 OFs / Year	02
LO_BA208	Basin-Based	CF18	Storage Tunnel	20 OFs / Year	02
LON_BA15-LOS_BA37	Basin-Based	CF02	RTB	4 to 6 OFs / Year (Reduced Sediment)	--
		CF14	Tank	4 to 6 OFs / Year (Reduced Sediment	--
		CF07	Tunnel	--	02
LON_BA15-LOS_BA50	Basin-Based	CF07	Tunnel	--	02
		CF08	Tunnel	0 OFs / Year	--
LON_BA15-LOS_BA51	Basin-Based	CF07	Tunnel	--	02
		CF08	Tunnel	1 to 3 OFs / Year	--
LON_BA15-LOS_BA52	Basin-Based	CF07	Tunnel	--	02
		CF08	Tunnel	4 to 6 OFs / Year	--

Table 9-43: Lower Ohio – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO
LON_BA15-LOS_BA53	Basin-Based	CF07	Tunnel	--	02
		CF08	Tunnel	7 to 12 OFs / Year	--
LON_BA15-LOS_BA55	Basin-Based	CF07	Tunnel	--	02
		CF08	Tunnel	20 OFs / Year	--
LO_BA38	Basin-Based	CF08	Sewer Separation	0 OFs / Year	--
		CF07	Tunnel	--	02
LO_BA217	Basin-Based	CF02	RTB	0 OFs / Year	--
		O-25	RTB	0 OFs / Year	--
		O-26	RTB	0 OFs / Year	--
		CF07	Tunnel	--	02
LO_BA218	Basin-Based	CF02	RTB	1 to 3 OFs / Year	--
		O-25	RTB	1 to 3 OFs / Year	--
		O-26	RTB	1 to 3 OFs / Year	--
		CF07	Tunnel	--	02
LO_BA219	Basin-Based	CF02	RTB	4 to 6 OFs / Year	--
		O-25	Underground Tank	4 to 6 OFs / Year	--
		O-26	Underground Tank	4 to 6 OFs / Year	--
		CF07	Tunnel	--	02
LO_BA220	Basin-Based	CF02	RTB	7 to 12 OFs / Year	--
		O-25	Underground Tank	7 to 12 OFs / Year	--
		O-26	Underground Tank	7 to 12 OFs / Year	--
		CF07	Tunnel	--	02

Table 9-43: Lower Ohio – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO
LO_BA222	Basin-Based	CF02	Underground Tank	20 OFs / Year	--
		O-25	Underground Tank	20 OFs / Year	--
		O-26	Underground Tank	20 OFs / Year	--
		CF07	Tunnel	--	02
LO_BA223	Basin-Based	CF02	Screening and Disinfection	0 OFs / Year	--
		O-25	Screening and Disinfection	0 OFs / Year	--
		O-26	RTB	0 OFs / Year	--
		CF03, O-18, CF22, CF06	5 Underground Tanks	--	02
LO_BA224	Basin-Based	CF02	Screening and Disinfection	1 to 3 OFs / Year	--
		O-25	Screening and Disinfection	1 to 3 OFs / Year	--
		O-26	RTB	1 to 3 OFs / Year	--
		CF03, O-18, CF22, CF06	5 Underground Tanks	--	02
LO_BA225	Basin-Based	CF02	Screening and Disinfection	4 to 6 OFs / Year	--
		O-25	RTB	4 to 6 OFs / Year	--
		O-26	RTB	4 to 6 OFs / Year	--
		CF03, O-18, CF22, CF06	5 Underground Tank	--	02

Table 9-43: Lower Ohio – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO
LO_BA226	Basin-Based	CF02	Screening and Disinfection	7 to 12 OFs / Year	--
		O-25	RTB	7 to 12 OFs / Year	--
		O-26	RTB	7 to 12 OFs / Year	--
		CF03, O-18, CF22, CF06	5 Underground Tanks	--	02
LO_BA228	Basin-Based	CF02	RTB	20 OFs / Year	--
		O-25	RTB	20 OFs / Year	--
		O-26	RTB	20 OFs / Year	--
		CF03, O-18, CF22, CF06	5 Underground Tanks	--	02
LON_BA13-LOS_BA63	Basin-Based	CF03, CF22, CF06, O-18	5 Underground Tanks	--	02
		CF02	Screening and Disinfection	4 to 6 OFs / Year (Reduced Sediment)	--
		CF14	Underground Tank	4 to 6 OFs / Year (Reduced Sediment)	--
LO_BA230	Basin-Based	CF20	LO Tunnel	0 OFs / Year	02
		CF02	LOS RTB	0 OFs / Year	--
LO_BA231	Basin-Based	CF20	LO Tunnel	1 to 3 OFs / Year	02
		CF02	LOS RTB	1 to 3 OFs / Year	--
LO_BA232	Basin-Based	CF20	LO Tunnel	4 to 6 OFs / Year	02
		CF02	LOS RTB	4 to 6 OFs / Year	--

Table 9-43: Lower Ohio – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Consolidation Flow Identification	Control Technology	Control Level	
				CSO	SSO
LO_BA233	Basin-Based	CF20	LO Tunnel	7 to 12 OFs / Year	02
		CF02	LOS RTB	7 to 12 OFs / Year	--
LO_BA235	Basin-Based	CF20	LO Tunnel	20 OFs / Year	02
		CF02	LOS Underground Tank	20 OFs / Year	--
LO_BA244	Alternative 3f	CF02	LOS Conveyance to Chartiers Creek	4 to 6 OFs / Year	--
		CF07	LON Underground Tunnel	-	02
		CF14	LON Underground Tank	4 to 6 OFs / Year	--
LO_BA247	Alternative 8a	CF02	LOS Conveyance to Chartiers Creek	13 to 15 OFs/Year	--
		CF07	LON Underground Tunnel	-	02
		CF14	LON Underground Tank	13 to 15 OFs/Year	--
LO_BA252	Alternative 3f-modified	CF02	LOS Conveyance to Chartiers Creek	4 to 6 OFs / Year	--
		CF20	LO Tunnel	4 to 6 OFs / Year	02
LO_BA243	Alternative 5	CF07	LON Underground Tunnel	-	02

Basin Alternative Ranking (LO): To assist in determining the most preferred basin alternatives for various CSO control levels analyzed, all of the BBS and RBS basin alternatives were ranked using the BARAT, as described in Section 9.4.1. Figure 9-33 and 9-34 provide summaries of the ranking results for alternatives analyzed under the BBS and RBS, respectively. Basin alternatives LON_BA15-LOS_BA19 through LOS_BA24 were identified as the top ranked BBS alternatives for the various levels of control that were evaluated. LON_BA16 through LON_BA21 and LOS_BA25 through LOS_BA30 were determined to be the top ranked RBS alternatives.

The LO Basin considered utilizing mixed use facilities as basin-based basin alternatives. One option (LO_BA203 through LO_BA208) was to store the flows from the entire LO Basin including the CSOs O-01-00 through O-05B-00, O-25-00 and O-26-00 along with flows from the SSOs, O-15-00 through O-24-00, in the storage tunnel located in the LON region. Flows from the LOS region, O-01-00 through O-05B-00, would be conveyed under the Ohio River. The second mixed use facility option (LO_BA230 through LO_BA235) was to store the CSOs O-25-00 and O-26-00 and the SSOs located north of the Ohio River in a storage tunnel, but then use a storage or treatment facility to handle the LOS region's overflows. The costs for the mixed-use facilities were estimated and ranked in the BARAT. Both mixed use basin alternative options were found to be potentially cost-effective solutions for the LO Basin. However, due to the regulatory complexities with a mixed-use facility with only limited existing combined flows and the operational difficulties in actively controlling the CSOs, the mixed-use alternatives were not selected as the 1st or 2nd preferred alternatives.

Knee of the Curve Analysis (LO): Figure 9-35 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional-based alternatives, as well as for additional alternatives that were evaluated in support of regional integration. Each of these points was determined by two values: a performance value (annual untreated overflow volume) resulting from a model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after predicted future growth has occurred and the basin alternative has been implemented. For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represents a continuous relationship between performance and cost. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

Summary of Preferred BBS and RBS Basin Alternatives (LO): Table 9-44 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. In addition, included are the other mandatory basin alternatives of complete sewer separation of combined sewered areas and 85% capture by receiving stream. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Figure 9-33: Lower Ohio BBS Basin Alternative Ranking Results

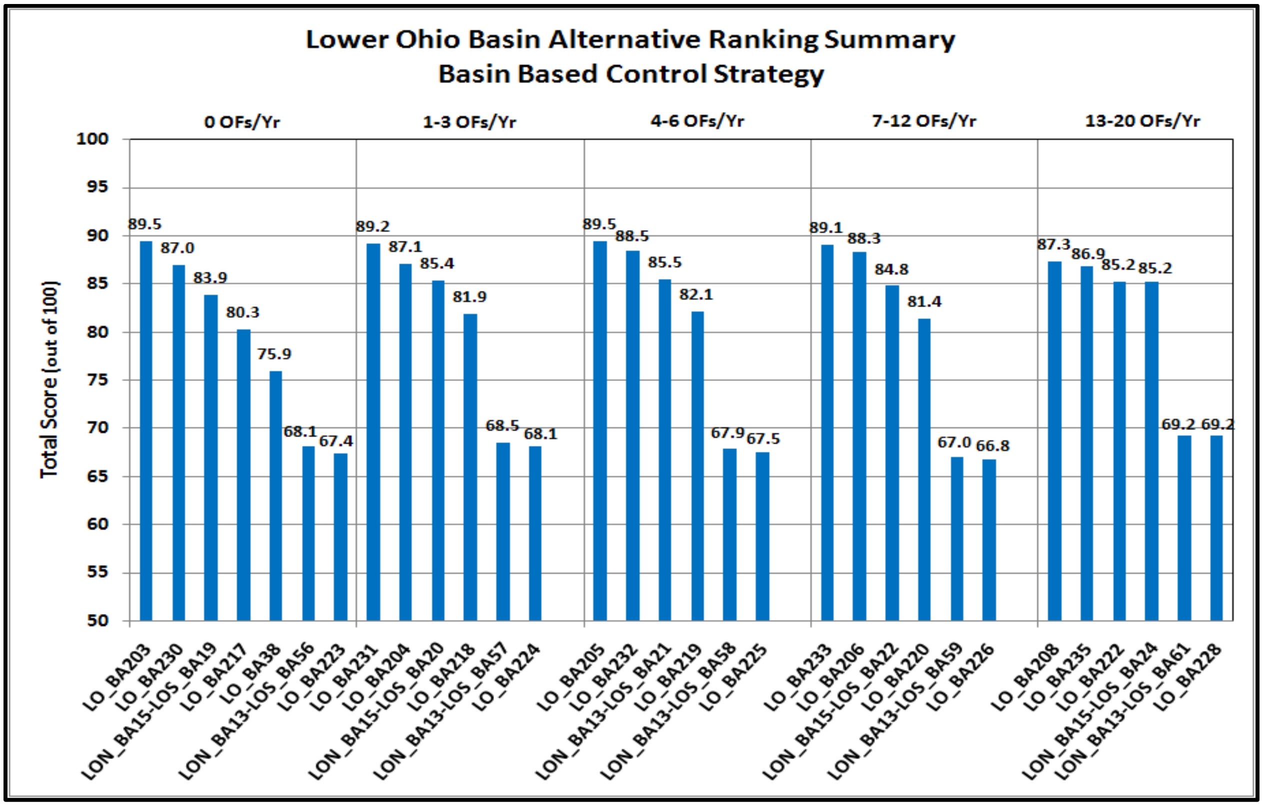


Figure 9-34: Lower Ohio RBS Basin Alternative Ranking Results

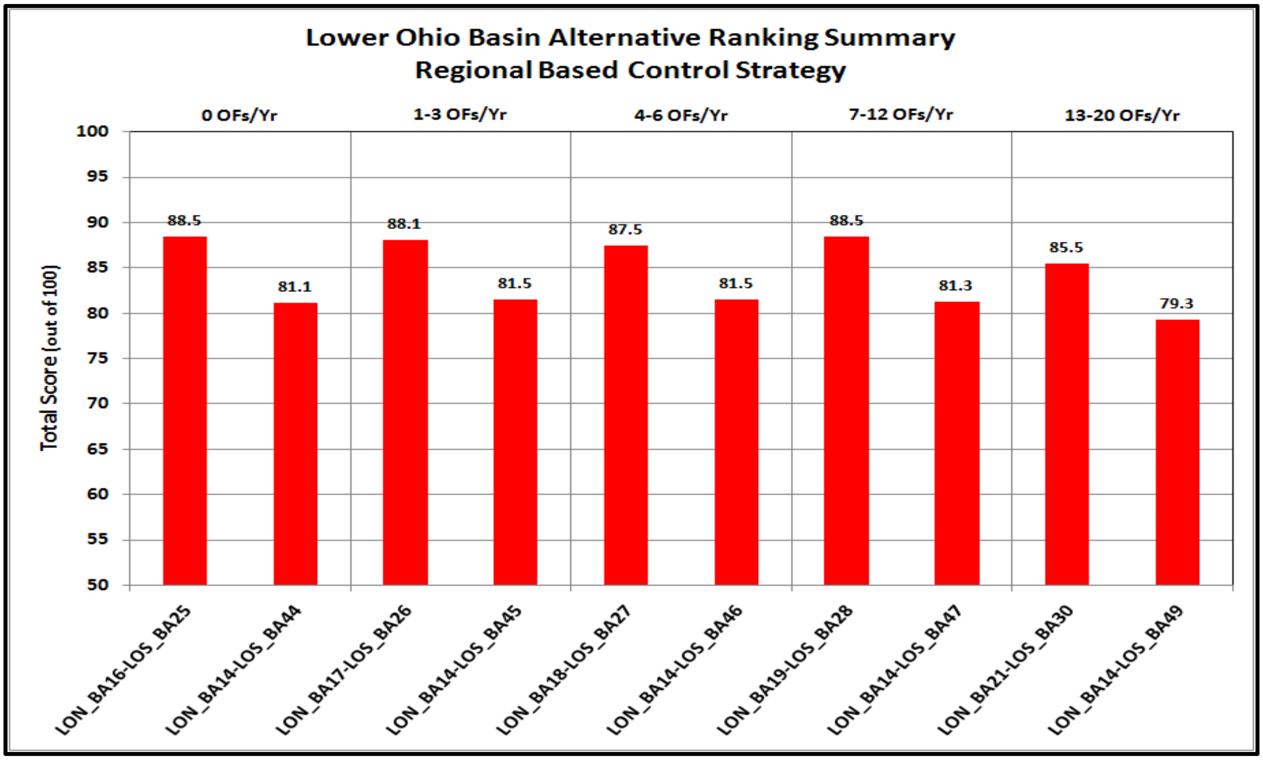


Figure 9-35: Lower Ohio Knee-of-the-Curve Analysis

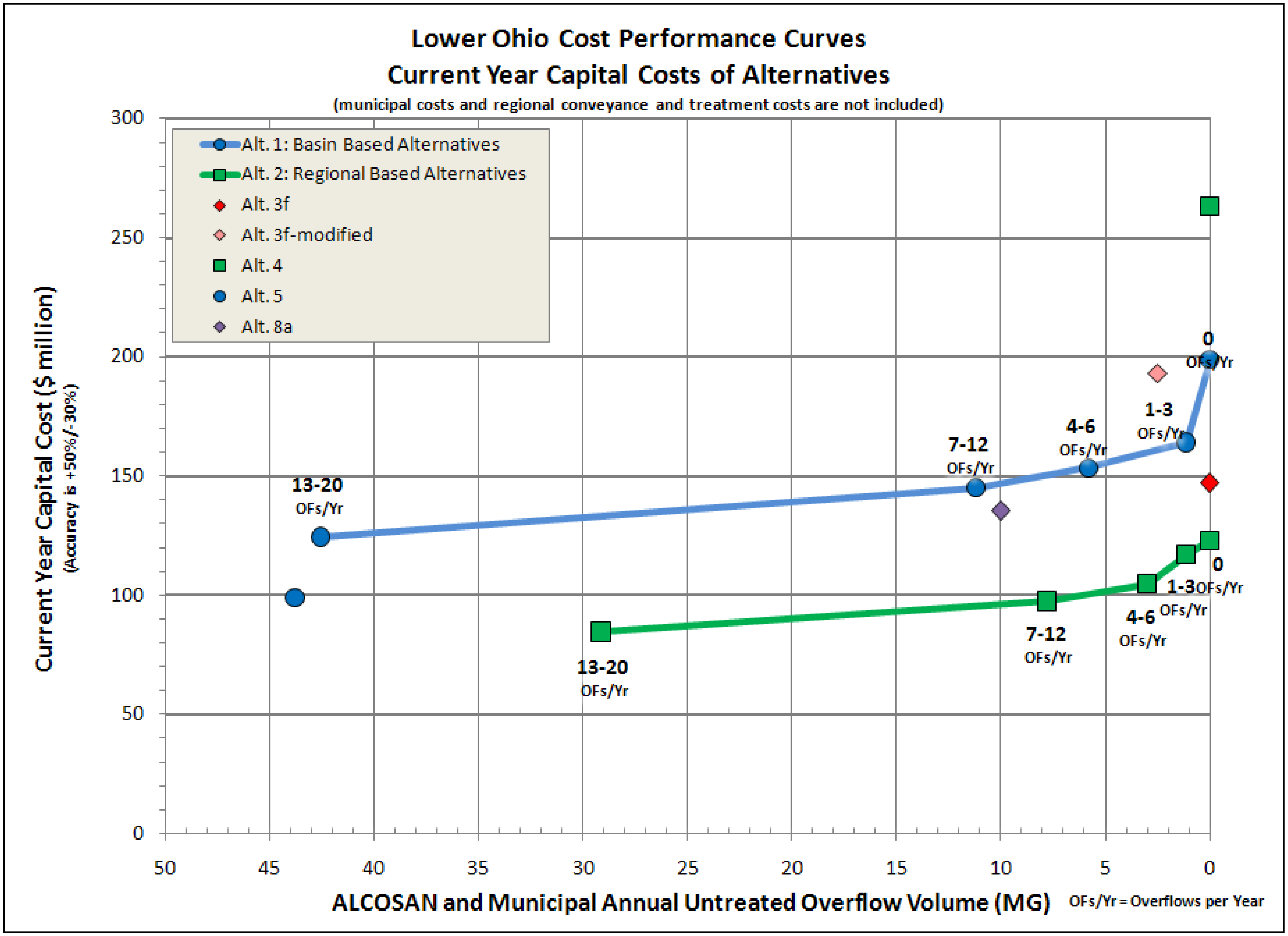


Table 9-44: Lower Ohio Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
LO_BA243	5	44	85% capture	2-year	99
LON_BA15-LOS_BA24	1	43	13-20	2-year	124
LON_BA15-LOS_BA22		11	7-12	2-year	145
LON_BA15-LOS_BA21		6	4-6	2-year	153
LON_BA15-LOS_BA20		1	1-3	2-year	164
LON_BA15-LOS_BA19		0	0	2-year	199
Regional Based Control Strategy					
LON_BA21-LOS_BA30	2	29	13-20	2-year	85
LON_BA19-LOS_BA28		8	7-12	2-year	98
LON_BA18-LOS_BA27		3	4-6	2-year	105
LON_BA17-LOS_BA26		1	1-3	2-year	117
LON_BA16-LOS_BA25		0	0	2-year	123
LON_BA15-LOS_BA62	4 (1)	0	0	2-year	263
Additional Alternatives in Support of Regional Integration					
LO_BA247	8a	10	13-15	2-year	136
LO_BA244	3f	0	4-6	2-year	147
LO_BA252	3f-Modified	3	4-6	2-year	193

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs alone were cost prohibitive.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended to the planning basin. All flows will have to be conveyed to the WWTP via the existing Ohio River deep tunnel interceptor.

LON_BA15-LOS_BA19 through LOS_BA24 (Alt. 1 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year): The preferred basin-based alternatives, LON_BA15-LOS_BA19 through LOS_BA24, for the LO basin consist of a storage tunnel located in the LON region and a combination of retention/treatment basins (RTBs) and/or underground storage tanks located in the LOS region. For the LON, a 12.5-foot diameter storage tunnel has been configured to handle the total peak wet weather SSO volumes from the CF07 consolidated flows for the 2-year design storm. The LON storage tunnel will work in combination with a facility to handle CSO consolidated flow CF02 at Site O-04.1 and a facility to handle CSO consolidated flow CF14 at Site O-26.2. For CF02, the preferred facility for the 0, 1 to 3, 4 to 6, and 7 to 12 overflows per year control levels is an RTB, and the preferred facility for the 20 overflows per year control level is an underground tank. For CF14, the preferred facility for the 0 and 1 to 3 overflows per year control levels is an RTB, and the preferred facility for the 4 to 6, 7 to 12, and 20 overflows per year control levels is an underground tank.

The LON storage tunnel would be a deep tunnel facility parallel to the existing deep tunnel interceptor along the bank of the Ohio River. The general alignment of the storage and conveyance tunnels in the LON is along the Ohio River and the railroad easement. At times, in the more downstream POCs, the storage tunnel alignment would fall within the existing ALCOSAN easement for the deep tunnel interceptor. The tunnel would start at property O-15.3, and would utilize the flat parking lot of the industrial facilities for staging and the construction lay down area. This area would serve as the most upstream drop shaft for O-15-00 and O-16-00 overflows as well as the proposed work shaft during construction. The storage tunnel would end near the ALCOSAN property, at approximately Site O-26.2, where it would be dewatered by pumping into the existing interceptor system at the existing O-25-00 vortex drop shaft.

Each of the LOS preferred alternatives is comprised of a facility at Site O-04.1 in Stowe Township and a facility at Site O-26.2, which is at the northwestern end of the ALCOSAN WWTP. At Site O-04.1, a consolidation sewer would collect flow from outfalls O-01-00, O-02-00, and O-03-00 and convey the flow to the site, while another consolidation sewer would collect flow from the O-05B-00, O-05A-00, O-05-00, and O-04-00 outfalls. For 0, 1 to 3, 4 to 6, and 7 to 12 overflows per year control levels, the preferred technology is a RTB, and a storage tank is the preferred technology for the 20 overflows per year control level. Flow would be collected from O-25-00 and O-26-00 and conveyed to Site O-26.2. The preferred facility for the 0 and 1 to 3 overflows per year control levels is a RTB, while the preferred facility for 4 to 6, 7 to 12, and 20 overflows per year control levels is a storage tank.

LO_BA243 (Alt. 5 - 85% Capture): Within the LO planning basin, 85% of the combined flows are captured under future baseline conditions (WWTP at 480 mgd), therefore no CSO control alternatives were required to bring the planning basin to an 85% capture control level. The SSO sewersheds are required to capture the 2-year design storm. For the LON consolidated flow

CF07 sewershed, a 12.5-foot diameter storage tunnel, approximately 14,775 linear feet in length, was configured to handle the total peak wet weather SSO volumes from CF07 for the 2-year design storm. Construction of the conveyance pipes to the storage tunnel will include microtunneling for pipes constructed under streams or at depths greater than 15 feet or for construction along the railroad right-of-way. The configuration of the storage tunnel is identical to the alignment of the storage tunnel in the Basin Alternative 3f.

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new regional tunnel would be constructed, and that this regional tunnel would take as much flow from the Lower Ohio planning basin as needed.

LON_BA16 through LON_BA21 and LOS_BA25 through LOS_BA30 (Alt. 2 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year): The preferred regional-based alternatives are LON_BA16 through LON_BA21 and LOS_BA25 through LOS_BA30. The first preferred regional-based option for the LO region is a combined conveyance system to ALCOSAN. The regional-based conveyance conduit to ALCOSAN would follow the same alignment as the LON regional storage tunnel in the 1st preferred basin-based alternative. The proposed combined conveyance system would be connected to the deep tunnel conveyance pipe with the following drop shafts:

- Site O-15.3 for O-15-00, O-16-00, and O-16z-00 overflows
- Near O-18z-00 for O-18-00 overflows
- Near the existing O-19-00 drop shaft for O-19-00 overflows
- At site O-21.1 for the O-20-00, O-21-00 and O-22-00 overflows
- Near existing drop shaft O-23-00 for overflows from O-24-00
- At the existing O-25-00 drop shaft for the O-25-00 overflows
- A drop shaft located near site O-26.1 for O-26 overflows

The conveyance system upstream of the proposed O-25-00 drop shaft would have the same pipe diameters as the individual LON conveyance tunnel. A drop shaft on the southern bank of the Ohio River would collect the Stowe Township flows and convey them under the river into the proposed O-25-00 drop shaft. Drop shafts and near surface pipes would collect and divert the municipal overflows to the proposed deep tunnel conveyance pipe.

LO_BA38 (Alt. 4 – Sewer Separation): Cost estimates for the Lower Ohio sewer separation alternatives were completed for all the combined sewersheds within the LO sub-basin, including the O-01, O-02, O-03, O-04, O-05A, O-05B, O-25, and O-26 sewersheds, by adding the separation performed within the public right- of-way with the separation performed on private property. The separation in public right-of-way was based on the number of acres to be separated for each land use within each sewershed. The types of land use considered comprised of low-, medium-, or high-density residential development; commercial/industrial development; and downtown development as appropriate. It was assumed that the length of sewer and number of manholes will be identical to the existing combined systems for the construction of the separated system. The separation in private property was based on the number of footing drains and roof leaders to be disconnected for residential or non-residential property within each sewershed. The SSOs in the Lower Ohio sewershed, O-15-00 through O-24-00, will be conveyed into a 12.5-foot diameter storage tunnel along the Ohio River, as described in the preferred basin-based basin alternative.

Summary of Additional Basin Alternatives in Support of Regional Integration (LO):
Table 9-44 provided details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. These basin alternatives reflected evolving municipal planning information, and levels of CSO and SSO control which varied by municipality.

The following provides brief summary descriptions of these alternatives. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

<u>LO_BA244 (Alt. 3f – 4-6 overflows/year):</u> The preferred basin alternative for the LO Basin with the Alternative 3f boundary condition includes conveying the CF02 (O-01-00 through O-05B-00) consolidation overflows for the targeted 4 to 6 overflows per year control level to the Chartiers Creek Planning Basin for ultimate transport to the regional tunnel. However, all conveyance was sized to convey the typical year peak flow (0 overflows per year control level). In addition, it includes a CF07 storage tunnel handling the 2-year design storm for the LON SSO sewersheds with an underground storage tank capturing the CF14 overflows for the 4-6 overflows per year control level.

For the SSO sewersheds along the Lower Ohio North (O-15-00 through O-24-00), a 12.5-foot diameter storage tunnel, approximately 14,775 linear feet in length, was configured to handle the total peak wet weather SSO volumes from CF07 consolidation flow for the 2-year design storm. The construction and cost of the storage tunnel is based on utilizing the tunnel boring machine (TBM) tunneling technology. Construction of the conveyance pipes to the storage tunnel will include microtunneling for pipes constructed under streams or at depths greater than 15 feet or for construction along the rail road right-of-way. The dewatering of the tunnel is based on emptying the total volume, approximately 13.2 MG, over a period of 2 days. The pump station will have a total dynamic head (TDH) of approximately 87 feet, with the stored volume then conveyed, via gravity pipes, to the existing O-25-00 drop shaft.

The CSO sewersheds along the Lower Ohio North (O-25-00 and O-26-00) will be conveyed to a proposed underground storage tank located at Site O-26.2, which is at the northwestern end of the ALCOSAN WWTP property limits. The facility would be dewatered through an 8” force main with a length of 1,600 LF to the plant side of the O-26-00 diversion structure. The facility would overflow through 50 LF of 54” pipe to the Ohio River.

<u>LO_BA252 (Alt. 3f-Mod – 4-6 overflows/year):</u> The preferred basin alternative for the LO Basin with the Alternative 3f - modified boundary condition (LO_BA252) includes conveying the CF02 (O-01-00 through O-05B-00) overflows for the targeted 4 to 6 overflows per year control level to the Chartiers Creek Planning Basin for ultimate transport to the regional tunnel. All

conveyance sewers were sized to convey the typical year peak flow (0 overflows per year control level). This alternative also includes storing the CF20 (O-15-00 through O-26-00) overflows in a storage tunnel sized for the 2-year design storm control level for the LON SSO and CSO sewersheds.

For the SSO and CSO sewersheds along the Lower Ohio North (O-15 through O-26), a 17-foot diameter storage tunnel, approximately 14,430 linear feet in length, was configured to handle the total peak wet weather SSO (O-15-00 through O-24-00) and CSO (O-25-00 and A-26-00) volumes from CF20 for the 2-year design storm. The construction and cost of the storage tunnel was based on utilizing the tunnel boring machine (TBM) tunneling technology. The dewatering of the tunnel is based on emptying the total design volume, approximately 24.36 MG over a period of 2 days. The pump station will have a TDH of about 99 feet, with the stored volume then conveyed via 30″ diameter DIP force main, to the existing O-25-00 drop shaft.

Consolidation pipes to the storage tunnel were designed to convey the 2-year design storm for the SSO sewersheds (O-15-00 through O-24-00), while the CSO sewersheds (O-25-00 and O-26-00) were designed to convey the 0 overflow per year control level. The SSO consolidation pipe diameters range in size from 12″ to 42″ and include a total of approximately 4,030 LF of piping. The CSO consolidated pipe diameters range in size from 60″ through 66″, with a total length of 1,820 LF. Construction of the conveyance pipes to the storage tunnel will include microtunneling for pipes constructed under streams or at depths greater than 15 feet or for construction along the railroad right-of-way.

As part of a cross basin consolidation sewer, CF02 consolidated overflow (O-01-00 through O-05B-00) is conveyed to a connection point with the Chartiers Creek consolidation sewer where the flow is ultimately transported to the regional tunnel. The CF02 portion of the consolidation sewer is comprised of pipe sized for the 0 overflow control level with diameters ranging from 8″ to 72″ and with a total length of 10,435 LF. Construction methods used for these pipes are a combination of open cut and microtunneling, where microtunneling was used to cross underneath railroad tracks, inverts are deeper than 15 ft, and where space for open cut is limited. Due to the relatively small magnitude and timing of the CF02 flow compared to the Chartiers Creek flows, the CF02 peak rates did not significantly impact the sizing of the Chartiers Creek conveyance sewers.

Sections of the shallow cut interceptor in Stowe Township, specifically from O-03-08 to O-04-00, were enlarged from 18″ to 24″ in diameter. This was done to increase the capacity in the interceptor and alleviate flooding caused by the wet weather flow exceeding the capacity in the shallow cut interceptor and river crossing.

<u>LO_BA247 (Alt. 8a – 13-15 overflows/year):</u> Alternative 8a, LO_BA247, describes the system wide alternative that captures the 2-year design storm for the SSO sewersheds and maintains the 13-15 overflow control level for the CSO sewershed basin alternatives. The only difference between the 3f and the 8a alternatives is the level of CSO control; therefore, the SSO control technologies for the CF07 consolidation will remain unchanged from the 3f Alternative.

In addition to the CF07 Storage Tunnel handling the 2-year design storm for the LON SSO sewersheds, the preferred basin alternative for the LO planning basin with the Alternative 8a boundary condition includes conveying the CF02 (O-01-00 through O-05B-00) consolidated overflows for the 13-15 overflow per year control level to the Chartiers Creek Planning Basin for ultimate transport to the regional tunnel and an underground storage tank capturing the CF14 overflows for the 13 to 15 overflow per year control level. All conveyance was sized to convey the 4 overflows per year control level flow.

The CSO sewersheds along the Lower Ohio North (O-25 and O-26) will be conveyed to a proposed underground storage tank located at Site O-26.2, which is at the northwestern end of the ALCOSAN WWTP property limits. For basin-based controls, overflows should only occur for 13 to 15 unique events for the entire group of outfalls in a consolidation group. Also, no more than 4 of these events at each outfall should be caused by conveyance limitations in getting flow to the control facility. The BP ran the H&H model for O-25-00, O-26-00, and CF14 (O-25-00 and O-26-00 combined) and recognized that the top 4 overflow rates for O-25-00 and O-26-00, individually, occurred during one of CF14's largest 13 exceedance events based on volume. Therefore, the facility was sized to allow the 13 largest events based on volume for CF14. The facility would be dewatered through a 6" force main with a length of 1,600 LF to the plant side of the O-26-00 diversion structure. The facility would overflow through a 50 LF of 30" pipe to the Ohio River.

As part of a cross basin consolidation sewer, CF02 consolidated overflow is conveyed to a connection point with the Chartiers Creek consolidation where the flow is ultimately transported to the regional tunnel. For flow consolidations associated with the regional tunnel, the BP focused on achieving a maximum of 4 overflow events year at each outfall, as caused by consolidation sewer/ diversion structure capacity issues. Therefore, the CF02 portion of the consolidation sewer is comprised of pipe sized for the 4 overflow per year control level with diameters ranging from 8" to 42" and with a total length of 10,455 LF. Construction methods used for these pipes are a combination of open cut and microtunneling, where microtunneling was used to cross underneath railroad tracks, inverts are deeper than 15 ft and where space for open cut is limited. Due to the relatively small magnitude and timing of the CF02 flow compared to the Chartiers Creek flows, the CF02 peak rates did not significantly impact the sizing of the CC conveyance sewers.

Just as the case with Alt 3f, as part of the cross basin alternative with Chartiers Creek, sections of the shallow cut interceptor in Stowe Township, specifically from O-03-08 to O-04-00, were enlarged from 18" to 24" in diameter to alleviate flooding caused by the wet weather flow exceeding the capacity in the river crossing.

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9.4.4 Main Rivers Planning Basin

This section summarizes the development, evaluation, and results of the basin alternatives analyzed for the Main Rivers (MR) planning basin. The overall development and evaluation process used by MR and the other six basin planners was described in Section 9.4.1. As such, this section primarily focuses on results of the basin alternatives evaluation and any features or methods that were unique to the MR planning basin.

Basin Alternatives Evaluation: A total of 36 basin alternatives were evaluated including 17 under the basin-based control strategy (BBS), 16 under the regional-based control strategy (RBS), and three additional alternatives in support of regional integration. The BBS assumed that additional regional conveyance beyond the existing interceptor system would not be available. The RBS assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Table 9-45 provides a summary of the basin alternatives that were evaluated. Included are the control strategy, a description of the alternative, and the CSO and SSO control levels associated with the alternative. The MR basin system is predominantly a combined sewer system with two small separate sewer areas.

As basin alternatives evolved, a number of facilities that were included early in the screening evaluation process were eliminated or changed resulting in the need for new site alternatives and basin alternatives. Several iterations of a basin alternative screening process were performed to reduce the number of basin alternatives to those most viable. This development and screening process for the Main Rivers planning basin is described below.

Basin-Based Control Strategy

An initial series of basin-based alternatives were developed. This series of BBS alternatives was identified as MR_BA01 through MR_BA06, where the associated level of control varied from 0 overflows (MR_BA01) to 20 overflows per year (MR_BA06) under typical year precipitation. Under this set of basin alternatives, modifications to the existing regulator structures throughout the system were proposed to allow more flow to enter the existing interceptor, within the given capacity limits of the interceptor. Some of the regulator structure modifications that were considered included tipping gate removal, enlarging the control orifice openings in the structures, and raising the crest elevation of the diversion weir wall. While these proposed modifications were initially developed at a conceptual level, later in the process it was determined that these proposed modifications needed to be revised to assume a more conservative approach regarding basin alternative development. The reasons for dismissing the proposed modifications were primarily based on: 1) the limited level of detail the model was able to provide regarding upstream HGL impacts and 2) the uncertainty as to whether the proposed modifications were constructible within the existing regulator structures.

Another set of BBS alternatives were developed as a form of comparison to the above described alternatives. MR_BA21 through MR_BA26 were developed utilizing source control measures as the primary components of control. Such measures were included as site alternatives, to a lesser degree and limited to certain areas, in MR_BA01 to MR_BA06.

Table 9-45: Main Rivers – Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Description	Control Level	
			CSO	SSO
MR_BA01	Basin Based	Control	0	NA
MR_BA02	Basin Based	Control	1 to 3	NA
MR_BA03	Basin Based	Control	4 to 6	NA
MR_BA04	Basin Based	Control	4 to 6 Red. Sediment*	NA
MR_BA05	Basin Based	Control	7 to 12	NA
MR_BA06	Basin Based	Control	20	NA
MR_BA11	Regional Based	Convey to Proposed HRC	0	NA
MR_BA12	Regional Based	Convey to Proposed HRC	1 to 3	NA
MR_BA13	Regional Based	Convey to Proposed HRC	4 to 6	NA
MR_BA15	Regional Based	Convey to Proposed HRC	7 to 12	NA
MR_BA16	Regional Based	Convey to Proposed HRC	20	NA
MR_BA21	Basin Based	Source Control	0	NA
MR_BA22	Basin Based	Source Control	1 to 3	NA
MR_BA23	Basin Based	Source Control	4 to 6	NA
MR_BA25	Basin Based	Source Control	7 to 12	NA
MR_BA26	Basin Based	Source Control	20	NA
MR_BA32	Regional Based	Sewer Separation – 100%	0	NA
MR_BA41	Regional Based	Convey to ALCOSAN	0	NA
MR_BA42	Regional Based	Convey to ALCOSAN	1 to 3	NA
MR_BA43	Regional Based	Convey to ALCOSAN	4 to 6	NA
MR_BA45	Regional Based	Convey to ALCOSAN	7 to 12	NA
MR_BA46	Regional Based	Convey to ALCOSAN	20	NA
MR_BA51	Basin Based	Control	85% Capture	NA
MR_BA61	Basin Based	Control	0	NA
MR_BA62	Basin Based	Control	1 to 3	NA
MR_BA63	Basin Based	Control	4 to 6	NA
MR_BA65	Basin Based	Control	7 to 12	NA
MR_BA66	Basin Based	Control	20	NA
MR_BA71	Regional Based	Convey to ALCOSAN	0	NA
MR_BA72	Regional Based	Convey to ALCOSAN	1 to 3	NA
MR_BA73	Regional Based	Convey to ALCOSAN	4 to 6	NA
MR_BA75	Regional Based	Convey to ALCOSAN	7 to 12	NA
MR_BA76	Regional Based	Convey to ALCOSAN	20	NA
MR_BA8a	System Wide**	Convey to ALCOSAN	13 to 15	NA
MR_BA3f	System Wide**	Convey to ALCOSAN	4 to 6	NA
MR_BA3fm	System Wide**	Convey to ALCOSAN	4 to 6	NA

*Assumes existing sediment deposits are removed from deep tunnel interceptors
**MR basin alternatives in support of regional integration

For the MR Basin, sewer separation was applied in a partial fashion unlike other planning basin areas where sewer separation was proposed for the entire point of connection (POC) sewershed. Under this approach, a portion of the POC sewershed was separated and the remainder continued to be served by combined sewers. A sensitivity analysis was completed over all MR basin POC sewersheds to determine the fraction of each sewershed area that should be separated to achieve or optimize a prescribed level of control. Although this approach deviated slightly from a 100% POC sewershed separation approach used for other planning basins, the MR BP retained the term "sewer separation" when referencing this approach. Stormwater redirection and inflow reduction were also analyzed in conjunction with sewer separation. Green technologies were investigated as a form of source control. Areas having the most potential for successfully utilizing green technologies were identified. In comparison with green technologies and stormwater redirection, sewer separation was determined to have a higher level of certainty in predicting that the estimated amount of control that is needed could be achieved. This being the case, green technologies and stormwater redirection did not have a direct application to MR_BA21 through MR_BA26 since a more precise predictor of achievable benefit was required.

It is believed that full reliance on source controls could potentially have a lower level of certainty in regard to quantifying the achieved level of flow reduction when compared to the level of certainty associated with the construction of traditional "grey" control facilities. With source control measures, whether sewer separation (partial or full sewershed), stormwater redirection, inflow reduction or green technologies, ALCOSAN would be depending on both the customer municipalities for compliance, and in some cases, the owners of private residences and businesses. Therefore, based on concerns with MR_BA01 through MR_BA06 in regard to the proposed modifications to existing regulators and with utilizing only source controls in MR_BA21 through MR_BA26, it was imperative to develop a new basin based alternative that fit a more conservative development approach, but still utilized a control strategy that would focus on becoming a preferred basin based alternative comparable to other refined alternatives. Alternative MR_BA63 was then created to achieve a 4 to 6 overflows per year level of control utilizing alternative development strategies very similar to the control technologies utilized in MR_BA03, but without the use of major regulator modifications. While MR_BA63 was developed, refined assumptions to improve estimated costs using the ACT were investigated. These assumptions provided more detailed information specific to each site alternative that related to pumping costs, conveyance costs, proposed regulator costs and site costs. More information was acquired regarding reduced availability of potential sites. Reduced site selection, coupled with no advantage of utilizing proposed modifications to the existing regulators, meant larger treatment/storage and more areas of sewer separation and consolidation would have to be developed. This was especially the case among areas where siting was most challenging near greater downtown Pittsburgh.

For MR_BA63, the 4 to 6 overflows per year level of CSO control was chosen because this was previously reported as the preferred alternative based on a preliminary knee-of-the-curve analysis. Consequently, the remaining set of basin alternatives that surround MR_BA63 that represent levels of control ranging from 0 to 20 activations per year (i.e., MR_BA61 – MR_BA66) were not modeled, but utilized previous modeled data from MR_BA01 – MR_BA06 to extrapolate the (new) alternatives estimated costs. The process used for extrapolation appeared to be reasonable because removing the existing regulator modifications from MR_BA03 to develop the MR_BA63 model would likely have similar impacts (in costs) while doing the same for the entire range of basin alternative (MR_BA61 – MR_BA66). The consequence of not revising and modeling the entire set of basin based alternatives may have required that one or more alternatives would need to be modeled at a later time if the preferred basin based alternative changed from MR_BA63.

In conclusion, basin alternatives MR_BA61 through MR_BA66 were identified as the most preferred BBS alternatives for the various levels of control that were evaluated. MR_BA63 was formally ranked using the Basin Alternative Ranking and Assessment Tool (BARAT) that allowed for an evaluation wet weather control performance levels and cost, as well as an evaluation of non-economic and performance related criteria such as public factors, operational impacts, and implementation concerns.

Regional-Based Control Strategy

The initial regional based alternatives developed were designated as MR_BA11 through MR_BA16, preferred alternative, and MR_BA41 through MR_BA46, second preferred alternative. These two sets of alternatives were exactly the same in concept with the exception that the downstream end, or tunnel terminus, and the pump station were located on different sites. One scenario, as represented by MR_BA41 through MR_BA46, assumed that the tunnel would terminate at the ALCOSAN WWTP. The other scenario, as represented by MR_BA11 through MR_BA16, proposed the tunnel would terminate at a potential site located on Brunot Island, where overflows would be pumped and treated at a proposed on-site high rate clarification (HRC) facility. In considering ALCOSAN's plans to increase their wastewater treatment plant (WWTP) capacity, a regional tunnel would be able to discharge directly to the WWTP rather than to Brunot Island. This knowledge, coupled with the fact that ALCOSAN would need to acquire Brunot Island to construct the HRC facility, made regional based alternatives MR_BA11 through MR_BA16 less preferred than the option which terminates directly at the WWTP. As such, alternatives MR_BA41 through MR_BA46 replaced alternatives MR_BA11 through MR_BA16 as the preferred regional based alternatives and were carried forward for additional evaluation.

Assumptions pertaining to proposing various modifications to the existing regulators were placed on developing MR_BA01 through MR_BA06. Likewise, these assumptions carried through to the development of MR_BA11 through MR_BA16 and MR_BA41 through MR_BA46. Similar to how the development of MR_BA63 was necessary, it was also deemed imperative to develop a new regional based alternative that did not require major regulator modifications as part of the alternative. This began with the development of MR_BA73, which was associated with the 4 to 6 overflows per year level of control. Shortly after, a full set of regional based alternatives were developed that are associated with the prescribed range of controls from 0 overflows per year (MR_BA71) to 20 overflows per year (MR_BA76). The refinements incorporated into alternatives MR_BA71 through MR_BA76, also included the trade-off between adding drop shaft structures and reducing the need for lengthy consolidation pipes. Also, finding available shaft sites in some areas of the MR Basin continued to be problematic. In these cases, sewer separation was selected. In other areas, sewer separation was used because it was more cost beneficial than utilizing the proposed storage tunnel. Generally, these were areas with either relatively small sewersheds or they were a significant distance from the tunnel itself.

In conclusion, basin alternatives MR_BA71 through MR_BA76 were identified as the most preferred RBS alternatives for the various levels of control that were evaluated. These five alternatives were formally ranked using the BARAT that allowed for an evaluation of wet weather control performance levels and cost, as well as an evaluation of non-economic and performance related criteria such as public factors, operational impacts, and implementation concerns.

Outside of cost issues, the reason that the MR basin planner focused on only one RBS alternative stems from the unique geographical position of the MR Basin itself. Being located at the downstream end of most of the other planning basins, and given the urban development and infrastructure that exists in and surrounds the MR Basin, all previously conceptualized regional based alternatives were structured around a tunnel concept. Consequently, each iteration of the regional based alternative refinement process through time has been in the form of an optimization or refinement of the same tunnel concept instead of the development of separate and unique alternatives.

Basin Alternative Ranking: The most preferred BBS and RBS basin alternatives identified in the basin alternative screening and evaluation process were ranked using the BARAT, as described in Section 9.4.1.3. Figures 9-36 and 9-37 provide summaries of the ranking results for alternatives analyzed under the BBS and RBS, respectively. The MR BP only ranked the most preferred BBS and RBS basin alternatives because many of the previously developed alternatives were not considered viable enough to be carried beyond the basin alternative evaluations. Although these alternatives were not carried beyond this stage of the analysis, it is important to note that many attributes from these alternative led to the development and refinement of the most preferred alternatives. Some reasons for which basin alternative were dismissed from the formal rankings include:

- Basin alternatives that proposed extensive regulator modifications as a basis for control. These alternatives carried feasibility and constructability concerns as well as the potential for creating undesirable hydraulic impacts to the upstream system.
- Basin alternatives that were developed solely upon source control measures. These alternatives were developed strictly for the purpose of performing a sensitivity analysis and the accuracy of the results were not considered comparable with other fully developed alternatives.
- Basin alternatives that did not undergo rigorous alternative analysis or modeling. These alternatives were developed as desktop, or spreadsheet analyses as a precursor to assist in decision-making and refinement of the preferred alternatives.

Knee of the Curve Analysis: Figure 9-38 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional based alternatives, as well as for additional alternatives that were evaluated in support of regional integration. Each of these points was determined by two values: a performance value (annual untreated overflow volume) resulting from a model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after predicted future growth has occurred and the basin alternative has been implemented. For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represents a continuous relationship between performance and cost. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

Summary of Preferred BBS and RBS Basin Alternatives: Table 9-46 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.

Figure 9-36: Main Rivers BBS Basin Alternative Ranking Results

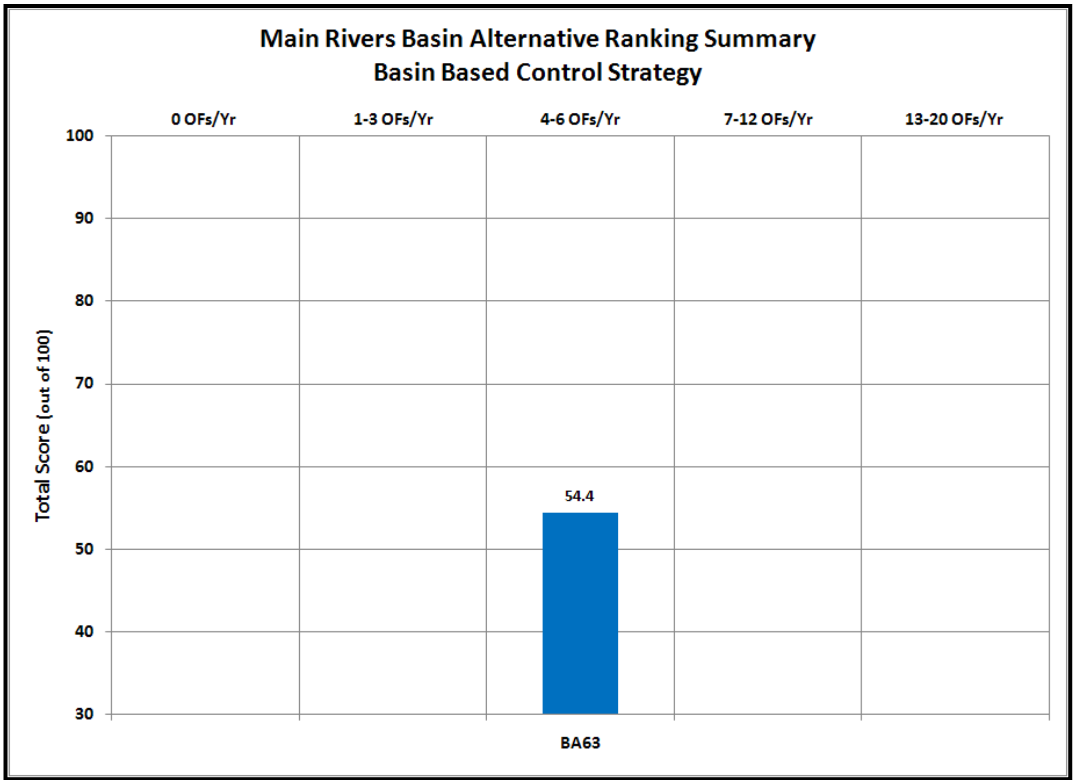

Figure 9-37: Main Rivers RBS Basin Alternative Ranking Results

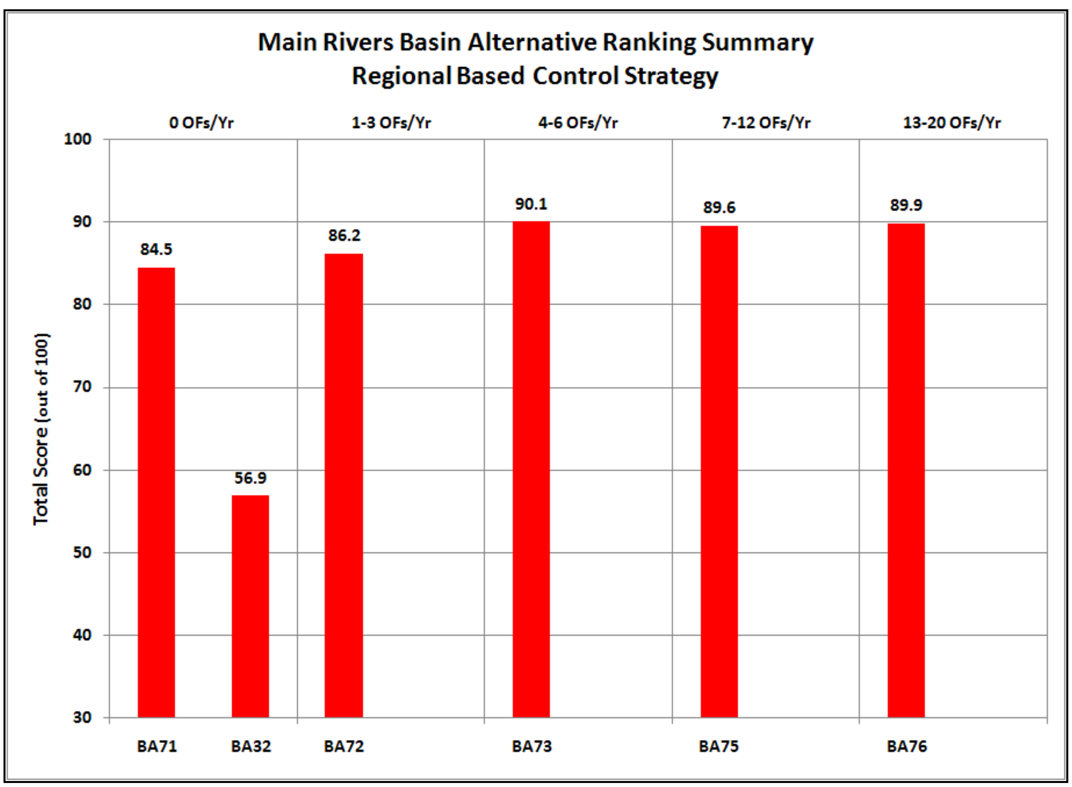

Figure 9-38: Main Rivers Knee-of-the-Curve Analysis

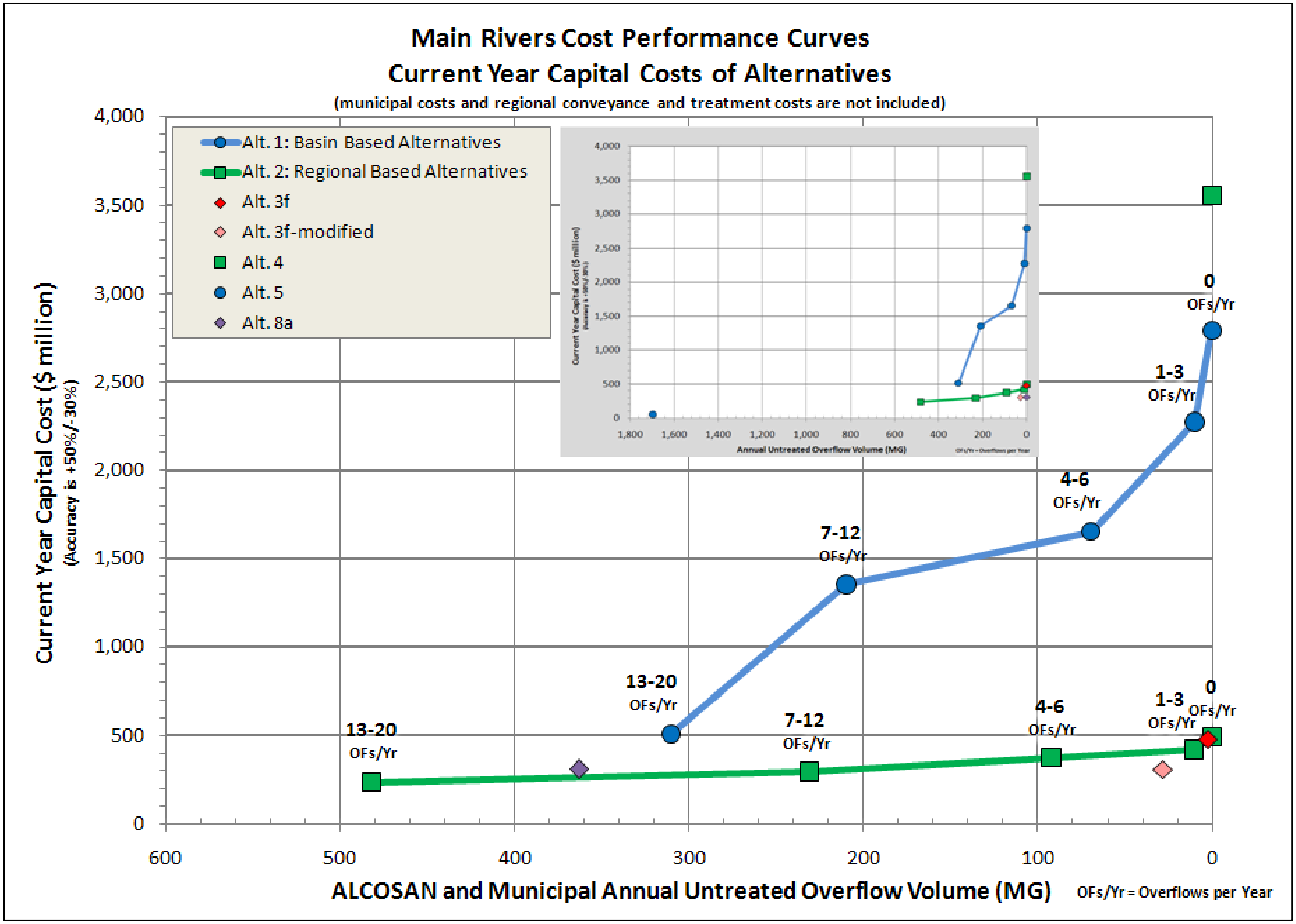

Table 9-46: Main Rivers Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
MR_BA51	5	1,697	85% capture	2-year	52
MR_BA66	1	310	13-20	2-year	512
MR_BA65		210	7-12	2-year	1,354
MR_BA63		70	4-6	2-year	1,653
MR_BA62		10	1-3	2-year	2,274
MR_BA61		0	0	2-year	2,794
Regional Based Control Strategy					
MR_BA51	2	482	13-20	2-year	237
MR_BA66		231	7-12	2-year	296
MR_BA65		92	4-6	2-year	375
MR_BA63		11	1-3	2-year	420
MR_BA62		0	0	2-year	496
MR_BA61	4 (1)	0	0	2-year	3,556
Additional Alternatives in Support of Regional Integration					
MR_BA8a	8a	363	13-15 (2)	2-year	310
MR_BA3f	3f	3	4-6 (3)	2-year	479
MR_BA3fm	3f-Modified	29	4-6 (4)	2-year	305

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs alone were cost prohibitive.
(2) Targeted outfalls directly upstream of sensitive areas were controlled to 4-6 overflows/year
(3) Targeted outfalls directly upstream of sensitive areas were controlled to 4-6 overflows/year, but the incremental cost to achieve relocation or elimination was also evaluated.
(4) Targeted outfalls upstream of sensitve areas were eliminated or relocated based on recommended approach per Alt. 3f.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. In addition, included are the other mandatory basin alternatives of complete sewer separation of combined sewered areas (MR_BA32) and 85% capture by receiving stream (MR_BA51). The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended to the planning basin. All flows will have to be conveyed to the WWTP via the existing deep tunnel interceptor.

MR_BA51 (Alt. 5 - 85% Capture)
Analyzing 85% capture obtained unique results in comparison to the results from the other basin alternatives. In fact, achieving 85% capture required less control facilities than all previously analyzed basin-based alternatives, including MR_BA06, which was associated with the level of control of 13–20 overflows per year when it was analyzed and presented. Only two control facilities were required for MR_BA51, a 40 mgd RTB facility to control overflows at M-29 and a 25 mgd RTB facility that consolidated overflow controls (via CF02) at A-22 and A-23.

MR_BA61 (Alt. 1 – 0 overflows/year)
MR_BA61 was conceptually developed from MR_BA01, which was dismissed because it incorporated major regulator modifications. MR_BA61 and MR_BA01 were associated with the level of control of 0 overflows per typical year. MR_BA01 was estimated to require 12 retention treatment basin (RTB) facilities, 3 screening and disinfection (SD) facilities and 4 storage tanks. Of the proposed 19 total facilities, 13 facilities include control from multiple CSOs. The proposed consolidation and other related conveyance pipes were sized to accommodate peak typical year flow. MR_BA61 was anticipated to require the same number of facilities as MR_BA01, although larger facilities and some source controls to account for the previously considered regulator modifications would also be expected. This difference (between MR_BA01 and MR_BA61) was considered while estimating the overall cost for MR_BA61.

MR_BA62 (Alt. 1 - 1 to 3 overflows/year)
MR_BA62 was conceptually developed from MR_BA02, which was dismissed because it incorporated major regulator modifications. MR_BA62 and MR_BA02 were associated with the level of control of 1-3 overflows per typical year. MR_BA02 was estimated to require 13 RTB facilities, 2 SD facilities and 2 storage tanks. Of the proposed 17 total facilities, 13 facilities include control from multiple CSOs. Two areas of sewer separation were also proposed as part of MR_BA02. The proposed consolidation and other related conveyance pipes were sized to accommodate peak typical year flow. MR_BA62 was anticipated to require the same number of facilities as MR_BA02, although larger facilities and some additional source controls to account for the previously considered regulator modifications would also be expected. This difference (between MR_BA02 and MR_BA62) was considered while estimating the overall cost for MR_BA62.

MR_BA63 (Alt. 1 – 4 to 6 overflows/year)
MR_BA63 was associated with the level of control of 4-6 overflows per typical year. MR_BA63 required 8 RTB facilities, 5 SD facilities and 3 storage tanks. Of the proposed 16 total facilities, 12 facilities include control from multiple CSOs. Eighteen areas of sewer separation were also proposed as part of MR_BA63. The proposed consolidation and other related conveyance pipes were sized to accommodate the level of control of 4-6 overflows per typical year.

MR_BA65 (Alt. 1 – 7 to 12 overflows/year)
MR_BA65 was conceptually developed from MR_BA05, which was dismissed because it incorporated major regulator modifications. MR_BA65 and MR_BA05 were associated with the level of control of 7-12 overflows per typical year. MR_BA05 was estimated to require 13 RTB facilities, 2 SD facilities and 2 storage tanks. Of the proposed 17 total facilities, 13 facilities include control from multiple CSOs. Two areas of sewer separation were also proposed as part of MR_BA02. The proposed consolidation and other related conveyance pipes were sized to accommodate the level of control of 4-6 overflows per typical year. MR_BA65 was anticipated to require the same number of facilities as MR_BA05, although larger facilities and some additional source controls to account for the previously considered regulator modifications would also be expected. This difference (between MR_BA05 and MR_BA65) was considered while estimating the overall cost for MR_BA65.

MR_BA66 (Alt. 1 – 13 to 20 overflows/year)
MR_BA66 was conceptually developed from MR_BA06, which was dismissed because it incorporated major regulator modifications. MR_BA66 and MR_BA06 were associated with the level of control of 13-20 overflows per typical year. MR_BA06 was estimated to require 6 RTB facilities. Of the 6 proposed RTB facilities, 4 facilities proposed control from multiple CSOs. Meanwhile CSOs M-29 and O-27 were each controlled individually by its own treatment facility. The proposed consolidation and other related conveyance pipes were sized to accommodate the level of control of 4-6 overflows per typical year. MR_BA66 was anticipated to require the same number of facilities as MR_BA06, although slightly larger RTB facilities and some source controls to account for the previously considered regulator modifications would also be expected. This difference (between MR_BA06 and MR_BA66) was considered while estimating the overall cost for MR_BA66.

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new regional tunnel will be constructed, and that this regional tunnel can take as much flow from the Main Rivers planning basin as needed.

MR_BA71 (Alt. 2 – 0 overflows/year)
MR_BA71 was associated the level of control of 0 overflows per typical year. MR_BA71 proposed 27 drop shafts to the new tunnel. Seventeen of the total 27 drop shafts proposed in MR_BA71 included control from multiple CSOs. Twenty-one sewersheds were also proposed for sewer separation as part of MR_BA71. The proposed consolidation and other related conveyance pipes were sized to accommodate peak typical year flow.

MR_BA72 (Alt. 2 - 1 to 3 overflows/year)
MR_BA72 was associated with the level of control of 1-3 overflows per typical year. MR_BA72 proposed 27 drop shafts to the new tunnel. Seventeen of the total 27 drop shafts proposed in MR_BA72 included control from multiple CSOs. Twelve sewersheds were also proposed for sewer separation as part of MR_BA72. The proposed consolidation and other related conveyance pipes were sized to accommodate peak typical year flow.

MR_BA73 (Alt. 2 – 4 to 6 overflows/year)
MR_BA73 was associated with the level of control of 4-6 overflows per typical year. MR_BA73 proposed 27 drop shafts to the new tunnel. Seventeen of the total 27 drop shafts proposed in MR_BA73 included control from multiple CSOs. Ten sewersheds were also proposed for sewer separation as part of MR_BA73. The proposed consolidation and other related conveyance pipes were sized to accommodate the level of control of 4-6 overflows per typical year.

MR_BA75 (Alt. 2 – 7 to 12 overflows/year)
MR_BA75 was associated with the level of control of 7-12 overflows per typical year. MR_BA75 proposed 24 drop shafts to the new tunnel. Fifteen of the total 24 drop shafts proposed in MR_BA75 included control from multiple CSOs. Nine sewersheds were also proposed for sewer separation as part of MR_BA75. The proposed consolidation and other related conveyance pipes were sized to accommodate the level of control of 4-6 overflows per typical year.

MR_BA76 (Alt. 2 – 13 to 20 overflows/year)
MR_BA76 was associated the level of control of 13-20 overflows per typical year. MR_BA76 proposed 15 drop shafts to the new tunnel. Six of the total 15 drop shafts proposed in MR_BA76 included control from multiple CSOs. Eleven sewersheds were also proposed for sewer separation as part of MR_BA76. The proposed consolidation and other related conveyance pipes were sized to accommodate the level of control of 4-6 overflows per typical year.

MR_BA32 (Alt. 4 – Sewer Separation)
MR_BA32 was developed to represent complete or 100 percent sewer separation as a means of eliminating future CSOs. Consequently this alternative was intended to provide the highest level of control of all alternatives evaluated. Although the other BBS and RBS alternatives represented the most likely scenarios in terms of implementation, MR_BA32 was considered in the analysis for the sake of comparison to garner a feel for magnitude of cost to implement the alternative over the others.

Summary of Additional Basin Alternatives in Support of Regional Integration: Table 9-46 provided details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As described in Section 9.3, each basin alternative includes an assumed level of municipal control. All of these additional alternatives considered higher levels of control for targeted outfalls in sensitive areas, but they are not included in the Alternative 3f costs reported.

The following provides brief summary descriptions of these alternatives. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

MR_BA3f (Alt. 3f – 4 to 6 overflows/year): The development of MR_BA3f began with selecting one of the previously analyzed regional-based or basin-based control strategies. For the MR Basin, the regional-based control strategy was most applicable to the assumptions (described in Section 9.5) associated with System-Wide Alternative 3f, and therefore was the most appropriate strategy to use as a starting point. The top ranked regional-based alternative was MR_BA73, which was previously analyzed to achieve a control level of 4-6 overflows per year. Consequently, MR_BA73 was used as a starting point to develop MR_BA3f.

The development of MR_BA3f, utilizing MR_BA73, proved to be effective since the two alternatives had many similarities. In addition to being associated with similar CSO and SSO control levels, some other notable similarities included the location and alignment of the proposed tunnel, the estimated available wet and dry weather treatment capacities at the Woods Run WWTP and its influent pump station wet well elevation. Consequently, the proposed drop shaft locations, CSO consolidation concepts, and routes for conveyance presented in MR_BA73 were also similar to MR_BA3f, although some modifications were necessary.

There were, however, some significant differences between MR_BA3f and MR_BA73. One primary difference is that MR_BA3f was modeled such that overflows could only occur during the precipitation that occurred on the storm dates described in Section 9.5, whereas MR_BA73 did not contain any specific precipitation date constraints. The precipitation dates identified by the PM were associated with the six events when the regional tunnel would be filled, resulting in overflows. By only considering specific precipitation dates for overflows, MR_BA3f was required to control more combined flows than the 6 events per year threshold. Consequently, the resultant level of control for MR_BA3f is closer to 1-2 per year for most CSO outfalls. Another noteworthy difference in the development of MR_BA3f from MR_BA73 pertains to the sizing of the consolidation/conveyance pipes. MR_BA73 has consolidation/conveyance pipes sized to accommodate flow rates associated with at least the 4-6 overflows per year control level. Consequently, while the pipe sizes were large enough to control the 4-6 overflows per year control level, they were not large enough to accommodate the peak typical year overflows. The MR_BA3f consolidation sewers were sized to be able to convey the largest CSO discharges during the typical year; this resulted in a more conservative approach to sizing the consolidation/conveyance pipes with resultant larger diameters.

MR_BA3fm (Alt. 3f – 4 to 6 overflows/year)

Similar to MR_BA3f, MR_BA3fm was analyzed to control 4-6 overflows per typical year with a 2-year design storm SSO control level. The development of MR_BA3fm began by utilizing the MR_BA3f model as a starting point. Then the following refinements were made that established MR_BA3fm as its own unique basin alternative:

- Additional drop shafts were added along the proposed tunnel based on further cost-benefit evaluations made to the proposed consolidation pipes in BA3f.

- CSOs identified within sensitive areas were controlled to the level of 0 overflows per year.
- Integration of municipal planned information (one planned project).
- Integration of new boundary conditions.
- Projects previously proposed for sewer separation in BA3f that were not accepted by the Municipality were replaced by proposing CSO control either via already proposed drop shaft (by means of further consolidation) or by adding a newly proposed drop shaft.

The most notable difference from between BA3f and BA3fm could be found in the total number of drop shafts that was being proposed for each alternative. BA3f proposed 33 drop shafts whereas BA3fm proposed 41 drop shafts. This difference was mostly attributed to replacing previously proposed areas of sewer separation (with the exception of one small Municipal planned project) with a control alternative that was affiliated with an existing or new drop shaft. Additionally, several areas were found where it was more cost-effective to propose an additional drop shaft instead of keeping a lengthy conveyance pipe (that was proposed in BA3f). Finally, one additional drop shaft was needed to control a CSO (to 0 overflows per year) that overflows into a sensitive area.

<u>MR_BA08a (Alt. 8a – 13 to 15 overflows/year)</u>
MR_BA8a was analyzed to control 13-15 overflows per typical year, except for CSOs within sensitive areas, which were targeted for 4 or fewer overflows per year. The development of MR_BA8a began by utilizing the top ranked regional based alternative that is most similar to achieving the same level of CSO control as MR_BA8a. Consequently, the MR_BA75 model was utilized as a starting point for developing MR_BA8a.
A summary of notable characteristics to the development of MR_BA8a included the following:

- A new regional tunnel was assumed to be provided to serve the MR Basin along all three rivers within the Basin.
- The peak wet weather Woods Run WWTP primary treatment capacity would be expanded to 600 mgd; the secondary treatment capacity would be expanded to 295 mgd.
- The dry weather wet well elevation at the Woods Run WWTP was assumed to be 670 feet.
- The 2-year design storm level of SSO control was assumed.

Consolidation and conveyance sewers were sized to accommodate the fifth largest typical year storm (peak flow), with the exception of CSOs discharging to sensitive areas, where sewers were sized for accommodating typical year peak flow. In summary, MR_BA8a proposed a total of 24 drop shafts to the new tunnel.

Section 9.5 describes the integration of these basin alternatives into system-wide alternatives. The section describes the system-wide alternative development process and provides descriptions of the system-wide alternatives that were evaluated.

Summary of Alternatives to Address Targeted CSO Outfalls near Sensitive Areas:
As described in Section 9.1, guidance was provided to the basin planners to evaluate alternatives for varying levels of enhanced control to Consent Decree defined sensitive areas. For basin alternatives in support of select system-wide alternatives targeting 4-6 overflows per year for all CSOs, the basin planners evaluated alternatives for providing a CSO level of control of zero overflows in the typical year for outfalls directly impacting sensitive areas.

Using MR_BA3f as a baseline condition, sensitive areas were analyzed for each targeted outfall by evaluating two options for increased overflow control:

- Complete (100%) sewer separation for each sewershed that is associated with the targeted outfalls (which would essentially be a municipal control option).
- Relocation of the targeted outfall to a location preferably downstream of the sensitive area such that the existing outfall may only overflow during precipitation events greater than the 2003 typical year.

In the case of other future system-wide alternatives to be evaluated that are associated with lower control levels than MR_BA3f, such as 7-12 or 13-20 overflows per year, a third possible option included increasing the level of control of the targeted CSOs within sensitive areas to at least 4-6 overflows per year.

The following eight targeted CSOs within the MR planning basin discharge directly to sensitive areas or discharge a fixed distance upstream of the sensitive area. There are 7 additional targeted outfalls that directly impact sensitive areas in the Lower Northern Allegheny and Upper Monongahela planning basins.

- Allegheny River Outfalls - A-47-00
- Monongahela River Outfalls - M-18-00, M-20-00, M-21-00, M-22-00
- Ohio River Outfalls - O-40-00, O-41-00, O-43-00

A systematic approach was used for considering targeted outfalls within the above-mentioned sensitive areas. Information that was readily available from previous alternatives analyses proved to be a valuable resource and a starting point for this analysis. Previously developed consolidation/conveyance pipes that were developed in MR_BA3f were considered if their discharge location fell within one or more of the targeted outfalls. Finally, the previous results from estimating complete sewershed sewer separation concepts and their costs were also considered.

The aforementioned sewer separation cost estimates were then used to compare sewer separation with concepts that relocated the outfall to the nearest point downstream of the sensitive area in question. The outfall relocation evaluations also considered consolidating targeted CSO outfalls, where applicable. The two options were evaluated for each sewershed based on ranking the present worth costs. This led to identifying the most cost effective recommendation per sewershed. Finally, the estimated impacts from incorporating the recommended actions to the previously reported MR_BA3f site alternatives were determined.

Table 9-47 summarizes the results of the sensitive areas analysis along with appropriate recommendations and their effect on MR_BA3f. Referencing the information in the table from left to right, the "Targeted CSO Information" identifies the sewersheds that were evaluated and the MR_BA3f site alternatives associated each sewershed(s). Note that some sewersheds were evaluated separately and some as a group as discussed earlier. The columns shown under "Sewer Separation" provided estimated costs for complete sewer separation per sewershed. The columns shown under "Install New CSO Discharge to Point Downstream of Sensitive Area" were provided to show how costs were prepared and evaluated with this option. The columns include a description of the conveyance route, the estimated cost for conveyance, the estimated cost for the MR_BA3f site alternative, and the total cost for conveyance plus the MR_BA3f site alternative. This total cost was then compared with the complete sewer separation costs to arrive with the recommended site alternative. The last three columns of the table contain the new site alternative and estimated cost impact to MR_BA3f considering sensitive areas.

Table 9-47: Main Rivers Sensitive Areas Analysis Results

Targeted CSO Information		Sewer Separation (SS)		Install New CSO Discharge to Point Downstream of Sensitive Area				Recommended Site Alternative			
Sewershed(s) Identified Affecting Sensitive Area(s)	MR_BA3f Site Alternative	Description	100% SS Estimated Cost (Million)	Estimated MR_BA3f Site Alternative(s) Cost (Million)	Description of Proposed Conveyance to New CSO Discharge	Estimated Cost to Convey to New CSO Discharge Point * (Million)	Estimated Costs for MR_BA3f Site Alternative(s) Plus New Conveyance (Million)	Description	MR_BA3f New Site Alternative Considering Sensitive Areas	New Site Alternative Present Worth Cost (Million)	Site Alternative Cost Impact Considering Sensitive Area Analysis (Million)
A-47	N/A	100%	$3.84	$0.00	Conduit from A-47 to O-39 Outfall	$29.16	$29.16	Sewer Separation	MR_A47_SS_TY_00_600SA	$3.84	$3.84
M-18	MR_CF19_TNL_TY_06_600	100%	$4.39	$14.52	M-18 Site Alternative conveys overflow to proposed drop shaft located downstream sensitive area.	$0.00	$14.52	Retain MR_BA3f Site Alternative	MR_CF19_TNL_TY_00_600	$14.52	$0.00
M-20, M-21, M-22	MR_CF20_TNL_TY_06_600	100%	$59.05	$9.96	Conduit from CF20 Drop Shaft to M-17 Outfall	$6.78	$16.74	Discharge to Point Downstream of Sensitive Area	MR_CF20_TNL_TY_00_600SA	$16.74	$6.78
O-40, O-41	MR_CF11_TNL_TY_06_600	100%	$10.58	$28.37	O-40, O-41 Site Alternative conveys overflow to a proposed drop shaft located downstream sensitive area.	$0.00	$28.37	Retain MR_BA3f Site Alternative	MR_CF11_TNL_TY_00_600	$28.37	$0.00
O-43	N/A	100%	$2.63	$0.00	Conduit from O-43 to O-39 Outfall	$15.04	$15.04	Sewer Separation	MR_O43_SS_TY_00_600SA	$2.63	$2.63
Total Estimated Impact to MR_BA3f Present Worth Cost (Million)											**$13.25**

* Estimated Cost does not include Drop Shaft Cost or Tunnel Capacity Cost

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The results from completing the sensitive areas analyses for MR_BA3f provided a valuable starting point for incorporating a higher level of control (0 overflows per year) for those CSOs affecting sensitive areas in MR_BA3fm. Similar to MR_BA3f, MR_BA3fm also was analyzed for controlling overflows within sensitive areas by considering possible CSO outfall relocation or sewer separation.

Additional clarification also suggested another possible consideration for MR_BA3fm that was not considered in MR_BA3f for sensitive areas. This option included retaining an alternative that was capable of achieving 0 overflows per year by conveying more overflow (than was estimated to achieve 4-6 overflows) to the proposed tunnel. This third option proved to have substantial benefits pertaining to cost and feasibility, and was utilized for nearly every CSO affiliated with a discharge to a sensitive area. It is important to note that for MR_BA3fm, sewer separation was not selected as a recommended project for any CSOs within sensitive areas. Sewer separation was no longer considered as an option unless the other options evaluated were deemed not viable.

In summary, the MR_BA3fm sensitive areas analysis was significantly refined from the MR_BA3f analysis with comparative results shown in Table 9-48 below.

Table 9-48: MR BA3fm Sensitive Area Analysis Results

Sewershed(s)	Site Alternative to Achieve 4-6 Overflows/ Yr.	Site Alternative to Achieve 0 Overflows/ Yr.	Impact to MR_BA3fm
A-47	Consolidation to New Drop Shaft (CF32)	Consolidation to New Drop Shaft (CF32)	No Impact*
M-18	Consolidation to New Drop Shaft (CF19)	Consolidation to New Drop Shaft (CF19)	No Impact*
M-20, 21, 22	Consolidation to New Drop Shaft (CF20)	Consolidation to New Drop Shaft (CF20)	No Impact*
O-40,41	Consolidation to New Drop Shaft (CF11)	Consolidation to New Drop Shaft (CF11)	No Impact*
O-43	No Site Alternative Needed	New Drop Shaft (O-43)	New Drop Shaft

* No change to proposed near-surface infrastructure. More overflow being controlled to proposed tunnel to achieve a level of control of 0 overflows per year.

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9.4.5 Saw Mill Run Planning Basin

This section summarizes the development, evaluation, and results of the basin alternatives analyzed for the Saw Mill Run (SMR) planning basin. The overall development and evaluation process used by SMR and the other six basin planners was described in Section 9.4.1. As such, this section primarily focuses on results of the basin alternatives evaluation and any features or methods that were unique to the SMR planning basin.

Basin Alternatives Evaluation: Flow Source Groupings are a grouping of site alternatives combined to provide a basin-wide control alternative for an assumed uniform level of control. From the site alternatives evaluations described in WWP Section 8, Flow Source Groupings were evaluated on a preliminary present worth cost basis. Since the SSOs are located upstream of the CSOs in the SMR planning basin, it was determined that the SSO Flow Source Groupings should be evaluated first to determine which of these Flow Source Groupings is preferred. The preferred SSO Flow Source Grouping would then be incorporated into each CSO Flow Source Grouping to develop overall basin Flow Source Groupings.

Given the significantly lower present worth cost associated with SSO Flow Source Grouping 2, it was determined that this Flow Source Grouping would be incorporated into the CSO Flow Source Groupings, which will now be termed "Basin Flow Source Groupings" since these Flow Source Groupings address all outfalls (both CSOs and SSOs) within the SMR planning basin.

A summary of the Basin Flow Source Groupings is presented in Table 9-49. A preliminary total present worth cost knee-of-the-curve analysis for each Basin Flow Source Grouping was conducted. The results of this preliminary present worth cost analysis resulted in selecting Basin Flow Source Grouping 3 as the first preferred Basin Flow Source Grouping. This was based upon Basin Flow Source Grouping 3 providing the best combination of low relative cost and low relative number of control facilities. In addition to Basin Flow Source Grouping 3, Basin Flow Source Grouping 1, although generally higher in present worth cost than Basin Flow Source Grouping 3, provided the least number of control facilities and, therefore, was chosen as the 2nd preferred Basin Flow Source Grouping.

In addition to the identified first and second preferred Basin Flow Source Groupings, the following two control strategies were developed and applied to the first and second preferred Basin Flow Source Groupings:

- Planning basin-based
- Regional-based

The planning basin-based strategy assumed that no additional regional conveyance is extended to the SMR planning basin and all flows would have to be conveyed to the ALCOSAN Woods Run wastewater treatment plant (WWTP) via the existing river crossing to the Ohio River deep tunnel interceptor. Controls such as storage and treatment facilities are located in the planning basin and are sized to control a portion of or all of the CSOs and SSOs generated in the basin.

Table 9-49: Summary of SMR Basin Flow Source Groupings

Basin Flow Source Grouping[1]	Flow Source	Site Alternative	Description
1	CF03	SMR_CF03_ATNK_02_00_600	Above Grade Tank and associated Consolidation Pipeline
	CF04	SMR_CF04A_SD_TY_04_600	Screening and Disinfection Facility and associated Consolidation Pipeline
2	CF03	SMR_CF03_ATNK_02_00_600	Above Grade Tank and associated Consolidation Pipeline
	CF04	SMR_CF04A_SD_TY_04_600	Screening and Disinfection Facility and associated Consolidation Pipeline
	CF06	SMR_CF06B_ATNK_TY_04_600	Above Grade Tank
3	CF03	SMR_CF03_ATNK_02_00_600	Above Grade Tank and associated Consolidation Pipeline
	CF06	SMR_CF06B_ATNK_TY_04_600	Above Grade Tank
	CF07	SMR_CF07A_SD_TY_04_600	Screening and Disinfection Facility and associated Consolidation Pipeline
	CF08	SMR_CF08A_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
4	CF03	SMR_CF03_ATNK_02_00_600	Above Grade Tank and associated Consolidation Pipeline
	CF06	SMR_CF06B_ATNK_TY_04_600	Above Grade Tank
	CF08	SMR_CF08A_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
	CF09	SMR_CF09A_SD_TY_04_600	Screening and Disinfection Facility and associated Consolidation Pipeline
	CF10	SMR_CF10B_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
	CF11	SMR_CF11_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
5	CF03	SMR_CF03_ATNK_02_00_600	Above Grade Tank and associated Consolidation Pipeline
	CF06	SMR_CF06B_ATNK_TY_04_600	Above Grade Tank
	CF09	SMR_CF09A_SD_TY_04_600	Screening and Disinfection Facility and associated Consolidation Pipeline
	CF10	SMR_CF10B_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
	CF12	SMR_CF12_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
	CF13	SMR_CF13_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
	CF14	SMR_CF14A_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
	CF15	SMR_CF15_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline
	CF16	SMR_CF16_ATNK_TY_04_600	Above Grade Tank and associated Consolidation Pipeline

Note:(1) Includes SSO Flow Source Grouping 2.

The regional-based strategy assumed that a new parallel deep tunnel interceptor would be constructed along the Ohio River and a new river crossing would connect the SMR basin to this new tunnel. A portion of or all of the CSOs and SSOs generated in the basin are conveyed to the ALCOSAN deep tunnel system for subsequent treatment at the ALCOSAN WWTP. Therefore, for each preferred Basin Flow Source Grouping there is a planning basin-based strategy (BBS) and a regional-based strategy (RBS). Additionally, a basin-wide sewer separation strategy was also developed.

The Basin Flow Source Groupings were evaluated at various CSO and SSO levels of control. For CSOs, these levels of control were: 0, 1to 3, 4 to 6, 7 to 12 and 20 overflows per year. For SSOs, the elimination of SSOs to a 2-year design storm was evaluated. A Basin Flow Source Grouping evaluated for a specific level of control was termed a "Basin Alternative".

A total of 26 basin alternatives were analyzed including 13 BBS basin alternatives and 13 RBS alternatives. Table 9-50 provides a summary of these basin alternatives that were evaluated. Included are descriptions of the alternatives, the CSO and SSO control levels that they were evaluated at, and the control technologies associated with the alternatives.

Basin Alternative Ranking: To assist in determining the most preferred basin alternatives for various CSO control levels analyzed, BBS and RBS basin alternatives were ranked using the Basin Alternative Ranking and Assessment Tool (BARAT), as described in Section 9.4.1.3. Figure 9-39 and Figure 9-40 provide summaries of the ranking results for alternatives analyzed under the BBS and RBS, respectively. Basin alternatives SMR_BA26 through SMR_BA31 were identified as the top ranked BBS alternatives for the various levels of control that were evaluated. SMR_BA44 through SMR_BA49 were determined to be the top ranked RBS alternatives.

Knee of the Curve Analysis: Figure 9-41 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional based alternatives, as well as for additional alternatives that were evaluated in support of regional integration. Each of these points was determined by two values: a performance value (annual untreated overflow volume) resulting from a model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after predicted future growth has occurred and the basin alternative has been implemented. For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represents a continuous relationship between performance and cost. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

It is important to note that the regional-based strategy is based on conveyance and does not include any treatment or storage facilities within the SMR planning basin. Since the regional-based strategy is based on wet weather flow conveyance to an ALCOSAN regional solution, and all conveyances downstream of separate sanitary sewer portions of the SMR planning basin (including the SMR interceptor system) must also convey the peak 2-year design storm without surcharging to a downstream control facility, the size of the tunnel/trenchless conveyance is dictated by the peak 2-year design storm flows from the separate sanitary sewer areas rather than by varying Levels of Control (LOCs). As such, the components associated with regional-based basin alternatives SMR_BA44 through SMR_BA49 (conventional tunnel construction, 5 LOCs) are identical for each LOC. However, the untreated CSO volume associated with each of the basin alternatives will differ since it was assumed that new regulators would be constructed to be consistent with the evaluated LOC.

Table 9-50: Saw Mill Run – Summary of Basin Alternatives Evaluated

Basin Alternative	Description	Level of Control		Control Technologies
		CSO(1)	SSO(2)	
SMR_BA01	Flow Source Grouping 3 Basin-Based	20 OF/YR	2 Year	Treatment and Storage
SMR_BA02	Flow Source Grouping 3 Basin-Based	85% Capture	2 Year	Treatment and Storage
SMR_BA03	Flow Source Grouping 3 Basin-Based	7 to 12 OF/YR	2 Year	Treatment and Storage
SMR_BA04	Flow Source Grouping 3 Basin-Based	4 to 6 OF/YR	2 Year	Treatment and Storage
SMR_BA04 (without sediment)	Flow Source Grouping 3 Basin-Based	4 to 6 OF/YR (without sediment)	2 Year	Treatment and Storage
SMR_BA05	Flow Source Grouping 3 Basin-Based	1 to 3 OF/YR	2 Year	Treatment and Storage
SMR_BA06	Flow Source Grouping 3 Basin-Based	0 OF/YR	2 Year	Treatment and Storage
SMR_BA07	Flow Source Grouping 3 Regional-Based	20 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA08	Flow Source Grouping 3 Regional-Based	85% Capture	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA09	Flow Source Grouping 3 Regional-Based	7 to 12 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA10	Flow Source Grouping 3 Regional-Based	4 to 6 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA11	Flow Source Grouping 3 Regional-Based	1 to 3 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA12	Flow Source Grouping 3 Regional-Based	0 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA13	Flow Source Grouping 1 Basin-Based	20 OF/YR	2 Year	Treatment and Storage
SMR_BA14	Flow Source Grouping 1 Basin-Based	85% Capture	2 Year	Treatment and Storage
SMR_BA15	Flow Source Grouping 1 Basin-Based	7 to 12 OF/YR	2 Year	Treatment and Storage
SMR_BA16	Flow Source Grouping 1 Basin-Based	4 to 6 OF/YR	2 Year	Treatment and Storage
SMR_BA17	Flow Source Grouping 1 Basin-Based	1 to 3 OF/YR	2 Year	Treatment and Storage
SMR_BA18	Flow Source Grouping 1 Basin-Based	0 OF/YR	2 Year	Treatment and Storage
SMR_BA19	Flow Source Grouping 1 Regional-Based	20 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA20	Flow Source Grouping 1 Regional-Based	85% Capture	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA21	Flow Source Grouping 1 Regional-Based	7 to 12 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA22	Flow Source Grouping 1 Regional-Based	4 to 6 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA23	Flow Source Grouping 1 Regional-Based	1 to 3 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA24	Flow Source Grouping 1 Regional-Based	0 OF/YR	2 Year	Conveyance to ALCOSAN and Storage
SMR_BA25	Basin-Wide Sewer Separation	0 OF/YR	N/A	Sewer Separation

Note(1): OF/YR = Overflow events per year with typical precipitation

Note(2): Design Storm return interval;   N/A = Not Applicable

Figure 9-39: Saw Mill Run BBS Basin Alternative Ranking Results

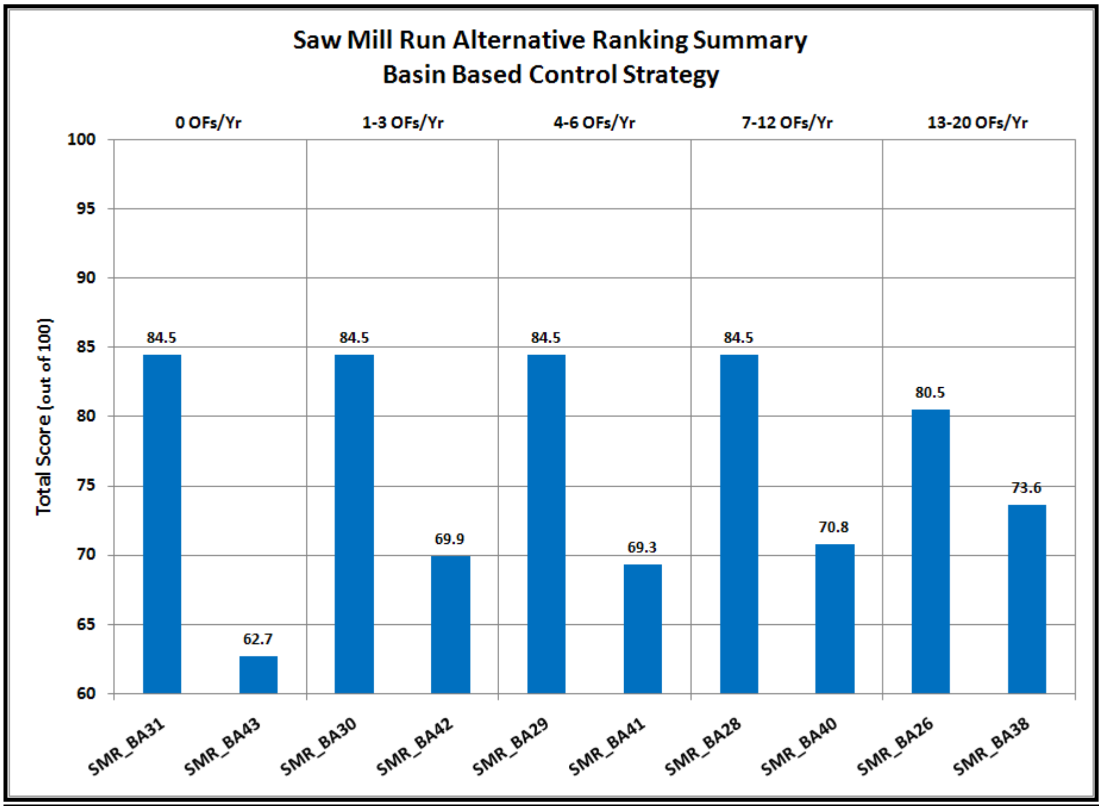


Figure 9-40: Saw Mill Run RBS Basin Alternative Ranking Results

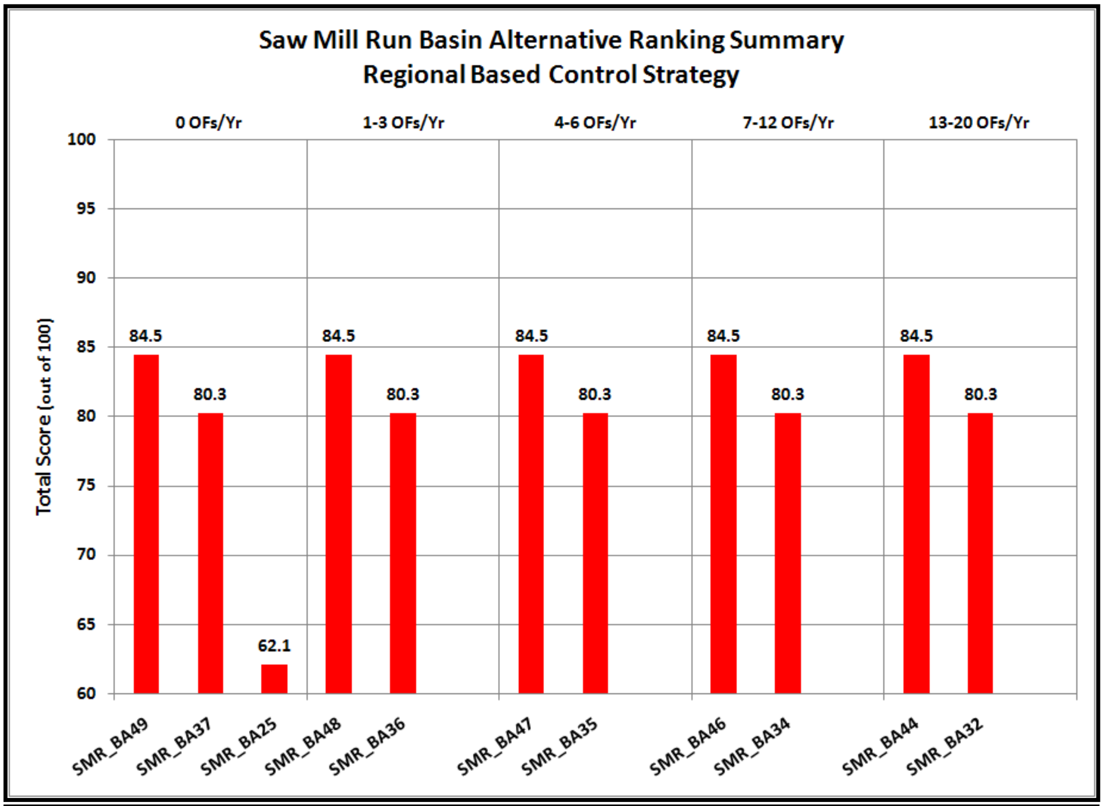
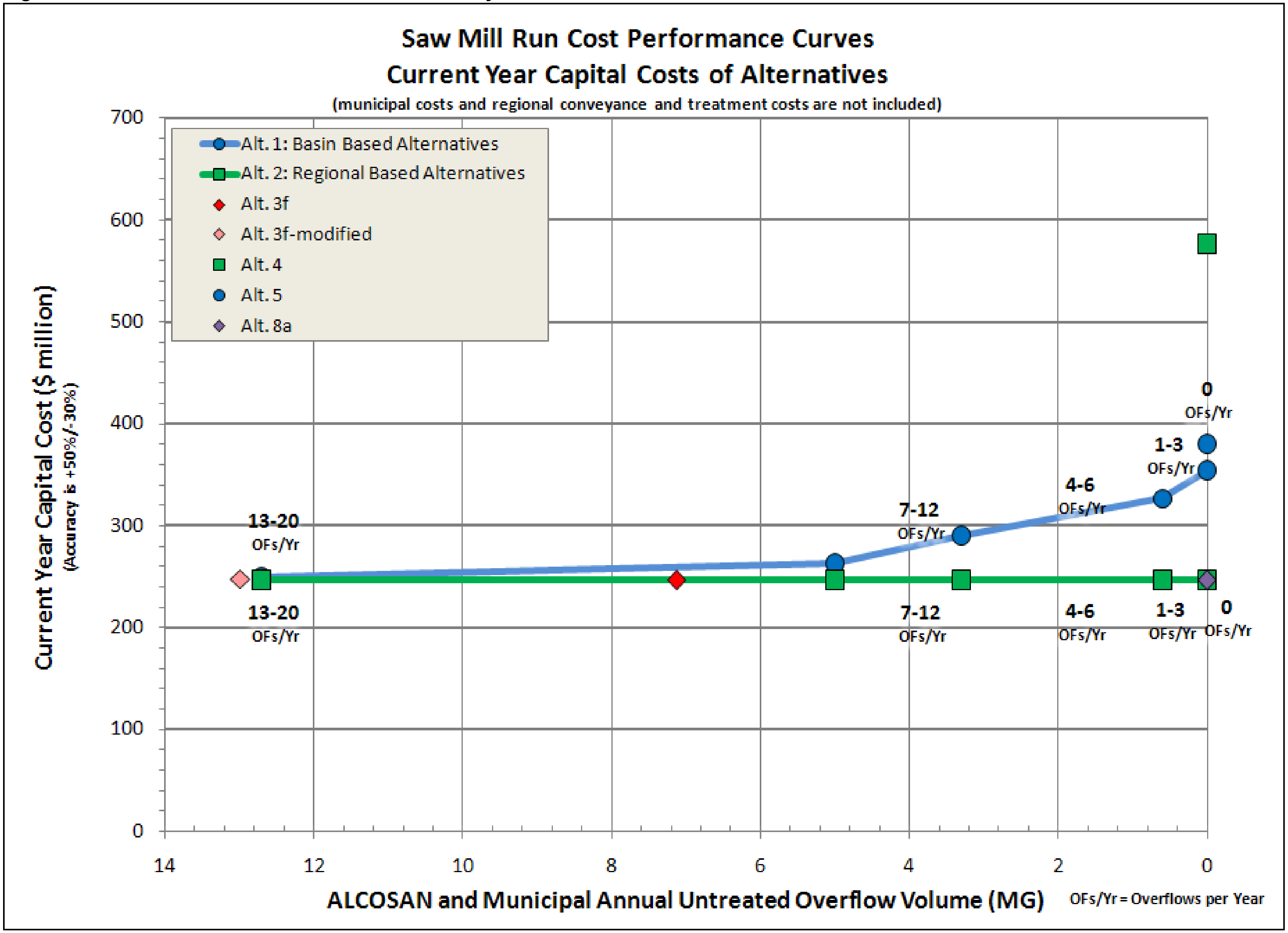


Figure 9-41: Saw Mill Run Knee-of-the-Curve Analysis



Summary of Preferred BBS and RBS Basin Alternatives: Table 9-51 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. In addition, included are the other mandatory basin alternatives of complete sewer separation of combined sewered areas and 85% capture by receiving stream. The system-wide alternative and the level of CSO control associated with each basin alternative are shown in parentheses behind the basin alternative identifier. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended to the planning basin. All flows will have to be conveyed to the WWTP via the existing river crossing to the Ohio River deep tunnel interceptor.

<u>SMR_BA27 (Alt. 5 - 85% Capture):</u> Basin Alternative SMR_BA29 was selected as the basis for developing Alternative 5 due to its association with the level of control equal to 4 to 6 overflows/year. SMR_BA29 consists of a 29,000 linear foot 15-foot diameter storage tunnel and a 12,350 linear foot 36-inch diameter upstream consolidation pipe.

Similar to SMR_BA29, for this system-wide alternative the 15-foot diameter storage tunnel extends from Site J-1 to Site A-2; however, ALCOSAN CSOs were only connected to the storage tunnel to achieve the target range of 85% capture by volume. It was found that by connecting only the two largest ALCOSAN CSOs (O-14-W-OF and O-14-E-OF), the 85% capture goal would be accomplished by capturing 299 MG of CSO. While it is recognized that this volume is slightly higher than the upper target for the SMR planning basin (256 MG), it should be noted that the objective of Alternative 5 was to identify the most cost-effective means to control wet-weather overflows. Capturing a smaller CSO volume for the purpose of being within the target range would result in new regulator structures and associated conveyance piping at almost all of the remaining ALCOSAN CSOs. Incorporation of only O-14-W-OF and O-14-E-OF results in one new regulator structure and associated conveyance piping, and is, therefore, more cost-effective.

It should be noted that for planning purposes, the new regulator structures and associated conveyance pipes were sized for peak typical year flows, rather than flows which would only accommodate 4 to 6 overflows per year.

Table 9-51: Saw Mill Run Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
SMR_Alt 5	5	0	85% capture	2-year	380
SMR_BA26	1	13	13-20	2-year	250
SMR_BA28		5	7-12	2-year	263
SMR_BA29		3	4-6	2-year	290
SMR_BA30		1	1-3	2-year	327
SMR_BA31		0	0	2-year	354
Regional Based Control Strategy					
SMR_BA44	2	13	13-20	2-year	246
SMR_BA46		5	7-12	2-year	246
SMR_BA47		3	4-6	2-year	246
SMR_BA48		1	1-3	2-year	246
SMR_BA49		0	0	2-year	246
SMR_BA25	4 (1)	0	0	2-year	577
Additional Alternatives in Support of Regional Integration					
SMR_Alt 8A	8a	0	13-15	2-year	247
SMR_Alt 3f	3f	7	4-6	2-year	246
SMR_Alt 3fm	3f-Modified	13	4-6	2-year	248

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs alone were cost prohibitive.

Unlike the other basin alternatives that were evaluated in support of regional integration, municipal improvements were not incorporated into the modeling and analysis of Alternative 5 As stated in the guidance constraints outlined in Section 9.5, it was assumed that all municipal flows are to be conveyed to ALCOSAN.

SMR_BA26 through SMR_BA31, excluding SMR_BA27 (Alt. 1 – 20, 7-12, 4-6, 1-3, and 0 overflows/year): In consideration of revised H&H modeling for the mixed sewersheds in the SMR planning basin, it was necessary to revise the first and second preferred Basin Flow Source Groupings. Due to the fact that increased size conveyances are necessary to convey the 2-year design storm peak flow rates to a downstream control facility, the SMR basin planning team considered that tunnel storage should be reconsidered as a preferred control strategy for the basin. In addition, subsequent evaluations of the site conditions for the downstream screening and disinfection (S&D) facility (located at the Ohio River) for the first preferred Basin Flow Source Grouping 1 revealed that construction of an S&D facility of the size required for Flow Source CF04 would be difficult to achieve. Therefore, Basin Flow Source Grouping 1 for the subsequent analysis of preferred Basin Alternatives was revised to include tunnel storage for Flow Source CF04 in lieu of an S&D Facility at the Ohio River.

Based upon the above discussions concerning the elimination of the previously identified aboveground storage tank for the control of ALCOSAN SSOs at Connor Road (Flow Source CF03), the storage was replaced by a 36-inch diameter consolidation pipe from Connor Road to the McNeilly Road area (Sewershed S-15). The elimination of the previously identified aboveground storage tank for control of CSOs in the Overbrook Drive area (Flow Source CF06) was accommodated by increasing the size of the conveyance pipes as required to convey the 2-year design storm peak flow rates. The previously identified S&D facility at the Ohio River (Flow Source CF04) was replaced with tunnel storage. The revised Basin Flow Source Groupings 1 and 3 for further analysis of the preferred alternatives were defined as follows.

- Basin Flow Source Grouping 1 (Planning Basin-based strategy)

  CF03: 36-inch diameter parallel consolidation pipeline from Connor Road to McNeilly Road (sized for the 2-year design storm condition).

  CF04: Parallel consolidation conveyance/storage tunnel from McNeilly Road to Ohio River with tunnel dewatering pump station at Site A-2* (sized accordingly to handle the level of control).

  *Note: The SMR basin planning team determined that due to the presence of significant underground utilities and infrastructure in the area of the West End Bridge (south shore) and the recent relocation of the West End Circle, that Site A-2 was a more preferential location for a downstream control facility at the Ohio River than the previously identified Site A-1.

- Basin Flow Source Grouping 3 (Planning Basin-based strategy)

  CF03: 36-inch diameter parallel consolidation pipeline from Connor Road to McNeilly Road (sized for the 2-year design storm condition)

CF06: Parallel consolidation pipeline from McNeilly Road to Flow Source CF08 (sized accordingly to handle the level of control)

CF07: Screening/disinfection facility at Site A-2 and associated conveyances (sized accordingly to handle the level of control)

CF08: Belowground storage tank at E-2/F-1 and associated conveyances (sized accordingly to handle the level of control)

To progress the evaluation of revised Basin Flow Source Grouping 1 and the associated tunnel storage, the SMR basin planning team was required to re-evaluate the basin control sites. One of the advantages of a storage tunnel relative to a storage tank is that the majority of the storage tunnel construction can be completed with trenchless construction. However, construction of the tunnel must include shafts for access, venting, maintenance, and for use during construction. The number and spacing of tunnel shafts associated with Basin Flow Source Grouping 1 were developed in accordance with guidance presented at a workshop with ALCOSAN, the Basin Coordinator, and the Basin Planners. Accordingly, additional control sites were necessary to be incorporated into revised Basin Flow Source Grouping 1 to accommodate the tunnel shafts.

As described above, revised Basin Flow Source Grouping 3 was maintained as a storage facility located in the West Liberty Avenue area (Site E-2/F-1) and a screening and disinfection facility located adjacent to the Ohio River (Site A-2). The sizes of the facilities and associated consolidation pipes were upsized as required to convey the flows and volumes associated with the revised H&H model. No additional control sites were identified for revised Basin Flow Source Grouping 3.

Basin Alternatives were developed from these two Basin Flow Source Groupings for each of the five CSO levels of control (the 2-year design storm condition was assumed as the level of control for SSOs). The results of the basin alternatives ranking and assessment indicated that for all levels of control Basin Alternatives SMR_BA26 through SMR_BA31 were preferred over Basin Alternatives SMR_BA38 through SMR_BA43. A summary of the preferred BBS basin alternatives is provided in Table 9-52.

Table 9-52: Saw Mill Run – Summary of Preferred BBS Alternatives

Basin Alternative	Description	Level of Control	
		CSO	SSO
SMR_BA26	• 29,000 LF 12-foot diameter storage tunnel from Site J-1 to Site A-2. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	20 OF/YR	2 Year
SMR_BA28	• 29,000 LF 13-foot diameter storage tunnel from Site J-1 to Site A-2. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	7 to 12 OF/YR	2 Year
SMR_BA29	• 29,000 LF 15-foot diameter storage tunnel from Site J-1 to Site A-2. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	4 to 6 OF/YR	2 Year
SMR_BA30	• 29,000 LF 19-foot diameter storage tunnel from Site J-1 to Site A-2. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	1 to 3 OF/YR	2 Year
SMR_BA31	• 29,000 LF 20-foot diameter storage tunnel from Site J-1 to Site A-2. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	0 OF/YR	2 Year

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new Saw Mill Run river crossing will be constructed and tied into the new regional tunnel system, and that this regional tunnel can take as much flow as needed.

<u>SMR_BA44 through SMR_BA49 (Alt. 1 – 20, 7-12, 4-6, 1-3, and 0 overflows/year):</u> The evaluated and assessed RBS basin alternatives were based on Basin Flow Source Grouping 1 (all CSOs and SSOs addressed with one control facility), due to Basin Flow Source Grouping 1 receiving higher scores for all LOCs in the planning basin-based assessment. Basin Flow Source Grouping 1 was evaluated using two approaches with respect to the regional-based strategy:

- Conventional Tunnel Construction (SMR_BA44 through SMR_BA49) – It was assumed that wet weather flows, including CSOs and SSOs up to the required level of control (LOC), in the SMR planning basin would be conveyed to the ALCOSAN regional solution by the implementation of a conventional tunnel.

- Microtunneling/Trenchless Construction (SMR_BA32 through SMR_BA37) - It was assumed that wet weather flows, including CSOs and SSOs up to the required LOC, in the SMR planning basin would be conveyed to the ALCOSAN regional solution by the implementation of a consolidation pipe installed using microtunneling or trenchless construction methods.

It is important to note that the RBS is based on conveyance and does not include any treatment or storage facilities within the SMR planning basin. The RBS is based on wet weather flow conveyance to an ALCOSAN regional solution, and all conveyances downstream of separate sanitary sewer portions of the SMR planning basin (including the SMR interceptor system) must also convey the peak 2-year design storm without surcharging to a downstream control facility. Therefore, the size of the tunnel/trenchless conveyance is dictated by the peak 2-year design storm flows from the separate sanitary sewer areas rather than varying LOCs. As such, the components associated with RBS basin alternatives SMR_BA44 through SMR_BA49 (conventional tunnel construction, 5 levels of control) are identical and RBS basin alternatives SMR_BA32 through SMR_BA37 (microtunneling/ trenchless construction, 5 levels of control) are identical. However, the untreated CSO volume associated with each of the basin alternatives differ since it was assumed that new regulators would be constructed to be consistent with the evaluated level of control.

It was discussed previously that, for the BBS basin alternatives, Site A-2 was preferred over Site A-1 for a control site located adjacent to the Ohio River. However, for the RBS basin alternatives, Site A-1 is preferred over Site A-2 for a control site located adjacent to the Ohio River. This is due to the location of the regional drop shaft proposed to be located on the north shore of the Ohio River. Termination of the SMR RBS basin alternatives at Site A-2 would require the conveyance tunnel or consolidation pipe to be installed at a greater length beneath the Ohio River and would also require a crossing beneath the West End Bridge. Therefore, the RBS basin alternatives are proposed to terminate at Site A-1.

The results of the basin alternatives ranking and assessment indicated that for all levels of control Basin Alternatives SMR_BA44 through SMR_BA49 were preferred over Basin Alternatives SMR_BA32 through SMR_BA37. A summary of the preferred RBS basin alternatives is provided in Table 9-53.

<u>SMR_BA25 (Alt. 4 – Sewer Separation):</u> Basin-wide sewer separation was also developed as a RBS basin alternative. This basin alternative assumes construction of new municipal conveyances to fully separate combined sewer areas. Therefore, unlike the other basin alternatives presented in this section, the estimated total present worth cost for SMR_BA25 includes municipal costs. Costs associated with increasing the capacity of the SMR interceptor system, ALCOSAN Deep Tunnel Interceptor and the ALCOSAN WWTP to accept increased flows from sanitary sewered areas, are not accounted for in the estimated total present worth cost.

Table 9-53: Saw Mill Run – Summary of Preferred RBS Alternatives

Basin Alternative	Description	Level of Control	
		CSO	SSO
SMR_BA44	• 29,000 LF 12-foot diameter conveyance tunnel from Site J-1 to Site A-1. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	20 OF/YR	2 Year
SMR_BA46	• 29,000 LF 12-foot diameter conveyance tunnel from Site J-1 to Site A-1. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	7 to 12 OF/YR	2 Year
SMR_BA47	• 29,000 LF 12-foot diameter conveyance tunnel from Site J-1 to Site A-1. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	4 to 6 OF/YR	2 Year
SMR_BA48	• 29,000 LF 12-foot diameter conveyance tunnel from Site J-1 to Site A-1. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	1 to 3 OF/YR	2 Year
SMR_BA49	• 29,000 LF 12-foot diameter conveyance tunnel from Site J-1 to Site A-1. • 12,350 LF 36-inch diameter consolidation pipe from Site M-1 to Site J-1.	0 OF/YR	2 Year

Summary of Additional Basin Alternatives in Support of Regional Integration: Table 9-51 provided details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in the table, these basin alternatives reflected evolving municipal planning information, and levels of CSO and SSO control which varied by municipality.

The following provides brief summary descriptions of these alternatives. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

<u>SMR_Alt3f (Alt. 3f – 4 to 6 overflows/year):</u> As previously presented, the top-ranked RBS alternatives for the SMR planning basin were Basin Alternatives SMR_BA44 through SMR_BA49. Since these five basin alternatives are identical, Basin Alternative SMR_BA49 was selected as the basis for developing Alternatives 3f due to its association with the highest level

of CSO control: zero overflows/year. SMR_BA49 consists of a 29,000 linear foot 12-foot diameter conveyance tunnel and a 12,350 linear foot 36-inch diameter upstream consolidation pipe.

For Alternative 3f, the 12-foot diameter conveyance tunnel was located from Site J-1 (on Library Road north of the intersection with McNeilly Avenue) to Site A-1 (near the West End bridge on the south shore of the Ohio River) and was extended across the Ohio River where it will connect into the regional tunnel at Drop Shaft CF-11. This site (MR-51) is located on the north shore of the Ohio River just west of the West End Bridge and was selected through coordination with the Main Rivers planning basin, which is located on the opposite side of the Ohio River from the SMR planning basin. The PM selected this site for a drop shaft connection from the Main Rivers planning basin into the regional tunnel based on input from the Main Rivers basin planning team. Rather than installing a second costly drop shaft for the SMR planning basin to connect into the regional tunnel within close proximity to the Main Rivers planning basin Drop Shaft CF-11, the SMR basin planning team decided to connect into the Main Rivers planning basin drop shaft.

Additionally, municipal improvements were incorporated into the modeling and analysis of the system-wide alternatives. These improvements reflect control of municipal CSOs to no more than four overflows per year, and control of municipal SSOs to the 2-year design storm. It should be noted that some municipalities have indicated that they may convey flows up to the 10-year design storm; however, for planning purposes conveyance up to the 2-year design storm was assumed.

One of the modeling criteria for Alternative 3f was to control flow leaving the SMR planning basin such that flow to the existing SMR interceptor system would be maximized before sending flow to the new regional tunnel. This was accomplished in the SMR H&H model by directly connecting all existing ALCOSAN CSOs (up to the fifth largest storm, which equates to four overflows per year) into the SMR interceptor system, and allowing the SMR interceptor system to only overflow into the SMR conveyance tunnel. As confirmed with hydraulic grade line elevations in the SMR H&H model, this is not anticipated to create any ad-hoc overflows or basement backups related to surcharged interceptor conditions.

<u>Alt. 3f-Mod (Alt. 3f-Modified – 4 to 6 overflows/year):</u> SMR_Alt3fm is a minor variation of SMR_Alt3f. The changes from SMR_Alt3f are as summarized below:

- Any additional municipal planning information was incorporated into the SMR H&H model.
- Model simulations used a new boundary condition. Instead of a free discharge boundary condition for flows to the regional tunnel, a boundary condition was supplied at each proposed drop shaft.
- Final model simulations used a new dry weather inflow file provided by the PM.

Alt. 08A (Alt. 8a – 13 to 15 overflows/year): Basin Alternative Alt. 08A 8a is an RBS approach targeting a CSO control level of 13 to 15 overflows per year. This alternative is similar to Alt. 3f except the ALCOSAN regulators were revised to allow between 13 and 15 overflows per year.

Similar to system-wide Alternative 3f-modified, for planning purposes the new regulator structures and associated conveyance pipes were sized for peak typical year flows, rather than flows which would only accommodate 4-6 overflows per year. The regulator structures and associated conveyance pipes are being used for a multitude of basin alternatives and levels of control. In the overall planning scheme, the cost differential resulting from resizing these components to accommodate only 4-6 overflows/year is insignificant when compared to the actual overall basin alternative costs. However, the effort associated with resizing and developing costs for these components to accommodate only 4-6 overflows/year is significant. Therefore, for the purpose of alternative analyses, regulator structures and associated conveyance piping are sized to convey he peak typical year flows and can be refined during optimization of a selected basin alternative.

Section 9.5 describes the integration of these basin alternatives into system-wide alternatives. The section describes the system-wide alternative development process and provides descriptions of the system-wide alternatives that were evaluated.

9.4.6 Turtle Creek Planning Basin

This section summarizes the development, evaluation, and results of the basin alternatives analyzed for the Turtle Creek (TC) planning basin. The overall development and evaluation process used by TC and the other six basin planners was described in Section 9.4.1. As such, this section primarily focuses on results of the basin alternatives evaluation and any features or methods that were unique to the TC planning basin.

It is important to note that, in the earlier stages of the basin alternatives analysis process, both the Thompson Run interceptor and the associated outfalls were included as ALCOSAN facilities, the analysis and costs were developed as such. Later in the process, the procedure was further refined to better reflect the actual municipal ownership of the Thompson Run interceptor and the interceptor was treated as a municipal responsibility. The Thompson Run regulator and outfall structures continued to be ALCOSAN operated facilities.

Basin Alternatives Evaluation: Basin alternatives for the initial screening step were developed for a number of control approaches, ranging from the maximum conveyance of flow to the downstream end of the basin to the maximum distributed storage of flow within the basin. The configuration, sizing, and costs for ALCOSAN system improvements were developed for the initial screening of alternatives based on a maximum flow to ALCOSAN scenario, in which all wet weather flows from all sewersheds would be delivered to the points of connection to the ALCOSAN system. Costs for municipal trunk sewer improvements were not analyzed as part of the initial screening of basin alternatives.

Design conditions considered in the initial basin alternatives screening process included the boundary condition and the CSO and SSO levels of control. The fixed hydraulic grade line, basin-based strategy boundary condition, which results in a maximum flow leaving the basin via the existing ALCOSAN interceptor of approximately 50 MGD, was applied to the initial screening of alternatives. A level of control corresponding to 0 overflows per year for CSOs during the 2003 typical year and the 10-year SCS Type II summer design storm for SSOs was also used. The summer design storm was applied to SSO control in the initial screening analysis for the TC basin because it was found to generate higher peak flows than the winter design storm.

Basin alternatives developed for the initial screening process were compared based on total present worth cost. The ALCOSAN Alternatives Costing Tool (ACT), Version 2.0, (as described previously in Section 9.1.3), was used to prepare cost estimates. Distributed control, represented by basin alternative TT-BA03 and comprising consolidation sewers and multiple storage tanks throughout the basin, was determined to be the most effective overall approach for wet weather control in the TC Basin. The hybrid approach of TT-BA05 and TT-BA05A, with upstream storage and a downstream tunnel, was determined to be a more cost-effective approach for conveying more flow out of the basin under the regional-based control strategy than the basin-wide conveyance approach of TT-BA01 and TT-BA01A.

Based on the results of the initial screening of alternatives, the TC Basin Planning team selected the distributed flow consolidation and storage approach, similar to TT-BA03, as the basis for the planning basin-based control strategy (BBS). Similarly, distributed flow consolidation with storage in the upper parts of the basin and connection to a regional tunnel in the lower portions of the basin, similar to TT-BA05, was selected as the basis for the regional-based control strategy (RBS).

The TC Basin Planning team proceeded to develop BBS and RBS basin alternatives for the levels of control and boundary conditions required. Levels of control were based on the 2-year design storm for SSOs and 0, 1 to 3, 4 to 6, 7 to 12 and 20 overflows per year for CSOs. The boundary condition for all levels of control was based on a 600 MGD capacity of the ALCOSAN treatment plant and a variable hydraulic grade line at manhole M-59. Boundary conditions for the RBS also assumed a free discharge condition for flows directed to a regional conveyance tunnel.

Including the six basin alternatives developed and analyzed in the initial screening step, a total of 21 alternatives were analyzed including 7 BBS basin alternatives, 5 RBS alternatives and 5 additional basin alternatives in support of regional integration. Table 9-54 provides a summary of these basin alternatives that were evaluated. Included are descriptions of the alternatives, the control strategy, and the CSO and SSO control levels that they were evaluated at.

Table 9-54: TC - Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Control Level	
		CSO	SSO
TT-BA01	Initial screening of alternatives	0 OF/yr	10-yr
TT-BA01A	Initial screening of alternatives	0 OF/yr	10-yr
TT-BA02	Initial screening of alternatives	0 OF/yr	10-yr
TT-BA03	Initial screening of alternatives	0 OF/yr	10-yr
TT-BA05	Initial screening of alternatives	0 OF/yr	10-yr
TT-BA05A	Initial screening of alternatives	0 OF/yr	10-yr
TT-BA10	Planning Basin	0 OF/yr	2-yr
TT-BA11	Planning Basin	1-3 OF/yr	2-yr
TT-BA12	Planning Basin	4-6 OF/yr	2-yr
TT-BA12A	Planning Basin	4-6 OF/yr	2-yr
TT-BA13	Planning Basin	7-12 OF/yr	2-yr
TT-BA14	Planning Basin	20 OF/yr	2-yr
TT-BA15	Planning Basin	85% Capture	2-yr

Table 9-54: TC - Summary of Basin Alternatives Evaluated

Basin Alternative	Control Strategy	Control Level	
		CSO	SSO
TC-BA16A	Planning Basin – Regional Integration	4-6	2-yr
TC-BA16A Modified	Planning Basin – Regional Integration	4-6	2-yr
TC-BA17	Planning Basin – Regional Integration	13-15	2-yr
TT-BA20	Regional	0 OF/yr	2-yr
TT-BA21	Regional	1-3 OF/yr	2-yr
TT-BA22	Regional	4-6 OF/yr	2-yr
TT-BA23	Regional	7-12 OF/yr	2-yr
TT-BA24	Regional	20 OF/yr	2-yr

OF/yr = Overflows per year

BBS = Basin-based control strategy boundary condition

600 = Boundary condition with 600 mgd capacity at the ALCOSAN treatment plant

600 Reduced Sediment = Boundary condition with reduced sediment deposits along ALCOSAN deep tunnel interceptors.

Note[a]: For the existing interceptor, with a free discharge to new regional conveyance tunnel.

Basin Alternative Ranking: Select BBS and RBS basin alternatives were ranked using the Basin Alternative Ranking and Assessment Tool (BARAT), as described in Section 9.4.1. Figures 9-42 and 9-43 provide summaries of the ranking results for alternatives analyzed under the BBS and RBS, respectively.

The tool was only used for alternatives that had been modeled at the typical year. In the initial screening of control alternatives, TC developed, costed and modeled alternatives for various levels of CSO control at the 10-year design storm for SSO control, but these alternatives were superseded based on ALCOSAN direction to base alternatives at the 2-year storm for SSO control. Guidance for the basin alternative ranking tool was to apply the tool for the alternatives at the 2-year design storm SSO control level, not the 10-year.

As a result, the BARAT was completed and submitted for all alternatives that were fully analyzed – configured, costed and modeled – for various levels of CSO control and the 2-year storm SSO control, which includes the first preferred BBS alternatives (BA10 through BA14) and the first preferred RBS alternatives (BA20 through BA24). Note that the BARAT was not applied to basin alternatives BA16A and BA16A-Modified developed for the regional integration phase since those alternatives were based on the preferred basin alternative previously selected. While the BARAT was completed for alternatives to the fullest extent possible, basin alternative ranking results were of limited value and were not used to identify the top-ranked basin alternatives, for the reasons described above.

Knee of the Curve Analysis: Figure 9-44 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional based alternatives, as well as for additional alternatives that were evaluated in support of regional integration. Each of these points was determined by two values: a performance value (annual untreated overflow volume) resulting from a model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.2). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after predicted future growth has occurred and the basin alternative has been implemented. For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represents a continuous relationship between performance and cost. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

Summary of Preferred BBS and RBS Basin Alternatives: Table 9-55 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.

Figure 9-42: Turtle Creek BBS Basin Alternative Ranking Results

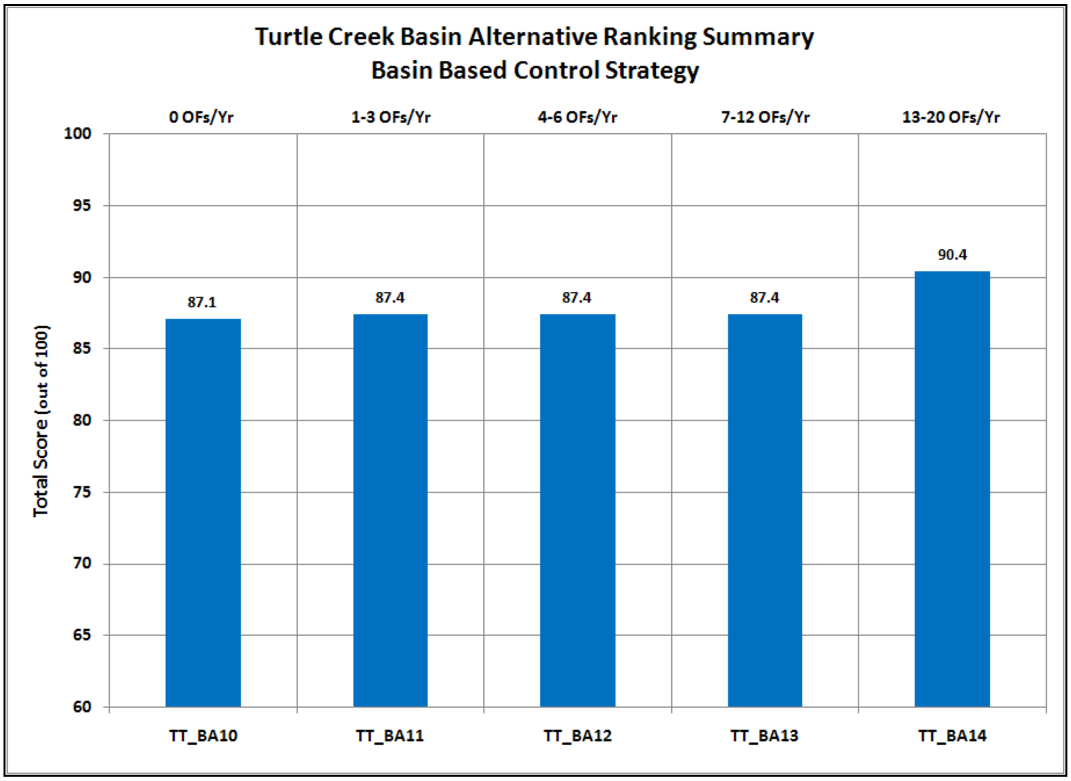


Figure 9-43: Turtle Creek RBS Basin Alternative Ranking Results

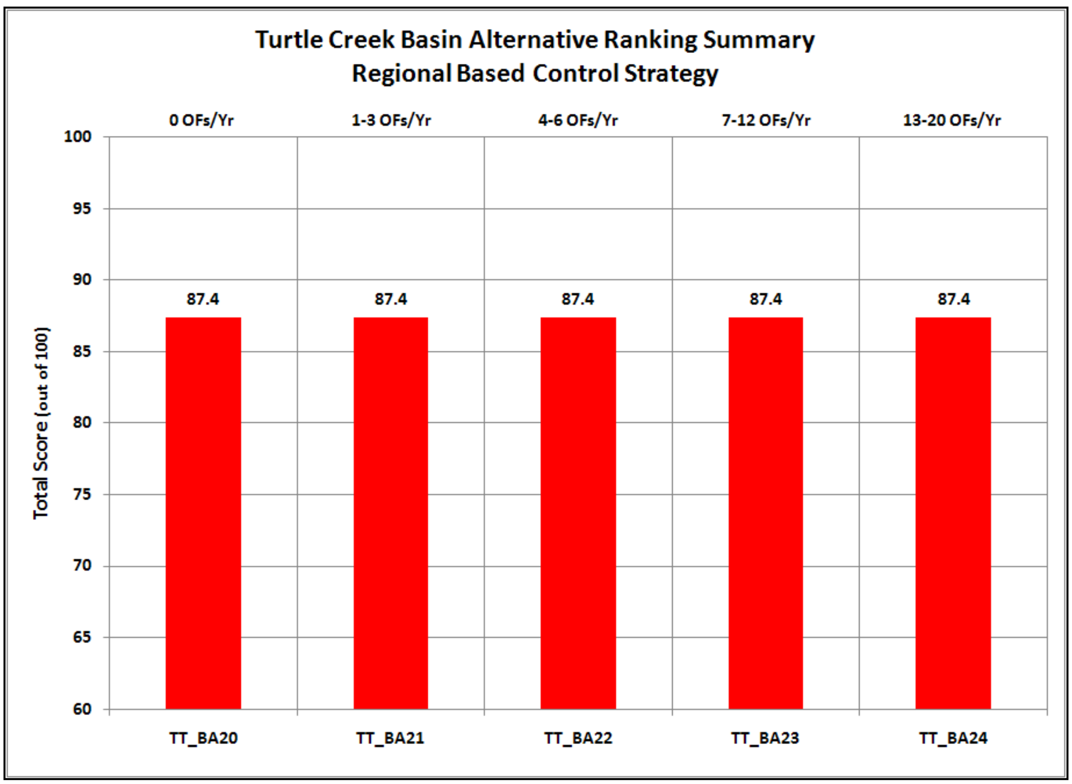


Figure 9-44: Turtle Creek Knee-of-the-Curve Analysis

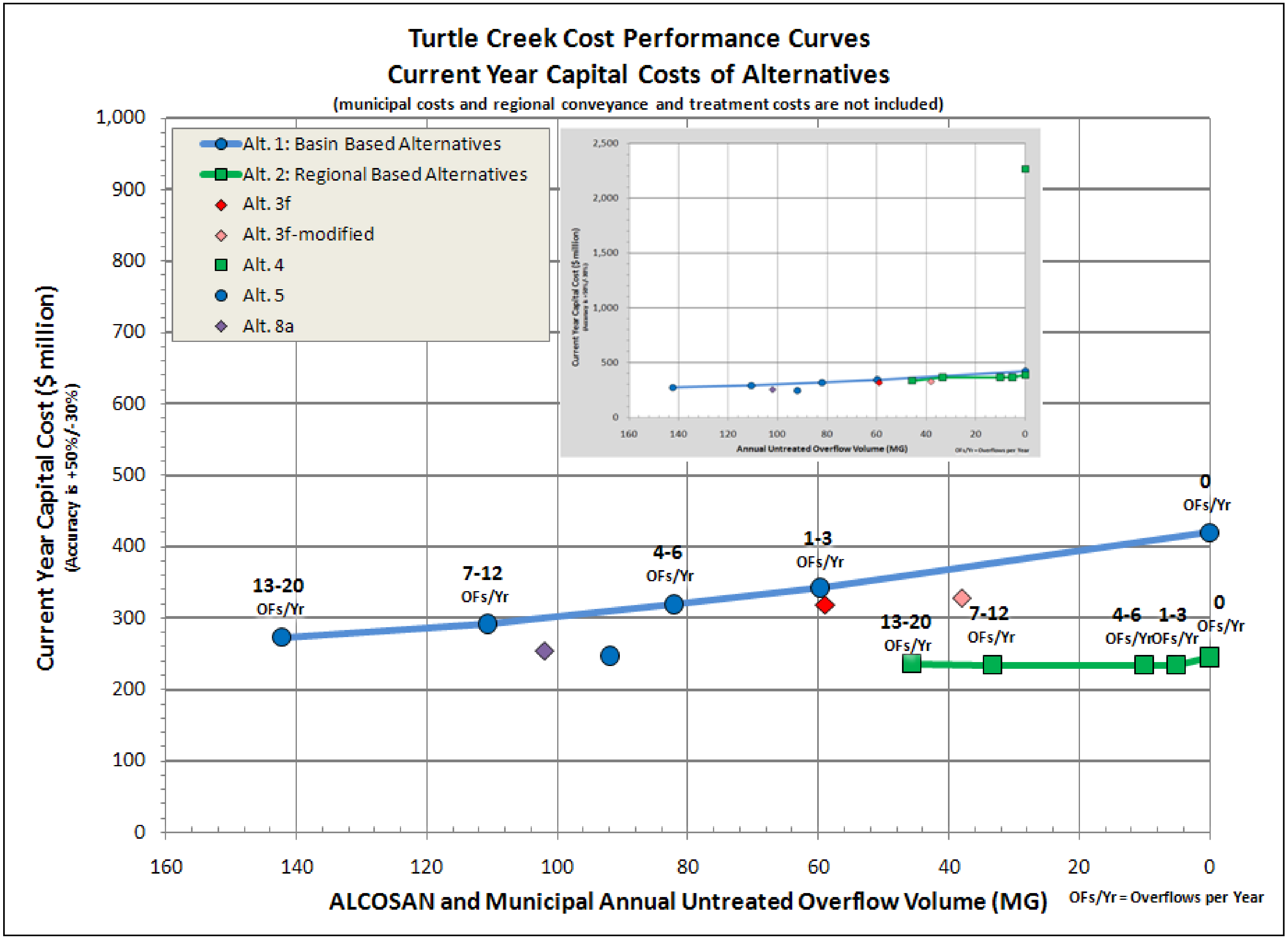


Table 9-55: Turtle Creek Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
TT-BA15	5	92	85% capture	2-year	247
TT-BA14	1	142	13-20	2-year	273
TT-BA13		111	7-12	2-year	292
TT-BA12		82	4-6	2-year	319
TT-BA11		60	1-3	2-year	343
TT-BA10		0	0	2-year	420
Regional Based Control Strategy					
TT-BA24	2	46	13-20	2-year	236
TT-BA23		33	7-12	2-year	234
TT-BA22		10	4-6	2-year	234
TT-BA21		5	1-3	2-year	234
TT-BA20		0	0	2-year	245
TT-BA02	4 (1)	0	0	2-year	2,264
Additional Alternatives in Support of Regional Integration					
BA17	8a	102	13-15	2-year	254
BA16A	3f	59	4-6	2-year	318
BA16A-modied	3f-Modified	38	4-6	2-year	328

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs alone were cost prohibitive.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. In addition, included are the other mandatory basin alternatives of complete sewer separation of combined sewered areas and 85% capture by receiving stream. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended from the Woods Run WWTP to the TC planning basin. All flows from the basin will have to be conveyed to the WWTP via the existing ALCOSAN deep tunnel interceptor system.

<u>TT-BA10 through TT-BA14</u> <u>(Alt. 1 – 0, 1-3, 4-6, 7-12, and 20 overflows/year):</u> Basin alternatives TT-BA10 through TT-BA14 were selected as the preferred alternatives for the planning basin-based control strategy. It is noted that BA10 through BA14 include ALCOSAN control facilities for CSOs and SSOs on the Thompson Run Interceptor since these alternatives were developed and submitted before ALCOSAN issued instructions to consider Thompson Run outfalls as municipal outfalls.

The preferred basin alternatives are composed of site alternatives located at selected preferred sites. Site alternatives that comprise the basin alternatives are located at preferred sites B, 5, A, 36, 7 and 18. The site alternative at Site B would be located on RIDC property on the east side of Turtle Creek in the East Pittsburgh Borough. The site alternative at Site 5 would be on RIDC property between Turtle Creek and Thompson Run in North Versailles Township. The site alternative at Site A would be located on park property in Monroeville along the border with Pitcairn, between Turtle Creek and Broadway Boulevard. The site alternative at Site 36 would be located on the abandoned industrial property along Turtle Creek in Trafford Borough.

The site alternative at Site 7 would be located on railroad property between Thompson Run Road and the railroad tracks along Thompson Run at overflow TR-04. Finally, the site alternative at Site 18 would be located on Sri Venkateswara Temple property, currently being used as an overflow parking site, on the north side of Thompson Run, north of TR-06.

Sites B, 5, A, and 36 support buried tank storage with consolidation sewers that convey flow from multiple overflows; whereas sites 7 and 18 support buried tank storage at single overflows (TR-04 and TR-06, respectively). Note that TT-BA10 includes a retention treatment basin instead of storage for consolidated flows CF03 and CF07 because a storage tank for the 0 overflows/year level of control in this alternative does not fit on Site 5. The required volume of storage at each site is based on the performance level of the basin alternative. The size of the storage tank required at each site is listed in Table 9-56.

Table 9-56: TC - Summary of Required Site Storage in Million Gallons

Site	Basin Alternative				
	TT-BA10 (0 OF / 2-yr)	TT-BA11 (1-3 OF / 2-yr)	TT-BA12 (4-6OF / 2-yr)	TT-BA13 (7-12OF / 2-yr)	TT-BA14 (20OF / 2-yr)
B	21.0	6.0	5.0	3.8	-
5	38.5*	11.0	6.6	1.8	13.0
A	5.0	2.2	2.2	2.2	2.2
36	12.0	12.0	12.0	12.0	12.0
18	4.8	4.8	4.8	4.8	4.8
7	0.9	0.9	0.9	0.9	0.9

* For reference only. An RTB sized for a peak flow of 202 MGD and a 20-minute retention time is provided at Site 5 in TT-BA10 because a tank of this size will not fit the site.

Consolidation sewer sizing was based on conveying wet weather flows exceeding the capacity of the existing ALCOSAN interceptor, using the peak flow in the typical year for combined sewer flows and the peak flow in the 2-year summer design storm for sanitary sewer flows. In this approach, overflows at various levels of control are driven by storage capacity and not by capacity constraints in the consolidation sewers. Maximum flows conveyed to each storage site, used for sizing influent screens at all sites and pump stations at sites where influent pumping is provided, are shown in Table 9-57 below. The maximum flow rates do not change between alternatives for the sites dominated by sanitary sewer systems because the alternatives all provide the same level of control for SSOs. For the combined sewer areas controlled at Site B and Site 5, the expected variation in peak flow rates between alternatives is dampened by the storage volume, and whether the peak flow arrives at the storage site before the tank is full.

Table 9-57: TC - Maximum Flows Conveyed to each Storage Site (MGD)

Site (CF)	Basin Alternative				
	TT-BA10 (0 OF / 2-yr)	TT-BA11 (1-3 OF / 2-yr)	TT-BA12 (4-6 OIF / 2-yr)	TT-BA13 (7-12 OF / 2-yr)	TT-BA14 (20 OF / 2-yr)
B (CF01,02)	268	268	197	197	-
5 (CF03,07)	202	202	202	112	202
A (CF04)	12	12	12	12	12
36 (CF05,06)	15	15	15	15	15
18 (TR-06)	15	15	15	15	15
Site 7 (TR-04)	3.3	3.3	3.3	3.3	3.3

TT-BA15 (Alt. 5 - 85% Capture): Basin Alternative BA15 was developed for system-wide alternative 5 to achieve the targeted levels of control of 85 percent capture for CSOs and elimination of SSOs at the 2-year design storm conditions. BA15 was developed and submitted before ALCOSAN issued the directive to consider Thompson Run outfalls as municipal outfalls. Therefore, BA15 includes ALCOSAN control facilities for CSOs and SSOs on the Thompson Run Interceptor.

Modeling for basin alternative BA15 showed that the 85 percent capture and 2-year design storm objectives could be achieved without the construction of consolidation sewers and storage in the downstream reaches of the Turtle Creek interceptor. Based on this result, the configuration of BA15 matches basin-based alternative BA14, which was described above, and does not include Site Alternative B.

The components of the BA15 for system-wide alternative 5 are summarized in Table 9-58 below.

Table 9-58: TC - Components of Basin Alternative BA15

Site Alternative	Tank Volume (MG)	Pumping Capacity (MGD)	Screening Capacity (MGD)	Consolidation Sewer	
				Open Cut	Micro-Tunnel
Site 5	4.2	2.1	225	CF03: 48” CF07: 36” to 60”	CF03: 60” to 144” CF07: 36” to 60”
Site A	2.2	1.1	12	CF04: 48” to 78”	CF04: 60”
Site 36	13.5	4.5	14	CF05: None CF06: 36”	CF05:24” CF06:36”
Site 7	6.3	2.5	3	24”	None
Site 18	0.9	1.5	15	None	36”

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new regional tunnel will be constructed, and that this regional tunnel can take as much flow from the TC basin as needed.

TT-BA20 through TT-BA24 (Alt. 2 – 0, 1-3, 4-6, 7-12, and 20 overflows/year): Basin alternatives TT-BA20 through TT-BA24 were selected as the preferred alternatives for the regional-based control strategy. These alternatives were developed and submitted before ALCOSAN issued the directive to consider Thompson Run outfalls as municipal outfalls. Therefore, BA20 through BA24 include ALCOSAN control facilities for CSOs and SSOs on the Thompson Run Interceptor.

Site Alternatives at Sites A, 36, 18 and 7 for the regional-based control strategy alternatives are identical to those for the basin-based control strategy alternatives BA10 through BA14, described above. For the regional-based strategy alternatives, the storage tanks and the RTB at

Site 5 and Site A are replaced with drop shafts to a proposed regional tunnel that would extend to Site 5.

TT_BA02 (Alt. 4 – Sewer Separation): An alternative representing a scenario of minimum flow to the ALCOSAN system, based on basin-wide sewer separation and infiltration and inflow (I/I) reduction in the municipal sewersheds was considered in the initial screening process. The minimum flow to ALCOSAN scenario was considered to evaluate the potential for reducing the extent and cost of ALCOSAN system improvements by reducing municipal flows conveyed to ALCOSAN, and to estimate the cost of basin-wide sewer separation and I/I reduction. Municipal costs alone for basin-wide sewer separation and I/I reduction in TT-BA02 are significantly higher than the other alternatives considered, and does not have a significant effect on the extent of ALCOSAN system improvements.

Summary of Additional Basin Alternatives in Support of Regional Integration: Table 9-55 provided details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the CSO and SSO control levels, and the total capital costs. These basin alternatives reflected evolving municipal planning information, and levels of CSO and SSO control which varied by municipality.

As previously noted, ALCOSAN had directed the TC basin planning team to consider outfalls on the Thompson Run Interceptor as municipal outfalls for the development of system-wide alternatives. Because municipal planning information for handling Thompson Run SSOs and CSOs was not received for the system-wide alternatives evaluation described here, this basin alternative was evaluated based on the assumption that all municipal flows would be delivered to the ALCOSAN interceptor system. Therefore, SSO storage for TR-06 and TR-04 and consolidation sewers for the lower Thompson Run interceptor in BA12 are replaced by an assumed municipal Thompson Run relief interceptor conveying wet weather flows to the proposed ALCOSAN storage facility at Site 5.

The following provides brief summary descriptions of these alternatives. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

BA16A (Alt. 3f – 4 to 6 overflows per year): Basin Alternative BA12, the preferred basin alternative selected for the 4 to 6 overflows per year level of CSO control, provided the framework for the basin alternative in support of system-wide alternative 3f.

A variation of BA12, basin alternatives BA16A was developed and consists of ALCOSAN consolidation sewers and four storage facilities, located at Sites B, 5, A, and 36, with the overall configurations matching those described previously for these same sites. Consolidation sewers were sized to convey the peak flow during the typical year for CSO control and the peak flow for the design storm for SSO control. Wet weather flows in excess of the flow sent to the ALCOSAN interceptor are diverted from the existing outfalls to the new consolidation sewers, which can be accomplished by modifying existing regulators. The storage tank at Site 36, which provides SSO-only control, was sized based on the volume required to eliminate overflows during the targeted design storm. Storage tanks that provide combined CSO and SSO control at Sites B, 5, and A were sized based on the targeted 4 to 6 overflows per year, or the total SSO volume delivered to the tank during the targeted design storms, whichever is larger. Storage tanks were sized to take advantage of the volume of storage provided in the consolidation sewers. Consolidation sewers and storage tanks are configured to produce CSOs only when the storage tank is full, and typically at the downstream CSOs with the lowest outfall inverts.

The components of the site alternatives corresponding to basin alternative BA16A are summarized in Table 9-59 below.

Table 9-59: TC - Components of Basin Alternative BA16A

Site Alternative	Tank Volume (MG)	Pumping Capacity (MGD)	Screening Capacity (MGD)	Consolidation Sewer	
				Open Cut	Micro-Tunnel
Site B	5.0	3.0	197	CF01: 72” to 78” CF02: None	CF01: 78” to 96” CF02: 36” to 48”
Site 5	9.5	5.5	202	CF03: 48”	CF03: 60” to 96”
Site A	2.2	2.5	32	CF04: 24” to 60”	CF04: 60”
Site 36	21.5	5.0	30	CF05: 36” CF06: 36”	CF05: 24” CF06: 36”

<u>BA16A-Modified (Alt. 3f-Modified – 4 to 6 overflows/year):</u> System-wide Alternative 3f-modifed was developed as a slight variation of system-wide Alternative 3f based on the following major changes:

- Reduction in the length of the new regional storage/conveyance tunnel, for portions of the tunnel located in the Upper Monongahela (UM) basin.
- Incorporation of additional municipal planning information received, including some adjustment in sewershed delineations and future developable areas as well as updates to some municipal flow projections.
- New boundary conditions based on a 600 MGD WWTP and a 120 MGD tunnel dewatering pump station.
- Revised dry weather flows.
- Adjustments to basin models based on regional model simulations.

System-wide Alternative 3f-modified is based on 4 to 6 overflows per year for CSO control and the 2-year design storm for SSO control, the same as system-wide Alternative 3f.

Basin Alternative BA16A-modified was developed for system-wide Alternative 3f-modified. BA16A-modified has the same overall configuration and comprises the same site alternatives as BA16A. However, the sizing of control facilities were refined as BA16A-modified was developed in greater detail for the Basin Facilities Plan, and as changes in boundary and other model conditions described above were incorporated. These changes were required to maintain the targeted 4 to 6 overflows per year for CSO control. Components for each site alternative for BA16A-modified are summarized in Table 9-60 below.

Table 9-60: TC - Components of Basin Alternative BA16A-Modified

Site Alternative	Tank Volume (MG)	Pumping Capacity (MGD)	Screening Capacity (MGD)	Consolidation Sewer	
				Open Cut	Micro-Tunnel
Site B	4.6	5.0	180	CF01: 54” to 72” CF02: 24”	CF01: 72” to 96” CF02: 48”
Site 5	16.1	9.0	212	CF03: 10” to 96”	CF03: 24” to 96”
Site A	1.1	2.5	72	CF04: 60”	CF04: 48” to 60”
Site 36	15.3	10.0	38	CF05: 18” to 24” CF06: 18” to 24”	CF05: 36” to 42”" CF06: 36” to 42”

<u>BA17 (Alt. 8a – 13 to 15 overflows/year):</u> Basin Alternative BA17 was targeted to achieve 13 to 15 overflows per year for CSO control. The 2-year level of SSO control was used.

BA17 has the same overall configuration as Basin Alternatives BA16A, consisting of consolidation sewers and four underground storage tanks at Sites B, 5, A, and 36. Consolidation sewers were sized to convey the typical year peak flow for CSO areas and the peak 2-year design storm flow for SSO areas. Consolidation sewer sizing matches those shown for Basin Alternative BA16A and the corresponding site alternatives. Storage tank, pump station, and screen sizing was adjusted in BA17 for CSO control facilities at Site B and Site 5, compared to BA16A, to achieve the targeted 13 to 15 overflows per year for CSO control. Components for each site alternative for BA17 are summarized in Table 9-61 below.

Table 9-61: TC- Components of BA17 Site Alternatives

Site Alternative	Tank Volume (MG)	Pumping Capacity (MGD)	Screening Capacity (MGD)	Consolidation Sewer	
				Open Cut	Micro-Tunnel
Site B	5.0	3.0	183	CF01: 72" to 78" CF02: None	CF01: 78" to 96" CF02: 36" to 48"
Site 5	4.5	2.5	153	CF03: 48"	CF03: 60" to 96"
Site A	2.2	2.5	32	CF04: 24" to 60"	CF04: 60"
Site 36	21.5	5.0	30	CF05: 36" CF06: 36"	CF05: 24" CF06: 36"

Section 9.5 describes the integration of these basin alternatives into system-wide alternatives. The section describes the system-wide alternative development process and provides descriptions of the system-wide alternatives that were evaluated.

9.4.7 Upper Allegheny Planning Basin

This section summarizes the development, evaluation, and results of the basin alternatives analyzed for the Upper Allegheny (UA) planning basin. The overall development and evaluation process used by UA and the other six basin planners was described in Section 9.4.1. As such, this section primarily focuses on results of the basin alternatives evaluation and any features or methods that were unique to the UA planning basin.

Basin Alternatives Evaluation: In developing and evaluating basin alternatives for the UA Basin, the UA team applied the following supplemental approaches in addition to the general approaches previously described in Section 9.4.1. These supplemental approaches accounted for characteristics that are unique to the UA basin.

SSO Evaluation:

- Evaluated independently from CSO areas: SSO areas in the UA Basin are situated in the far upstream reaches, so extensive conveyance improvements to consolidate these with CSO controls were not practical.
- Initially prioritized storage: Based on the technology evaluation presented in Section 8, storage was the most logical initial SSO control alternative for the UA basin.
- Additional regulator optimization and bottleneck elimination was considered to reduce/eliminate storage where practical.
- Evaluated additional infiltration and inflow (I/I) reduction: Cost-effective I/I reduction, which assumes achievable I/I reduction percentages, would not completely eliminate SSOs in the UA Basin. However, it was evaluated as part of the overall strategy for mitigating SSOs as a means for potentially reducing required storage or conveyance costs.

CSO Evaluation:

- Assembled basin alternatives, including SSO controls, from site alternatives that were carried forward after the screening and evaluation described in Section 8
- Evaluated basin-wide storage tunnels as a stand-alone alternative and in combination with preferred site alternatives
- Evaluated basin-wide sewer separation as a stand-alone alternative
- Developed and evaluated a regional-based strategy alternative that would consider additional conveyance of the UA flows to the downstream (Main Rivers) basin and the WWTP.
- Reviewed source control sensitivity analysis for potential inclusion of source controls in the alternatives.

Absent reconciled municipal preliminary flow estimates (PFEs) or municipal planning information at the time of the BBS and RBS evaluations, alternatives were evaluated assuming all flows were conveyed to the ALCOSAN system with no overflows (regulator or manhole) occurring in the municipal system. This "worst case" scenario provided a conservative estimate of facility sizes, space requirements and costs. This approach remained largely unchanged after the municipal flow reconciliation efforts and no significant revisions to the basin alternatives were required as a result of the municipal planning information reconciliation.

After thorough evaluations and optimizations of the SSO site alternatives, the selected preferred SSO control alternatives were incorporated into the CSO basin alternatives for all CSO levels of control. SSO basin alternatives were independently evaluated for the UA basin and then assembled with the CSO basin alternatives as necessary to provide the basin-wide alternatives. These basin alternatives were then evaluated to determine sizes and costs of the CSO control facilities required for each level of control.

Based on the site alternative evaluation results presented in Section 8, four alternative configurations were evaluated under the basin-based control strategy (BBS) and one configuration were assembled and evaluated under the regional-based control strategy (RBS) (for a total of 24 distinct basin alternatives). The BBS assumed that additional regional conveyance beyond the existing interceptor system would not be available. The RBS assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Table 9-62 provides a summary of the basin alternatives that were evaluated. Included are descriptions of the alternatives, the control strategy, and the CSO and SSO control levels the alternatives were evaluated at.

Basin Alternative Ranking: To assist in determining the most preferred basin alternatives for various CSO control levels analyzed, the Basin Alternative Ranking and Assessment Tool (BARAT), as described in Section 9.4.1, was applied to each of the BBS alternatives described on Table 9-62. The RBS conveyance tunnel alternative (UA_BA19 – UA_BA24) was determined to be the only regional-based alternative considered feasible for the UA Basin, and therefore was not formally ranked. However, the sewer separation alternative was evaluated using the BARAT for comparison against other alternatives at the 0 overflows per year level of control. BBS Alternative Grouping 2 Basin-wide Storage Tunnel (UA_BA07 – UA_BA12) was not evaluated beyond an initial screening because the required tunnel dewatering rates make a basin-wide storage tunnel infeasible. Also, BBS Alternative Grouping 3 Treatment/Storage (UA_BA13 – UA_BA18) was only evaluated for 3 viable levels of control due to the tunnel dewatering rates at high levels of control (1 to 3 and 0 overflows per yr). Figure 9-45 provides a summary of the ranking results.

Knee of the Curve Analysis: Figure 9-46 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional based alternatives, as well as for additional alternatives that were evaluated in support of regional integration. Each of these points was determined by two values: a performance value (annual untreated overflow volume) resulting from a model simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after predicted future growth has occurred and the basin alternative has been implemented.

Table 9-62: Upper Allegheny – Summary of Basin Alternatives Evaluated

Basin Alternative	Description	Control Strategy	Level of Control	
			CSO[1]	SSO[3]
UA_BA01	**Best of Site Alternatives:** Screening/ Disinfection with Limited Storage at Lower LOC	BBS	20	2 yr
UA_BA02			7 to 12	
UA_BA03			4 to 6	
UA_BA04			1 to 3	
UA_BA06			0	
UA_BA07	**Basin-wide Storage Tunnel:** Storage Tunnel - North/South Shores	BBS	20	2 yr
UA_BA08			7 to 12	
UA_BA09			4 to 6	
UA_BA10			1 to 3	
UA_BA12			0	
UA_BA13	**Treatment/Storage:** RTBs - North Shore; Storage Tunnel - South Shore	BBS	20	2 yr
UA_BA14			7 to 12	
UA_BA15			4 to 6	
UA_BA16			1 to 3	
UA_BA18			0	
UA_BA19	**Regional Alternative:** Conveyance/Storage Tunnel - South Shore with Consolidation - North Shore	RBS	20	2 yr
UA_BA20			7 to 12	
UA_BA21			4 to 6	
UA_BA22			1 to 3	
UA_BA24			0	
UA_BA25	**Basin-Wide Sewer Separation[2]**	BBS/RBS	0[1]	2 yr[3]
UA_BA26	**Increased Treatment:** RTBs with Limited Storage at Lower LOC	BBS	20	2 yr
UA_BA27			7 to 12	
UA_BA28			4 to 6	
UA_BA29			1 to 3	
UA_BA31			0	
UA_BA32	**Basin Alternative in Support of Regional Integration:** Conveyance/Storage Tunnel - South Shore with Consolidation - North Shore	RBS	4 to 6	2 yr
UA_BA35		RBS	13 to 15	2 yr
UA_BA36		RBS	4 to 6	2 yr

Notes: [1] Overflows per year
[2] Sewer separations did not eliminate overflows at all CSO locations.
[3] 2-yr SSO LOC applied to existing SSO areas (A-45, A-82, and A-85) as well as to newly separated areas that had remaining overflows after separation (e.g., A-68).

Figure 9-45: Upper Allegheny BBS Basin Alternative Ranking Results

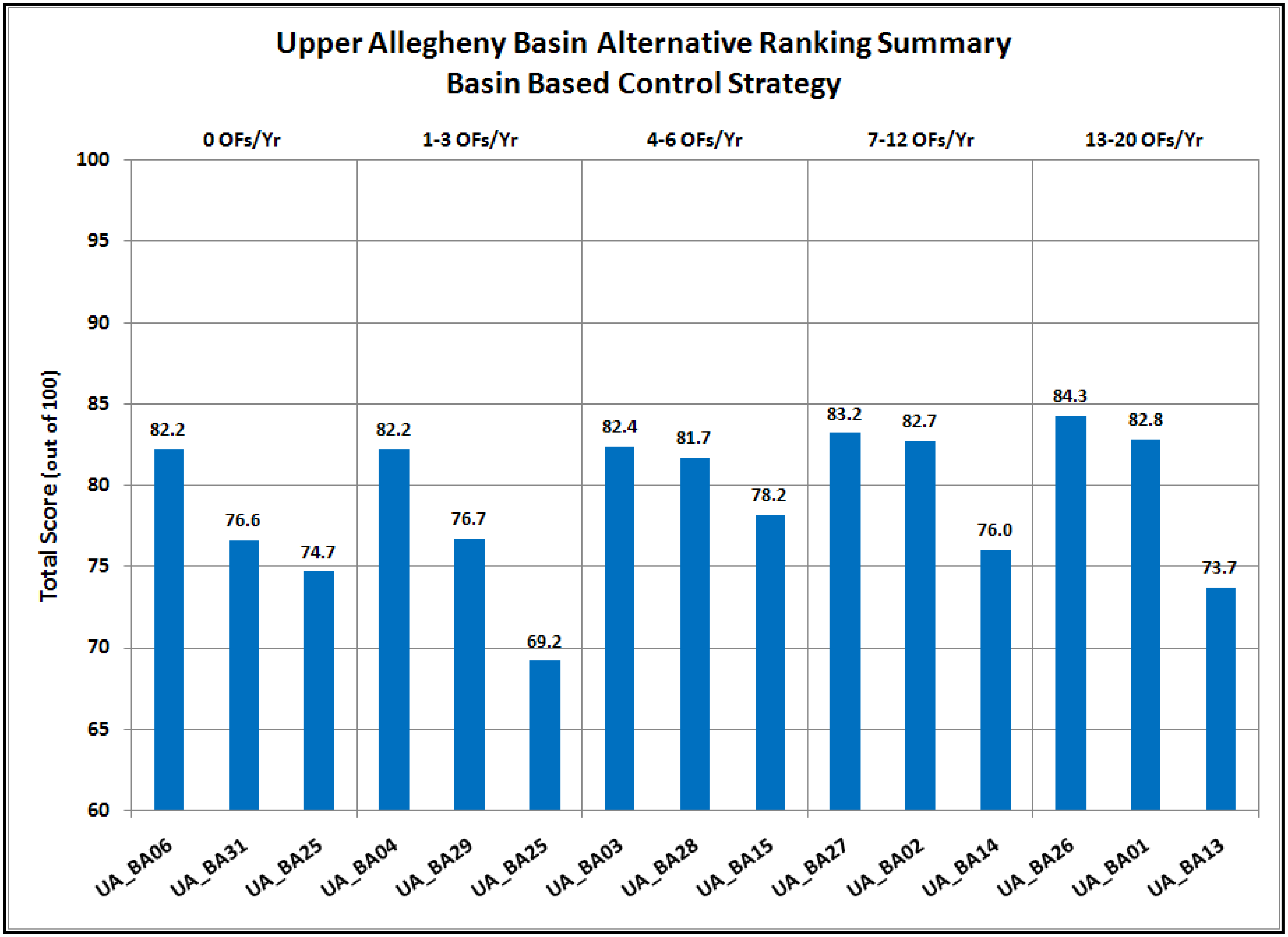
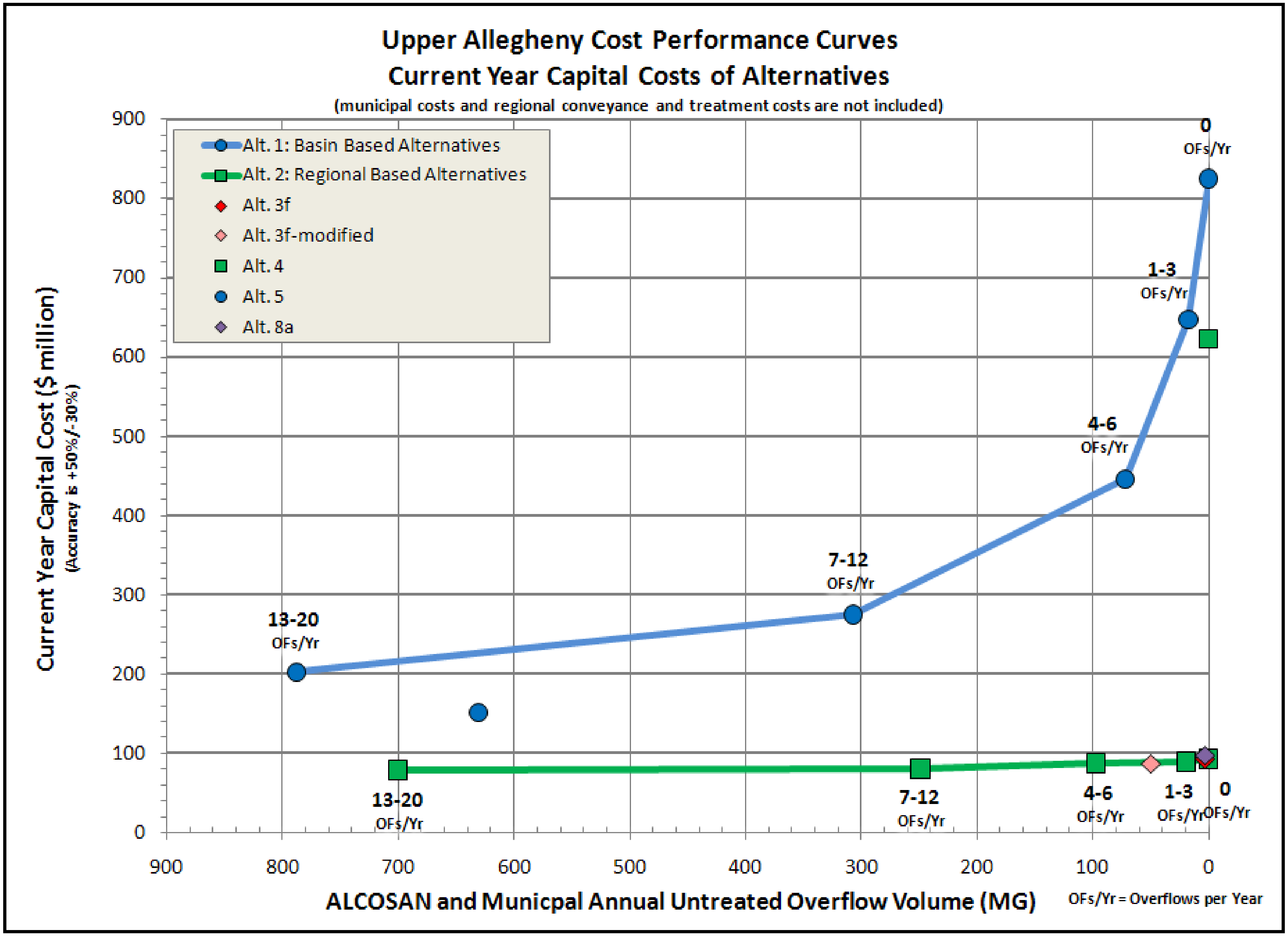


Figure 9-46: Upper Allegheny Knee-of-the-Curve Analysis



For alternatives with the same boundary condition and/or control strategy, points were connected so that the KOC plot represents a continuous relationship between performance and cost. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

Summary of Preferred BBS and RBS Basin Alternatives: Table 9-63 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. In addition, included are the other mandatory basin alternatives of complete sewer separation of combined sewer areas and 85% capture by receiving stream. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended to the planning basin. All flows will have to be conveyed to the WWTP via the existing ALCOSAN interceptor system.

<u>UA Alternative 5 (Alt. 5 - 85% Capture):</u> The goal of Alternative 5 was to achieve 85% capture for each receiving stream (within each basin) in a cost-effective manner. ALCOSAN estimated the target range of untreated overflows in the UA Basin to be between 662 and 757 MG in the typical year. To meet this target range, the untreated overflow volumes from the preferred basin alternatives over various levels of control were evaluated to select alternatives that had remaining discharges within the identified range. Based on ALCOSAN's guidance documents, all control facilities were to be retention-treatment basins (RTBs).

The combination of site alternatives that will achieve 85% capture included:

- CF01 – No facilities
- A-41 – RTB to control to 7 to 12 overflows
- A-42 – RTB to control to 7 to 12 overflows
- A-68 – RTB to control to 7 to 12 overflows
- CF04 – No facilities

Although controlling to the 7 to 12 overflow level of control is still costly (due primarily to the large volumes at A-42), the three selected sites with RTB facilities require minimal consolidation and the sites all have available acreage for future expansion if additional facilities are required to control to a higher level. The leading alternative was discussed with ALCOSAN and incorporated into the UA model to verify the annual untreated CSO volumes were within the target range. The SSOs were held to a 2-year design storm level of control, and all municipal flows to ALCOSAN scenario was used for municipal controls.

Table 9-63: Upper Allegheny Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
UA Alternative 5	5	631	85% capture	2-year	151
UA_BA26	1	788	13-20	2-year	202
UA_BA27		307	7-12	2-year	275
UA_BA03		72	4-6	2-year	446
UA_BA04		18	1-3	2-year	648
UA_BA06		0	0	2-year	825
Regional Based Control Strategy					
UA_BA19	2	700	13-20	2-year	78
UA_BA20		249	7-12	2-year	81
UA_BA21		97	4-6	2-year	88
UA_BA22		19	1-3	2-year	89
UA_BA24		0	0	2-year	93
UA_BA25	4 (1)	0	0	2-year	623
Additional Alternatives in Support of Regional Integration					
UA_BA35	8a	3	13-15	2-year	98
UA_BA32	3f	3	4-6	2-year	93
UA_BA36	3f-Modified	50	4-6	2-year	87

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs alone were cost prohibitive.

Since most of CSO locations were not controlled, the typical year statistics for these overflows were similar to the future baseline conditions. The UA Alternative 5 configuration resulted in a slightly higher percent capture of 87% because the annual overflow volume (631 MG) associated with the remaining activations is slightly lower than the targeted range developed by ALCOSAN.

UA_BA03, BA04, BA06, BA26, and BA27 (Alt. 1 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year): Five basin alternative groupings were developed and evaluated under the BBS. However, only BBS Alternative Groupings 1 and 4 (UA_BA01 – UA_BA06 and UA_BA26 – UA_BA31) were determined to be feasible at all levels of control and BBS Alternative Grouping 3 (UA_BA13 – UA_BA18) feasible at three lower levels of control. Based on the evaluation and ranking of these basin alternatives, viable first and second preferred BBS alternatives including screening and disinfection (SD), retention treatment basins (RTB) and limited tank storage technologies were developed that address all LOCs at all consolidation groups. RTB technology ranked higher at lower levels of control while SD technology ranked higher at higher levels of control.

Table 9-64 below presents the matrix of first preferred basin alternative options for CSO groups at each level of control, while also including the first preferred SSO site alternatives.

Table 9-64: UA – Preferred Basin Alternatives for CSO/SSO Control

Preferred Basin Alternative – CSO Areas Consolidation Group Technology Selection by Control Level					
Control Level (Overflows)	**0**	**1 to 3**	**4 to 6**	**7 to 12**	**20**
CF01 (A-35 - A-38)	SD	SD	SD	TNK	TNK
CF02 (A-40 - A-41)	SD	SD	SD	RTB	RTB
CF04 (A-69 - A-78)	SD	SD	SD	RTB	RTB
A-42	SD	SD	SD	RTB	RTB
A-68	SD	SD	SD	RTB	RTB
Preferred Basin Alternative – SSO Areas Consolidation Group Technology Selection by Control Level					
Control Level (Overflows)	**0**	**1 to 3**	**4 to 6**	**7 to 12**	**20**
A-45	TNK	TNK	TNK	TNK	TNK
A-82	C	C	C	C	C
A-85	C	C	C	C	C

Note: SD = Screening/Disinfection; TNK = Storage Tank (above or below ground); RTB = Retention Treatment Basin; C = Conveyance

Using the matrices above, BBS Alternative models were developed and simulated to determine estimated costs as well as the effectiveness of each alternative in terms of projected CSO frequency and volume. Table 9-65 below summarizes the first preferred BBS basin alternatives. Included is a description of the alternatives, the technology(s) utilized, and the CSO and SSO control levels that they were evaluated at.

Table 9-65: UA – Summary of Preferred BBS Basin Alternatives

<table>
<tr><th rowspan="2">Basin Alternative</th><th rowspan="2">Description</th><th rowspan="2">Technology(s) Utilized[1]</th><th colspan="2">Level of Control (LOC)</th></tr>
<tr><th>CSO[2]</th><th>SSO</th></tr>
<tr><td>UA_BA26</td><td rowspan="5">Treatment Alternative: SD at higher LOC; RTBs/Storage at Lower LOC</td><td rowspan="5">SSO:
- Storage at A-45 (SSO)
- Conveyance Optimization at A-82, A-85
CSO:
- North/South Shores: Screening/ Disinfection for higher LOCs; RTBs for lower LOCs
- Storage at CF01 for 7-12 and 20 OF per year only</td><td>20</td><td rowspan="5">2-year design storm</td></tr>
<tr><td>UA_BA27</td><td>7 to 12</td></tr>
<tr><td>UA_BA03</td><td>4 to 6</td></tr>
<tr><td>UA_BA04</td><td>1 to 3</td></tr>
<tr><td>UA_BA06</td><td>0</td></tr>
</table>

[1] SD = Screening/Disinfection; RTB = Retention Treatment Basin
[2] Overflows per year based on typical year rainfall

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new regional tunnel will be constructed up to A-42, and that this regional tunnel can take as much flow from the UA planning basin as needed.

UA_BA19 through UA_BA24 (Alt. 2 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year):
This grouping of basin alternatives was designed to meet the RBS, and represents a regional conveyance-storage tunnel on the south shore of the Allegheny River, with additional river crossing from A-68 and consolidation piping and additional river crossings at A-72 (serving CF04) on the north shore. The conveyance tunnel alternative is the only regional-based alternative considered feasible for the UA Basin and addresses the downstream capacity limitations for conveying UA wet weather flows to the regional WWTP. It was assumed that the UA tunnel system would convey flows to the regional tunnel at a maximum rate of up to 50 MGD. The flows would be conveyed as the tunnel begins to fill and would continue at a rate of up to 50 MGD until the event concludes.

This alternative assumes that the UA boundary conditions at the connection with the Main Rivers system in the existing deep tunnel interceptor would be similar to existing conditions and the additional conveyance capacity of 50 MGD would be provided via a new regional tunnel. The RBS alternatives were further refined based on the revised boundary conditions for the existing and new tunnels provided by the PM.

This RBS provides a higher level of CSO treatment as compared to BBS Alternative Grouping 1 (UA_BA01 through UA_BA06) and unlike BBS Alternative Grouping 3 (UA_BA13 through UA_BA18) is feasible for higher LOCs, with the added benefit of no additional satellite facilities to operate. The RBS also provides redundancy to the existing tunnel interceptor. Costs are minimized within the UA Basin since no pumping would be required at the CSO consolidation locations and the required size (tunnel diameter) for a conveyance/storage tunnel is smaller than for a storage tunnel.

Similar to BBS Alternative Grouping 2, the space requirements are lower because pump stations (required with treatment technologies) would not be required, and the smaller footprint of the tunnel shafts. However, this alternative can only be considered along with a tunnel system in the Main Rivers portion of the system.

<u>UA_BA25 (Alt. 4 – Sewer Separation):</u> Sewer separation was evaluated as a basin-wide alternative to determine its potential effectiveness as well as to develop an understanding of its cost. As described in Section 8, sewer separation resulted in significant reductions in CSO volumes and activations. However, many of the CSOs were still active despite full separation. In most cases, this was observed in locations where either the ALCOSAN interceptor was capacity limited, and either caused or contributed to overflows, or where existing regulator settings (primarily orifice plates) limited the municipal flow into the interceptor. Even when the regulators were opened up in the UA H&H model, ALCOSAN interceptor limitations exhibited control and resulted in overflow activations. High wet weather flows generated in many separate sanitary sewersheds, and a lack of the downstream interceptor capacity, also contributes to remaining overflows.

For those basins that continue to experience overflows after separation is completed, the basin alternative should evaluate controlling the remaining overflows using an SSO level of control, in this case, the 2-year storm. Costs presented in this report reflect the SSO costs only for the known SSO areas (A-45, A-82, and A-85). Given that this alternative would not eliminate the overflows, the extremely high separation costs and the fact that controlling any remaining overflow after sewer separation would require using SSO levels of control (2-year or 10-year design storm), basin-wide sewer separation was not considered further. Instead, cost-effective sewer separation in selected sewersheds, as determined feasible based on discussions with customer municipalities, should be considered in conjunction with other preferred alternatives.

Summary of Additional Basin Alternatives in Support of Regional Integration: Table 9-63 provided details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the CSO and SSO control levels, and the total capital costs. These basin alternatives reflected evolving municipal planning information, and levels of CSO and SSO control which varied by municipality.

The following provides summary descriptions of these alternatives. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. The alternatives assumed a 2-year design storm level of control for the elimination of SSOs. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

UA_BA32 (Alt. 3f – 4 to 6 overflows/year): In the UA Basin, Alternative 3f included a new regional tunnel extending northwest from the ALCOSAN WWTP along the south shore of the Allegheny River to A-42 with river crossing connections to the north shore CSOs. The UA Basin's top-ranked regional based CSO control strategy was incorporated into Alternatives 3f. This top-ranked strategy included drop shafts to the regional tunnel along the south shore of the Allegheny River, with river crossings from A-68 and A-74 (serving CF04) on the north shore to the regional tunnel.

ALCOSAN provided a new boundary condition time series that was applied in the ALCOSAN interceptor at the UA basin boundary near A-35. This boundary condition represented the 2003 typical year rainfall with a 600 MGD WWTP and the new regional conveyance, including a 120 MGD tunnel dewatering pump station.

Alternative 3f also incorporated some municipal planning information based on the reconciled information to date. Specifically, only the Upper Nine Mile Run (UNMR) underground storage facility in PWSA's Negley Run sewershed (A-42) was incorporated into the UA basin model. The proposed 2.4 MG storage facility is located near the Pittsburgh-Wilkinsburg border and is designed to control to 4 annual overflow activations. The remaining uncaptured activations overflow through the existing control structure to the Nine Mile Run outfall (M-47) to the Monongahela River. The filling and dewatering of the storage facility was incorporated into the UA basin model. The "all flows to ALCOSAN" scenario, similar to that evaluated for the basin based and regional based alternatives was assumed for all other municipalities for Alternative 3f. In this scenario, all municipal pipes were conservatively sized in the UA model to convey all flows to ALCOSAN during the 2-year design storm.

As previously discussed, the top-ranked regional-based basin alternative included consolidation piping to drop shafts near A-35, A-37, A-41 and A-42, along with river crossings from A-68 to the tunnel near A-35 and A-74 to the tunnel near A-41. Also, the existing ALCOSAN interceptor from A-69 to A-72 was replaced with a larger diameter pipe. But, unlike the top-ranked UA regional alternative, which modeled the UA tunnel system with the maximum downstream tunnel conveyance and dewatering rate of 50 MGD, Alternative 3f did not model the tunnel or the river crossings and assumed a free discharge at the tunnel drop shafts. This assumption was necessary to gauge the potential peak flow to the tunnel from each drop shaft and aid in the development of the Alternative 3f-modified scenario (see below). The regional tunnel size requirements will be ultimately determined based on the treatment capacity at the WWTP and the contributions from downstream basins to the tunnel.

The SSO controls within the UA Basin for Alternative 3f consisted of:

Conveyance & Storage at A-44 & A-45

- Removed orifices at the A-44 and A-45 POC structures
- Raised the A-45 overflow pipe weir elevation by 2 feet
- Increased the diameter of ALCOSAN interceptor pipes A-45-SO (276 lf) and A-44-02 (70 lf) from 18 inches to 24 inches

- Added 2,050 lf of 24-inch parallel pipe from manhole VER-21 to the Verona Pump Station wet well
- Added a 0.30 MG storage facility near the Verona PS
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

Conveyance at A-82

- Removed the orifice at the A-82 POC structure
- Raised the weir to the overflow pipe 2.1 feet from the original elevation
- Increased the diameter of ALCOSAN interceptor pipes A-82-SO (232 lf) and A-82-02 (240 lf) from 12 inches to 24 inches and pipe A-82-04 (25 lf) from 18 inches to 24 inches
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

Conveyance at A-85

- Removed the orifice at the A-85 POC structure
- Raised the weir to the overflow pipe 1.1 feet from the original elevation
- Increased 2,900 lf of ALCOSAN Interceptor pipe from 12-15 inches to 15-30 inches between A-84-02 to A-84-16 to provide consistent slope and to reduce hydraulic bottleneck.
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

Conveyance at A-84

- Lowered the invert of node A-84-00 0.4 ft to maintain consistent pipe slope
- Raised the weir to the overflow pipe 3.6 feet from the original elevation
- Increased the diameter of ALCOSAN interceptor pipes A-83-02 (55 lf) and A-84-00 (48 lf) from 12 to 15 inches to 30 inches
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

UA_BA36 (Alt. 3f-modified – 4 to 6 overflows/year): A modified version of Alternative 3f served as the basis for the UA Basin Facilities Plan and also is expected to meet the bacteria water quality standards. The extent of the tunnel in the UA Basin was not modified, but an additional drop shaft was placed near A-40. The horizontal alignment of the tunnel was also modified by ALCOSAN to place it closer to the Allegheny River requiring the diversions from the municipal systems and conveyance to the tunnel to be reevaluated. Additional optimization was performed for the CSO group CFO4. Previous alternatives considered replacing the existing ALCOSAN's interceptor from A-69 to A-72 with a new larger pipe while constructing

CSO a consolidation pipe parallel to the existing ALCOSAN interceptor from A-78-02 to A-72. As a result of the additional optimization, the proposed consolidation pipe was eliminated and the existing ALCOSAN interceptor from A-78-02 to A-72 was replaced with a new larger pipe.

Boundary conditions representing the tunnel operation were provided by the PM and applied at each of the drop shafts. A tunnel relief point was added (per the PM) near A-42 and manhole flooding was allowed at the CF04 regulating structure near A-72. Municipal planning information was incorporated, with the remaining, unreconciled municipalities still sized to convey all flows to ALCOSAN during the 2-year design storm. As with Alternative 3f, the SSO level of control performance target was the 2–year design storm, based on overflow volume. Additionally, new Allegheny River boundary conditions were introduced for A-35 and A-68.

The SSO controls within the UA Basin for Alternative 3f modified are described below. The items in bold reflect the improvements that vary from Alternative 3f:

Conveyance & Storage at A-44 & A-45

- Removed orifices at the A-44 and A-45 POC structures
- Raised the A-45 overflow pipe weir elevation by 2 feet
- Added 2,050 lf of 24-inch parallel pipe from manhole VER-21 to the Verona Pump Station wet well
- Added a 0.30 MG storage facility near the Verona PS
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

Conveyance at A-82

- Removed the orifice at the A-82 POC structure
- Raised the weir to the overflow pipe 2.1 feet from the original elevation
- Increased the diameter of ALCOSAN interceptor pipes A-82-SO (232 lf) and A-82-02 (240 lf) from 12 inches to 24 inches and pipe A-82-04 (25 lf) from 18 inches to 24 inches
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

Conveyance at A-85

- Removed the orifice at the A-85 POC structure
- Raised the weir to the overflow pipe 1.6 feet from the original elevation
- Increased 2,900 lf of ALCOSAN Interceptor pipe from 12-15 inches to 15-30 inches between A-84-02 to A-84-16 to provide consistent slope and to reduce hydraulic bottleneck.
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

Conveyance at A-84 to support the A-85 SSO control

- Lowered the invert of node A-84-00 0.4 ft to maintain consistent pipe slope
- Raised the weir to the overflow pipe 4.0 feet from the original elevation
- Increased the diameter of ALCOSAN interceptor pipes A-83-02 (55 lf) and A-84-00 (48 lf) from 12 to 15 inches to 30 inches
- Assumed municipal improvements (increasing pipe diameters) to alleviate upstream flooding in the model (*not included in the Site and Basin Alternative cost estimates*)

UA_BA35 (Alt. 8a – 13 to 15 overflows/year): In the UA Basin, Alternative 8a was based on the preferred basin-based regional alternative and was developed from Alternative 3f with some modifications. Specifically, the consolidation sewers and diversion structures were sized to convey the 5th largest storm in the typical year in terms of peak flow, instead of the typical year peak flow used for Alternative 3f. ALCOSAN provided a new boundary condition time series that was applied in the ALCOSAN interceptor at the UA Basin boundary near A-35. This boundary condition represented the 2003 typical year rainfall with a CSO level of control of 13 to 15 overflows/year, a 600 MGD WWTP and the new regional conveyance, including a 120 MGD tunnel dewatering pump station.

Per the guidance provided by the PM, the UA Basin was required to achieve a maximum of 4 overflows per year at each CSO due to consolidation sewer and diversion structure limitations. It was anticipated that once the basin-based regional alternatives were incorporated into the Regional Basin Model (RBM) by the PM, the tunnel conditions will drive additional overflow events up to the desired 13-15 overflows/year level of control. For this alternative, the activation events within the UA Basin were therefore not limited to the six events listed in the guidance for developing and evaluating this alternative (as described in Section 9.5).

Section 9.5 describes the integration of these basin alternatives into system-wide alternatives. The section describes the system-wide alternative development process and provides descriptions of the system-wide alternatives that were evaluated.

9.4.8 Upper Monongahela Planning Basin

This section summarizes the development, evaluation, and results of the basin alternatives analyzed for the Upper Monongahela (UM) planning basin. The overall development and evaluation process used by UM and the other six basin planners were described in Section 9.4.1. As such, this section primarily focuses on results of the basin alternatives evaluation and any features or methods that were unique to the UM planning basin.

Basin Alternatives Evaluation: The UM basin planning team undertook a multi-step approach in identifying and developing basin alternatives. Their bottom up approach for evaluating and selecting site and basin alternatives started with individual facilities at numerous sites, carrying the most attractive alternatives forward for evaluation against regional (Mon Valley, Hazelwood, etc.) consolidation of outfalls, and then finally, carrying forward the most attractive local and regional alternatives to create basin alternatives. This process provided the ability to isolate and understand the contributions of each site alternative. This methodology provided two main benefits, first allowing only cost effective site alternatives to be considered as part of basin alternative, and second limiting the number of basin alternatives (combinations of viable site alternatives) to be evaluated.

As described in Section 8, this approach allowed for the evaluation of various combinations of individual site alternatives and consolidated facilities to best serve the UM planning basin in a cost effective manner. This analysis led to an array of fully developed basin alternatives. Initially, five basin alternatives were identified (Basin Alternatives 1 through 5). UM_BA1 consisted of consolidation conveyance sewers to retention-treatment basins (RTBs), while UM_BA2 through UM_BA5 consisted of variations of deep tunnels with consolidation sewers to drop shafts for some areas while other areas were conveyed to RTBs. As the analysis progressed, an additional five "A" alternatives (UM_BA1A through UM_BA5A) were added by incorporating controls for M-59 into UM_BA1 through UM_BA5.

The results of the analysis determined that UM_BA1A and UM_BA4A were the most cost effective alternatives. As the concept of basin-based strategy (BBS) and regional-based strategy (RBS) evolved, the selected alternatives converged with UM_BA1A being the preferred BBS alternative and UM_BA4A being the preferred RBS alternative. These alternatives were subsequently analyzed for various levels of control as programmatic guidance and boundary conditions developed and the naming convention changed to account for the various levels of control. Subsequent analyses and guidance resulted in the names evolving to their current format (ex. UM_BA0A for 0 overflows per year, which was the original Basin Alternative 1A at the same level of control).

As such, basin alternatives UM_BA0A through UM_BA0F were selected as the most preferred BBS alternatives and UM_BA0G through UM_BA0K were considered the most preferred RBS alternatives. The BBS assumed that additional regional conveyance beyond the existing interceptor system would not be available. The RBS assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Table 9-66 provides a summary of the basin alternatives that were evaluated. Included are descriptions of the alternatives, the control strategy, and the CSO and SSO control levels the alternatives were evaluated at. Note that there are no ALCOSAN SSOs in the UM planning basin.

Table 9-66: Upper Monongahela – Summary of Basin Alternatives Evaluated

Basin Alternative	Description	Control Strategy	Control Level	
			CSO	SSO
UM_BA0A	Basin Wide	Planning Basin Based	0	N/A
UM_BA0B	Basin Wide	Planning Basin Based	1 to 3	N/A
UM_BA0C	Basin Wide	Planning Basin Based	4 to 6	N/A
UM_BA0D	Basin Wide	Planning Basin Based	4 to 6 With Reduced Sediment	N/A
UM_BA0E	Basin Wide	Planning Basin Based	7 to 12	N/A
UM_BA0F	Basin Wide	Planning Basin Based	20	N/A
UM_BA0G	Basin Wide	Regional Based	0	N/A
UM_BA0H	Basin Wide	Regional Based	1 to 3	N/A
UM_BA0I	Basin Wide	Regional Based	4 to 6	N/A
UM_BA0J	Basin Wide	Regional Based	7 to 12	N/A
UM_BA0K	Basin Wide	Regional Based	20	N/A
UM_BA10	Basin Wide	Satellite Secondary Treatment	Various	N/A
UM_BA0M	Basin Wide	Regional Based	4-6	N/A
UM_BA0R	Basin Wide	Planning Basin Based	13-15	N/A
UM_BA0S	Basin Wide	Regional Based	4-6	N/A
UM_BA11	Basin Wide	Sewer Separation	Various	N/A

Basin Alternative Ranking: The most preferred BBS and RBS basin alternatives identified in the basin alternative screening and evaluation process were ranked using the Basin Alternatives Ranking and Assessment Tool (BARAT), as described in Section 9.4.1. Figures 9-47 and 9-48 provide summaries of the ranking results for alternatives analyzed under the BBS and RBS, respectively.

The ranking scores presented in the summaries have minimal value as there were only two alternatives being considered, one basin-based and one regional-based, albeit at varying levels of control. As documented earlier in this section, a step-wise approach was taken in identify various basin alternatives. This approach evaluated various combinations of individual site alternatives and consolidated facilities that led to an array of fully developed basin alternatives. However, as the concept of BBS and RBS alternatives evolved, the most preferred alternatives were identified prior to the formal ranking of alternatives.

Knee of the Curve Analysis: Figure 9-49 presents a cost vs. performance plot for the preferred basin alternatives that were evaluated. A point is represented on the plot for each of the most preferred basin-based and regional based alternatives, as well as for additional alternatives that were evaluated in support of regional integration. Each of these points was determined by two values: a performance value (annual untreated overflow volume) resulting from a model Simulation of the basin alternative, and a capital cost estimate for that alternative, developed using the Alternatives Costing Tool (as described in Section 9.1.3). The annual untreated overflow volumes (ALCOSAN and municipal outfalls) represent the future (2046) conditions after predicted future growth has occurred and the basin alternative has been implemented.

It is important to note that the large difference in cost between basin-based and regional-based alternatives is mainly due to the fact that the costs for regional-based alternatives do not include costs for new drop shafts, nor any portion of the regional tunnel, whereas, the basin-based alternatives include costs for storage and/or treatment facilities in addition to conveyance facilities. For alternatives with the same boundary condition and/or control strategy, points were connected so that the knee of the curve plot represents a continuous relationship between performance and cost. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

Figure 9-47: Upper Monongahela BBS Basin Alternative Ranking Results

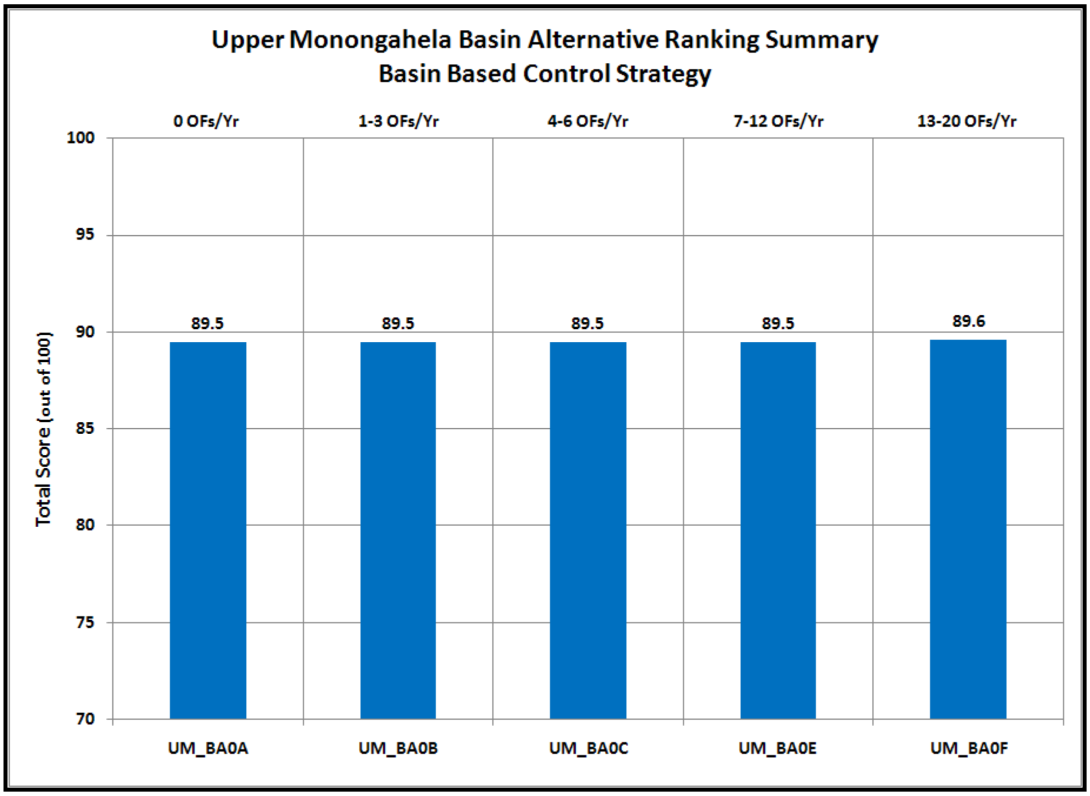


Figure 9-48: Upper Monongahela RBS Basin Alternative Ranking Results

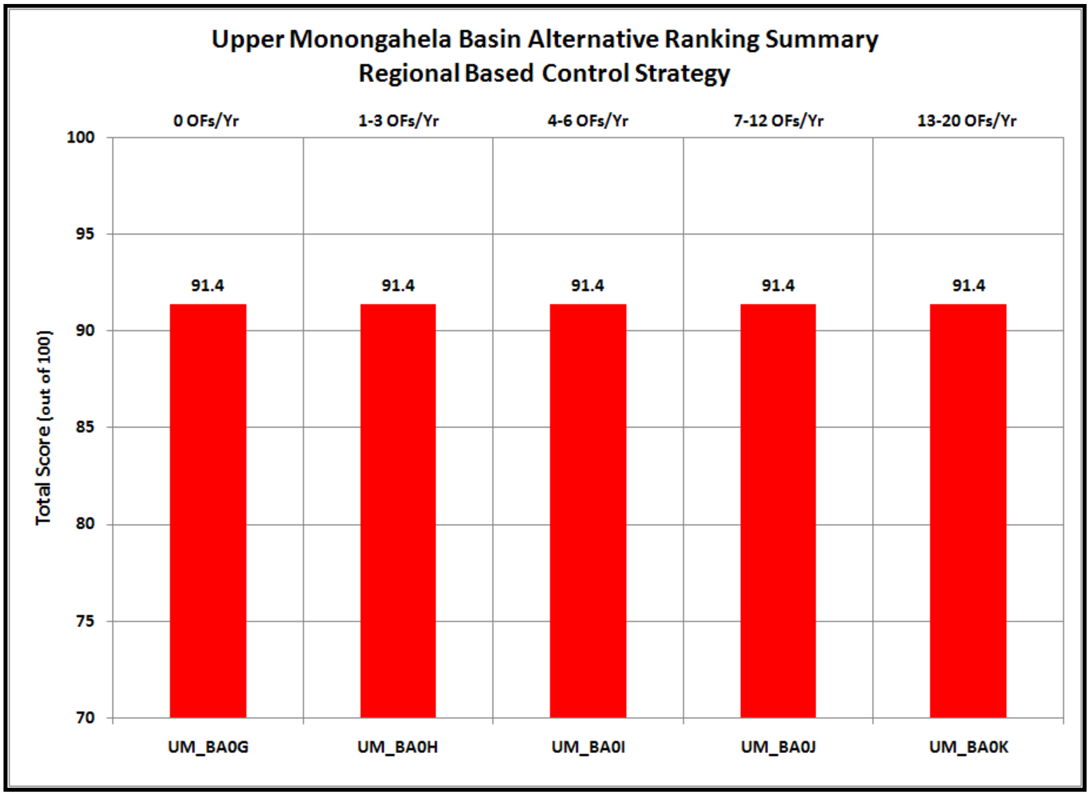
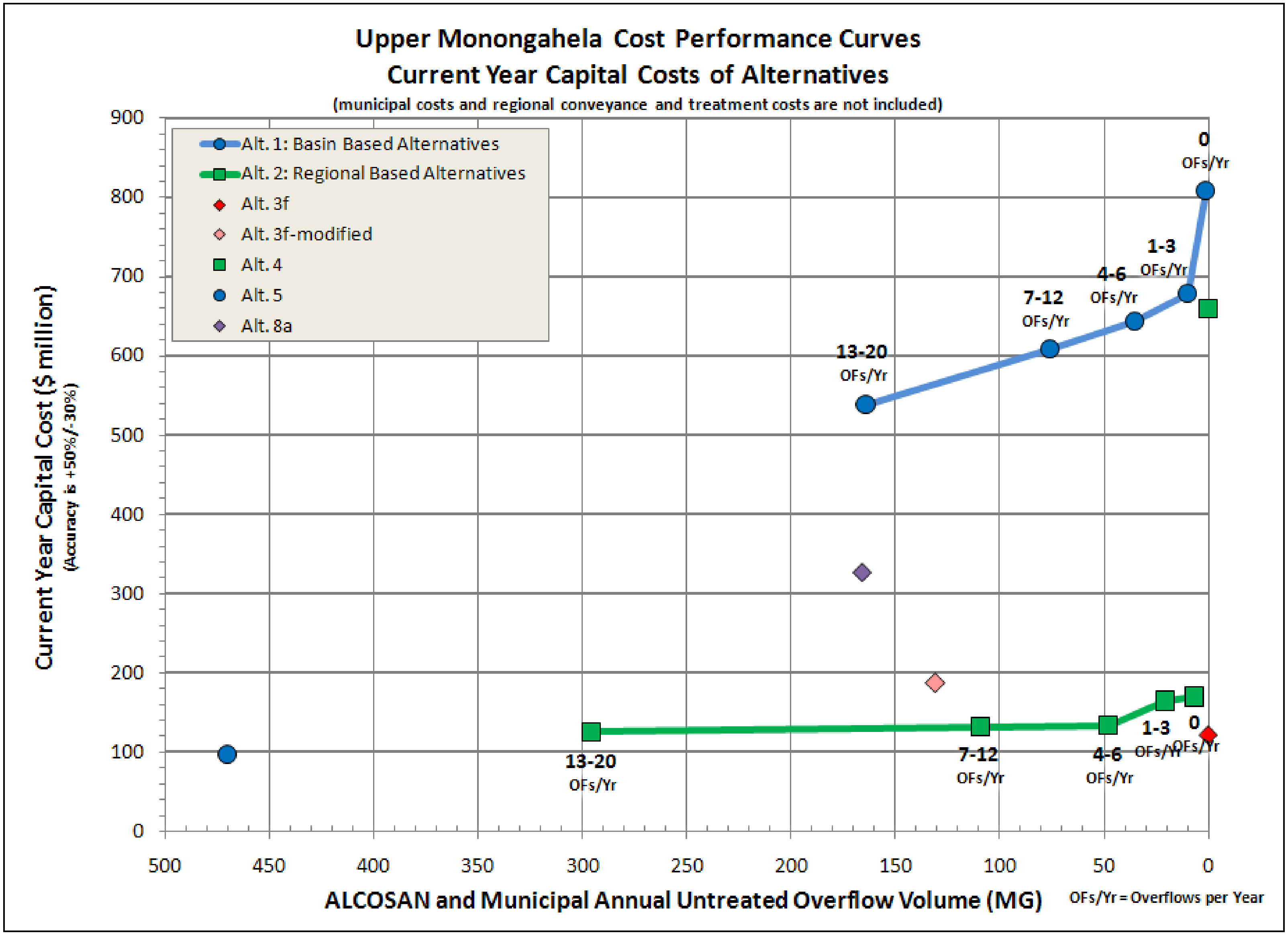


Figure 9-49: Upper Monongahela Knee-of-the-Curve Analysis



Summary of Preferred BBS and RBS Basin Alternatives: Table 9-67 provides details on the most preferred BBS and RBS alternatives for the various levels of control that were evaluated (including alternatives for complete sewer separation and 85% capture). Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, each BBS and RBS basin alternative assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm. Because there are no ALCOSAN SSOs within the UM planning basin, there are no ALCOSAN capital costs for SSO control.

The following provides brief summary descriptions of these preferred BBS and RBS basin alternatives. In addition, included are the other mandatory basin alternatives of complete sewer separation of combined sewered areas and 85% capture by receiving stream. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

Basin-Based Control Strategy

The following preferred BBS alternatives are based on the premise that no additional regional conveyance is extended from the Woods treatment plant to the planning basin. All flows will have to be conveyed to the treatment plant via the existing ALCOSAN interceptor system.

UM_BA0L (Alt. 5 - 85% Capture): The intent of the Alternative 5 analysis was to take the highest ranked basin based alternative and determine the facilities required to meet an 85 percent capture level of CSO control for each planning basin. The highest ranked basin based alternative for the UM planning basin consisted of RTBs serving the Hazelwood area, the Streets Run area, and the Mon Valley area. An additional RTB and a separate storage tank were proposed for M-47 and an RTB was also identified for M-59.

The UM planning basin team analyzed basin based alternatives to identify the optimum mix of facilities and overflow frequency to satisfy the given the volumetric range (471 MG to 538 MG) of annual overflow volume related to 85% capture. Through this analysis, it was determined that the optimum facility configuration for an alternative to achieve 85% capture consists of the M-59 RTB and the CF-02 consolidated RTB facility, both sized at a 4 to 6 overflow per year level of control as well as some other low cost modifications to low volume overflows. The key factors used to select these facilities, and the level of control, are discussed in further detail below:

Table 9-67: Upper Monongahela Basin Alternative Costing Summary

Basin Alternative ID	System-Wide Alternative #	ALCOSAN & Municipal Untreated CSO Volume (MG)	ALCOSAN CSO Control Level (OFs/Yr)	ALCOSAN SSO Control Level (Design Storm)	Total Capital Cost ($ million)
Basin Based Control Strategy					
UM_BA0L	5	470	85% capture	2-year	97
UM_BA0F	1	164	13-20	2-year	539
UM_BA0E		76	7-12	2-year	608
UM_BA0C		36	4-6	2-year	644
UM_BA0B		10	1-3	2-year	679
UM_BA0A		1	0	2-year	808
Regional Based Control Strategy					
UM_BA0K	2	296	13-20	2-year	126
UM_BA0J		109	7-12	2-year	132
UM_BA0I		48	4-6	2-year	134
UM_BA0H		21	1-3	2-year	165
UM_BA0G		7	0	2-year	170
UM_BA11	4 (1)	0	0	2-year	660
Additional Alternatives in Support of Regional Integration					
UM_BA0R	8a	166	13-15 (2)	2-year	327
UM_BA0M	3f	0	4-6 (3)	2-year	122
UM_BA0S	3f-Modified	131	4-6 (4)	2-year	187

(1) Estimated costs only reflect municipal costs. Additional ALCOSAN conveyance costs were not determined since the municipal costs alone were cost prohibitive.
(2) Targeted outfalls directly upstream of sensitive areas were controlled to 4-6 overflows/year
(3) Targeted outfalls directly upstream of sensitive areas were controlled to 4-6 overflows/year, but the incremental cost to achieve relocation or elimination was also evaluated.
(4) Targeted outfalls upstream of sensitve areas were relocated based on recommended approach per Alt. 3f.

- Cost – The selected mix of facilities and level of control resulted in the second lowest present worth cost, costing approximately 10% more than the lowest cost alternative.

- Sensitive areas – The selected mix of facilities addresses M-43, which currently discharges within the Sandcastle WaterPark and just upstream of a designated sensitive area.

- Land availability – Currently only one of the sites under consideration in the UM planning basin (the LTV site in Hazelwood) has development plans. Several discussions have been had with the development agency (RIDC) and they have assured ALCOSAN that they are willing to site a facility on the property and have included space in their development plans. Therefore, land availability did not factor into the selection of these facilities.

- Number of facilities – Implementation of this alternative would result in the development of two facilities. The lowest cost alternative would result in the development of three facilities, sized for a lower level of control (20 overflows per year). It is more likely that facilities sized at the lower level of control would require expansion in the future, which would result in additional costs that have not been quantified.

- Other Considerations – The CF-02 consolidation facility includes a consolidation pipe that could be designed to replace ALCOSAN's existing sub-aqueous pipe. Access to and cleaning of this pipe has been identified as an issue by ALCOSAN.

<u>UM_BA0A through UM_BA0F (Alt. 1 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year):</u> As previously noted, UM_BA0A through UM_BA0F were determined to be the most preferred BBS alternatives. Retention treatment basins (RTBs) were determined to be the most cost-effective wet weather control technology for the UM planning basin. As such, each of the site alternatives included in UM_BA0A through UM_BA0F use RTBs. However, a storage tank was incorporated as the main ALCOSAN facility to address wet weather issues for the M-47 sewershed. Alternatives BA0A through BA0F consist of the following components:

- A Hazelwood Consolidation Site Alternative (CF04) at Site Hz-6,
- A Streets Run Consolidation Site Alternative (CF02) at Site S-3,
- An Individual M-47 Site Alternative at Site N-5,
- An Individual M-47 Site Alternative at Site N-2,
- A Mon Valley Consolidation Site Alternative (CF07) at Site M-5, and
- An Individual M-59 Site Alternative at Site M-6.

Regional-Based Control Strategy

The following RBS alternatives are based on the premise that a new Main Rivers regional tunnel will be constructed, and that this regional tunnel can take as much flow from the UM planning basin as needed.

UM_BA0G through UM_BA0K (Alt. 2 – 0, 1-3, 4-6, 7-12, and 13-20 overflows/year): The second most preferred BBS alternatives at the various levels of control were BA0G through BA0K. When conceived, the main element of these alternatives was a deep storage tunnel that collected overflows from all points of connection located within the UM planning basin, except a few low volume overflows, M-38, M-39, and M-61. As the RBS was developed, BA0G through BA0K naturally became the leading RBS alternatives. The analysis of these alternatives presented included the size and costs for the deep storage tunnel. However, through the regional optimization effort, the basin specific tunnels evaluated within each planning basin have been replaced by regional tunnel concepts, and as such the cost for the tunnel itself has been rolled into the regional component of the Wet Weather Plan costs. Therefore, cost information presented within this section does not include the cost for tunnels themselves. What is included are costs for all (relatively) near surface conveyance piping and drop shafts for the alternative described in this section. The preferred RBS alternatives, BA0G through BA0K, consist of the following components:

- Tunnel Option BA4A (CF25) as modified by regional planning,
- A drop shaft at Site B-1 to convey overflows from M-34,
- A consolidation sewer to convey overflows from M-35 through M-37 to a drop shaft at Site Hz6,
- A drop shaft at Site Hz-4 to convey overflows from M-40,
- A consolidation sewer to convey overflows from M-42 through M-45 to a drop shaft at Site S-3,
- A drop shaft at Site N-5 to convey overflows from M-47,
- A drop shaft at Site H-1 to convey overflows from M-49, and
- A consolidation sewer to convey overflows from M-48 through M-60 to a drop shaft at Site M-6.

UM_BA11 (Alt. 4 – Sewer Separation): Sewer separation costs were developed for each of the combined sewer areas located within the UM planning basin. Costs were developed based on the area to be separated and the associated density (residential high, medium, or low, or commercial/industrial). There is approximately 4,000 acres of combined areas in the UM planning basin. Although separating the sewers would result in a 48 percent, or approximately 475 MG reduction in annual CSO during the typical year, there would be an associated increase in stormwater discharges to local waterways of approximately 700 MG, thus offsetting some of the expected water quality improvements realized from the CSO reduction. Furthermore, for the UM planning basin, sewer overflows would still occur after this separation, which may present a regulatory compliance issue, considering that these outfalls previously permitted as CSOs could potentially be considered SSOs. The sewer separation option throughout the UMPB was set aside, based on the high estimated cost and pending assessment of water quality improvement.

UM_BA10 (Satellite Secondary Treatment): In addition to UM_BA0A through UM_BA0F and UM_BA0G through UM_BA0K, satellite secondary treatment at the LTV site (BA10) was carried forward for further consideration as a potential RBS alternative, however it was not developed as completely as the other alternatives at this stage of planning (prior to regional optimization). Preliminary sizing was completed and resulted in a 45 MGD facility with a peak capacity of 135 MGD.

***Summary of Additional Basin Alternatives in Support of Regional Integration*:** Table 9-67 provided details on the additional basin alternatives that were evaluated as part of the regional integration process. Included are a list of these alternatives, the ALCOSAN CSO and SSO control levels, and the total capital costs. As noted in Table 9-30, these basin alternatives reflected evolving municipal planning information, and levels of CSO and SSO control which varied by municipality. All of these additional alternatives considered higher levels of control for targeted outfalls in sensitive areas, but they are not included in the Alternative 3f costs reported.

The following provides summary descriptions of these alternatives. The system-wide alternative, and the level of CSO control associated with each basin alternative, are shown in parentheses behind the basin alternative identifier. Maps are included in Section 9.5 that illustrate these basin alternative components as part of an overall system-wide alternative.

UM_BA0M (Alt. 3f – 4 to 6 overflows/year)
This alternative evaluated conveyance of overflows within the UM planning basin to a regional conveyance tunnel that would extend to M-51. Drop shafts were located near M-34, M-33, M-40, M-42, M-47, M-49, and M-51. Three consolidation conveyance pipes are proposed to convey overflows from (1) M-37, M-36, and M-35 to the drop shaft near M-33; (2) M-45, M-44, M-43 to a draft shaft near M-42; and (3) M-48, M-50, and M-51 through M-60 to a drop shaft near M-51. While the consolidation pipes to M-33 and M-51 are proposed for wet weather flows only, the M-42 consolidation pipe is proposed to carry both dry and wet weather flows. This new consolidation pipe has a dry weather flow pipe that connects to M-42A-00. During wet weather, the capacity of this connection will be exceeded and flow will begin to store in the consolidation pipe. Once the volume of this pipe is exceeded, flows are diverted to the new drop shaft for discharge into the regional conveyance tunnel. This configuration is considered necessary to address the existing sub-aqueous Shallow-Cut Monongahela River Interceptor and the inherent difficulties in maintaining this interceptor.

It should be noted that this modeling was completed prior to the availability of detailed municipal planning information. Therefore, the model includes larger municipal pipes where necessary to ensure unrestricted conveyance of municipal peak flows to their point of connection to the ALCOSAN system. Because this alternative is intended to limit overflows to specific dates (as described in Section 9.5), the connection to the drop shafts was modeled without any downstream boundary conditions. Further analysis conducted by the PM did apply a boundary condition at the drop shafts to represent a more realistic simulation of the new tunnel operation. As modeled, this boundary condition causes a backwater effect at the drop shaft locations which leads to 4 to 6 overflows at points of connection across the UM planning basin.

UM_BA0S (Alt. 3f-modified – 4 to 6 overflows/year)
This system-wide alternative is a minor variation of Alternative 3f, described in Section 9.5, which includes a higher level of CSO control for targeted outfalls in sensitive areas. Alternative 3f-modified was modeled in the same way as Alternative 3f, except that boundary conditions mimicking operation of the new regional conveyance tunnel were provided by the PM to be applied at each of the drop shafts. Another difference from Alternative 3f, is that Alternative 3f modified incorporated planned municipal upgrades in lieu of assuming full municipal peak flow conveyance as was done for Alternative 3f.

Alt 8a (Alt. 8a – 13 to 15 overflows/year)
System-wide Alternative 8a is an additional basin alternative targeted at a CSO level of control of 13 to 15 overflows/year. System-wide Alternative 8a is based upon the UM planning basin preferred basin-based alternative and includes the following site alternatives:

- Hazelwood Consolidation Facility (RTB) and associated consolidation sewers (CF-31) described below.

- Streets Run Consolidation Facility (RTB) and associated consolidation sewers (CF-02) described below.

- An individual facility (storage tank) upstream of M-47 in Nine Mile Run and associated sewer improvements.

- Mon Valley Consolidation Facility (RTB) and associated consolidation sewers (CF-07) described below.

- An individual facility (RTB) to serve M-59 in the Mon Valley and associated sewer improvements.

Several of the site alternatives differ from the preferred basin-based approach. For example, the M-47 site alternative does not include an RTB near M-47. This RTB is only required for higher levels of control (0 to 4 overflows per year) than what is required for this alternative. Additionally, there are no modifications to M-32, M-33 and M-61 because these points of connections overflow less than 15 times per year under Future Baseline with Conveyance of All Municipal Flows (i.e. without additional controls in place). The following consolidation site alternatives address each of the identified points of connection (POCs):

- CF02 (Streets Run) – A consolidation pipe picking up excess flow from the M-42, M-43, M-44, M-45, and M-49 POCs;

- CF07 (Mon Valley) – Consists of two consolidation pipes one for intercepting flow from the M-48 and M-50 POCs and one for intercepting flows from POCs M-58 through M-60, except M-59;

- CF31 (Hazelwood) – Consists of several new sewers consolidating excess flows from the M-31, M-34, and M-35 through M-40 POCs.

Similar to Alternative 3f, the model includes larger municipal pipes to ensure municipal peak flow conveyance to the ALCOSAN point of connection. Furthermore, a new boundary condition for the existing ALCOSAN deep tunnel interceptor was applied based on the targeted CSO level of control of 13 to 15 overflows per year.

New diversion structures and conveyance pipes were sized to convey the peak flow from the fifth largest typical year storm in terms of peak flow, with one exception. The diversion structure at M-43 is sized to pass the peak typical year flow since it is a targeted outfall which discharges to a sensitive area.

The capacity of the consolidation facility (RTB) and associated influent pumping station was used to achieve the 13 to 15 unique overflow events identified for all outfalls that do not discharge near a sensitive area. When the capacity of the facility is exceeded, the new sewers back up and cause the 13 to 15 overflow events to occur at one or more of the consolidated outfalls. Because M-43 is near a sensitive area, its overflows were limited to no more than 4 times in the typical year.

The outfall at M-47 was also an exception because of the location of the proposed storage tank upstream of the ALCOSAN point of connection in Frick Park. There are several other sewers entering the existing trunk sewer between the tank location near MH128R001 and the point of connection. Due to the tank's location upstream, it cannot control downstream flows to completely eliminate overflows at the POC and therefore the diversion dam within the M-47 point of connection would need to be raised to an elevation of 719.26 ft to limit overflows at the point of connection to 4 per year to be consistent with the configuration of other diversions under this alternative. To achieve the 13 to 15 overflows per year target, the tank was sized to completely fill during larger storms, sending excess flow downstream to the POC where it would overflow. However, due to the capacity limitations of the existing trunk sewer downstream of the tank, 13 to 15 overflows per year could not be achieved before needing to relieve the tank through an overflow to Nine Mile Run. Therefore, the proposed diversion dam elevation at the M-47 POC was lowered in the model from 719.26 back to its existing elevation of 712.26 which results in 14 overflow events at the POC.

Section 9.5 describes the integration of these basin alternatives into system-wide alternatives. The section describes the system-wide alternative development process and provides descriptions of the system-wide alternatives that were evaluated.

Summary of Alternatives to Address Targeted CSO Outfalls near Sensitive Areas:
As described in Section 9.1, guidance was provided to the basin planners to evaluate alternatives for varying levels of enhanced control to Consent Decree defined sensitive areas. For basin alternatives in support of select system-wide alternatives targeting 4 to 6 overflows per year for all CSOs, basin planners evaluated alternatives for providing a 1 year level of control (zero overflows in the typical year) for outfalls directly impacting sensitive areas.

There is only one CSO outfall within the UM planning basin, M-43, that discharges directly upstream of a sensitive area. There are 14 additional targeted outfalls that directly impact sensitive areas in the Main Rivers and Lower Northern Allegheny planning basins.

Using BA3f as a baseline condition, two options were evaluated for providing a 1 year level of control for outfall M-43. These options are described below.

Complete Sewer Separation for Targeted CSO Outfalls Near Sensitive Areas

The M-43 outfall is situated directly in the middle of Sandcastle WaterPark, less than 2,000 feet upstream of the designated sensitive area adjacent to the park. This alternative evaluated completely separating the combined sewers tributary to M-43 to eliminate this CSO. The evaluation was based on System-Wide Alternative 3f described above. The results of the analysis indicated that separation of the small combined sewer area tributary to M-43 did not impact the size of the consolidation sewer. Therefore, the cost of separating the sewers would increase the cost of System-Wide Alternative 3f. The cost to completely separate the area tributary to M-43 is estimated at $27.3 million. Because separating these sewers would not change the size of the consolidation sewer, this cost would add to the proposed consolidation.

Relocation of Targeted CSO Outfalls Near Sensitive Areas

As an alternative to sewer separation, another alternative was devised for eliminating the M-43 outfall by transporting excess flow downstream of the sensitive area. This was again evaluated as part of System-Wide Alternative 3f. Because that alternative is essentially a relocation of excess flows (to a new drop shaft and conveyance pipe), this alternative evaluated phasing of the overall alternative to allow for relocation of the flow from M-43 prior to the construction of the drop shaft and tunnel. To eliminate M-43, a portion of the consolidation sewer would be built to convey both dry and wet weather flows to Manhole M-42A-00 just downstream of M-42. Since a phased approach is considered where the additional regional conveyance tunnel is not yet available, a large enough portion (length) of the new consolidation sewer would be built such that it can provide enough inline storage within the consolidation to eliminate M-43 overflows. Stored flow would be released back to the existing interceptor system through the dry weather connection to M-42A-00. Alternatively at full build out, when the consolidation pipe will be carrying excess flow from M-44 and M-45 as well, the consolidation would not have capacity for inline storage, but would carry the excess flow to the new regional conveyance tunnel. The cost of this initial phase of the consolidation is estimated at $26.32 million. For this initial phase, the proposed alternative includes the elimination of the targeted outfall (M-43) using inline storage of a consolidation sewer that extends from just downstream of M-44 (but not connected to it) to M-42. As such, any additional costs would be minor and related to issuing multiple contracts, which may be done anyway if the full alternative was constructed within a single timeframe.

Based on the additional cost and limited water quality benefits associated with sewer separation, relocation of the targeted CSO outfall was recommended through phasing of the full 3f-modified alternative.

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9.5 System-Wide Alternatives Analysis

As described in Section 9.4, basin alternatives were analyzed by the ALCOSAN basin planners (BPs) for various levels of CSO and SSO control. In parallel with this effort, the Program Manager (PM) analyzed complementary regional alternatives that included new regional conveyance, storage, and treatment serving some or all planning basins. As the BPs identified and improved upon basin alternatives for different levels of CSO and SSO control, the PM integrated the basin alternatives for all seven planning basins with complementary regional alternatives to form various system-wide alternatives. Each system-wide alternative represented a complete plan to control ALCOSAN and municipal CSOs and SSOs, to a selected level of control. As prescribed by the National CSO Policy[9-8], a range of CSO levels of control were evaluated, including alternatives targeting "presumption" and "demonstration" approach criteria. The "presumption approach" presumes that achievement of certain performance criteria (i.e., 4-6 untreated overflow events per year or 85 percent capture of the combined sewage generated during rainfall events) would provide an adequate level of control to not preclude attainment with water quality standards. Whereas, a "demonstration approach" entails developing and implementing a control plan that demonstrates it will not preclude attainment with water quality standards. A range of SSO control levels was also considered, including the 2-year and 10-year level of control as indicated in ALCOSAN's Consent Decree (CD). This section describes the system-wide alternatives analysis process and presents the results. The section is organized as follows:

- Section 9.5.1 - Provides a description of the system-wide alternatives development process and categories of alternatives that were analyzed
- Section 9.5.2 - Includes descriptions and maps of the alternatives that were evaluated
- Section 9.5.3 - Presents the results of the initial basin-based and regional-based alternatives
- Section 9.5.4 - Describes the satellite sewage treatment and regional tunnel extents analysis results
- Section 9.5.5 – Presents the SSO control analysis and results
- Section 9.5.6 - Presents the results of hybrid alternatives (mix of basin-based and regional-based) evaluated to compare the cost effectiveness of a Presumption Approach based Plan to a Demonstration Approach based Plan
- Section 9.5.7 – Describes the system-wide alternatives ranking analysis and presents the ranking results

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[9-8] EPA (U.S. Environmental Protection Agency). 1994. Combined Sewer Overflow (CSO) Control Policy. FRL-4732-7. Federal Register 59(75).

9.5.1 Introduction

Initial system-wide alternatives were derived based on the two control strategies analyzed by the BPs for five levels of CSO control. The planning basin-based strategy (BBS) assumed that additional regional conveyance beyond the existing interceptor system would not be available. The regional-based strategy (RBS) assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Under these two control strategies, the preferred basin alternatives developed by each BP (as described in Sections 9.4.2 through 9.4.8) were integrated system-wide, with regional facilities, to establish System-Wide Alternatives 1 and 2.

An additional alternative that was evaluated by the BPs under the BBS control strategy was to identify the most cost-effective means to achieve 85% CSO capture by receiving stream, using a subset of controls that comprise the preferred BBS alternative in each planning basin. This BBS alternative targeted the 85% capture by volume criterion that is presumed to meet the water-quality based requirements of the Clean Water Act (CWA) under the Presumption Approach. Preliminary BP percent capture estimates were used to estimate the annual untreated overflow volume that equated to 85% capture by receiving stream. The 85% capture basin alternatives were compiled to formulate System-Wide Alternative 5. An additional alternative that was evaluated under the RBS control strategy was to control all CSOs via complete sewer separation. The sewer separation basin alternatives were compiled to formulate System-Wide Alternative 4. The individual basin alternatives comprising System-Wide Alternatives 4 & 5 are described in Sections 9.4.2 through 9.4.8.

In addition to these initial alternatives, a series of preliminary hybrid alternatives (mix of BBS and RBS basin alternatives) were developed in support of evaluating satellite sewage treatment (SST) and regional tunnel extents. As described in Section 9.2, each of the ALCOSAN BPs analyzed the potential of a SST alternative within their respective planning basin. The most viable alternative for the implementation of a SST plant was in the Upper Monongahela planning basin. The proposed 125 MGD SST plant near M-30 would treat all flows conveyed by the existing deep tunnel interceptor from the Upper Monongahela and Turtle Creek planning basins. Additional regional conveyance plus this SST alternative was evaluated as System-Wide Alternative 3c. In addition to this alternative, system-wide alternatives 3, 3d, 3e, 3f-prelim, and 3g were developed in support of evaluation of regional tunnel extents. As a starting point, a maximum extent regional tunnel that served each of the seven planning basins was established by integrating the selected RBS alternatives for each planning basin. To evaluate the most cost effective system-wide combination of regional-based and basin-based control strategies, various regional tunnel extents were analyzed as a series of alternatives that were based on subsets of this maximum extent regional tunnel. These included five different tunnel extents along the Allegheny and Monongahela Rivers with various combinations of remote CSO and SSO facilities. These facilities were based on the strategically selected combinations of the BP's most preferred BBS and RBS alternatives. The satellite sewage treatment and regional tunnel extents analysis is described in more detail in Section 9.5.4.

The cost and performance differences for various levels of SSO control were evaluated using System-wide Alternatives 3f, 3h and 3i. The performance target for Alternative 3f was a 2–year level of SSO control. Alternatives 3h and 3i represented variations of Alternative 3f with the primary difference being that facility sizes and costs were updated to control ALCOSAN SSO discharges to a 10-year and typical year level of control, respectively. The ALCOSAN CSO performance target for all three alternatives was 4-6 overflows per year, consistent with one of the Presumption Approach criterion that is presumed to meet the water-quality based requirements of the CWA. There was no difference in municipal controls for these three alternatives as they assumed that all flows would be conveyed to ALCOSAN. The SSO control analysis is described in Section 9.5.5.

To further identify the best mix of basin-based and regional-based facilities and converge on a recommended wet weather plan that most cost effectively achieves the water quality based requirements of the CWA, a number of additional hybrid alternatives were evaluated. These alternatives targeted the most cost effective means of achieving the Presumption Approach criterion of 4-6 overflows per year and the Demonstration Approach. These alternatives (3f, 3j, 8a, 3m, 3f-modified, and 3f-modified-10pct) evaluated variables such as different tunnel extents and sizes, varying CSO control levels, and enhanced levels of control to sensitive areas. A significant difference between these additional hybrid alternatives and the other previously described system-wide alternatives is the level of municipal planning information incorporated. Modeling and analysis of these additional hybrid alternatives included incorporation of municipal planning information that represented the latest understanding of each municipality's submitted planning information, including their preferred municipal control strategy (if available). In contrast, all of the previously described alternatives assumed that all municipal flows would be conveyed downstream; i.e. there would be no municipal CSOs during the typical year, and no municipal SSOs for the 2-year design storm.

9.5.2 Summary of System-Wide Alternatives

Table 9-68 lists the system-wide alternatives that were developed and analyzed, including basin-based control strategies, regional-based control strategies, preliminary hybrid alternatives to evaluate SST and regional tunnel extents, hybrid alternatives for evaluating SSO levels of control, and additional hybrid alternatives for evaluating CSO levels of control. Included on the table are descriptions of the alternatives, the CSO and SSO levels of control, the wastewater pumping and treatment capacities, municipal flows assumption, and the basis for consolidation sewer and regulator sizing.

Table 9-69 provides a costing summary of the system-wide alternatives that were evaluated. Included are a list of the alternatives, a description, and a breakdown of the life cycle costs. Shown are the total capital, operation and maintenance (O&M), renew and replacement (R&R) and total present worth (TPW) costs. These costs shown reflect the total planning basin, regional conveyance, WWTP expansion, and municipal costs associated with each alternative.

The remainder of this sub-section provides summary descriptions of these system-wide alternatives, including a description of the regional improvements (if applicable), municipal planning assumptions, and specific guidance that was followed in the development and evaluation of these alternatives. Maps of the ALCOSAN facilities comprising each system-wide alternative are provided as well. Maps of the municipal control strategies are provided in Section 9.3.

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Table 9-68: Summary of System-Wide Alternatives Evaluated

Alternative	Description	ALCOSAN CSO Control Level [1] (OFs/yr)	ALCOSAN SSO Control Level (Design Storm)	WWTP Influent Pumping Capacity		Treatment Capacity		Municipal Flows Assumption	Basis for Consolidation Sewer and Regulator Sizing
				Main Pump Station (MGD)	Wet Weather Pump Station (MGD)	Primary (MGD)	Secondary (MGD)		
Basin-Based Control Strategy									
1	Basin-Based Control Strategy	0	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
1	Basin-Based Control Strategy	1-3	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
1	Basin-Based Control Strategy	4-6	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
1	Basin-Based Control Strategy	7-12	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
1	Basin-Based Control Strategy	13-20	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
5	85% CSO Capture by Receiving Stream w/ Remote CSO Treatment & Storage	85% Capture	2-year	480	---	480	295	Convey all flows to ALCOSAN	5th largest storm in typical year in terms of peak flow
Regional-Based Control Strategy									
2	Regional-Based Control Strategy	0	2-year	400	200	600	295	Convey all flows to ALCOSAN	Selected by BPs
2	Regional-Based Control Strategy	1-3	2-year	400	200	600	295	Convey all flows to ALCOSAN	Selected by BPs
2	Regional-Based Control Strategy	4-6	2-year	400	200	600	295	Convey all flows to ALCOSAN	Selected by BPs
2	Regional-Based Control Strategy	7-12	2-year	400	200	600	295	Convey all flows to ALCOSAN	Selected by BPs
2	Regional-Based Control Strategy	13-20	2-year	400	200	600	295	Convey all flows to ALCOSAN	Selected by BPs
4	Complete Sewer Separation and SSO Storage/Conveyance	0	2-year	---	---	Not determined	Not determined	Convey all flows to ALCOSAN	Not determined
Preliminary Hybrid Alternatives for Evaluating Satellite Sewage Treatment and Regional Tunnel Extents									
3	Regional Tunnel w/ Remote CSO Treatment and Storage (Tunnel from WWTP to A-42 and M-29)	4-6	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
3c	Same as Alt. 3 Except Satellite WWTP Serving M-30 and Upstream	4-6	2-year	480 Woods Run 125 Satellite	120 Woods Run	600 Woods Run 125 Satellite	275 Woods Run 125 Satellite	Convey all flows to ALCOSAN	Selected by BPs
3d	Same as Alt. 3 Except Tunnel along Allegheny stops around A-35	4-6	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs

Table 9-68: Summary of System-Wide Alternatives Evaluated

Alternative	Description	ALCOSAN CSO Control Level [1] (OFs/yr)	ALCOSAN SSO Control Level (Design Storm)	WWTP Influent Pumping Capacity		Treatment Capacity		Municipal Flows Assumption	Basis for Consolidation Sewer and Regulator Sizing
				Main Pump Station (MGD)	Wet Weather Pump Station (MGD)	Primary (MGD)	Secondary (MGD)		
3e	Same as Alt. 3 Except Tunnel along Monongahela stops around M-42	4-6	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
3f-prelim	Same as Alt. 3 Except Tunnel along Monongahela stops around M-59	4-6	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
3g	Same as Alt. 3 Except Tunnel along Monongahela stops around T-04	4-6	2-year	480	120	600	295	Convey all flows to ALCOSAN	Selected by BPs
Hybrid Alternatives for Evaluating SSO Level of Control									
3f	Same as Alt. 3f-prelim except tunnel end moved from M-59 to M-51	4-6	2-year	480	120	600	295	Limited municipal planning info incorporated	Peak flow in typical year
3h	Same as Alt. 3f Except 10 year SSO control	4-6	10-year	480	120	600	295	Limited municipal planning info incorporated	Peak flow in typical year
3i	Same as Alt. 3f Except Typical Year SSO control	4-6	Typical Year	480	120	600	295	Limited municipal planning info incorporated	Peak flow in typical year
Additional Hybrid Alternatives for Evaluating Presumption and Demonstration Approaches									
3j	Same as Alt. 3f Except Tunnel Diameter Reduced	4-6	2-year	480	120	600	295	Limited municipal planning info incorporated	Peak flow in typical year
8a	Alt 3 Tunnel Extent with Diameter Reduced	13-15 (4-6 for sensitive areas)	2-year	480	120	600	295	Limited municipal planning info incorporated	5th largest storm in typical year in terms of peak flow [2]
3m	Same as Alt. 8a Except UM Served by Regional Tunnel (same tunnel extent as Alt. 3f)	13-15 (4-6 for sensitive areas)	2-year	480	120	600	295	Limited municipal planning info incorporated	5th largest storm in typical year in terms of peak flow [2]
3f-mod	Same as Alt. 3f Except Higher Level of CSO Control for Outfalls in Sensitive Areas	4-6 (0 for sensitive areas)	2-year	480	120	600	295	Latest municipal planning info incorporated	Peak flow in typical year
Alt. 3f-mod-10pct.	Same as Alt 3f-mod Except Small Volume Overflows Not Connected to New Conveyance	Varies	2-year	480	120	600	295	Latest municipal planning info incorporated	Peak Flow in Typical Year

Note 1: For the first four categories of system-wide alternatives, the CSO control levels reflect the stated number of overflow events allowed at each regulator. For the last two categories, the CSO control levels indicate the number of unique overflow events for an entire facility such as the regional tunnel or group of outfalls served by a single storage facility.

Note 2: Except used peak flow in typical year for sensitive areas

Table 9-69: System-Wide Alternatives Costing Summary

Alternative	Description	Total Capital Cost ($ million)	Total O&M Cost ($ million)	Total R&R Cost ($ million)	Total Present Worth Cost ($ million)
Basin-Based Control Strategy					
1	Basin-Based Control Strategy (0 overflows/year)	$7,604	$283	$55	$7,940
1	Basin-Based Control Strategy (1-3 overflows/year)	$6,613	$254	$48	$6,915
1	Basin-Based Control Strategy (4-6 overflows/year)	$5,590	$223	$44	$5,855
1	Basin-Based Control Strategy (7-12 overflows/year)	$4,982	$203	$41	$5,226
1	Basin-Based Control Strategy (13-20 overflows/year)	$3,896	$165	$36	$4,097
5	85% CSO Capture by Receiving Stream w/ Remote CSO Treatment & Storage	$2,529	$130	$28	$2,688
Regional-Based Control Strategy					
2	Regional-Based Control Strategy (0 overflows/year)	$4,933	$133	$33	$5,098
2	Regional-Based Control Strategy (1-3 overflows/year)	$4,463	$133	$48	$4,644
2	Regional-Based Control Strategy (4-6 overflows/year)	$4,206	$127	$37	$4,370
2	Regional-Based Control Strategy (7-12 overflows/year)	$3,811	$123	$36	$3,969
2	Regional-Based Control Strategy (13-20 overflows/year)	$3,560	$124	$34	$3,717
4	Complete Sewer Separation and SSO Storage/Conveyance *	$9,794	$125	$14	$9,933
Preliminary Hybrid Alternatives for Evaluating Satellite Sewage Treatment and Regional Tunnel Extents					
3	Regional Tunnel w/ Remote CSO Treatment and Storage (Tunnel from WWTP to A-42 and M-29)	$4,200	$146	$37	$4,383
3c	Same as Alt. 3 Except Satellite WWTP Serving M-30 and Upstream	$4,267	$233	$50	$4,550
3d	Same as Alt. 3 Except Tunnel along Allegheny stops around A-35	$4,214	$152	$37	$4,403
3e	Same as Alt. 3 Except Tunnel along Monongahela stops around M-42	$3,988	$141	$37	$4,166
3f-prelim	Same as Alt. 3 Except Tunnel along Monongahela stops around M-59	$3,891	$137	$37	$4,065
3g	Same as Alt. 3 Except Tunnel along Monongahela stops around T-04	$3,903	$129	$37	$4,069
Hybrid Alternatives for Evaluating SSO Level of Control					
3f	Same as Alt. 3f-prelim except tunnel end moved from M-59 to M-51	$4,071	$130	$35	$4,236
3h	Same as Alt. 3f Except 10 year SSO control	$4,076	$131	$35	$4,242
3i	Same as Alt. 3f Except Typical Year SSO control	$3,932	$129	$34	$4,094
Additional Hybrid Alternatives for Evaluating Presumption and Demonstration Approaches					
3j	Same as Alt. 3f Except Tunnel Diameter Reduced	$3,996	$129	$35	$4,160
8a	Alt 3 Tunnel Extents with Diameter Reduced	$3,645	$133	$34	$3,811
3m	Same as Alt. 8a Except UM Served by Regional Tunnel (same tunnel extent as Alt. 3f)	$3,680	$128	$34	$3,841
3f-mod	Same as Alt. 3f Except Higher Level of CSO Control for Targeted Outfalls in Sensitive Areas	$4,216	$126	$34	$4,386
Alt. 3f-mod-10pct.	Same as Alt 3f-mod Except Small Volume Overflows Not Connected to New Conveyance	$3,550	$146	$87	$3,780

*Note: The costs shown only include estimates of municipal costs. This alternative would also require new regional conveyance and an expanded WWTP, but the concepts and costs for the required regional improvements were not developed due to the high cost of the municipal share alone.

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9.5.2.1 Basin-Based Control Strategy

System-Wide Alternative 1

The first phase of the basin alternative evaluation process had the ALCOSAN BPs frame the development of basin alternatives within the context of the basin-based control strategy. In general, due to the constraints of the existing system hydraulic capacity, alternatives developed as part of this control strategy resulted in numerous remote wet weather storage and/or treatment facilities within each planning basin.

Regional Improvements: The peak wet weather flow from the planning basin into the ALCOSAN system would be limited to the hydraulic capacity of the existing interceptor conveyance system; hence there would not be additional regional conveyance facilities extended to the planning basins. The existing deep and shallow-cut tunnel and interceptor system would remain as the sole regional conveyance system. The Woods Run peak wet weather plant capacity and primary treatment capacity will be expanded to 600 MGD. The secondary treatment capacity will be expanded to 295 MGD.

Planning Basin Controls / Guidance: Under this control strategy, alternatives were developed and analyzed for ALCOSAN CSO levels of control of 0, 1 to 3, 4 to 6, 7 to 12, and 13 to 20 overflows per year and the elimination of ALCOSAN SSOs up to a 2-year design storm. For each level of control, the targeted number of overflow events was allowed to occur at every ALCOSAN regulator, without restricting the number of unique dates of overflow events within a planning basin. As described in Section 9.4, for each of these levels of control the BPs determined their most preferred (or recommended) basin alternative. These preferred basin-based control strategies collectively provided a suite of basin alternatives that were then integrated to establish System-Wide Alternative 1, for each control level.

Municipal Improvements: It was generally assumed that all municipal flows would be conveyed to ALCOSAN meaning that there would be no municipal CSOs during the typical year, and no municipal SSOs for the 2-year design storm. However some limited sewer separation projects were assumed to be implemented by municipalities where this appeared to be cost-effective.

Figures 9-50 through 9-54 provide maps of System-Wide Alternative 1 for the CSO levels of control of 0, 1to 3, 4 to 6, 7 to 12, and 13 to 20 overflows per year, respectively. Shown are the locations and types of ALCOSAN control facilities associated with this alternative.

Figure 9-50: System-Wide Alternative 1: Basin-Based Control Strategy (0 overflows per year)

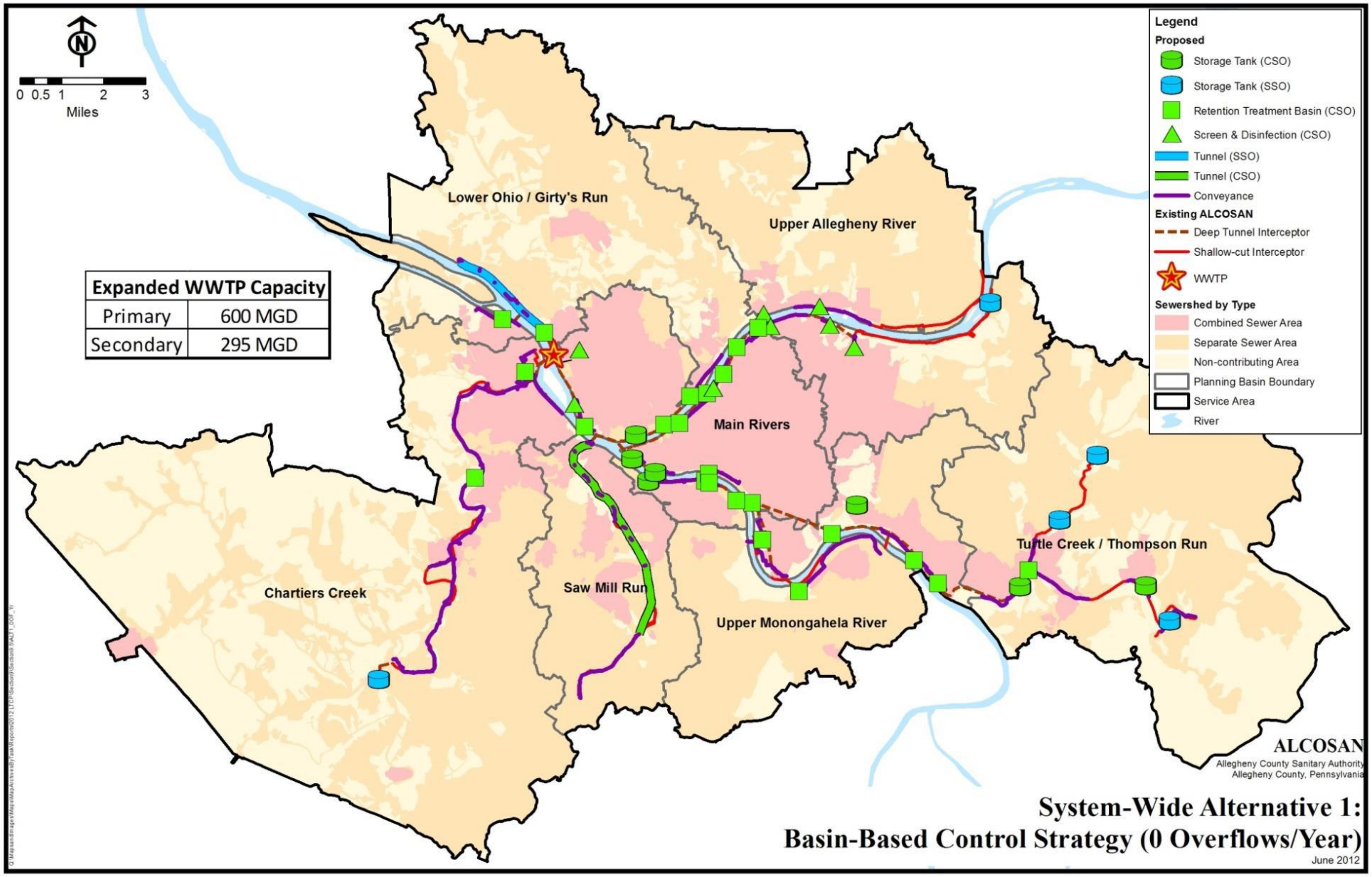
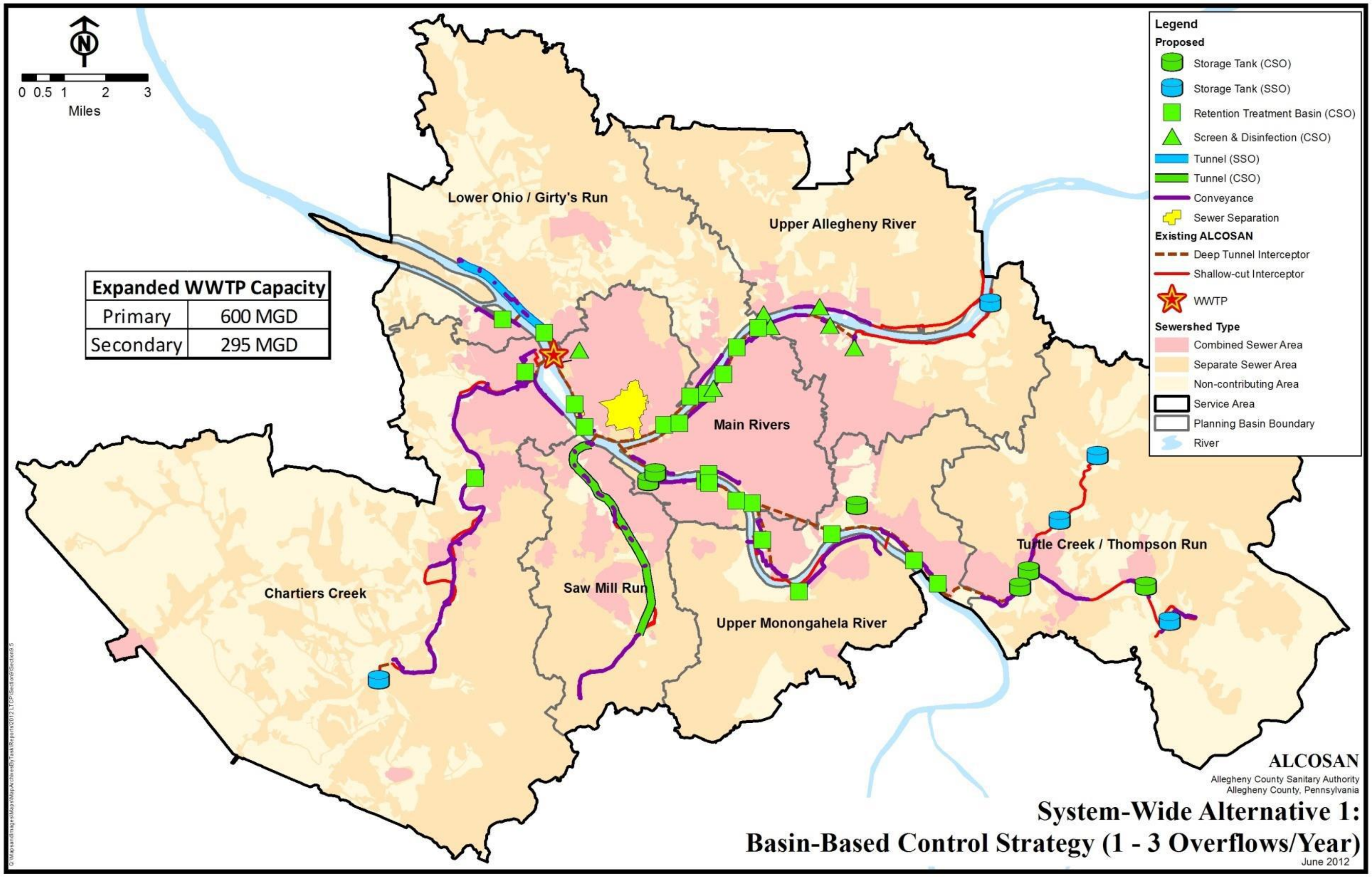


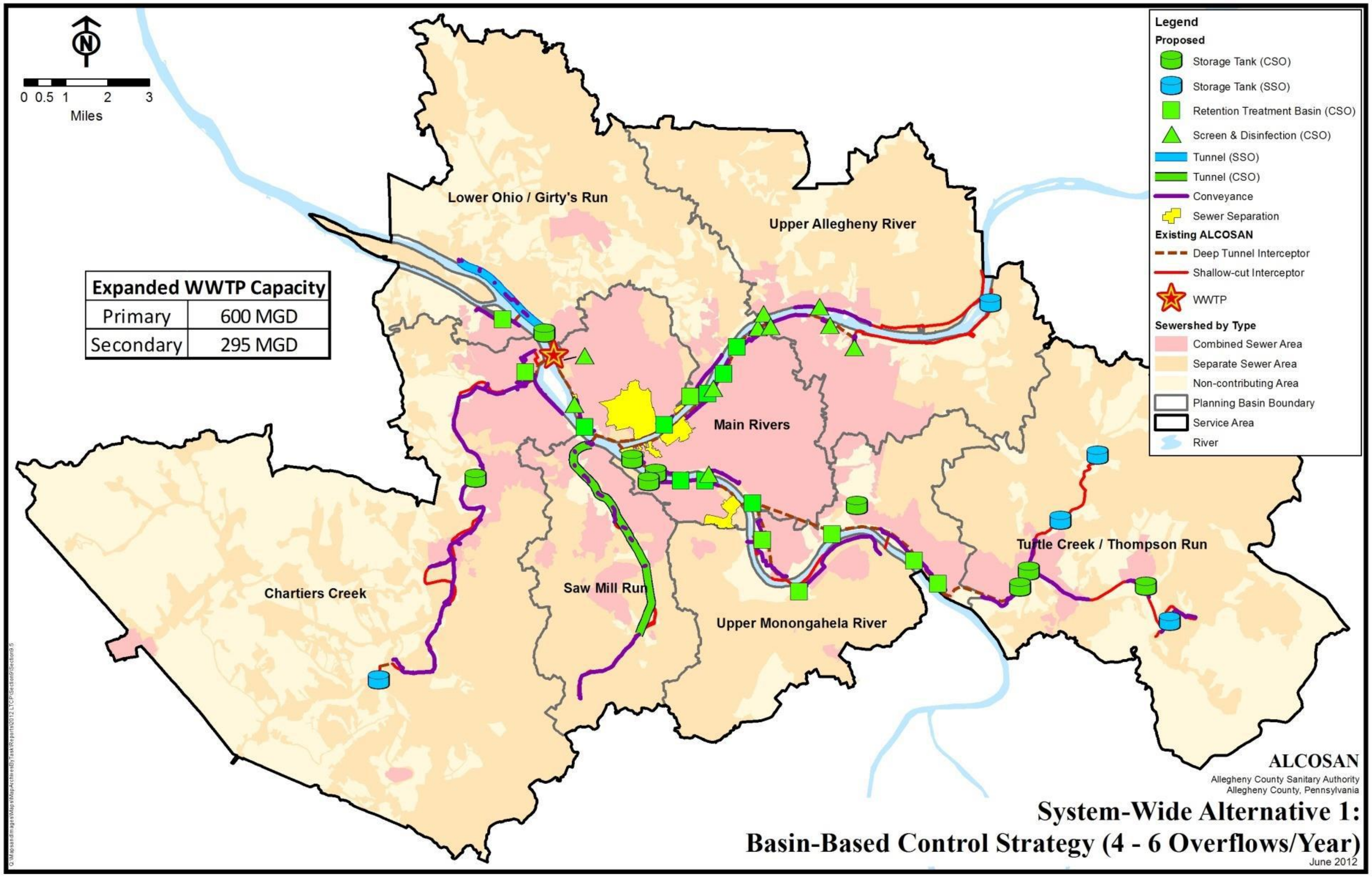
Figure 9-51: System-Wide Alternative 1: Basin-Based Control Strategy (1 to 3 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does not represent a preferred municipal control strategy.

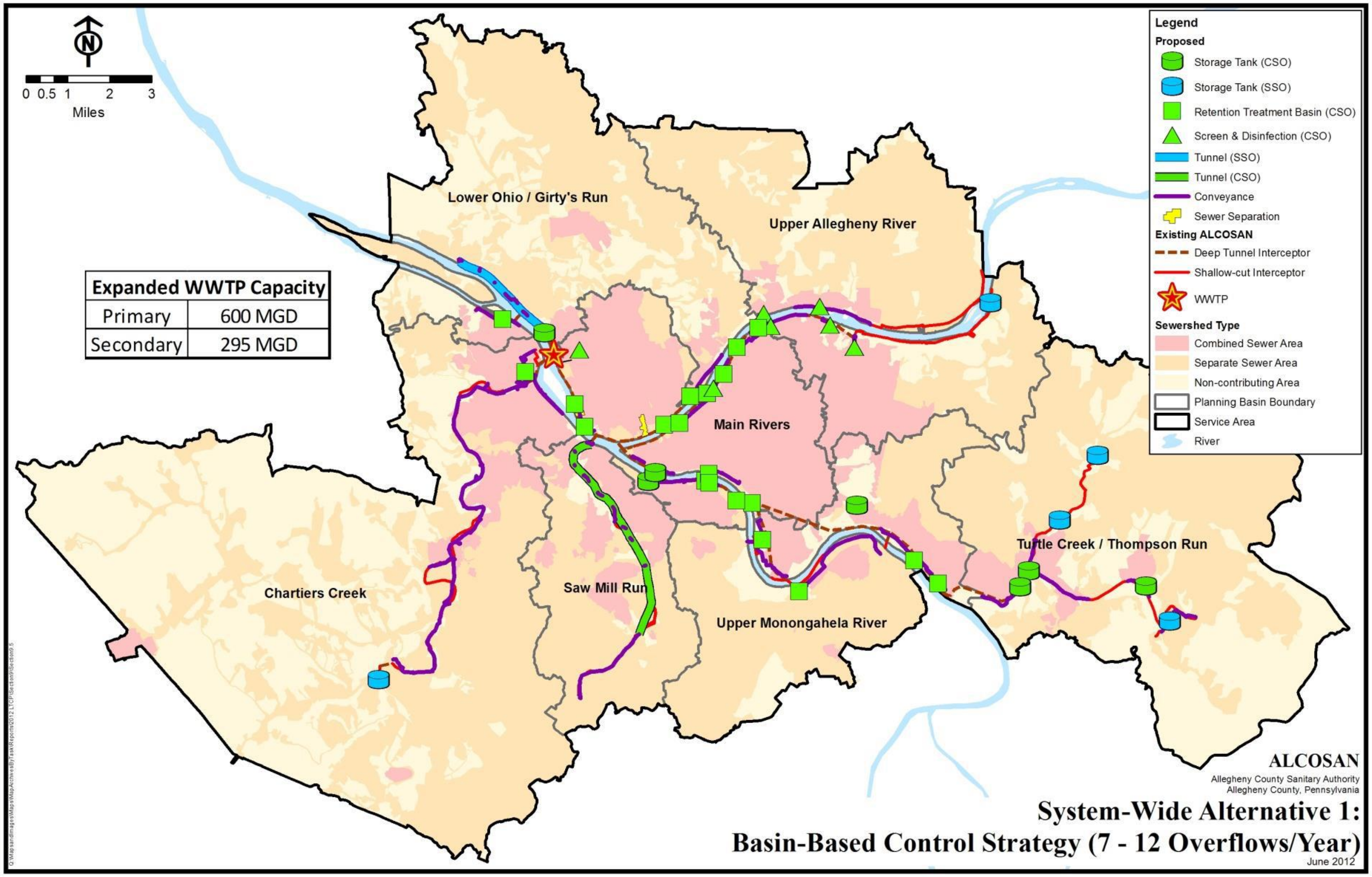
Figure 9-52: System-Wide Alternative 1: Basin-Based Control Strategy (4 to 6 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does not represent a preferred municipal control strategy.

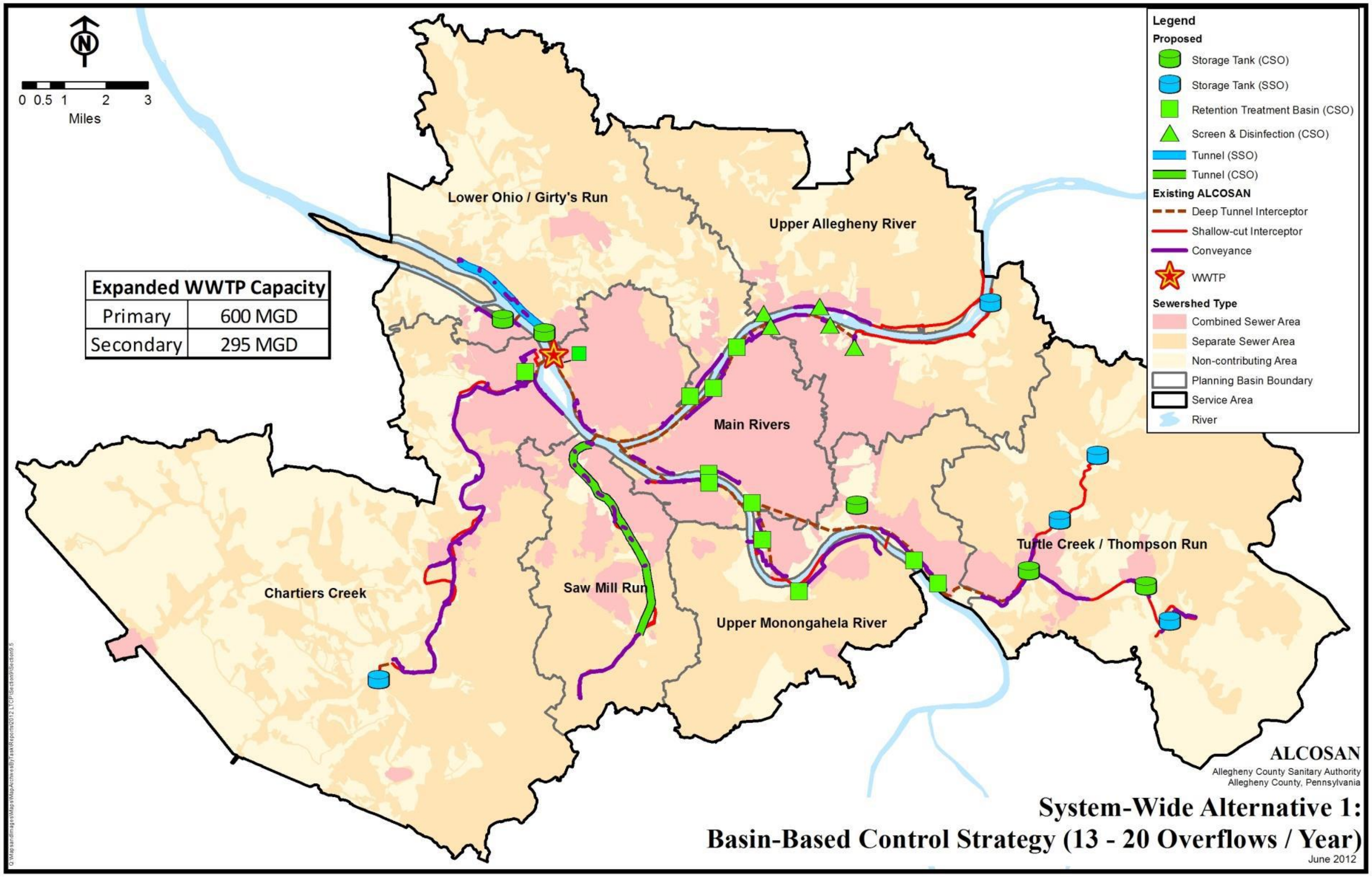
Figure 9-53: System-Wide Alternative 1: Basin-Based Control Strategy (7 to 12 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does <u>not</u> represent a preferred municipal control strategy.

Figure 9-54: System-Wide Alternative 1: Basin-Based Control Strategy (13 to 20 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does <u>not</u> represent a preferred municipal control strategy.

System-Wide Alternative 5

The objective of System-Wide Alternative 5 was to identify the most cost-effective means to achieve 85% CSO capture by receiving stream, using a subset of controls that comprise the preferred BBS basin alternative in each planning basin. Preliminary basin planner percent capture estimates were used to estimate the annual untreated overflow volume which equated to 85% CSO capture by receiving stream. The target values for annual untreated overflow volumes were in the range of 84% to 86% based on total influent volume.

Regional Improvements: regional improvements associated with this alternative included:

- No new regional conveyance
- Expanded Woods Run peak wet weather plant capacity of 480 MGD, with all flow entering the existing pump station via existing interceptors. The secondary treatment capacity will be expanded to 295 MGD.
- No new satellite WWTPs

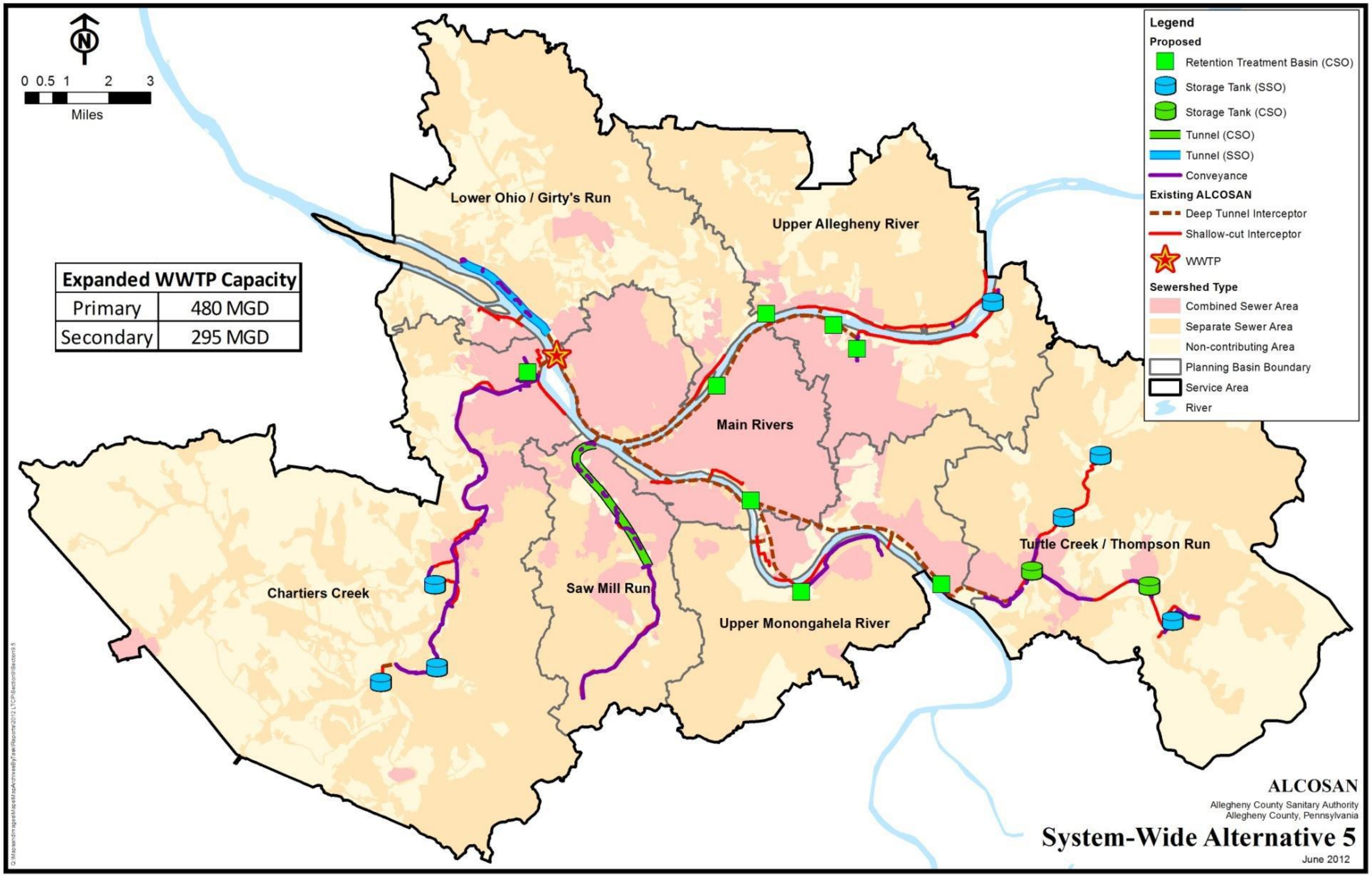
Planning Basin Controls / Guidance: the BPs developed models of selected facilities to establish their size to control ALCOSAN CSOs to 85% capture by receiving stream (within each basin) and a 2-year level of ALCOSAN SSO control. For each level of control, the targeted number of overflow events was allowed to occur at every regulator, without restricting the number of unique dates of overflow events within a planning basin.

Each BP was to develop their alternative subject to the additional guidance constraints below.

- Any level of control could be selected for any CSO facilities proposed, but all storage and treatment facilities needed to be placed on sites with room for future expansion to the size needed for 4 to 6 overflows per year.
- All remote CSO treatment facilities for all planning basins were assumed to be RTBs designed primarily to achieve screening and disinfection, and discharges from those facilities were to be considered treated.
- New diversion structures, consolidation sewers and other needed conveyance were only to be constructed for the selected storage/treatment facilities that were needed to achieve 85% capture.
- New CSO diversion structures and consolidation sewers were to be sized for the highest potential future level of control, which was assumed to be 4 overflows per year. Using this basis, all CSO consolidation sewers and diversion structures were sized to convey the peak flow from the 5th largest storm in terms of peak flow.

Municipal Improvements: modeling and analysis of this alternative assumed that all municipal flows would be conveyed to ALCOSAN, meaning that there would be no municipal CSOs during the typical year, and no municipal overflows for the 2-year design storm.
The individual 85% CSO capture basin alternatives were integrated to establish System-Wide Alternative 5. A map of this alternative is included as Figure 9-55.

Figure 9-55: System-Wide Alternative 5



Note:

1) Detailed mapping of proposed conveyance, pump stations, and drop shaft locations not available and not shown

9.5.2.2 Regional-Based Control Strategy

System-Wide Alternative 2

The first phase of the basin alternative evaluation process also had the ALCOSAN BPs frame the development of basin alternatives within the context of the regional-based control strategy (RBS), as described below. In contrast to the BBS, due to the added regional conveyance, alternatives developed under this control strategy resulted in few to no remote wet weather storage and/or treatment facilities within each planning.

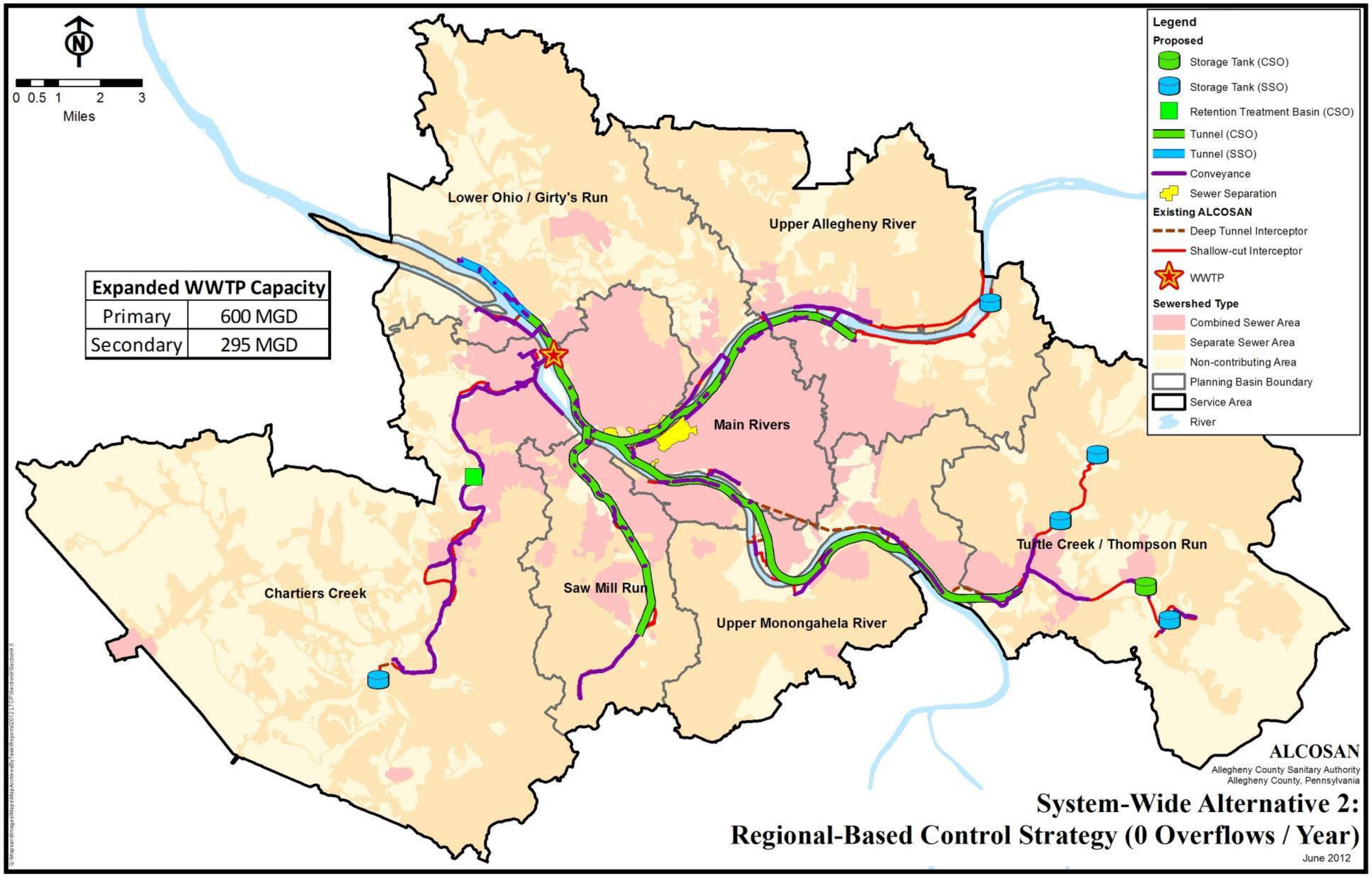
Regional Improvements: peak wet weather flow from each planning basin to the ALCOSAN system was not limited and the amount of conveyance to a new regional conveyance system was maximized. This new regional conveyance would supplement the existing interceptor conveyance in order to significantly increase the conveyance to the ALCOSAN treatment plant. The new regional tunnel would terminate in a tunnel dewatering pump station with a capacity of 200 MGD. The Woods Run peak wet weather plant capacity and primary treatment capacity will be expanded to 600 MGD. The secondary treatment capacity will be expanded to 295 MGD.

Planning Basin Controls / Guidance: under the RBS, basin alternatives were developed and analyzed for CSO levels of control of 0, 1 to 3, 4 to 6, 7 to 12, and 13 to 20 overflows per year and the elimination of SSOs up to a 2-year design storm. For each level of control, the targeted number of overflow events was allowed to occur at every regulator, without restricting the number of unique dates of overflow events within a planning basin. As described in Section 9.4, for each of these levels of control the BPs determined their most preferred (or recommended) basin alternative. These preferred regional-based control strategies collectively provided a suite of basin alternatives that were then integrated to establish System-Wide Alternative 2.

Municipal Improvements: it was generally assumed that all municipal flows would be conveyed to ALCOSAN meaning that there would be no municipal CSOs during the typical year, and no municipal SSOs for the 2-year design storm. However, some limited sewer separation projects were assumed to be implemented by municipalities where this appeared to be cost-effective.

Figures 9-56 through 9-60 provide maps of System-Wide Alternative 2 for the CSO levels of control of 0, 1 to 3, 4 to 6, 7 to 12, and 13 to 20 overflows per year, respectively. Shown are the locations and types of ALCOSAN control facilities associated with this alternative.

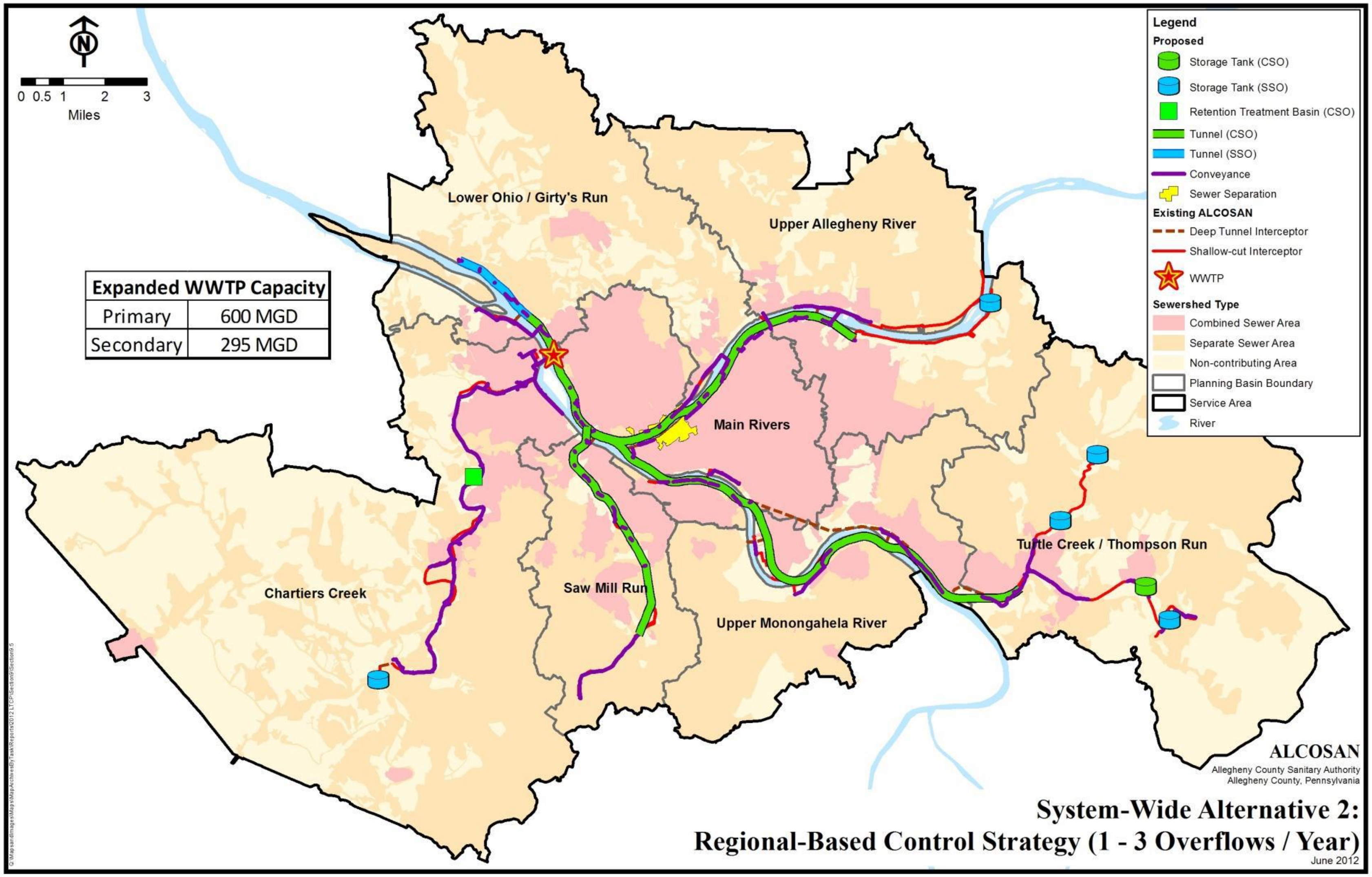
Figure 9-56: System-Wide Alternative 2: Regional-Based Control Strategy (0 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does not represent a preferred municipal control strategy.

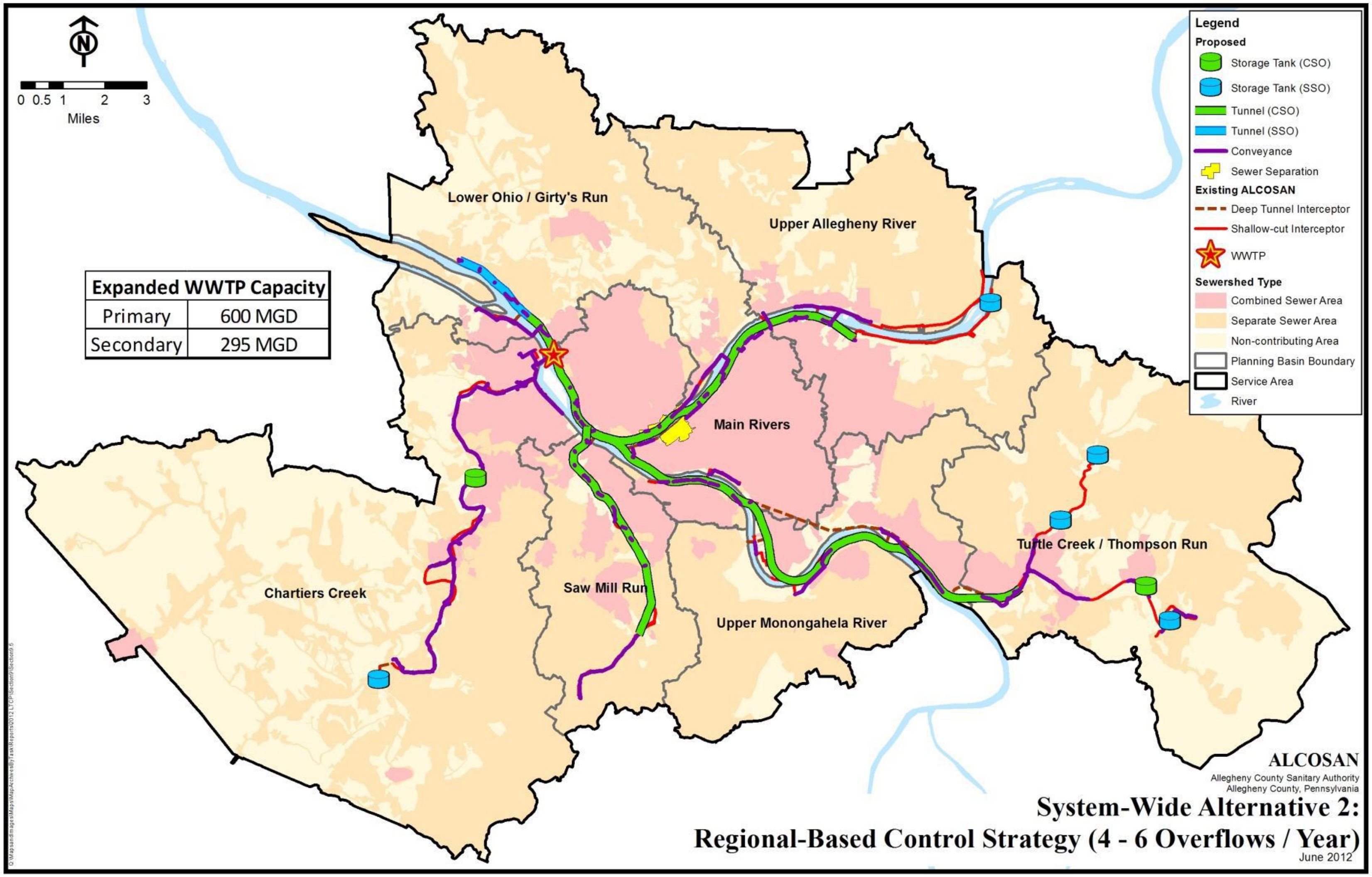
Figure 9-57: System-Wide Alternative 2: Regional-Based Control Strategy (1 to 3 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does <u>not</u> represent a preferred municipal control strategy.

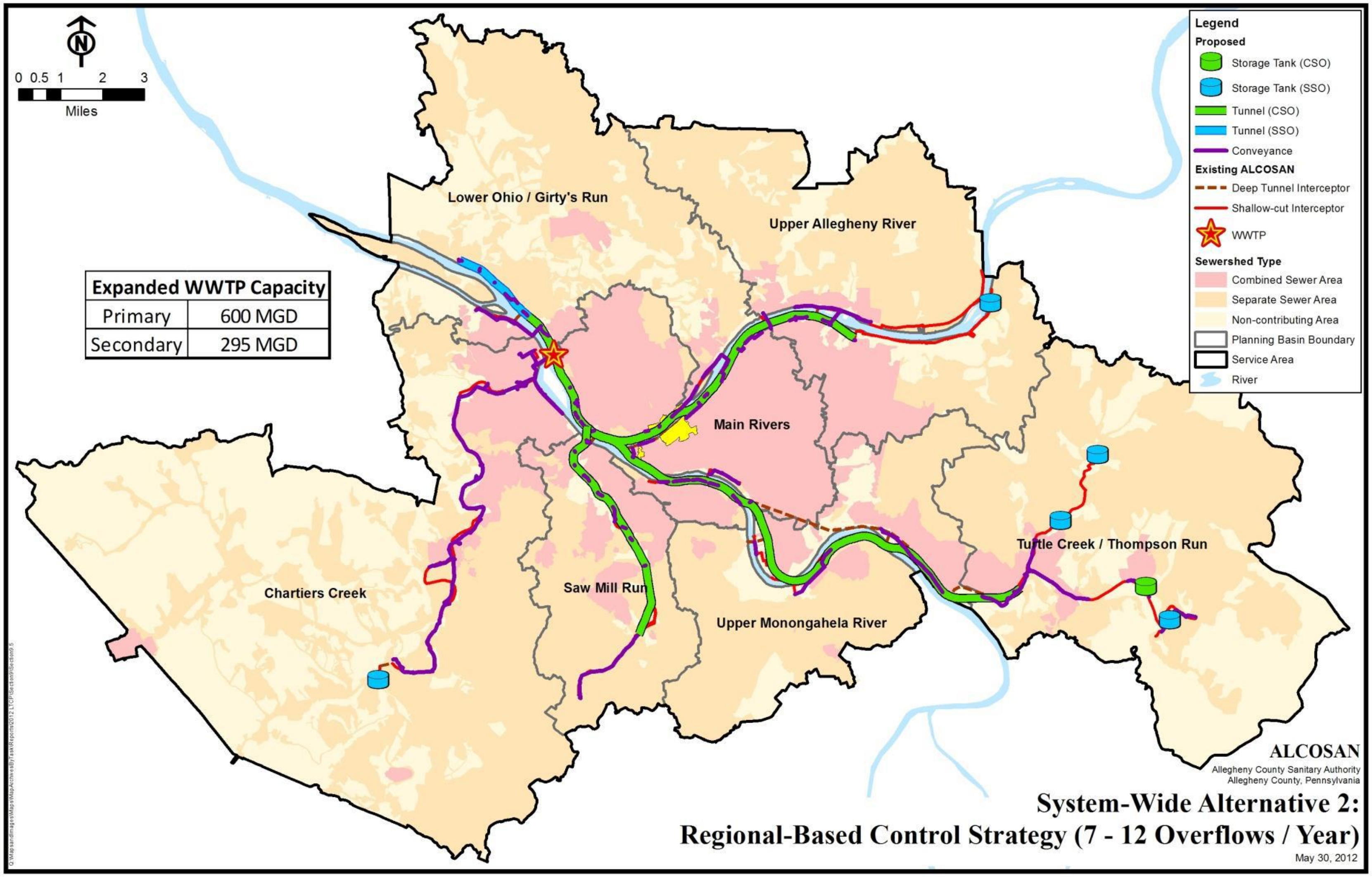
Figure 9-58: System-Wide Alternative 2: Regional-Based Control Strategy (4 to 6 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does <u>not</u> represent a preferred municipal control strategy.

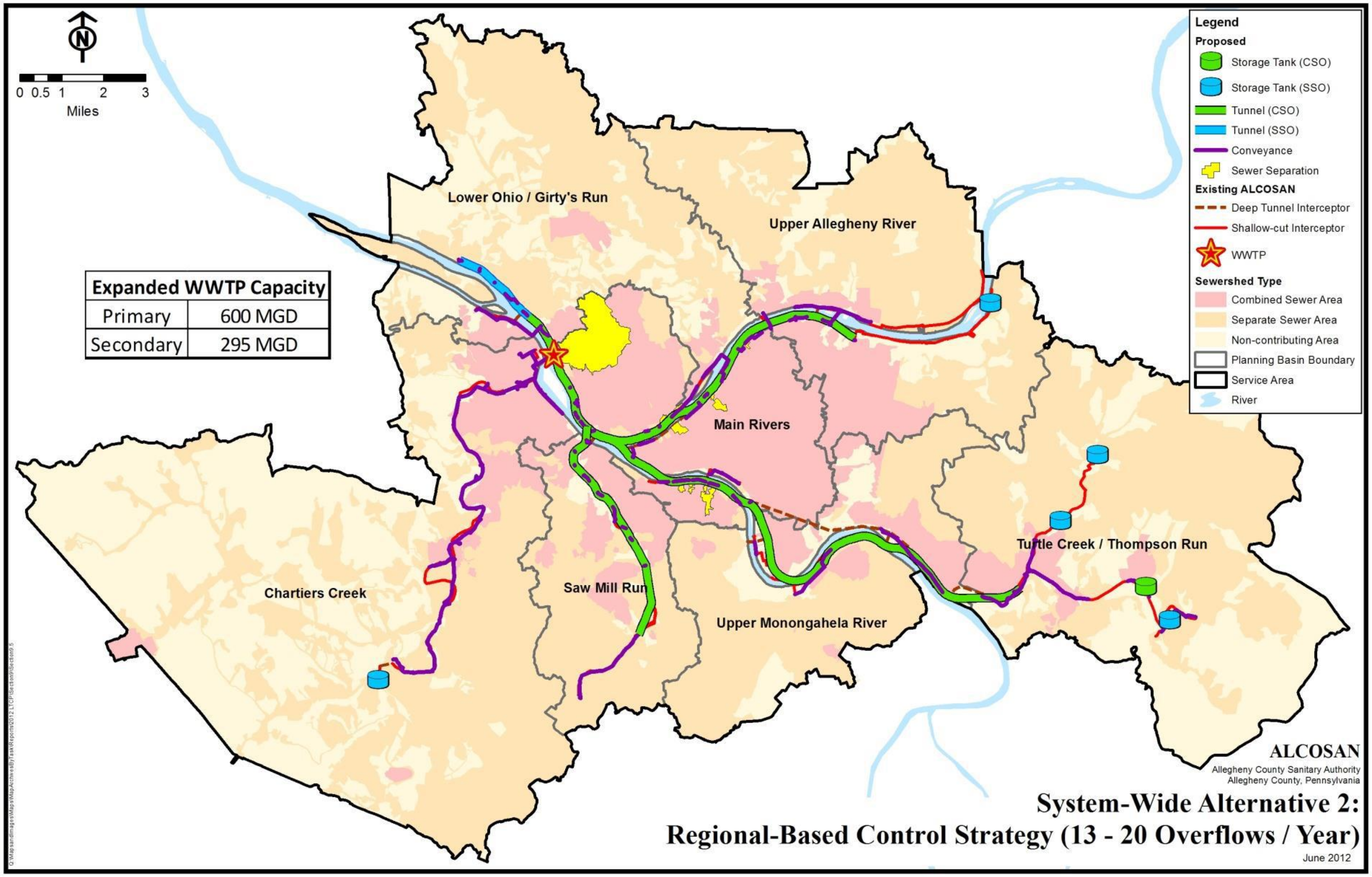
Figure 9-59: System-Wide Alternative 2: Regional-Based Control Strategy (7 to 12 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does not represent a preferred municipal control strategy.

Figure 9-60: System-Wide Alternative 2: Regional-Based Control Strategy (13 to 20 overflows per year)



Note:

1) Sewer separation was an assumed municipal control since no municipal planning information was available at the time of analysis. It does <u>not</u> represent a preferred municipal control strategy.

System-Wide Alternative 4

Sewer separation is the practice of separating a combined sewer system into separate sewers/pipes for sanitary and storm water flows, both within the public right-of-way and on private property. This may involve converting the existing combined sewer to a sanitary sewer or a storm sewer, but in either case it includes reducing wet weather flow into the sanitary sewer to the extent needed to comply with standards for new sanitary sewer construction. On private property, this often involves disconnection of all foundation drains and roof leaders from the sanitary system (including verification testing), and redirection of those flows in a safe and responsible matter.

Under the RBS, the BPs developed and evaluated a complete sewer separation alternative and a cost estimate was prepared that included the separation of all combined areas within the planning basin. Municipal cost estimates were developed by the Basin Planners (not the municipalities) using the ACT (as described in Section 9.1.3) and were based on the area and the land use of the area to be separated. This alternative would also require new regional conveyance and an expanded WWTP, but the concepts and costs for the required regional improvements were not developed due to the high cost of the municipal share alone. Descriptions of these individual sewer separation basin alternatives are provided in Sections 9.4.2 through 9.4.8. The sewer separation basin alternatives were compiled to formulate System-Wide Alternative 4.

9.5.2.3 Preliminary Hybrid Alternatives for Evaluating Satellite Sewage Treatment and Regional Tunnel Extents

System-Wide Alternative 3c

As described in Section 9.2, satellite sewage treatment (SST) plants were considered as one alternative for treatment of SSOs and CSOs, in lieu of partial treatment at the Woods Run WWTP. A preliminary evaluation of potential SST plants included the conceptual design and cost estimating for eight SST plants. Through this evaluation, it was determined that SST plants include a technical challenge to provide sufficient average daily flow (ADF) to sustain biological treatment processes. In doing this, flow must be diverted from the Woods Run WWTP, thereby reducing its ADF and peak treatment capacity. In effect, wastewater treatment would be decentralized at a higher cost than the proposed plant expansion for wet weather treatment.

Following this preliminary evaluation, each of the ALCOSAN BPs reviewed the sites presented in the preliminary evaluation and analyzed the potential of an SST alternative within their respective planning basin. The most viable case for the implementation of a SST plant was in the Upper Monongahela (UM) planning basin at the site of the former LTV Steel property in Hazelwood (identified as Site Alternative Hz-1 by the UM Basin Planner). A new pump station would be built to intercept the deep tunnel interceptor and pump all flow to a new SST plant, effectively splitting the Upper Monongahela and Turtle Creek planning basins from the rest of the ALCOSAN system. The preliminary sizing indicated that the proposed SST would need 45 mgd ADF and 125 mgd peak flow capacities to treat all flows conveyed by the existing deep tunnel interceptor from the Upper Monongahela and Turtle Creek planning basins. A conceptual site layout determined that more than 20 acres would be required unless high-rate processes are used. This SST alternative plus new regional conveyance was retained for evaluation as System-Wide Alternative 3c. A map of this alternative is included as Figure 9-61.

System-Wide Alternatives 3, 3d, 3e, 3f-prelim, and 3g

A series of preliminary hybrid alternatives were developed in support of evaluating the cost effectiveness of various regional tunnel extents. As a starting point, a maximum extent regional tunnel that served each of the seven planning basins was established and was based on integrating the selected RBS alternatives for each planning basin. To evaluate the most cost effective system-wide combination of regional-based and basin-based control strategies, various regional tunnel extents were analyzed as subsets of this maximum extent regional tunnel. This resulted in the development of system-wide alternatives 3, 3d, 3e, 3f-prelim, and 3g which included five different tunnel extents along the Allegheny and Monongahela Rivers coupled with various combinations of remote CSO and SSO facilities based on select combinations of the BPs' most preferred BBS and RBS alternatives. These alternatives were evaluated at an ALCOSAN CSO control level of 4 to 6 overflows per year and the elimination of ALCOSAN SSOs up to a 2-year design storm. The alternatives assumed that all municipal flows would be conveyed downstream to ALCOSAN meaning that there would be no municipal CSOs during the typical year, and no municipal SSOs for the 2-year design storm.

Maps of these alternatives are included as Figures 9-62 through 9-66. The regional tunnel extents analysis is described in Section 9.5.4.

Figure 9-61: System-Wide Alternative 3c

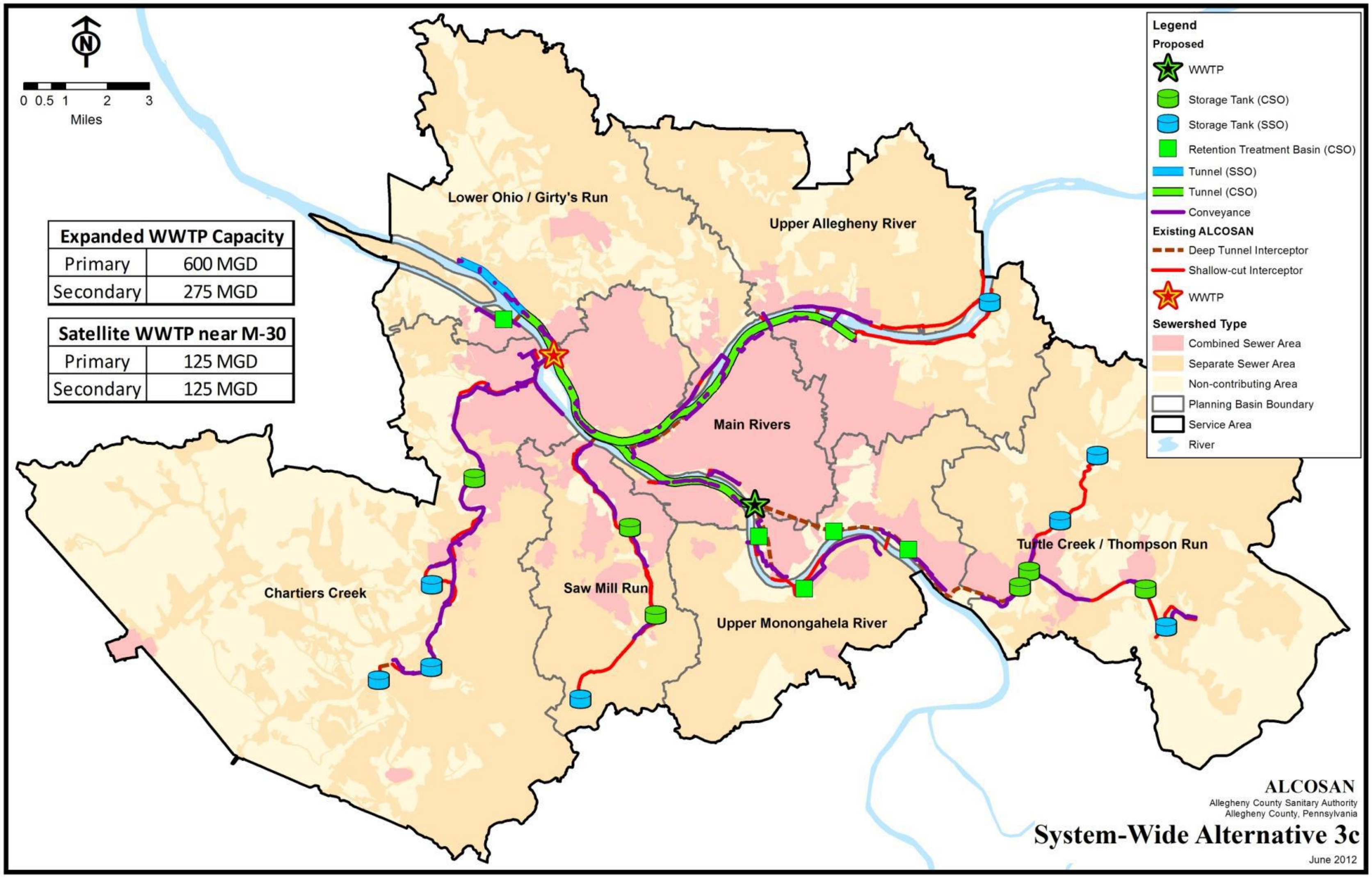


Figure 9-62: System-Wide Alternative 3

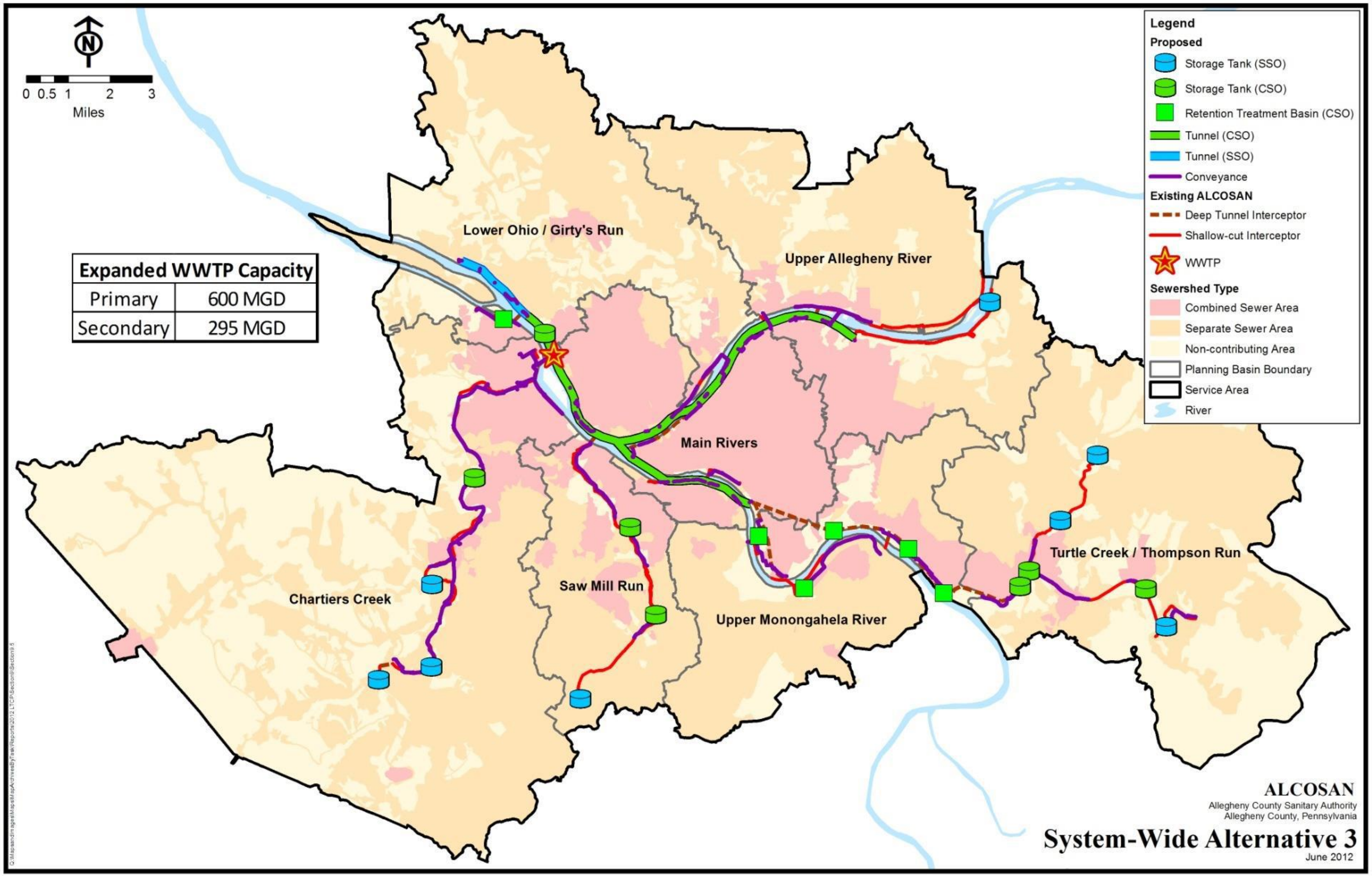


Figure 9-63: System-Wide Alternative 3d

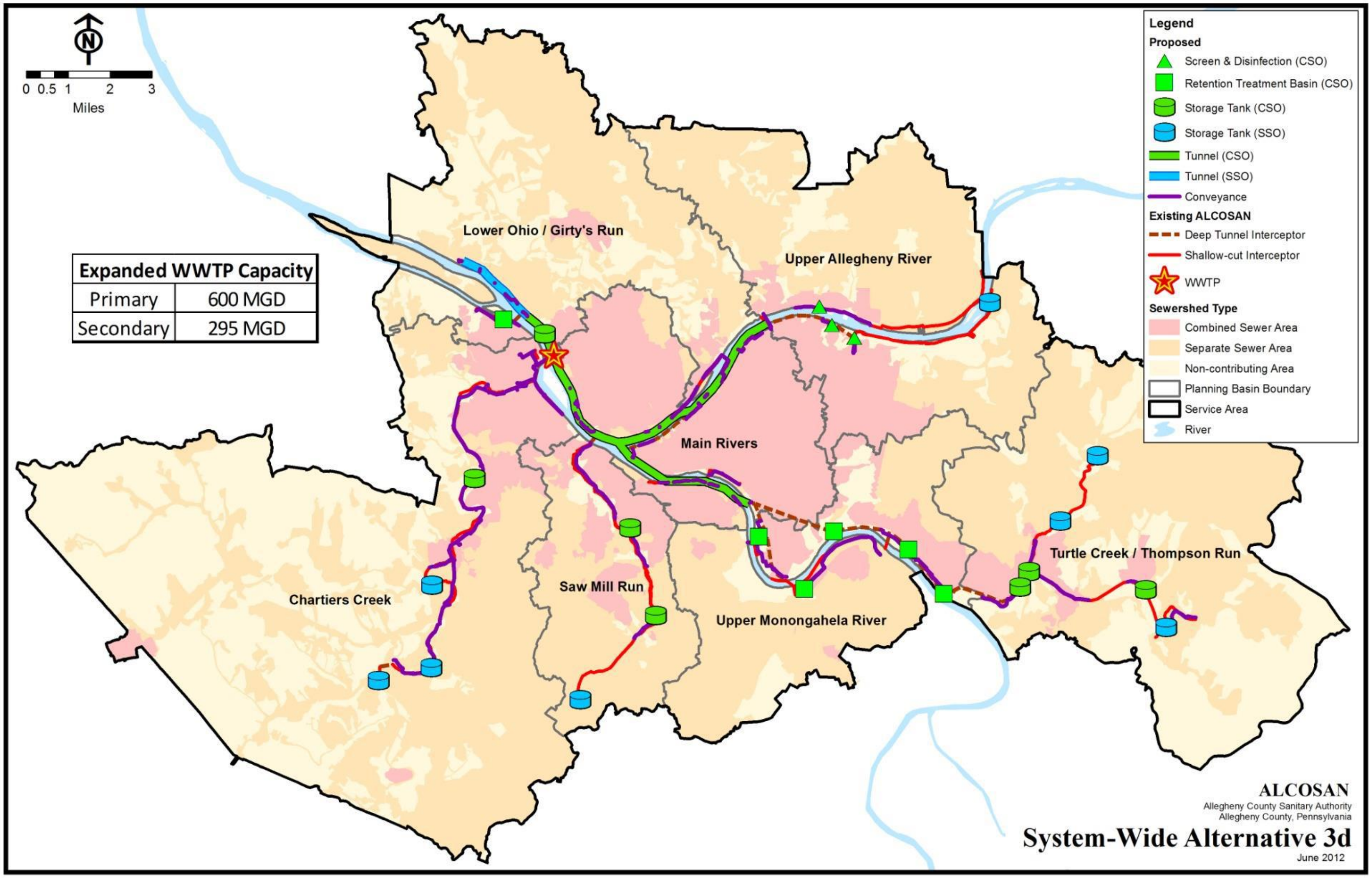


Figure 9-64: System-Wide Alternative 3e

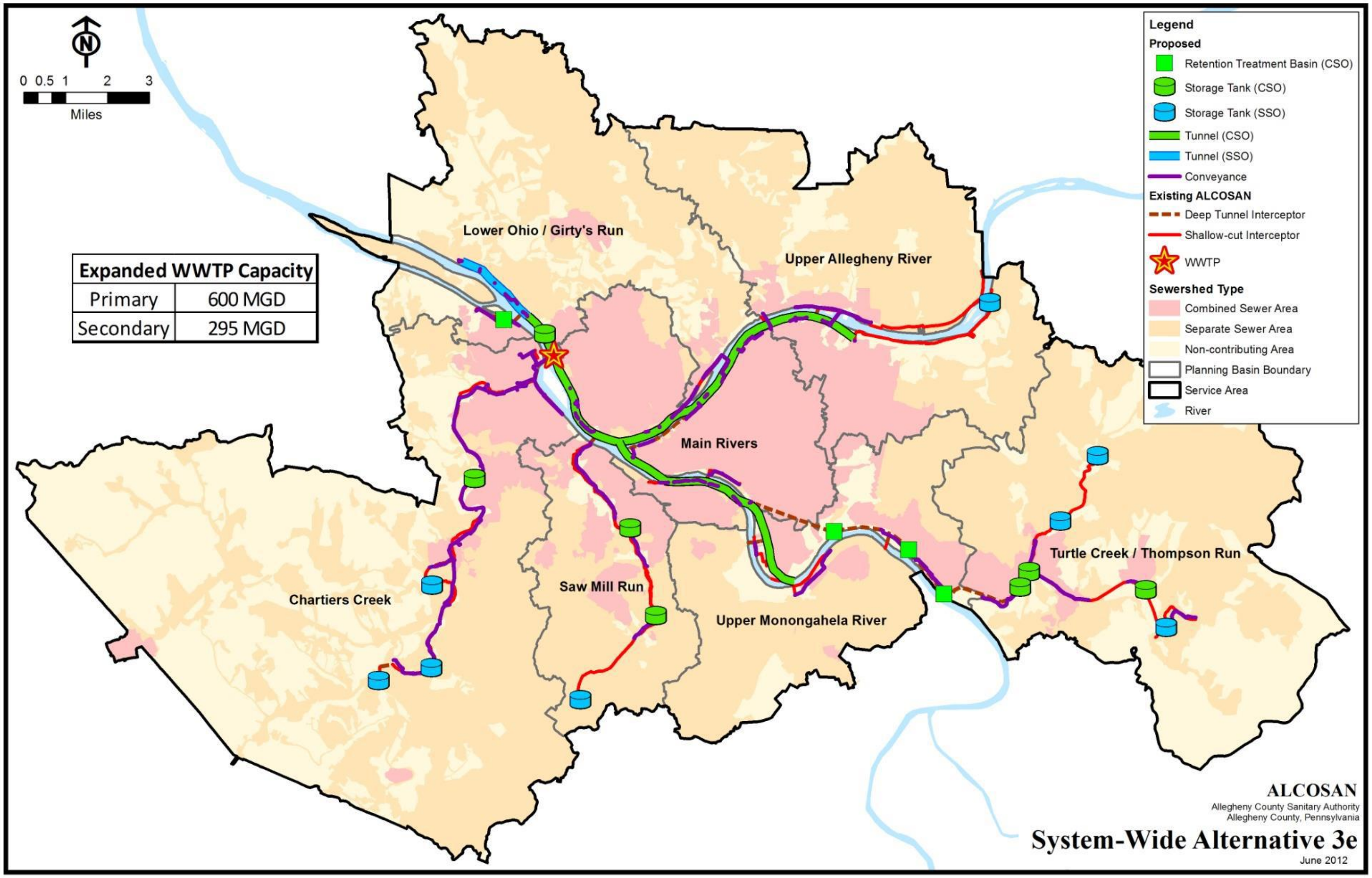


Figure 9-65: System-Wide Alternative 3f-prelim

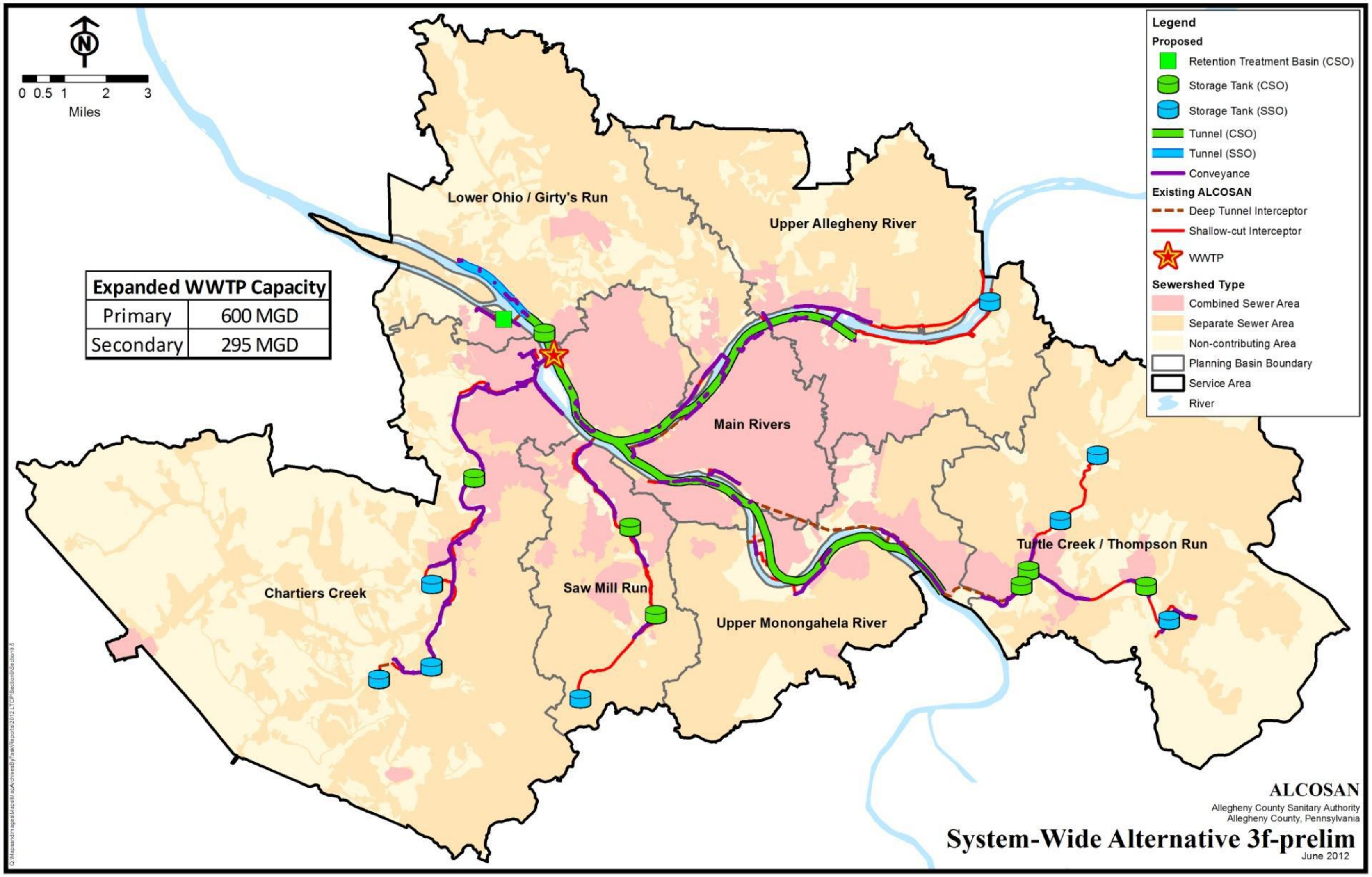
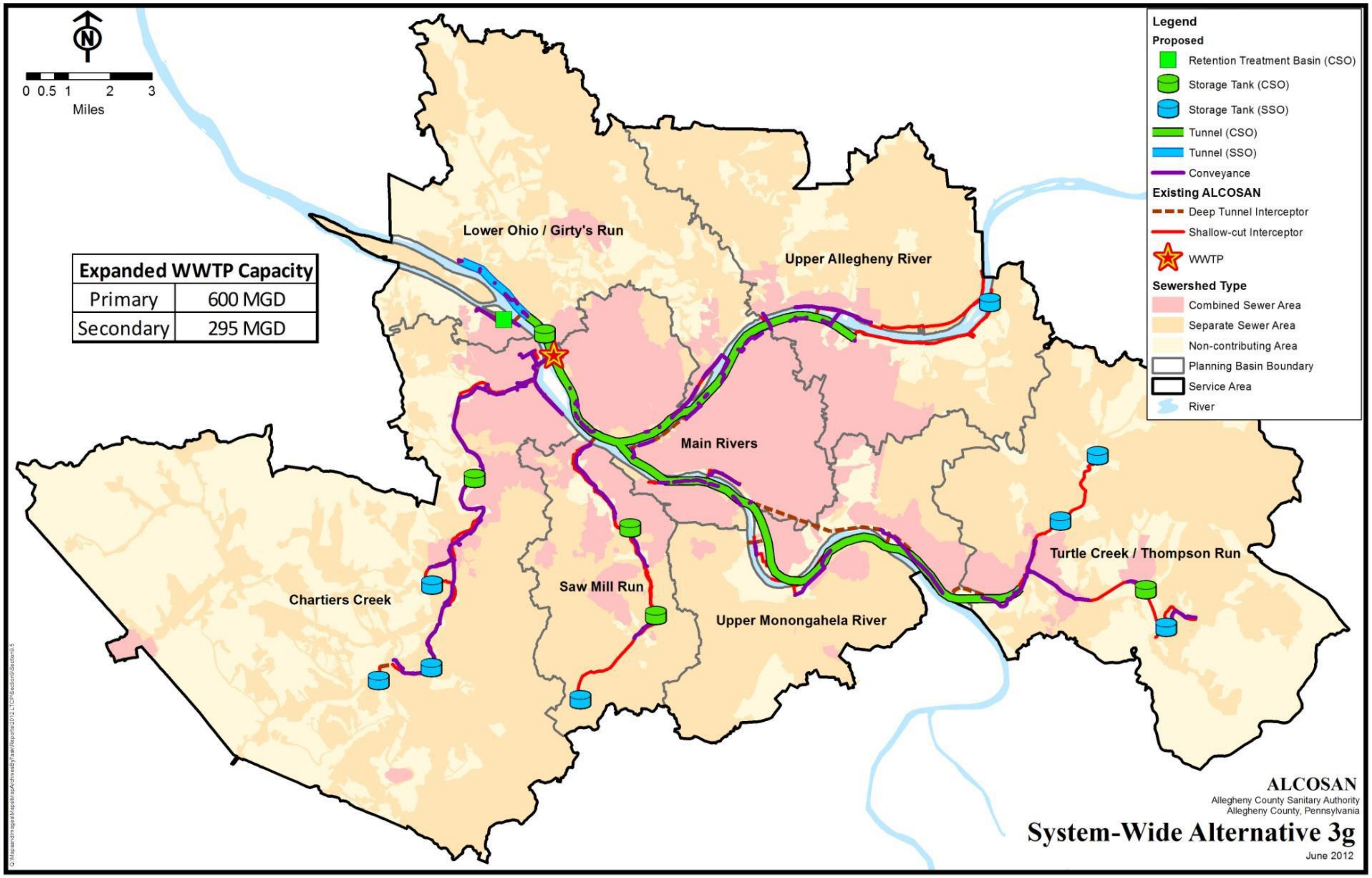


Figure 9-66: System-Wide Alternative 3g



It is important to note that, in the four previously described stages of the system-wide alternatives analysis process, both the Thompson Run interceptor and the associated outfalls were included as ALCOSAN facilities, and analyzed and costed as such. Later in the process, the representation of these facilities was refined to better reflect the actual municipal ownership of the Thompson Run interceptor and the interceptor was treated as a municipal responsibility. Therefore, the previously described alternatives included ALCOSAN control facilities for CSOs and SSOs on the Thompson Run Interceptor while the following alternatives do not.

9.5.2.4 Hybrid Alternatives for Evaluating SSO Levels of Control

System-Wide Alternatives 3f, 3h, and 3i

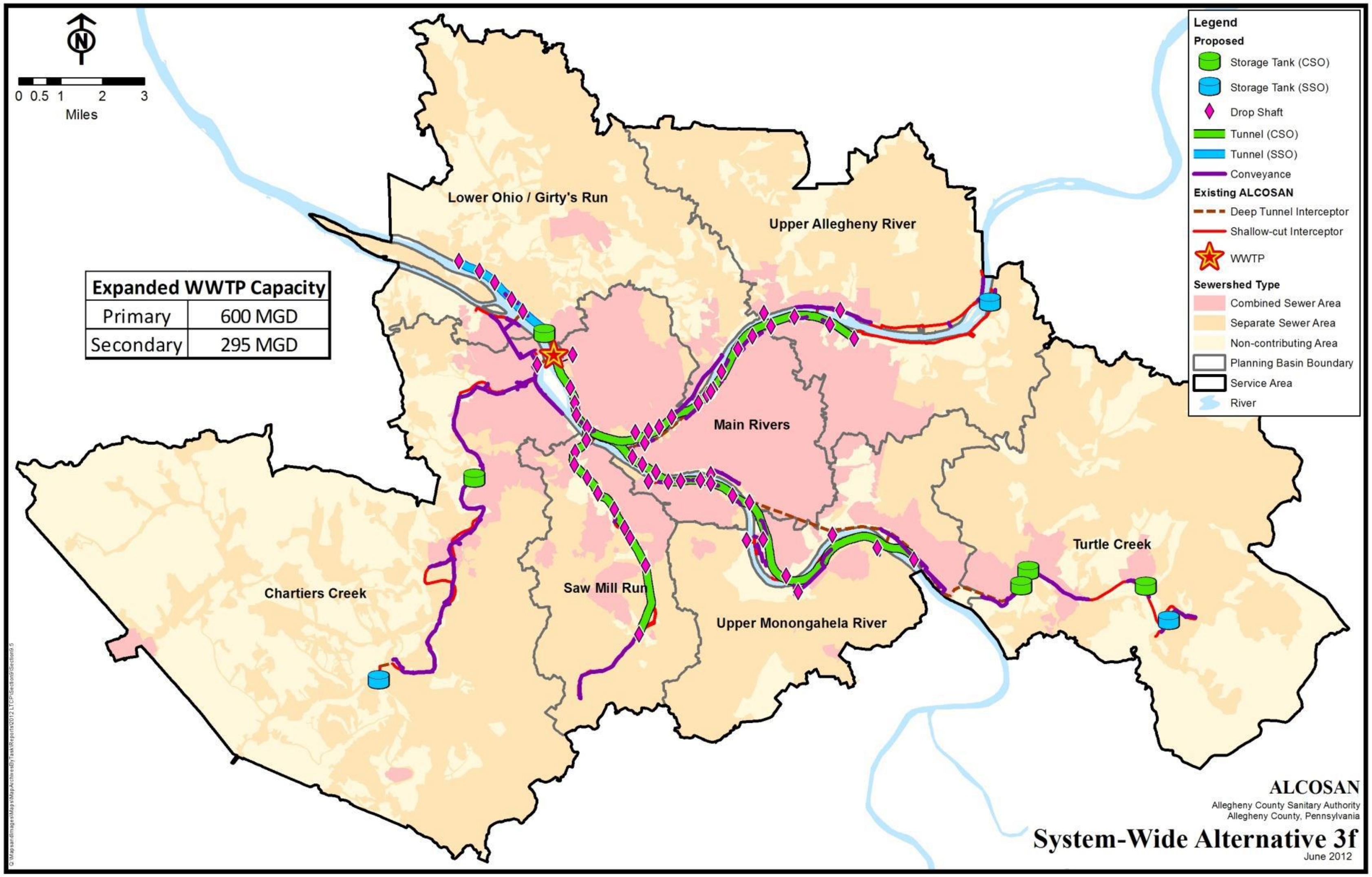
The cost and performance differences for various levels of SSO control were evaluated using System-wide Alternatives 3f, 3h and 3i. The results of this SSO control analysis are presented in Section 9.5.5.

The objective of system-wide Alternative 3f was to evaluate the most cost-effective combination of remote storage and treatment facilities to complement a new regional tunnel serving most planning basins. Each BP was asked to evaluate basin alternatives which would become part of system-wide Alternative 3f, targeting the 4 to 6 overflows per year criterion that is presumed to meet the water-quality based requirements of the Clean Water Act under the Presumption Approach. This alternative targeted the 2–year level of SSO control. A map of this alternative is included as Figure 9-67.

Regional Improvements: regional improvements associated with this alternative included,

- A new regional storage/conveyance tunnel serving the Main Rivers, Lower Northern Allegheny, Upper Allegheny, Upper Monongahela, Chartiers Creek, and Saw Mill Run planning basins.
- The new tunnel will receive flow from each drop shaft identified by the BPs for these basins.
- The new regional tunnel will not extend to the Lower Ohio and Turtle Creek basins.
- The tunnel will terminate at the WWTP with a new dewatering pump station having a capacity of at least 120 MGD.
- The Woods Run peak wet weather plant capacity and primary treatment capacity will be expanded to 600 MGD. The secondary treatment capacity will be expanded to 295 MGD.
- No new satellite WWTPs

Figure 9-67: System-Wide Alternative 3f



Planning Basin Controls / Guidance: for Alternative 3f, each BP was to select their top-ranked basin alternative within the control strategy and constraints identified below. This guidance was derived from the regional integration process whereby the most cost effective solutions for each planning basin (based on their preferred basin alternatives) were identified. Based on the tunnel extent analysis described in Section 9.5.4, the selected tunnel extent for Alternative 3f makes use of a basin-based approach for the Lower Ohio and Turtle Creek basins and a regional-based approach in all other planning basins.

- The Main Rivers, Lower Northern Allegheny, Upper Allegheny, Upper Monongahela, Chartiers Creek, and Saw Mill Run planning basins were to select their top-ranked basin alternative within the regional based control strategy.
- The Lower Ohio and Turtle Creek basins were to select their top-ranked basin alternative within the basin-based control strategy.
- If possible, flow leaving the Saw Mill Run and Chartiers Creek basins would be controlled such that all dry weather flow would pass through the existing river crossing; and flow to the existing interceptor would be maximized before sending flow to the new regional tunnel via a new river crossing.
- The Chartiers Creek basin was to eliminate the McKees Rock retention treatment basin (RTB) from their regional alternative and instead send all flow to the regional tunnel.
- All remote CSO treatment facilities were to be RTBs designed primarily to achieve screening and disinfection, and discharges from those facilities were to be considered treated.
- Consolidation sewers and diversion structures were sized for the peak flow in the typical year.
- While earlier alternatives were targeted at controlling CSOs to 4-6 overflows/year at each outfall, Alternative 3f was intended to reflect a Presumption Approach which allows 4-6 overflows/year on a system-wide annual average basis. As a result, multiple outfalls controlled by a single CSO control facility were collectively limited to overflow for no more than six events in the typical year. Due to the unique nature of the regional tunnel which serves multiple planning basins, it was specified that overflows from areas tributary to the regional tunnel could only occur on the following dates indicated in Table 9-70. The events are listed in order of largest event precipitation volume to smallest.

Table 9-70: Allowable Overflow Event Dates

Precipitation Start Date	Start Time	Estimated End Date/Time
11/18/2003	22:00:00	11/22/03 16:15
8/30/2003	3:00:00	09/01/03 17:03
7/21/2003	21:00:00	07/25/03 20:03
12/10/2003	14:00:00	12/13/03 20:03
1/1/2003	5:00:00	01/04/03 21:30
6/17/2003	8:00:00	06/23/03 04:15

Municipal Improvements: modeling and analysis of the basin alternative was to reflect incorporation of municipal planning information that included the BP's latest understanding of each municipality's submitted Planning Information, including their preferred municipal control strategy (if available). The levels of CSO and SSO control varied by municipality, but for most municipalities this meant assuming that all combined sewers were sized to convey at least the typical year flows to ALCOSAN, and all separate sanitary sewers were sized to convey at least the 2-year design storm flows to ALCOSAN.

The individual basin alternatives comprising System-Wide Alternative 3f are described in Sections 9.4.2 through 9.4.8.

In addition to Alternative 3f, variations of this alternative were analyzed that included:

<u>Alternative 3h</u> – same as Alternative 3f except facility sizes and costs were to be updated as needed to control ALCOSAN SSO discharges to a 10-year design storm level.

<u>Alternative 3i</u> – same as Alternative 3f except facility sizes and costs were to be updated as needed to control ALCOSAN SSO discharges to zero occurrences during a typical year.

9.5.2.5 Additional Hybrid Alternatives for Evaluating Presumption and Demonstration Approaches

To further identify the best mix of basin-based and regional-based facilities and converge on a recommended wet weather plan that most cost effectively achieves the water quality based requirements of the CWA, a number of additional hybrid alternatives were evaluated. These alternatives targeted the most cost effective means of achieving either the Presumption Approach criterion of 4-6 overflows per year or the Demonstration Approach to adequately meet the water quality based requirements of the CWA. These alternatives are described below.

Presumption Approach System-wide Alternatives 3f, 3j, and 3f-modified

In addition to being used to converge on the most cost-effective combination of remote storage and treatment facilities to complement a new regional tunnel serving most planning basins and support the cost and performance differences for various levels of SSO control, the previously described System-Wide Alternative 3f was used to represent a 4 to 6 overflows per year Presumption Approach alternative. System-Wide Alternative 3j is the same as Alternative 3f except the regional tunnel diameter was reduced to evaluate cost and performance differences.

System-wide Alternative 3f-modified reflects a minor variation from Alternative 3f, in that it incorporated updated municipal planning information, refined basin alternative control strategies, and enhanced control to sensitive areas. The regional tunnel extent is the same as for Alt. 3f, although some additional drop shafts were evaluated. ALCOSAN CSOs directly impacting sensitive areas are either relocated to a point downstream of the sensitive area, or eliminated for all events in the typical year. As with Alt. 3f, a two-year level of control was used for ALCOSAN SSOs. Along with typical year model simulations, each BP evaluated 2-year design storm runs with conveyance/controls in place needed to confirm that there are no ALCOSAN or municipal SSOs and that there is no flooding in sanitary systems. A map of Alternative 3f-modified is included as Figure 9-68.

Demonstration Approach System-wide Alternatives 8a and 3m

System-Wide Alternatives 8a and 3m were developed to evaluate potential Demonstration Approach alternatives and to further evaluate tunnel extent cost and performance. These alternatives were targeted to achieve 13 to 15 overflows per year for CSO control, except for 4 to 6 overflows per year at targeted outfalls directly impacting sensitive areas. The 2-year level of SSO control was used. A map of Alternative 8a is included as Figure 9-69. System-wide Alternative 3m is the same as Alternative 8a except the regional tunnel is extended to M-51 to serve the Upper Monongahela planning basin, thus eliminating the four retention treatment basins (RTBs) and 1 storage tank proposed as part of System-Wide Alternative 8a. A map of Alternative 3m is included as Figure 9-70.

Figure 9-68: System-Wide Alternative 3f-modified

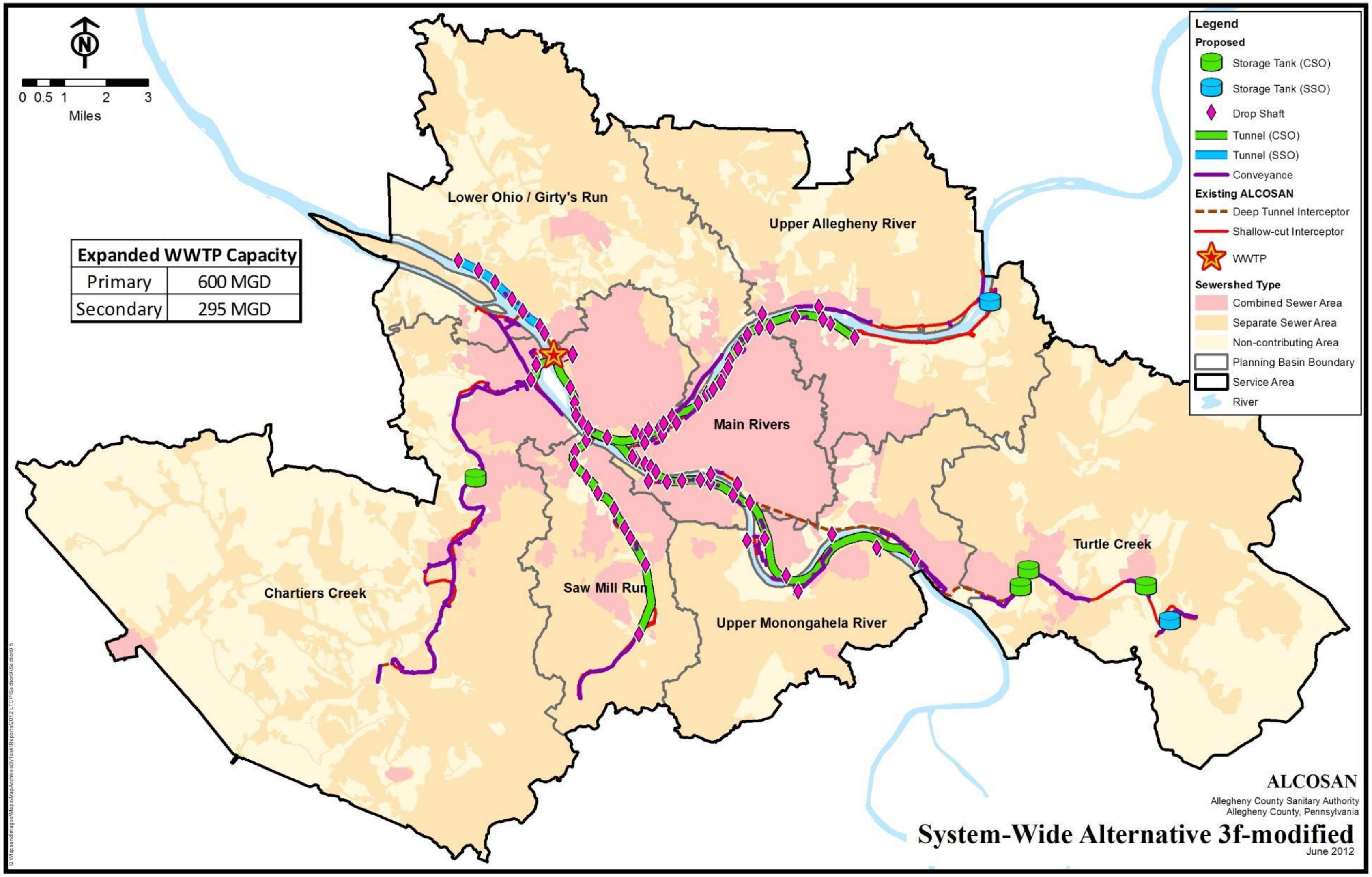


Figure 9-69: System-Wide Alternative 8a

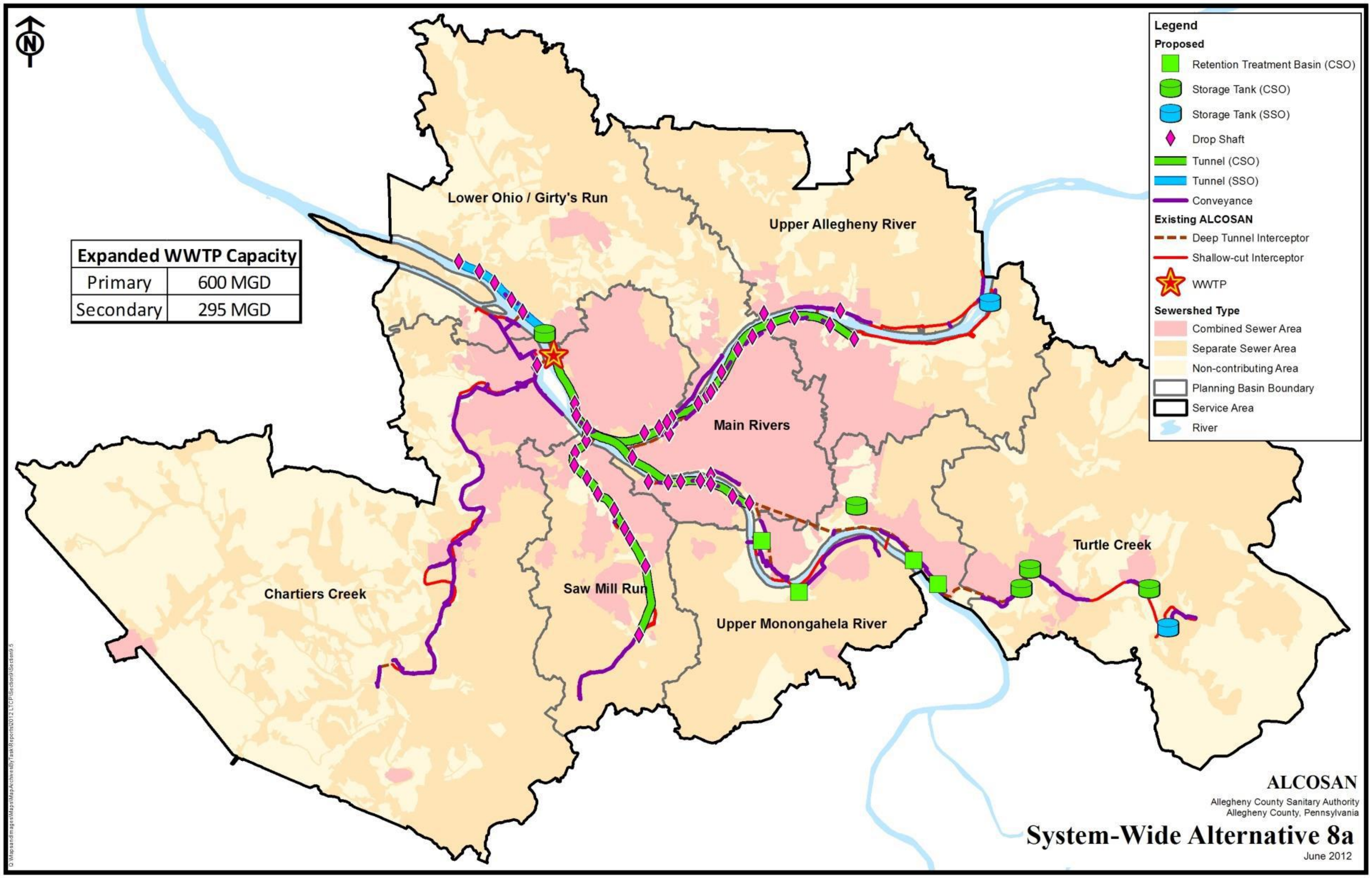
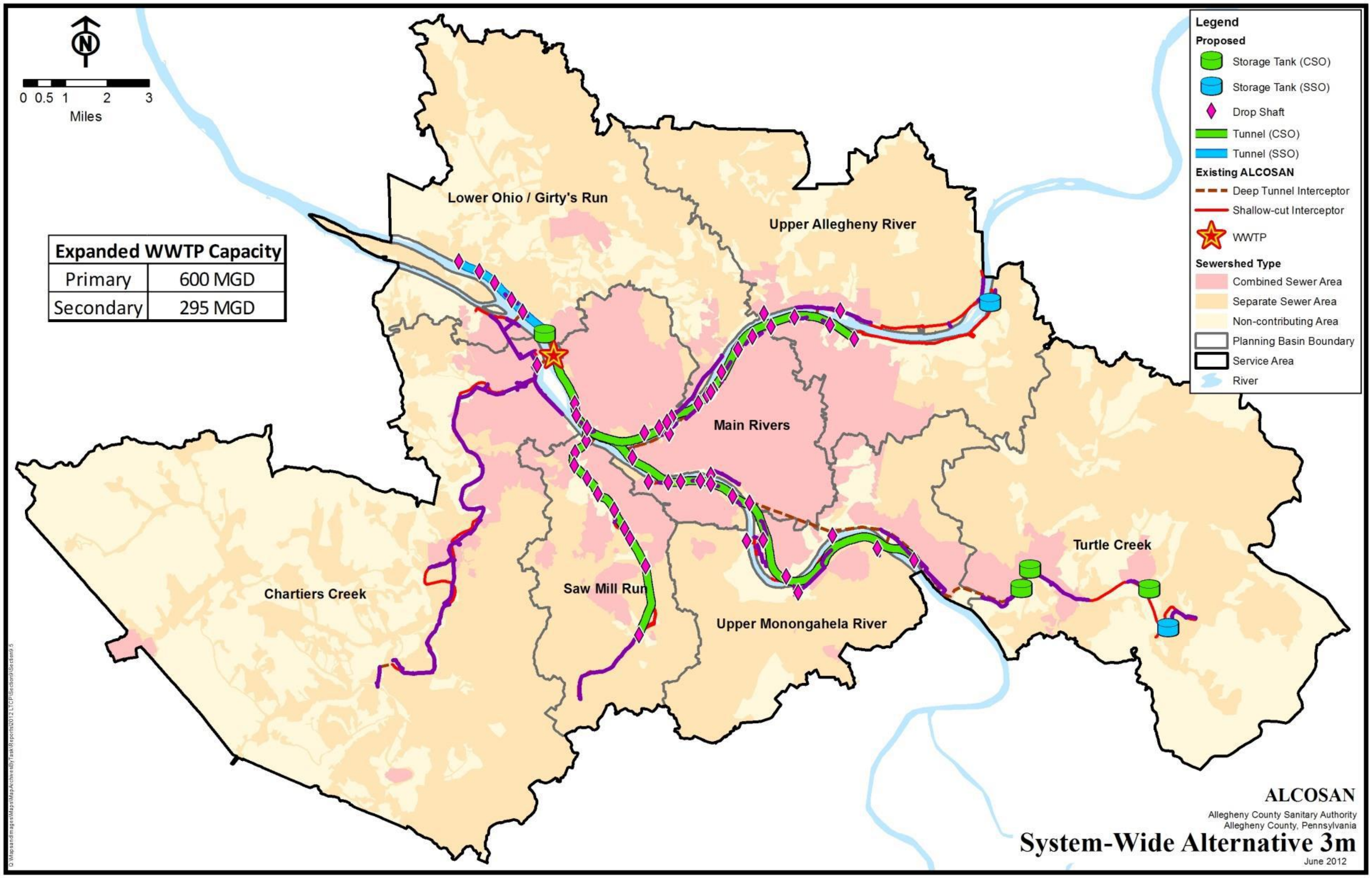


Figure 9-70: System-Wide Alternative 3m



Regional Improvements: regional improvements associated with Alternative 8a and 3m included,

- A new regional storage/conveyance tunnel serving the Main Rivers, Lower Northern Allegheny, Upper Allegheny, Chartiers Creek, and Saw Mill Run planning basins.
- The new tunnel to receive flow from each drop shaft proposed by the BPs for these basins.
- The new regional tunnel will not extend to the Upper Monongahela, Lower Ohio, and Turtle Creek basins.
- The tunnel will terminate at the WWTP with a new dewatering pump station having a capacity of at least 120 MGD.
- The Woods Run peak wet weather plant capacity and primary treatment capacity will be expanded to 600 MGD. The secondary treatment capacity will be expanded to 295 MGD.
- No new satellite WWTP.

Planning Basin Controls / Guidance: for Alternative 8a and 3m, each BP was to select their top-ranked basin alternative within the control strategy and other constraints identified below. This guidance was derived from the regional integration process whereby the most cost effective solutions for each planning basin (based on their preferred basin alternatives) were identified.

- The Main Rivers, Lower Northern Allegheny, Upper Allegheny, Chartiers Creek, and Saw Mill Run planning basins were to select their top-ranked basin alternative within the regional based control strategy.
- For Alternative 8a, the Lower Ohio, Upper Monongahela and Turtle Creek basins were to select their top-ranked basin alternative within the basin-based control strategy. For Alternative 3m, the only difference was that the Upper Monongahela basin was to select their top-ranked basin alternative within the regional-based control strategy instead of the basin-based strategy.
- If possible, flow leaving the Saw Mill Run and Chartiers Creek basins would be controlled such that: all dry weather flow would pass through the existing river crossing; and flow to the existing interceptor would be maximized before sending flow to the new regional tunnel via a new river crossing.
- The Chartiers Creek basin was to eliminate the McKees Rock RTB from their regional alternative and instead send all flow to the regional tunnel.
- All remote CSO treatment facilities were to be RTBs designed primarily to achieve screening and disinfection, and discharges from those facilities were to be considered treated.

- In order to reduce the sizes and costs of consolidation sewers and diversion structures, they were to be sized to convey the 5th largest storm in the typical year in terms of peak flow, instead of the typical year peak flow used for Alternative 3f.; except consolidation sewers for CSOs that discharge to sensitive areas which were sized for the typical year peak flow.
- Multiple outfalls controlled by a single CSO control facility were collectively limited to overflow for 13 to 15 events in the typical year, with the exception of the higher level of control (four to six overflows/year) required for outfalls directly impacting sensitive areas.

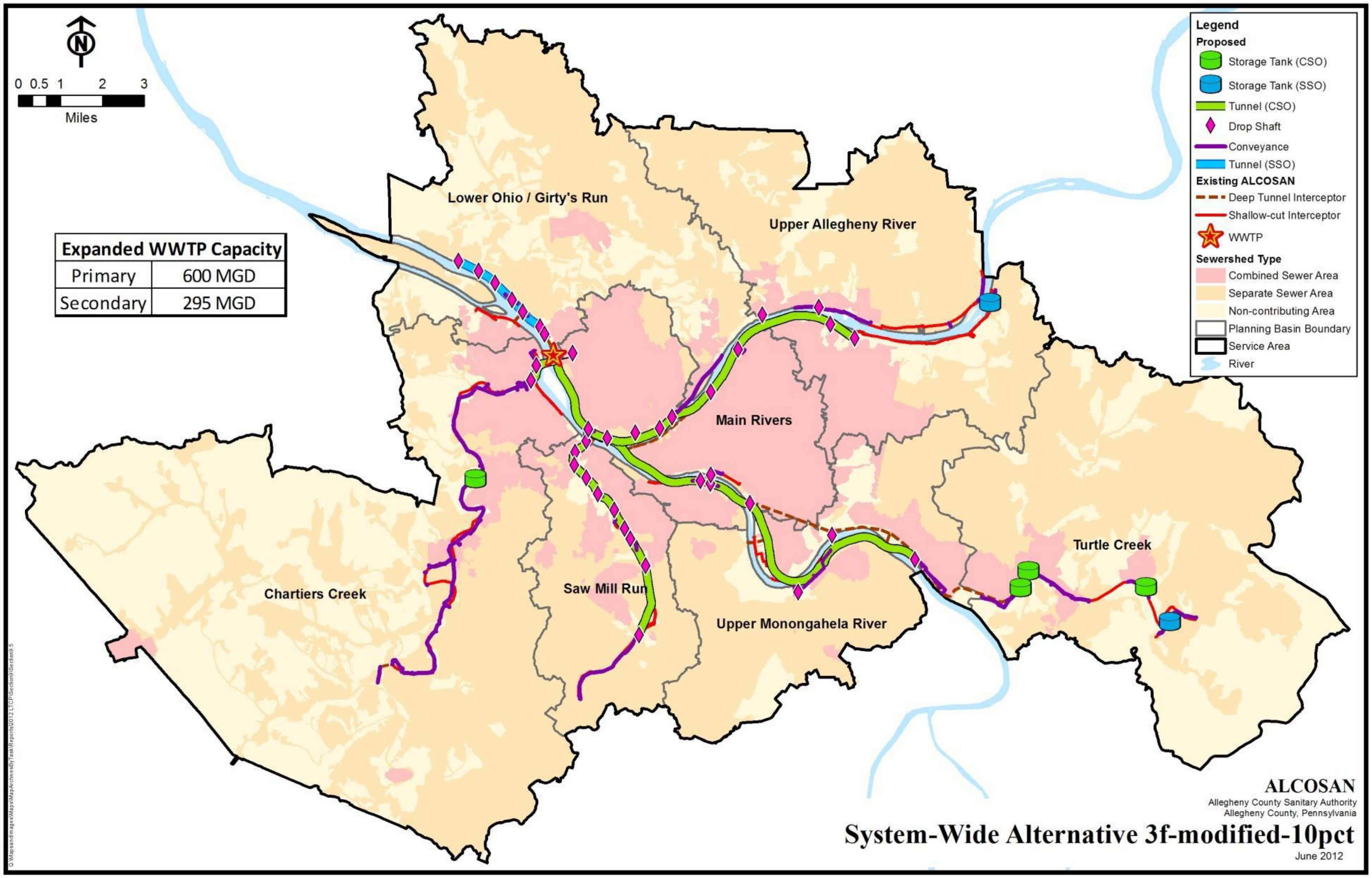
Municipal Improvements: modeling and analysis of the basin alternative was to reflect incorporation of municipal planning information that included the BP's latest understanding of each municipality's submitted Planning Information, including their preferred municipal control strategy (if available).

Demonstration Approach System-wide Alternative 3f-modified-10pct

The objective of System-Wide Alternative 3f modified-10pct was to evaluate the most cost-effective means of meeting the Demonstration Approach using remote storage and a new regional tunnel serving most planning basins. Using System-Wide Alternative 3f-modified as a starting point, the development of this alternative evaluated site alternative cost per million gallons removed and identified the facilities and site alternatives that controlled the largest outfalls in terms of CSO volume. Under this alternative, facilities and site alternatives controlling the larger outfalls are served by the new regional tunnel while the smaller outfalls (in terms of CSO volume) remain served by the existing deep tunnel interceptor. Outfalls served by the existing interceptor would be controlled by regulator modifications which maximize flow to the existing interceptor. Cross connections would be placed between the new and existing tunnel systems to free up capacity in the existing interceptor.

Under this alternative, larger CSOs served by the new regional tunnel are controlled to 4 to 6 overflows per year by facility. CSOs discharging to sensitive areas are controlled to zero overflows per year or re-located downstream of the sensitive area. CSOs discharging to the existing tunnel vary by outfall and depend on the existing drop shaft capacity. As with Alt. 3f-modified, a two-year level of control was used for ALCOSAN SSOs. Modeling and analysis of this alternative reflected the incorporation of the latest municipal planning information. A map of this alternative is included as Figure 9-71.

Figure 9-71: System-Wide Alternative 3f-modified-10pct



9.5.3 Basin and Regional Based Control Alternatives

As described in Section 9.5.2, initial system-wide alternatives were derived based on the two control strategies analyzed by the ALCOSAN BPs for five levels of CSO control. The BBS assumed that additional regional conveyance beyond the existing interceptor system would not be available. The RBS assumed that additional regional conveyance would be available to convey peak flows to the ALCOSAN treatment plant. Under these two control strategies, the preferred alternatives developed for each ALCOSAN planning basin were integrated system-wide to establish System-Wide Alternatives 1 and 2.

These BBS and RBS system-wide alternatives were developed in support of the knee-of-the-curve (KOC) analysis. This analysis allowed for a preliminary assessment as to whether the most cost effective means of addressing CSO and SSO discharges was through remote wet weather storage and/or treatment facilities within each planning basin, or through added regional conveyance to the ALCOSAN treatment plant. This analysis was also conducted to meet the requirements of Paragraph D of Appendix U of the ALCOSAN Consent Decree (CD).

To support this effort, performance values (annual untreated overflow volumes) were computed from H&H model simulations of the BBS and RBS system-wide alternatives at each level of CSO control. Figure 9-72 shows a plot of the annual untreated ALCOSAN and municipal CSO volumes for each of the BBS and RBS alternatives. As a basis of comparison, also shown are the existing conditions and the future baseline (2046) annual untreated CSO volumes. Since the BBS and RBS system-wide alternatives were analyzed under the assumption that all municipal flows would be conveyed to ALCOSAN, there are no municipal overflows associated with these alternatives.

Using the Alternatives Costing Tool (as described in Section 9.1.3), capital cost estimates were generated for each of these alternatives as well. The capital cost estimates reflect the total basin planner, regional conveyance, WWTP expansion, and municipal costs associated with each alternative. The municipal capital costs included in the totals for each alternative reflect the preferred and/or assumed preliminary municipal control strategies (as described in Section 9.3).

Using these data, the relationships between the performance of the system-wide alternatives, and the costs associated with these alternatives, were developed and evaluated to identify the level of control at which the increment of pollution reduction achieved diminishes compared to the incremental increased costs, as prescribed by EPA's CSO Control Policy[9-9]. The resulting KOC plot of the BBS and RBS system-wide alternatives is shown on Figure 9-73. For alternatives evaluated under the same basis for consolidation sewer and regulator sizing, the points were connected so that the KOC plot represents a continuous relationship between performance and cost. The inflection point of this connected line is referred to as the knee-of-the-curve. Also shown on the plot are the corresponding overflow frequencies (overflows per year) associated with each of the alternatives.

[9-9] Environmental Protection Agency. *Combined Sewer Overflow (CSO) Control Policy; Notice* (1994). Federal Register / Vol. 59, No. 75 / Tuesday, April 19, 1994 / Notices

Figure 9-72: BBS and RBS Alternatives - Annual Untreated CSO Volume Comparison

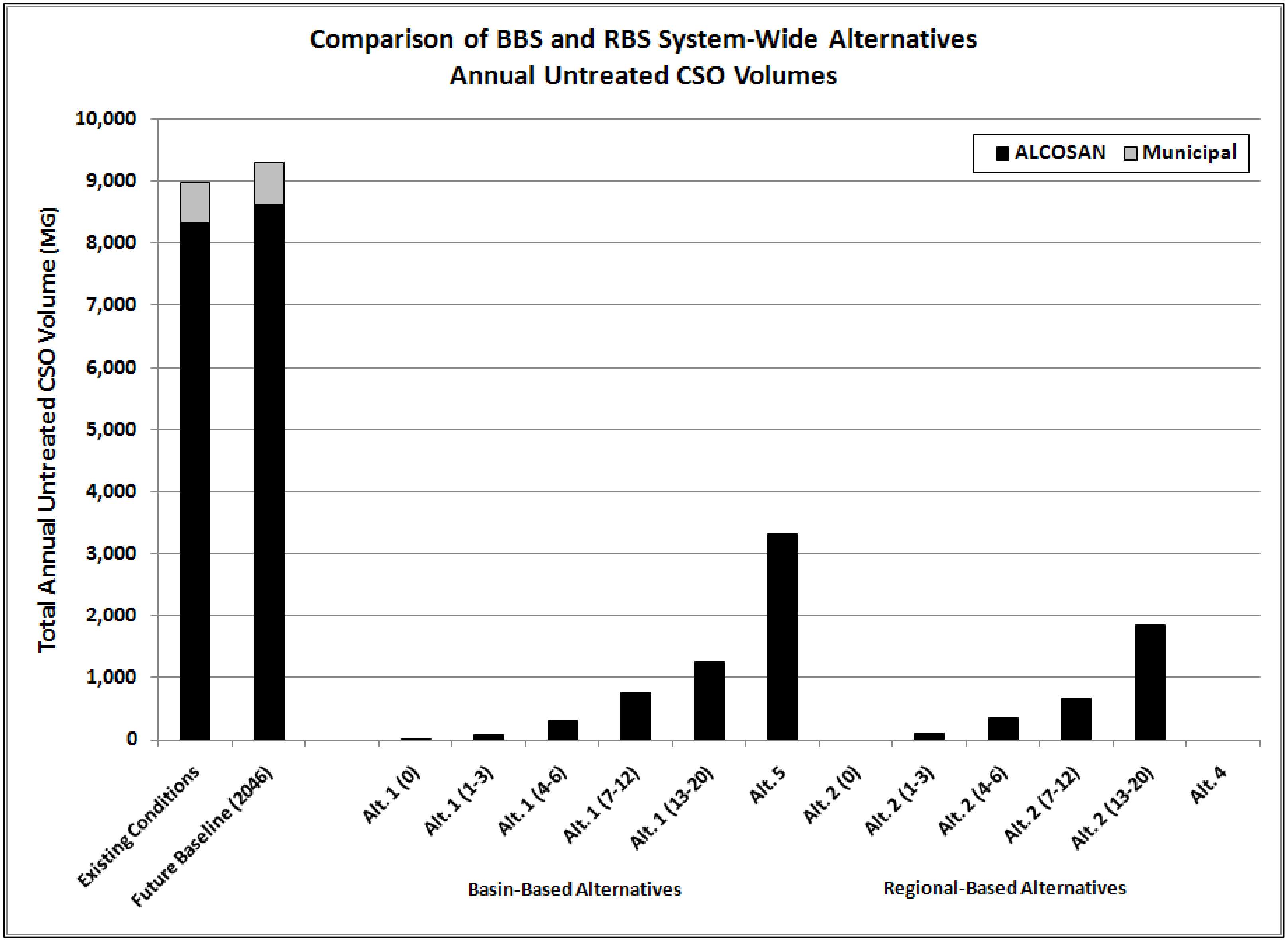
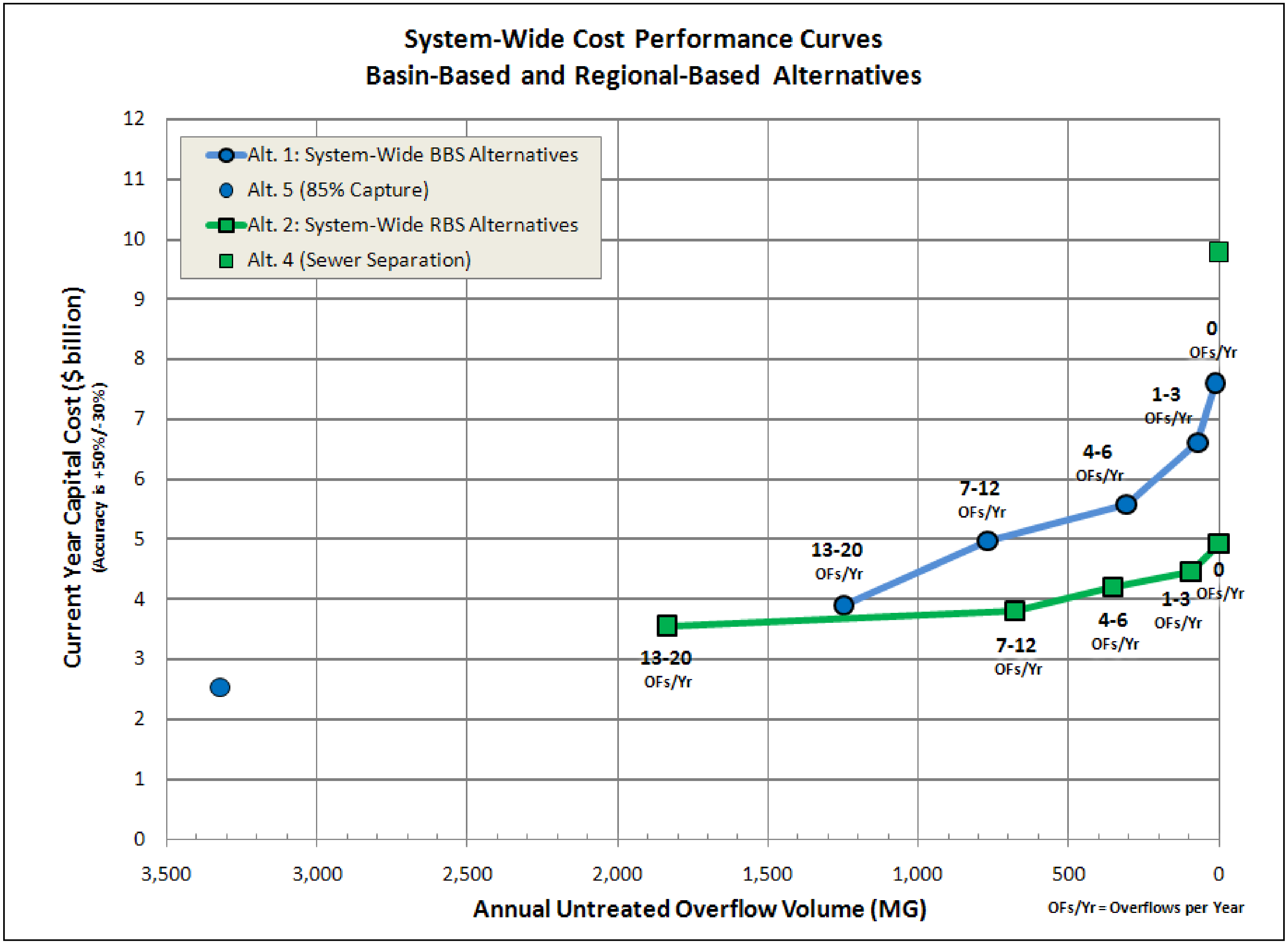


Figure 9-73: Knee-of-the-Curve Analysis for BBS and RBS Alternatives



Analysis of the results for these two control strategies led to preliminary findings that guided the development of additional system-wide alternatives. For example, the regional-based control strategy (in green) presents more cost-effective overflow control solutions than the basin-based strategy (shown in blue), particularly at higher levels of CSO control. This observation was acknowledged early in the system-wide alternatives development process and led to a detailed evaluation of options focused on additional regional conveyance. Correspondingly, the H&H model confirmed significant conveyance limitations along the existing deep tunnel interceptor. A cost performance analysis of the additional regional conveyance capacity required to achieve the CSO levels of control analyzed determined that tunnel boring machine (TBM) construction techniques would be most cost effective. This preliminary analysis did not conclude, however, that a new tunnel to all planning basins was necessarily the best solution. As a result, system-wide alternatives were developed to evaluate the cost effectiveness of various tunnel extents with the results described in Section 9.5.4.

9.5.4 Regional Tunnel Extents and Satellite Sewage Treatment Analysis

As described in Section 9.5.3, system-wide regional-based alternatives presented more cost-effective pollution reduction solutions than system-wide basin-based alternatives. As a result, preliminary hybrid alternatives were compared to determine the most cost-effective extent of a regional tunnel, including one alternative that incorporated a satellite sewage treatment (SST) plant. These preliminary hybrid alternatives are described in Section 9.5.2. H&H models were used to develop regional tunnel sizes for Alternatives 3, 3c, 3d, 3e, 3f-prelim and 3g, and served as the basis for preparing cost estimates for each alternative. The goal of the analysis was not to optimize a given alignment, but rather to determine the most cost-effective blend of regional tunnel extents and basin-based controls as well as evaluation of construction of an SST plant in addition to the Woods Run WWTP. This section describes the initial regional tunnel alignment used a basis for the evaluation, the extent of each alternative evaluated, and the results of the evaluation. Maps of the given alternatives are included in Section 9.5.2, and referenced within the text of this section as appropriate.

Initial Regional Tunnel Alignment Used: The alignment of a maximum extent regional tunnel that served each of the seven planning basins was previously established with System-Wide Alternative 2 and was based on integrating the selected regional-based control strategies for each basin. As previously depicted in Figures 9-56 through 9-60, this alternative is a combination of a regional CSO tunnel, a short SSO tunnel segment, and CSO and SSO storage facilities in the furthest reaches of the ALCOSAN service area where conveyance to the maximum tunnel extent is not cost-effective. One branch of the regional tunnel commences near ALCOSAN structure A-42 and closely follows the existing ALCOSAN deep tunnel interceptor along the Allegheny River. The second branch commences near structure T-04 and follows the Monongahela River. The two branches meet at the confluence of the Allegheny and Monongahela Rivers. A single segment continues downstream along the Ohio River where it terminates near the Woods Run Treatment Plant.

The alignment of the maximum extent regional tunnel represented by System-Wide Alternative 2 was used as basis for evaluating various tunnel extents, based on an ALCOSAN CSO control level of 4 to 6 overflows per year and the elimination of ALCOSAN SSOs up to a 2-year design storm.

Development of Preliminary Hybrid Alternatives: To evaluate the most cost effective system-wide combination of regional-based and basin-based control strategies, system-wide alternatives 3, 3c, 3d, 3e, 3f-prelim and 3g were developed, each providing an ALCOSAN CSO control level of 4 to 6 overflows per year and the elimination of ALCOSAN SSOs up to a 2-year design storm. For each alternative, a blend of the BP-developed basin-based and regional-based controls were integrated into a regional model from which the PM developed sizes for a regional tunnel. Similarly, a blend of the BP-developed basin-based and regional-based costs were combined with PM-developed costs for a regional tunnel to develop total costs for each alternative. The BP models and costs used in the evaluation represented the preferred alternatives for each level of control as provided to the PM at the time the evaluation was conducted.

Each of the alternatives includes a regional tunnel of varying extent that conveys wet weather flows to a new 120 MGD dewatering pump station at the Woods Run WWTP. The dewatering pump station conveys flow to a new wet weather headworks for treatment. Each alternative also includes an expansion of the Woods Run primary treatment and disinfection capacity to 600 MGD. Finally, each alternative also includes an increase of the Wood Runs secondary treatment capacity to 275 MGD for Alternative 3c, and to 295 MGD for all other alternatives. Alternative 3c also includes a new satellite sewage treatment (SST) plant as described further below. A brief description of each alternative follows:

- Alternative 3 – This is similar to Alternative 2 regional tunnel extent along the Ohio and Allegheny rivers, but the Monongahela tunnel terminates near structure M-29 instead of T-04. The basin alternatives for Turtle Creek/Thompson Run, Upper Monongahela, and Lower Ohio include basin-based controls. All other basin alternatives are regional-based. See Figure 9-62 for a layout of Alternative 3.
- Alternative 3c - The regional tunnel alignment for Alternative 3c is similar to Alternative 3, but a satellite SST near M-30 serves the entire Upper Mon and Turtle Creek planning basins. The 125 MGD satellite SST would include an influent pump station, preliminary treatment, primary treatment, secondary treatment using a conventional activated sludge process, and disinfection. Treated flows would be discharged to the Monongahela River. In dry weather the plant would treat all wastewater flows generated in the tributary basins which are expected to average 45 MGD. In wet weather, the SST would treat up to 125 MGD of dry and wet weather flows, with the remaining wet weather flows treated by upstream basin-based facilities or overflowing untreated up to 6 times per year. The satellite WWTP influent pump station decreases the existing hydraulic grade line in the deep tunnel interceptor, thereby reducing the required treatment capacity of some Upper Mon and Turtle / Thompson basin-based facilities, in comparison to the other alternatives. See Figure 9-61 for a layout of Alternative 3c.
- Alternative 3d – The regional tunnel alignment is similar to Alternative 3, but the Allegheny River segment terminates near ALCOSAN structure A-35 instead of A-42. Screening and disinfection facilities are proposed to handle CSO flows upstream of A-35. See Figure 9-63 for a layout of Alternative 3d.

- Alternative 3e – The regional tunnel alignment is similar to Alternative 3, but the Monongahela River segment terminates near ALCOSAN structure M-42 instead of M-29. Two CSO storage facilities present in Alternative 3 are eliminated in the Upper Monongahela Basin due to the extension of the regional tunnel for Alternative3e. See Figure 9-64 for a layout of Alternative 3e.
- Alternative 3f-prelim – The regional tunnel alignment is similar to Alternative 3, but the Monongahela River segment terminates near ALCOSAN structure M-51 instead of at M-29. This extension in the tunnel alignment eliminates the need for any treatment facilities in the Upper Monongahela Basin. See Figure 9-65 for a layout of Alternative 3f-prelim.
- Alternative 3g – The regional tunnel alignment is the same as the maximum tunnel extent in Alternative 2, with the Monongahela River segment terminating near ALCOSAN structure T-04. See Figure 9-66 for a layout of Alternative 3g.

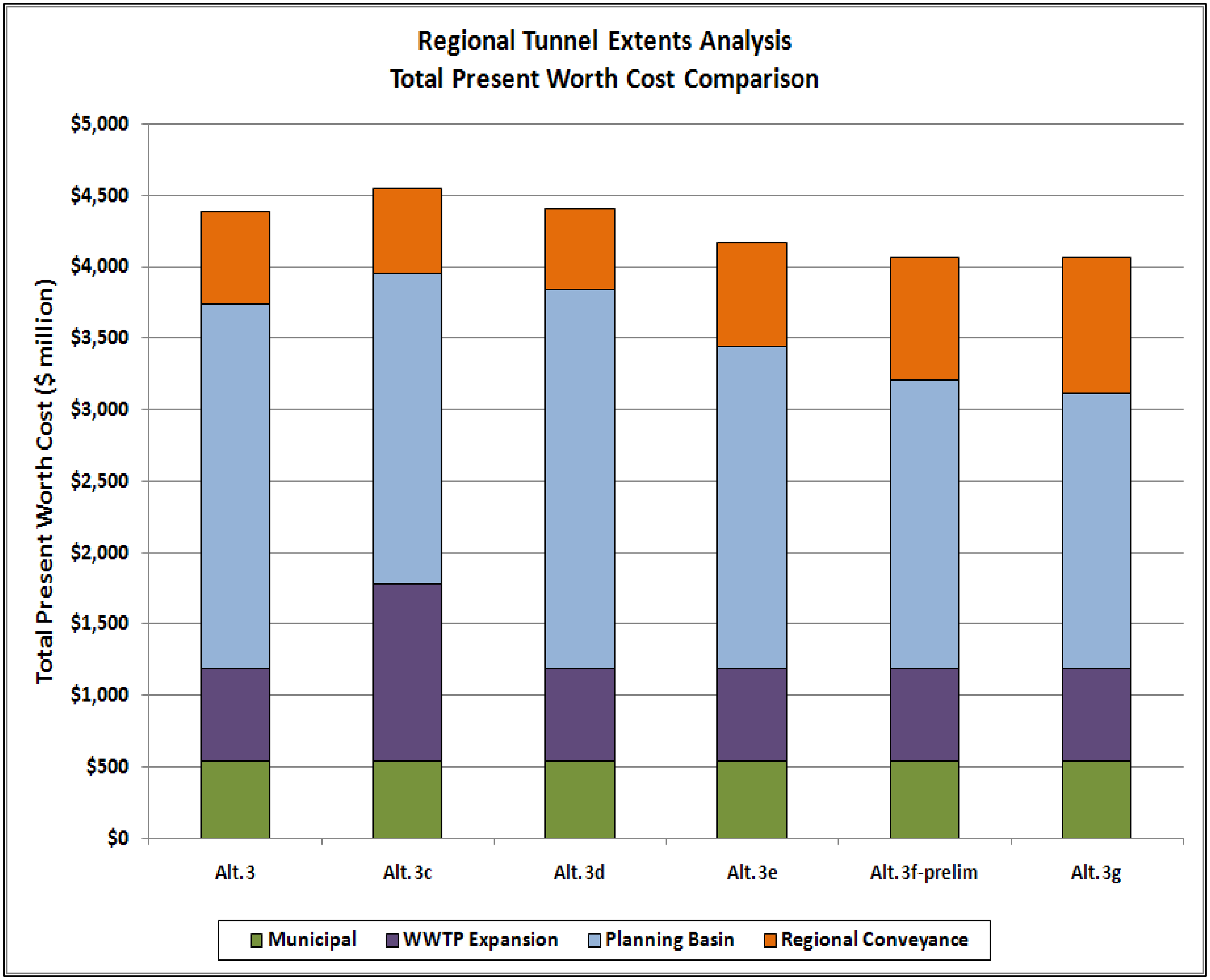
Evaluation of Regional Tunnel Extents and Satellite Sewage Treatment: The preliminary hybrid alternatives are summarized in Table 9-71, which indicates the tunnel length and size, as well as the total present worth costs for each alternative. The table also indicates the annual ALCOSAN untreated overflow volume for each alternative. There are no municipal overflows as all municipal flows for these alternatives were assumed to be conveyed to ALCOSAN. Each of the alternatives was designed to meet the same level of CSO control, so the differences in untreated overflow volumes are relatively small: all result in a 92 to 94 percent decrease in untreated overflow volumes relative to future baseline (2046) conditions.

The total costs are also depicted in Figure 9-74. A comparison of total present worth costs was necessary to account for the differences in O&M and renew/replacement costs between the alternatives.

Table 9-71: Regional Tunnel Extents Analysis Results

Alternative	Tunnel Length (miles)	Tunnel Diameter (feet)	Tunnel Storage Volume (MG)	Total Present Worth Costs (Millions)					Annual Untreated Overflow Volume (MG)
				Regional Conveyance Tunnel	Planning Basins	WWTP	Municipal	Total	
3	14	15	102	$648	$2,549	$648	$538	$4,383	674
3c	14	13	80	$595	$2,178	$1,238	$538	$4,550	711
3d	12	15	86	$561	$2,655	$648	$538	$4,403	552
3e	17	14	105	$722	$2,258	$648	$538	$4,166	652
3f-prelim	21	13	118	$860	$2,019	$648	$538	$4,065	667
3g	23	13	128	$952	$1,931	$648	$538	$4,069	632

Figure 9-74: Preliminary Hybrid Alternatives – Total Present Worth Cost Comparison



The evaluation of results led to the following findings based on a comparison of total present worth costs.

- Alternative 3c, which relies on a new satellite WWTP near M-30, was the most expensive preliminary hybrid alternative and therefore was not considered further in the regional tunnel extents analysis. However, Alternative 3c was retained for further analysis in support of the knee-of-the-curve, water quality benefits, and system-wide alternatives ranking analyses found in Sections 9.5.6.4, 9.5.6.5, and 9.5.7, respectively. A more detailed description of other satellite secondary treatment options evaluated can be found in Section 9.2.6.
- Alternative 3d, which serves much of the Upper Allegheny basin with basin-based controls rather than a tunnel extending to A-42, is the most expensive alternative. This is largely due to the high costs to control flow within the UA basin without wet weather relief from a new regional interceptor. Based on this observation, the maximum tunnel extent to A-42 within the Upper Allegheny basin was retained as an essential element for further consideration. It is more cost effective to control the Upper Allegheny basin by a regional tunnel.
- The comparison of the remaining alternatives indicates the upper portions of the Upper Monongahela basin and the Turtle Creek basin could be controlled by either regional-based controls or basin-based controls as the costs relative to one another for Alternatives 3e, 3f-prelim and 3g are close enough that other non-economic factors would need to be taken into account for determining the recommended alternative. The Turtle Creek basin planner concluded that a regional tunnel through that basin was not cost effective and that the basin would be better served by a series of storage tanks. Since Alternative 3f-prelim appeared to be the lowest cost alternative and extending the tunnel through the Upper Monongahela basin would result in fewer remote treatment facilities with lower long term operations and maintenance considerations, Alternative 3f-prelim was retained as the regional tunnel extent for later alternatives.

9.5.5 SSO Control Analysis

As described in Section 9.5.2, initial BBS and RBS alternative and the preliminary hybrid alternatives for evaluating regional tunnel extents, were evaluated at controlling SSOs to a 2-year design storm level. The selection of this control level was based, in part, on the SSO control level being evaluated by the customer municipalities. Many were evaluating a 2-year level of control and the decision on the ALCOSAN SSO level of control considered compatibility with the municipal control level. The development and evaluation of Alternatives 3f, 3h, and 3i allowed for a comparison of alternatives at different levels of ALCOSAN SSO control.

As described in Section 9.5.2, the performance target for System-Wide Alternative 3f was a 2–year level of SSO control and served as a baseline for comparison. Alternatives 3h and 3i represented variations of Alternative 3f with the primary difference being that facility sizes and costs were updated to control ALCOSAN SSO discharges to a 10-year and typical year level of control, respectively. The ALCOSAN CSO control level for all three alternatives was 4 to 6 overflows per year. In order to determine only the costs for varying the ALCOSAN level of SSO control using Alternatives 3h and 3i, the municipal levels of CSO and SSO control were held constant between these alternatives and the baseline Alternative 3f. The levels of CSO and SSO control varied by municipality and were based on the best available municipal planning information at the time, but for most municipalities this meant assuming that all combined sewers were sized to convey at least the typical year flows to ALCOSAN, and all separate sanitary sewers were sized to convey at least the 2-year design storm flows to ALCOSAN.

The submitted BP models for each of the three alternatives were integrated into three regional models, and these regional models were used to confirm the elimination of ALCOSAN SSOs and to refine facility sizes as needed. In like manner, the submitted BP costs were adjusted to reflect refinements in sizing, and then combined with regional costs to arrive at total costs for each system wide alternative. Figure 9-75 compares the total capital cost of the three alternatives, and provides the breakdown of system-wide CSO and SSO control costs. Controlling ALCOSAN SSOs to a typical year level of control as in Alternative 3i would cost about $17 million less than the 2-year level of control used in the baseline Alternative 3f, while controlling these same SSOs to a 10-year level of control would cost about $128 million more than the 2-year level of control.

Figure 9-75: Total Capital Cost for Alternatives 3f, 3h and 3i

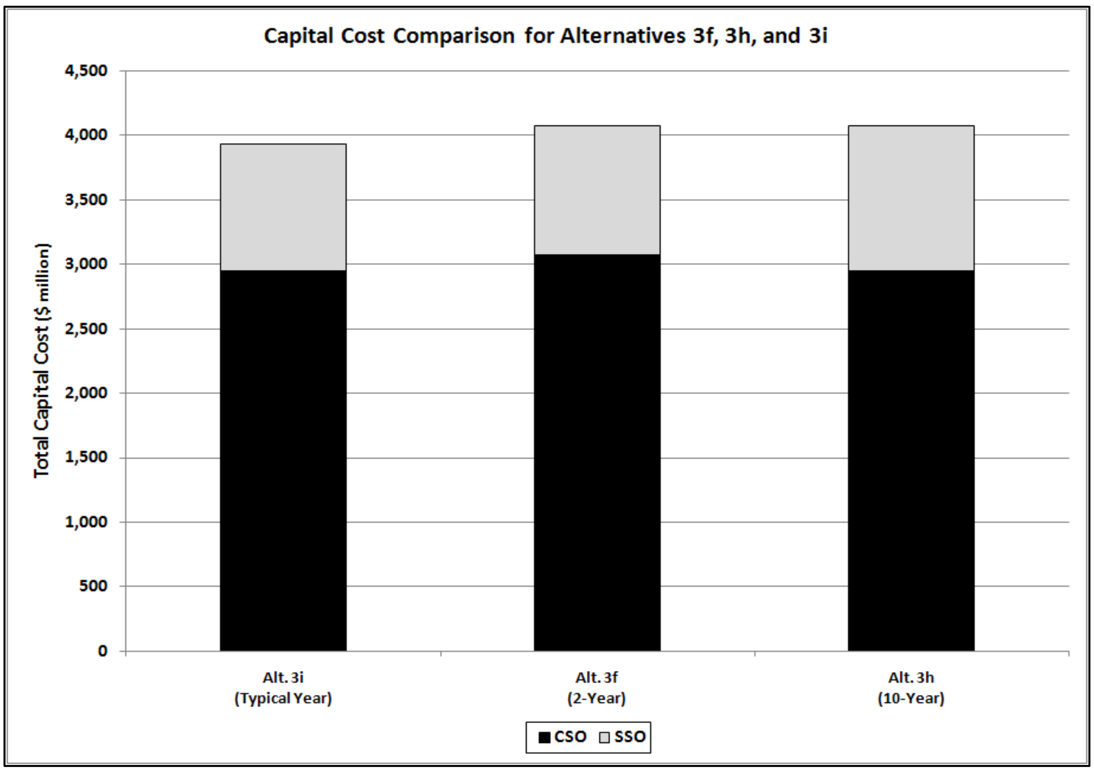


Figure 9-76 shows the three major components of the SSO control costs for these three alternatives. The ALCOSAN SSO control costs within each planning basin were estimated by the basin planners and are the only portion of the SSO costs which vary with the ALCOSAN level of SSO control: ranging from a low of $654 million for the typical year to a high of $816 million for the 10-year level of control. ALCOSAN costs to expand and maximize secondary treatment capacity at the Woods Run plant are the same for all three alternatives: $96 million for the addition of two settling tanks and disinfection of secondary effluent through a new ultraviolet (UV) disinfection process, followed by post-aeration and discharge via a new plant outfall. The assumed municipal SSO control cost of $217 million is also the same for all three levels of control.

Figure 9-76: SSO Control Costs for Alternatives 3f, 3h and 3i

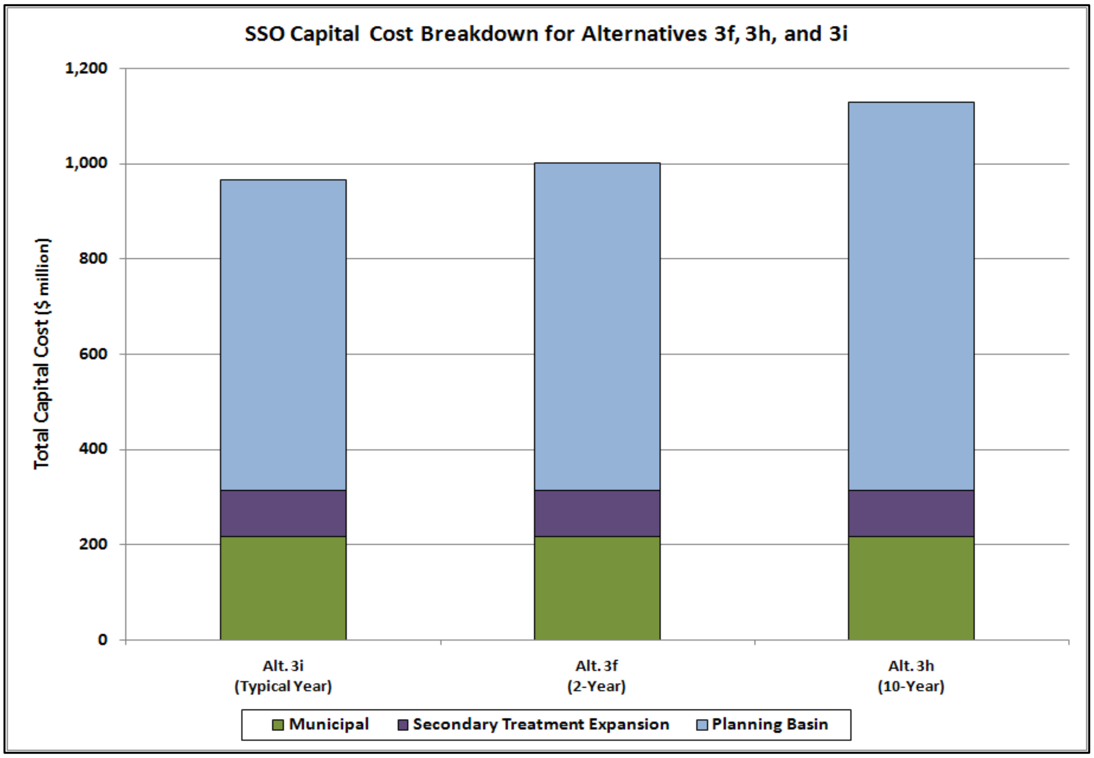
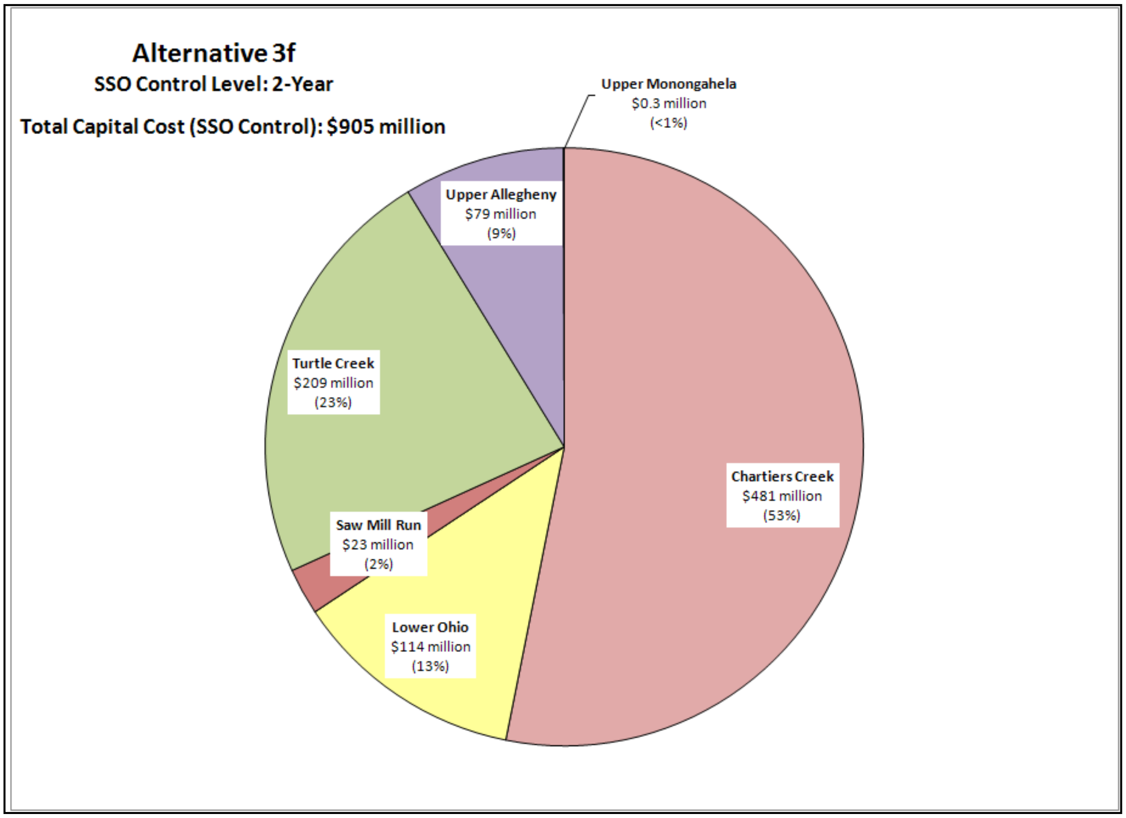


Figure 9-77 shows the SSO control costs for Alternative 3f by ALCOSAN planning basin. Depicted are the ALOCSAN and municipal SSO control costs associated with each planning basin to eliminate SSOs up to a 2-year design storm level, with WWTP expansion costs not included. Note that the Lower Northern Allegheny, Main Rivers, and Upper Monongahela planning basins do not have ALCOSAN SSOs. The Chartiers Creek planning basin accounts for the largest portion of the basin-specific SSO control costs, nearly 53% of the total.

It should be noted that due to the inherent uncertainty of municipal plans, this analysis could not fully account for all costs associated with the various levels of SSO control. First, municipal SSO control costs for the new conveyance assumed in this analysis were not available from all municipalities. The assumed municipal cost of $217 million is based on the latest municipal planning information received before issuing the draft WWP. The conveyance associated with this latest municipal planning information (on which the assumed cost was based) varied somewhat from what was assumed in Alternatives 3f, 3h and 3i.

Figure 9-77: Alternative 3f –SSO Control Cost by Planning Basin



Secondly, based on the municipal plans at the time of the analysis, some municipal conveyance was only sized to convey the 2-year level of control. In some of those instances, the model simulation of the 10-year storm for Alternative 3h sometimes resulted in municipal SSOs, flooding or sewer system surcharging. As a result, the Alternative 3h costs reported herein do not account for municipal costs to provide a 10-year level of control. Furthermore, they do not account for the increased ALCOSAN costs that would be required to provide a 10-year level of control if these additional instances of municipal SSOs, flooding or sewer system surcharging were addressed by increased conveyance to ALCOSAN.

Regional models of Alternatives 3f, 3h and 3i were simulated with the summer and winter 10-year design storms to illustrate the incremental benefit of the three ALCOSAN levels of SSO control. Figures 9-78 and 9-79 illustrate the cost performance curves generated from this analysis. For the summer design storm, increasing the ALCOSAN level of SSO control from the typical year to the 2-year design storm requires a cost of about $34 million to eliminate an additional 0.01 MG of ALCOSAN overflow volume for the 10-year summer design storm and 0.8 MG for the winter design storm. Further increasing this level of control from the 2-year to the 10-year design storm requires a cost of about $128 million to eliminate an additional 0.5 MG of ALCOSAN overflow volume for the 10-year summer design storm and 0.8 MG for the winter design storm.

Figure 9-78: SSO Control Cost-Performance Curve for Summer Design Storm

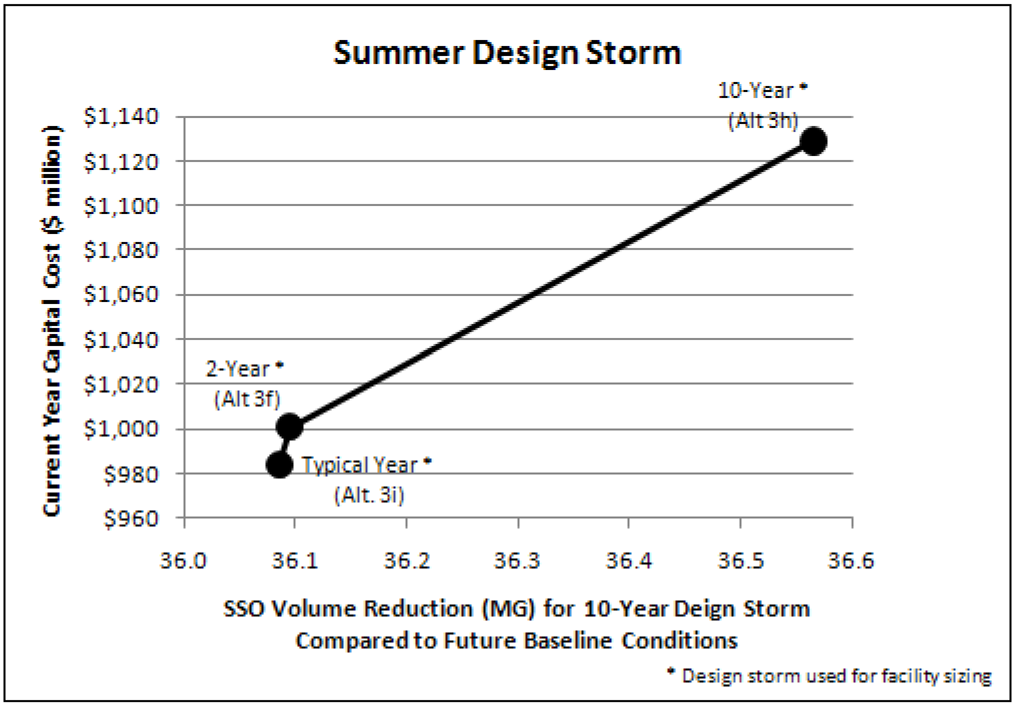
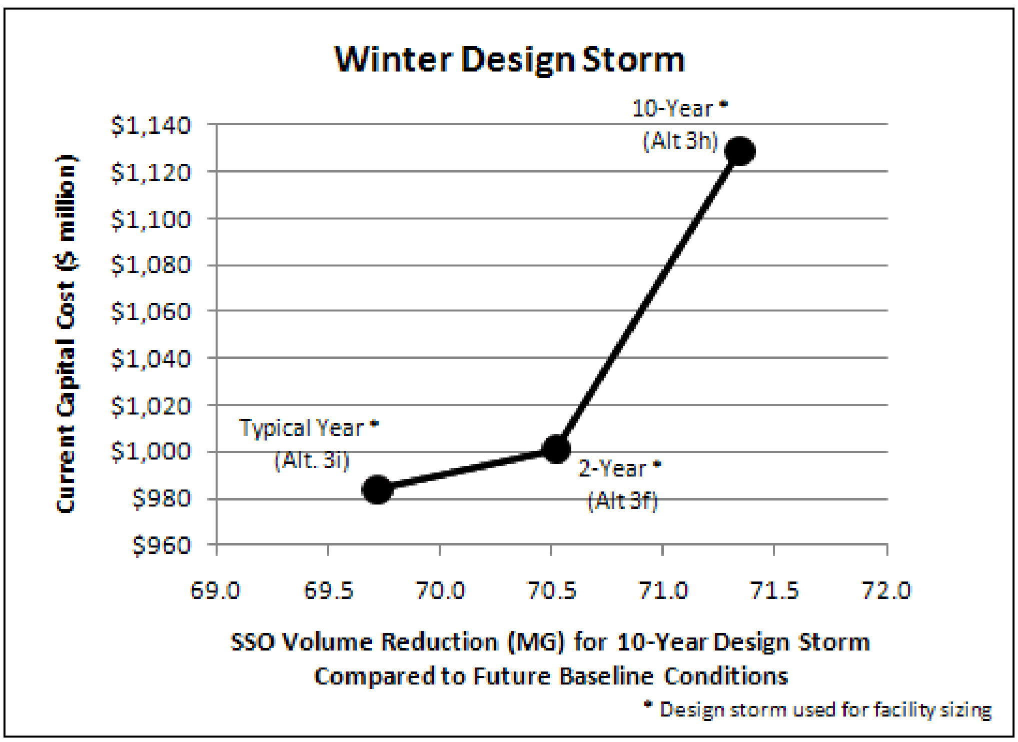


Figure 9-79: SSO Control Cost-Performance Curve for Winter Design Storm



At the time of the analysis, preliminary financial capability analyses indicated an affordability estimate of around $2 billion dollars of new capital expenditures (2010 dollars) for ALCOSAN and municipal controls. As shown previously in Figure 9-76, the estimated SSO control costs alone will consume between $0.98 and $1.13 billion depending on the ALCOSAN level of SSO control selected, and those costs do not include the additional municipal and ALCOSAN costs required if all municipalities provided a 10-year level of SSO control. Therefore the SSO control costs were expected to use about half, or more than half of the available funds for new capital investments, compromising the ability to fund the competing CSO control objectives.

Ultimately, a 2-year level of control was selected as the basis for additional system-wide alternatives evaluated and as the basis of the recommended 2026 plan for the following reasons.

- In conducting a cost-benefit analysis, the additional cost for a 2-year level of control compared to the typical year was modest when compared to the additional cost required for a 10-year level of control compared to a 2-year.
- The SSO control costs are expected to consume a significant share of the available funds for new capital investment when these SSO only account for a small percentage of the total bacteria load to the ALCOSAN receiving waters (see Figure 9-90). The cost required to achieve a 10-year level of control will provide a far greater benefit in overflow volume reduction if invested instead on CSO controls.

9.5.6 Analysis of Presumption and Demonstration Approach Alternatives

To identify the most cost-effective mix of basin-based and tunnel-based facilities and converge on a recommended wet weather plan that meets the water quality based requirements of the CWA, a number of additional hybrid alternatives were developed and analyzed to identify the most cost effective compliance approach: Presumption or Demonstration as outlined in EPA's CSO Policy. These alternatives focused on the most cost-effective regional tunnel extents that were identified in Section 9.5.4 coupled with various strategically selected remote CSO and SSO facilities. Many of these additional hybrids (Alternatives 8a, 3m, 3f-modified, and 3f-modified-10pct) included providing enhanced levels of control to outfalls discharging to sensitive areas. Unlike the initial BBS and RBS and preliminary hybrid alternatives, these additional hybrid alternatives included incorporation of the latest understanding of each municipality's submitted Planning Information, including their preferred municipal control strategy (if available). These additional hybrid alternatives served as the finalists for the selection of a recommended wet weather plan (as described in Section 9.6). Presented in this section are the H&H and water quality performance results associated with these additional hybrid alternatives.

9.5.6.1 Frequency, Duration, and Volume of Overflows

To support the assessment of alternative measures to control wet weather CSO and SSO discharges, and to identify a preferred control alternative, the typical year precipitation dataset was applied to each of the modeled system-wide alternatives to generate statistics on the annual frequency, duration, and volume of overflows resulting from implementation of the alternative. As baseline conditions to evaluate the performance of these alternative control measures, model run results were compiled for existing conditions and future baseline (2046) conditions. The following present the resultant H&H modeling CSO and SSO discharge statistics for the additional hybrid alternatives as compared to each other and against existing and future baseline (2046) conditions.

Figure 9-80 shows the total annual untreated CSO volumes for the additional hybrid alternatives of 3f, 3j, 8a, 3m, 3f-modified, and 3f-modified-10pct as well as existing and future baseline (2046) conditions. Both the ALCOSAN and municipal CSO volumes are reflected.

Figure 9-81 presents the percent reduction of ALCOSAN and municipal CSO discharge volumes for these alternatives as compared to future baseline (2046) conditions. All six alternatives produce more than a 90% reduction in annual untreated CSO discharge volume.

Figure 9-82 shows the total annual SSO discharge volumes for the additional hybrid alternatives as compared to existing and future baseline (2046) conditions. Both the ALCOSAN and municipal SSO volumes are reflected. All six alternatives show no SSO overflow volume in the typical year because they are controlled to the 2 year return interval for each.

Figures 9-83 provides a histogram of the ALCOSAN CSO frequencies for each of these additional hybrid alternatives and shows the number of outfalls that fall within specified CSO frequency ranges. Figures 9-84 shows a histogram of ALCOSAN untreated CSO volumes and Figures 9-85 shows a histogram of ALCOSAN CSO durations for these alternatives. All three histograms include existing and future baseline (2046) conditions results that serve as a basis of comparison as to the performance of these alternative control measures.

Figure 9-80: Additional Hybrid Alternatives - Annual Untreated CSO Volume Comparison

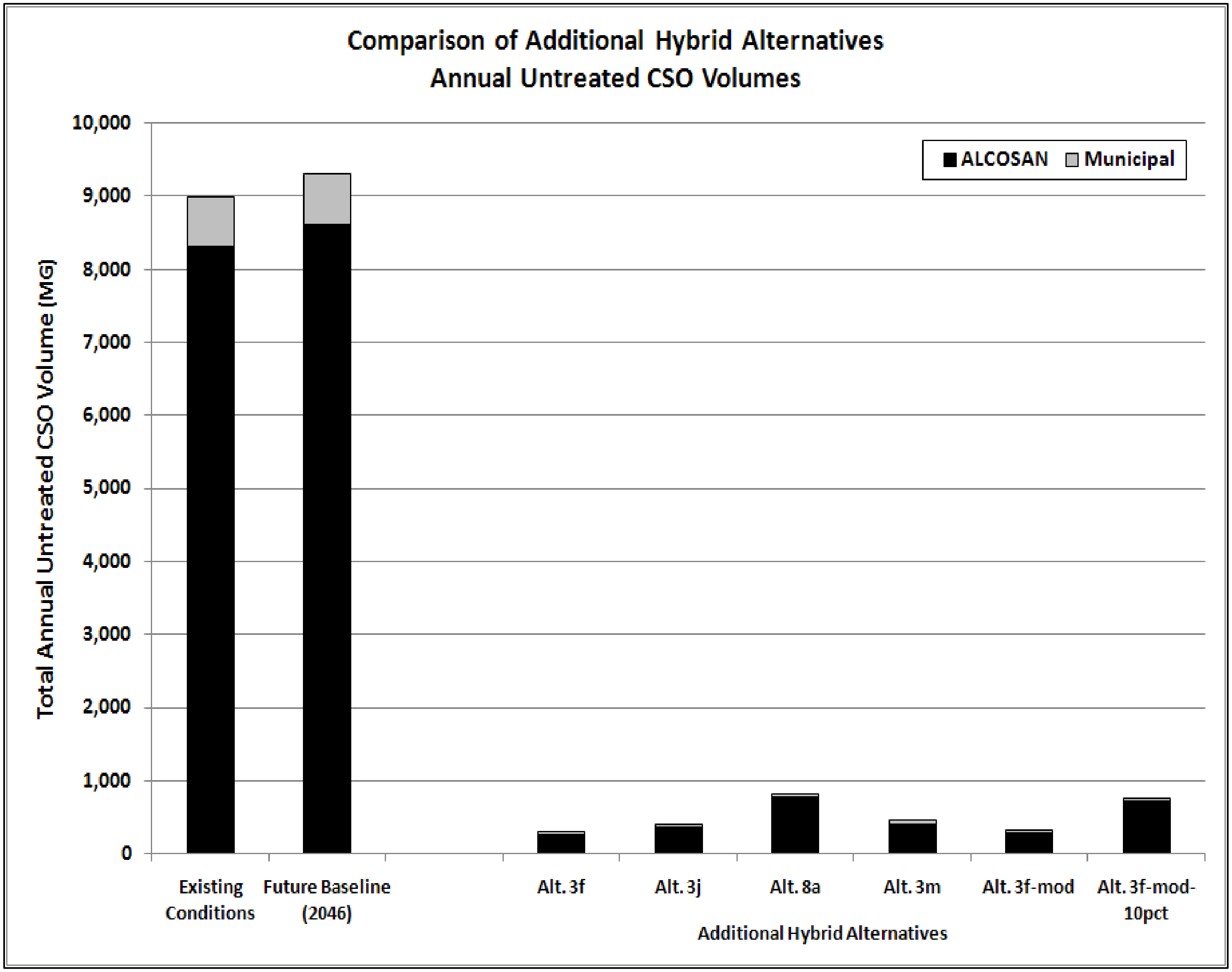


Figure 9-81: Additional Hybrid Alternatives – CSO Volume Reduction Comparison

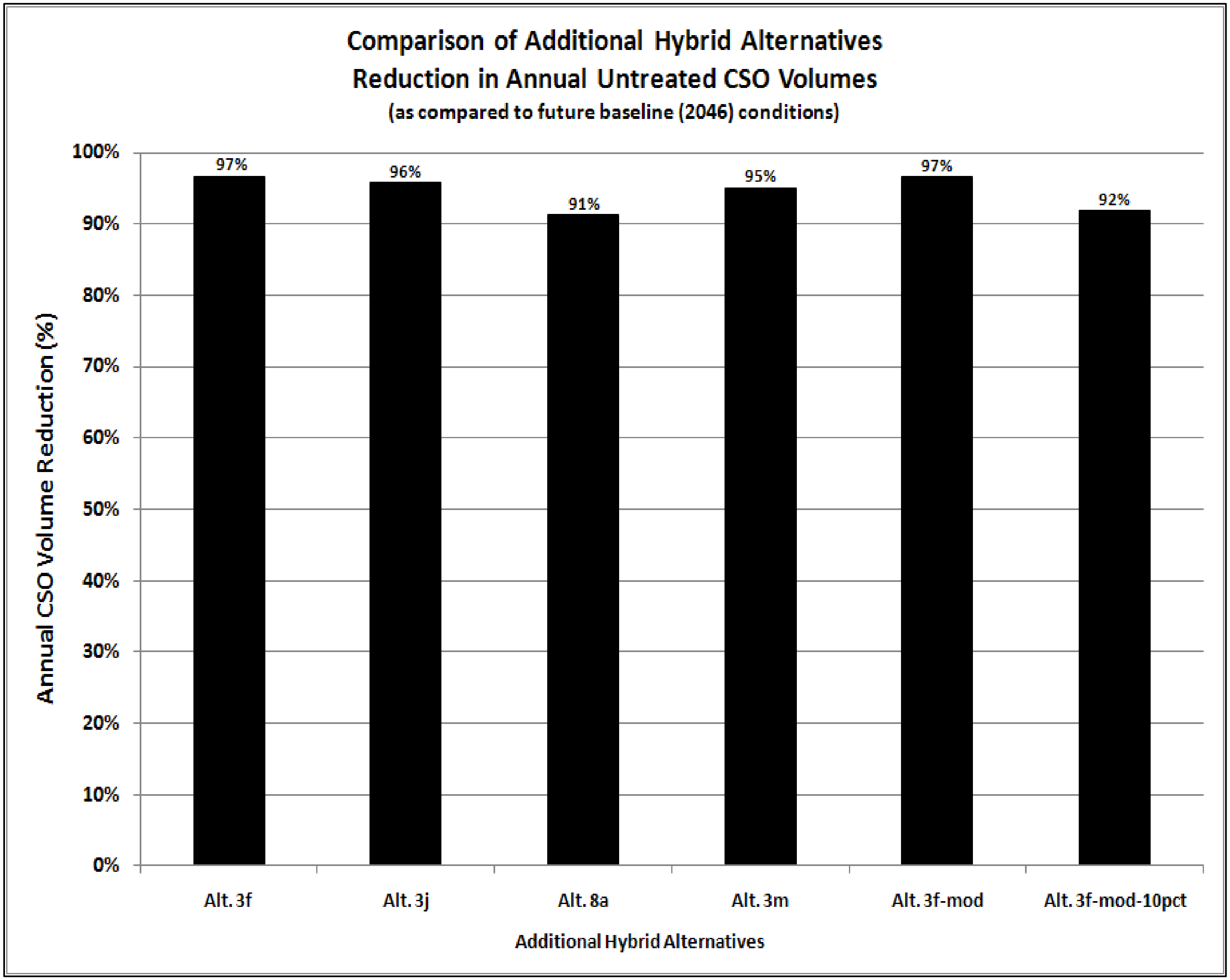


Figure 9-82: Additional Hybrid Alternatives – SSO Discharge Volume Comparison

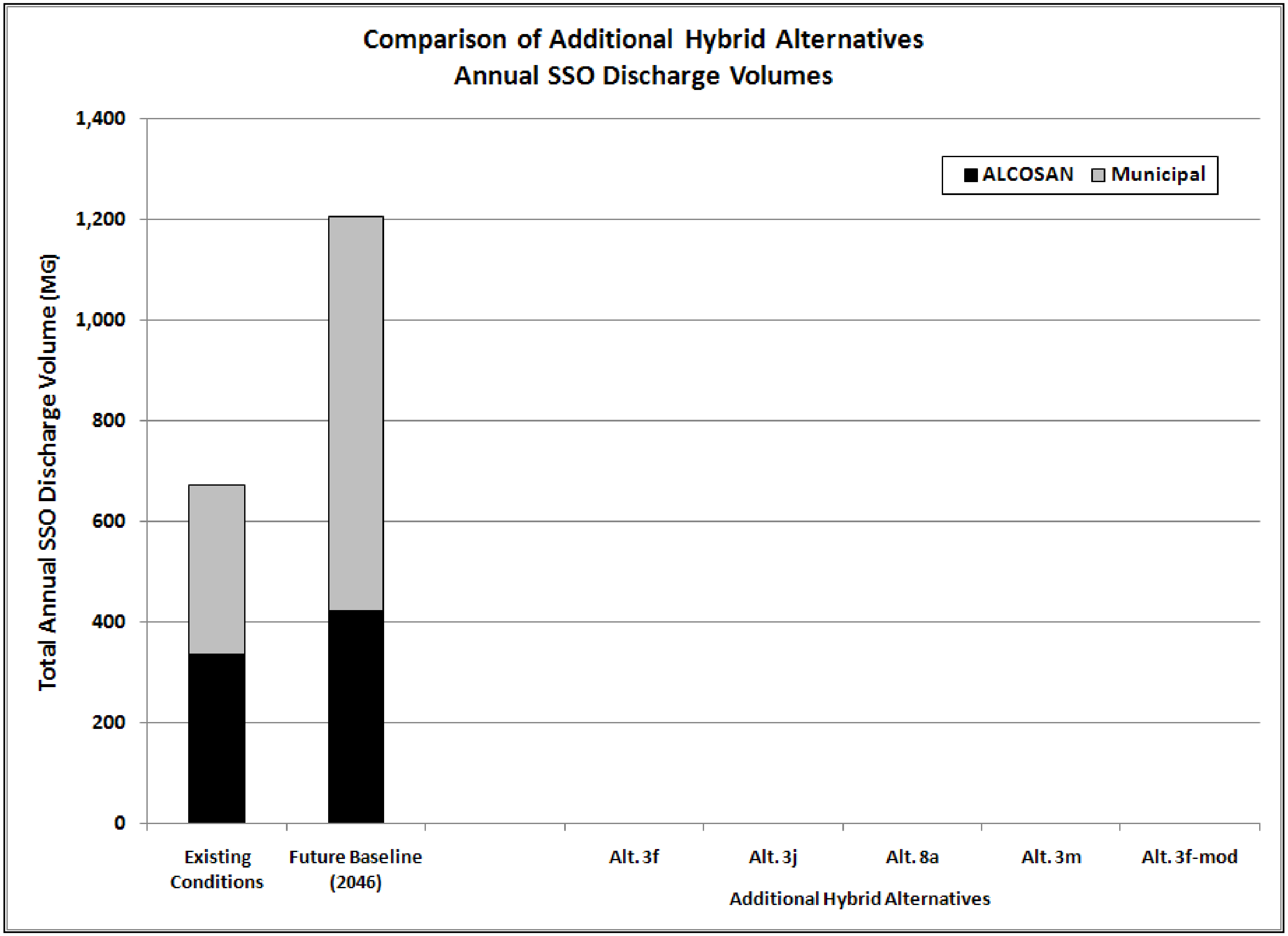


Figure 9-83: Additional Hybrid Alternatives – ALCOSAN CSO Frequency Histogram

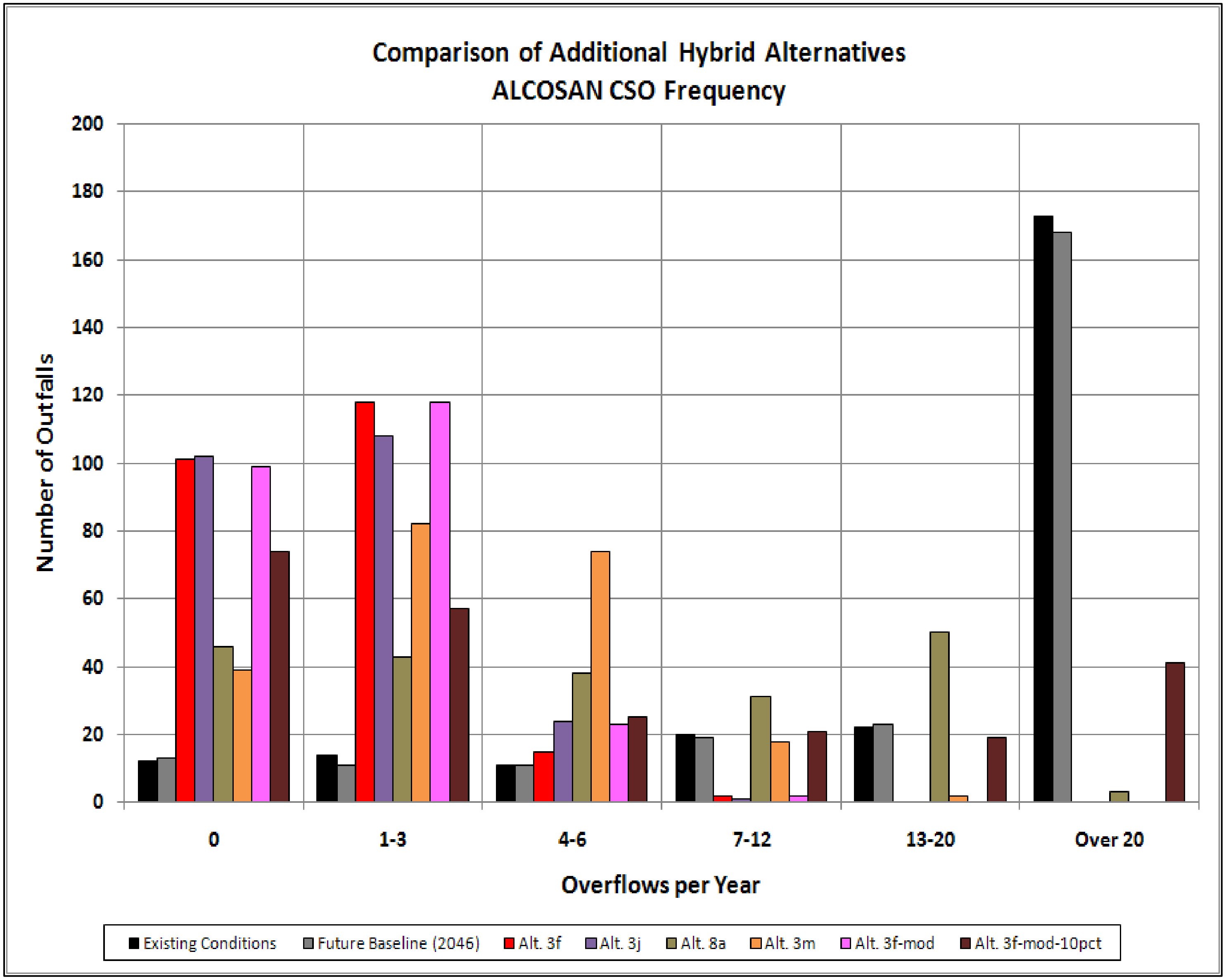


Figure 9-84: Additional Hybrid Alternatives – ALCOSAN CSO Volume Histogram

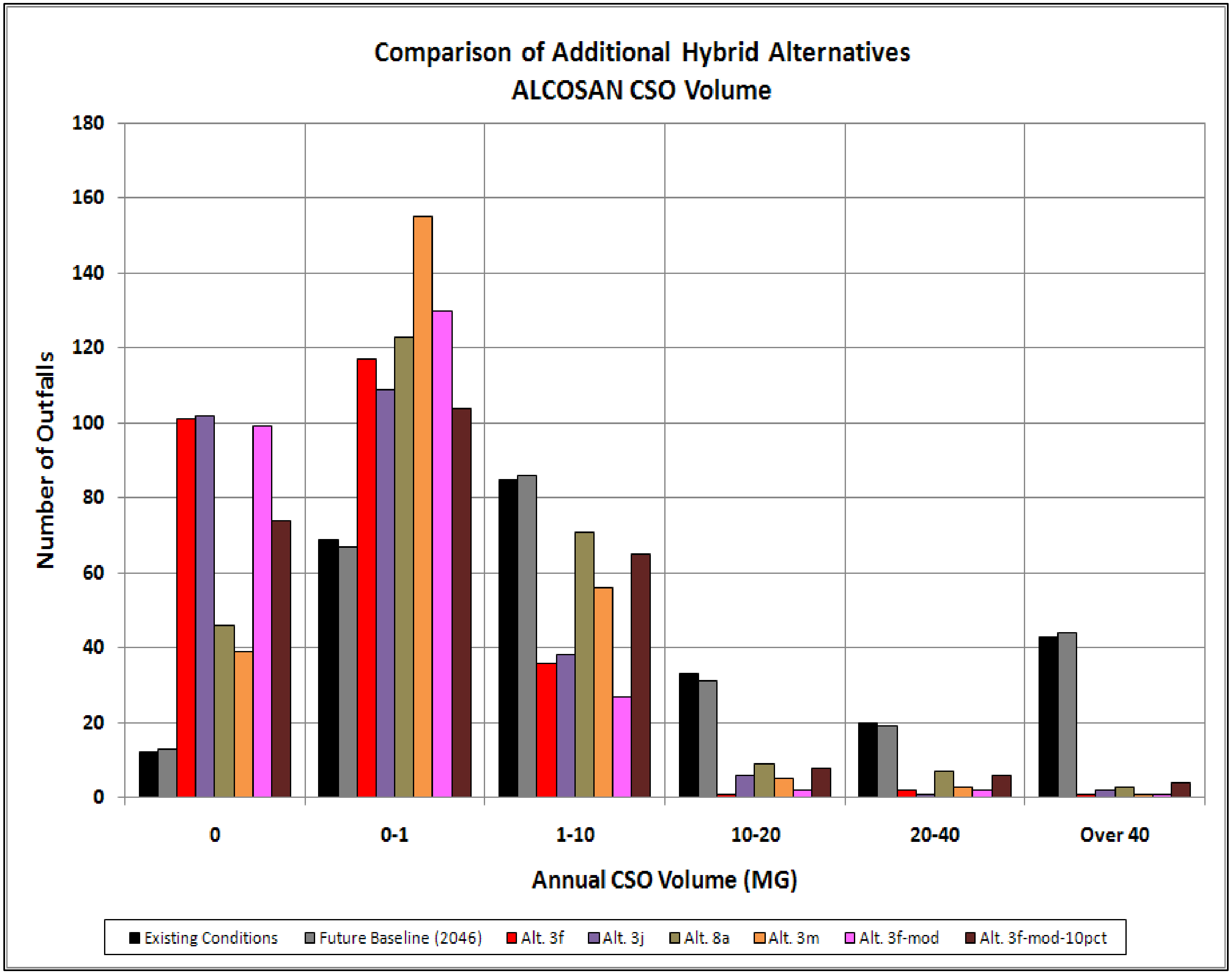
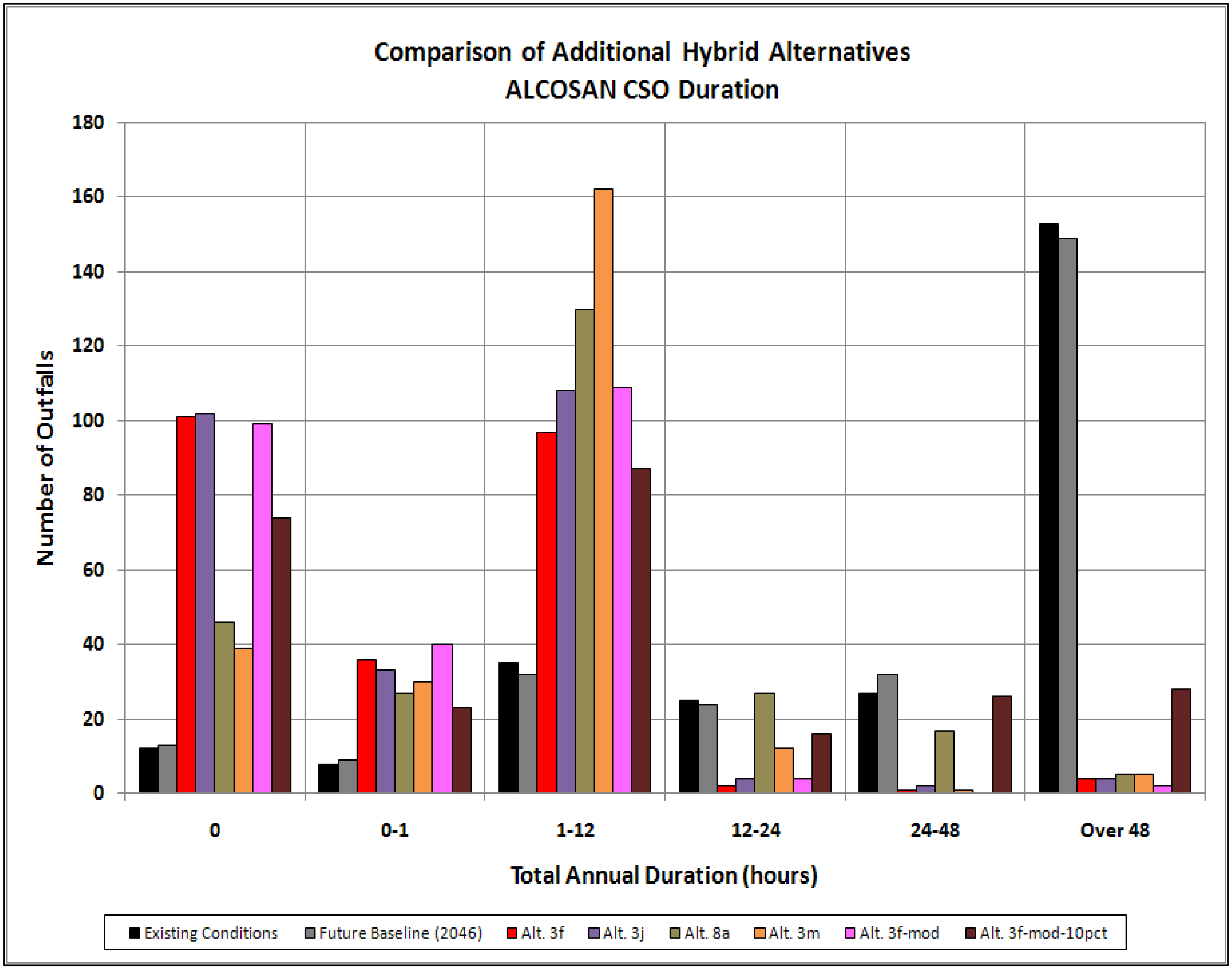


Figure 9-85: Additional Hybrid Alternatives – ALCOSAN CSO Duration Histogram



9.5.6.2 Percent Capture

One of three possible criteria within the Presumption Approach is to provide "…the capture for treatment of no less than 85% by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide annual average basis."

Percent capture for the entire ALCOSAN system was computed using the following formula:

$$\%\ Capture = \frac{(Total\ Inflow\ During\ Wet\text{-}Weather\ Periods - Untreated\ Combined\ Sewer\ Overflow)}{(Total\ Inflow\ During\ Wet\text{-}Weather\ Periods)} \times 100$$

where: *Total Inflow During Wet Weather Periods* is the sum of all dry weather flow volume and wet weather volume entering the system during all defined wet weather periods in the year; and

Untreated Combined Sewer Overflow is the sum of all untreated combined sewer overflow volume in the year.

The CSO policy description of percent capture includes the dry weather flow during a wet-weather period as part of the captured flow. Thus, identifying the wet-weather periods was an important step when estimating percent capture. For this analysis, a wet-weather period was defined as "a reported period of time during which the system experienced wet weather flow conditions and the system inflow exceeded the system dry weather inflow by a threshold of five percent or a reported period of time when the system is experiencing an overflow event resulting from wet weather conditions."

Percent capture calculations were performed for each of the additional hybrid alternatives that served as finalists for selecting a recommended wet weather plan. Figure 9-86 shows, for each of these alternatives, the percent capture of wet weather flow that is captured and treated. As a basis of comparison, the percent capture of wet weather flow under existing and future baseline (2046) conditions are shown as well. Figure 9-87 presents a cost versus performance plot that shows the percent capture of wet weather flow for each of the additional hybrid alternatives on the horizontal axis with the total capital costs of the alternatives depicted on the vertical axis. As both figures show, all six additional hybrid alternatives are well in excess of the Presumption Approach achievement of 85 percent capture of the combined sewage generated during rainfall events thus presuming to provide an adequate level of control to not preclude attainment with water quality standards.

Figure 9-86: Additional Hybrid Alternatives – Percent Capture Comparison

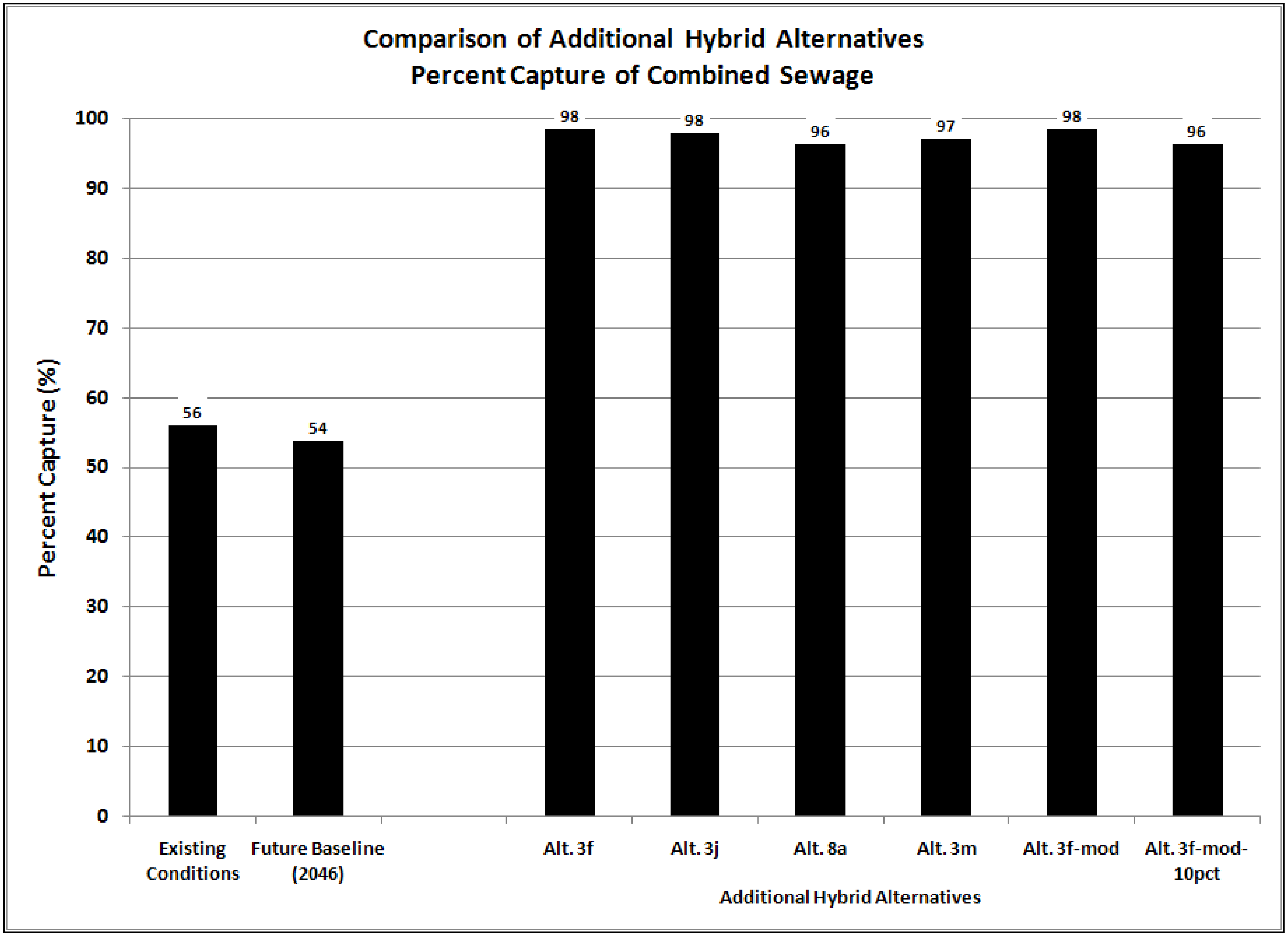
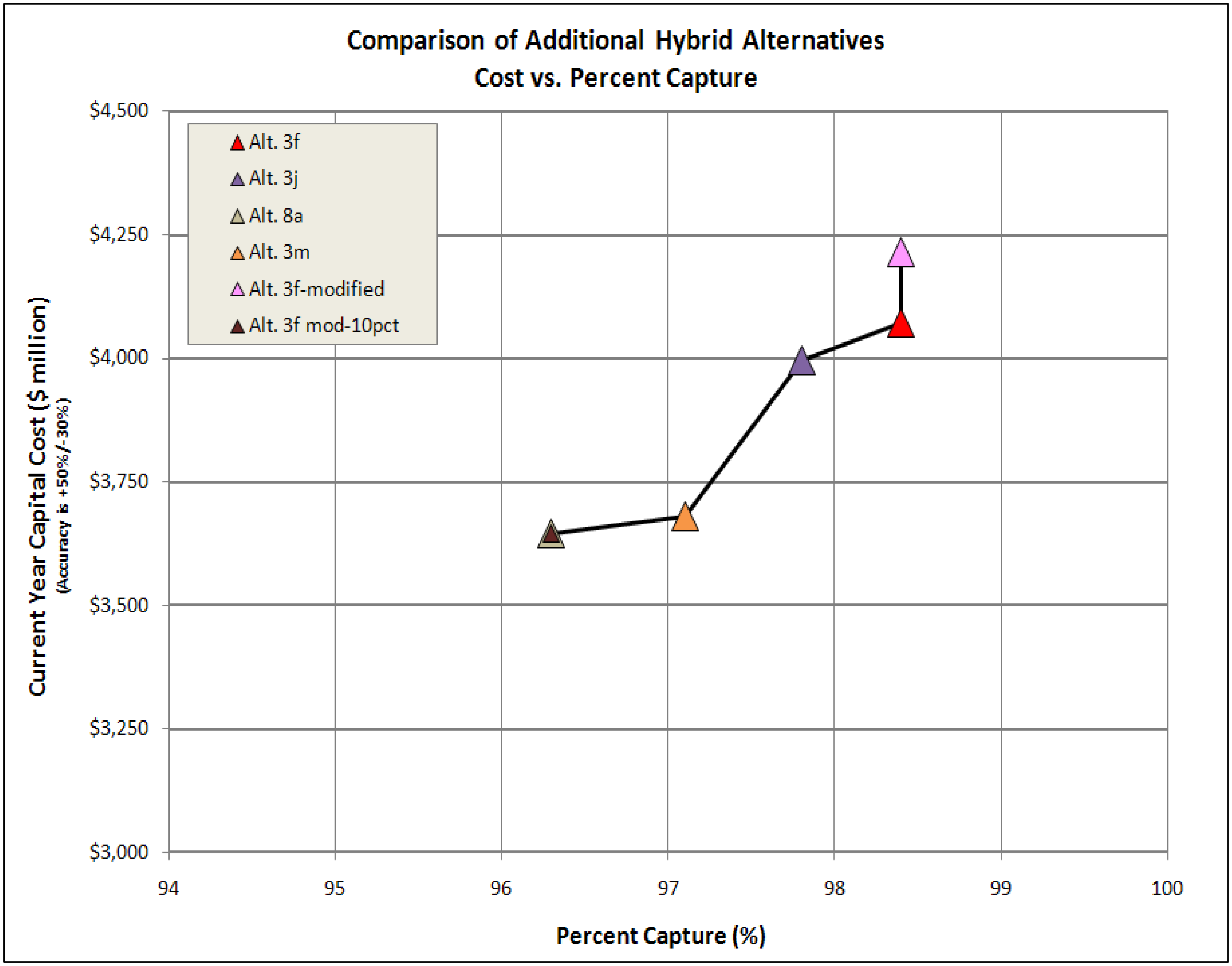


Figure 9-87: Additional Hybrid Alternatives – Cost Versus Percent Capture



9.5.6.3 Secondary Treatment and Core Flow Requirements

Selected system-wide alternatives were evaluated to ensure that they met the secondary treatment capacity requirements as summarized in Section 9.2.4, including Core Flow requirements. These requirements were assessed for Alternatives 3f-modified and 3f-modified-10pct as these reflect the latest municipal planning information.

As described in Section 9.2.4, the proposed facilities and other improvements which comprise the Wet Weather Plan must fulfill several requirements in regards to secondary treatment capacity:

- The facilities must be designed to capture and provide secondary treatment for a flow volume equivalent to all of the Sanitary Sewer System flow that is generated in the Regional Collection System.[9-10]
- If the WWP relies on the Demonstration Approach or the 85% Presumption Approach, the facilities must be designed to capture and provide secondary treatment to the volumetric equivalent of all Peak Dry Weather Combined Sewer System Flow generated from within the Regional Collection System.[9-11]
- If ALCOSAN proposes as part of its WWP to bypass all or any portion of the primary or secondary treatment processes at the sewage treatment plant, a secondary treatment requirement within Appendix T of the ALCOSAN CD would be invoked. ALCOSAN must demonstrate that Core Flow, as defined in Appendix T, will receive secondary treatment.[9-12]

The H&H models for Alternatives 3f-modified and 3f-modified-10pct are identical in terms of the volume of flow generated in the sewer system. These models were used to calculate the volumes described in the first two bullets above as follows, based on a typical year model simulation for Alternatives 3f-modified and 3f-modified-10pct. These simulations incorporate future baseline (2046) wastewater flows.

- The total volume generated in the Sanitary Sewer System was calculated as the sum of all dry and wet weather flow generated from all sanitary sewer subsheds as reflected in the models.
- The dry weather volume generated in the Combined Sewer System was calculated as the sum of all dry weather flow generated from all combined sewer subsheds as reflected in the models. The "volumetric equivalent of all Peak Dry Weather Combined Sewer System Flow" is interpreted to mean a volume, not a flow rate.

As shown in Table 9-72, secondary treatment must be provided for a volume equivalent to 80,400 MG in the typical year. The predicted volume receiving secondary treatment in the

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[9-10] Paragraph 17(b)
[9-11] Paragraph 18(a) & 18(b)(i)
[9-12] Appendix T, Paragraph 1(g)

typical year simulation is 83,300 MG, which exceeds, and therefore satisfies, the annual volume requirement for secondary treatment of 80,400 MG.

Table 9-72: Total Volume Requiring Secondary Treatment Per Consent Decree Paragraphs 17 and 18

Flows From Typical Year Model Simulation of Alternatives 3f-modified and 3f-modified-10pct	Annual Volume (MG)	Equivalent Annual Average Flow Rate (MGD)
Total Sanitary Sewer System flow generated in the Regional Collection System	42,000	115
Volumetric equivalent of all dry weather Combined Sewer System Flow generated from within the Regional Collection System	38,400	105
Total Volume Requiring Secondary Treatment:	**80,400**	Not applicable

The third requirement for secondary treatment as described above (treating Core Flow) must also be met since Alternatives 3f-modified and 3f-modified-10pct both rely on a bypass of the secondary treatment processes at the sewage treatment plant during wet weather events. The Sanitary Sewer System and Combined Sewer System components of Core Flow were calculated as follows from a typical year model simulation for Alternatives 3f-modified and 3f-modified-10pct. These simulations incorporate future baseline (2046) wastewater flows.

- The Sanitary Sewer System Core Flow component was calculated as the sum of all dry and wet weather flow generated from all sanitary sewer subsheds as reflected in the models.

- Calculation of the Combined Sewer System Core Flow component is derived from the Peak Dry Weather Flow, calculated in accordance with the Consent Decree definition, which is 119 MGD. The Combined Sewer System Core Flow component was calculated as the volumetric sum of dry and wet weather flow up to 148 MGD (125% of 118.6 MGD), as generated from all combined sewer subsheds reflected in the models. Figure 9-88 presents the approach used for calculating the Combined Sewer System Core Flow component. The annual core flow volume in the combined area of 39,700 MG includes all dry weather flow plus wet weather flows up to a maximum flow of 148 MGD.

As shown in Table 9-73, secondary treatment must be provided for a volume equivalent to 81,700 MG in the typical year to meet the Core Flow requirements. The predicted volume receiving secondary treatment in the typical year simulation is 83,300 MG, which exceeds, and therefore satisfies, the annual Core Flow volume requirement for secondary treatment of 81,700 MG.

Figure 9-88: Combined Sewer System Core Flow Component

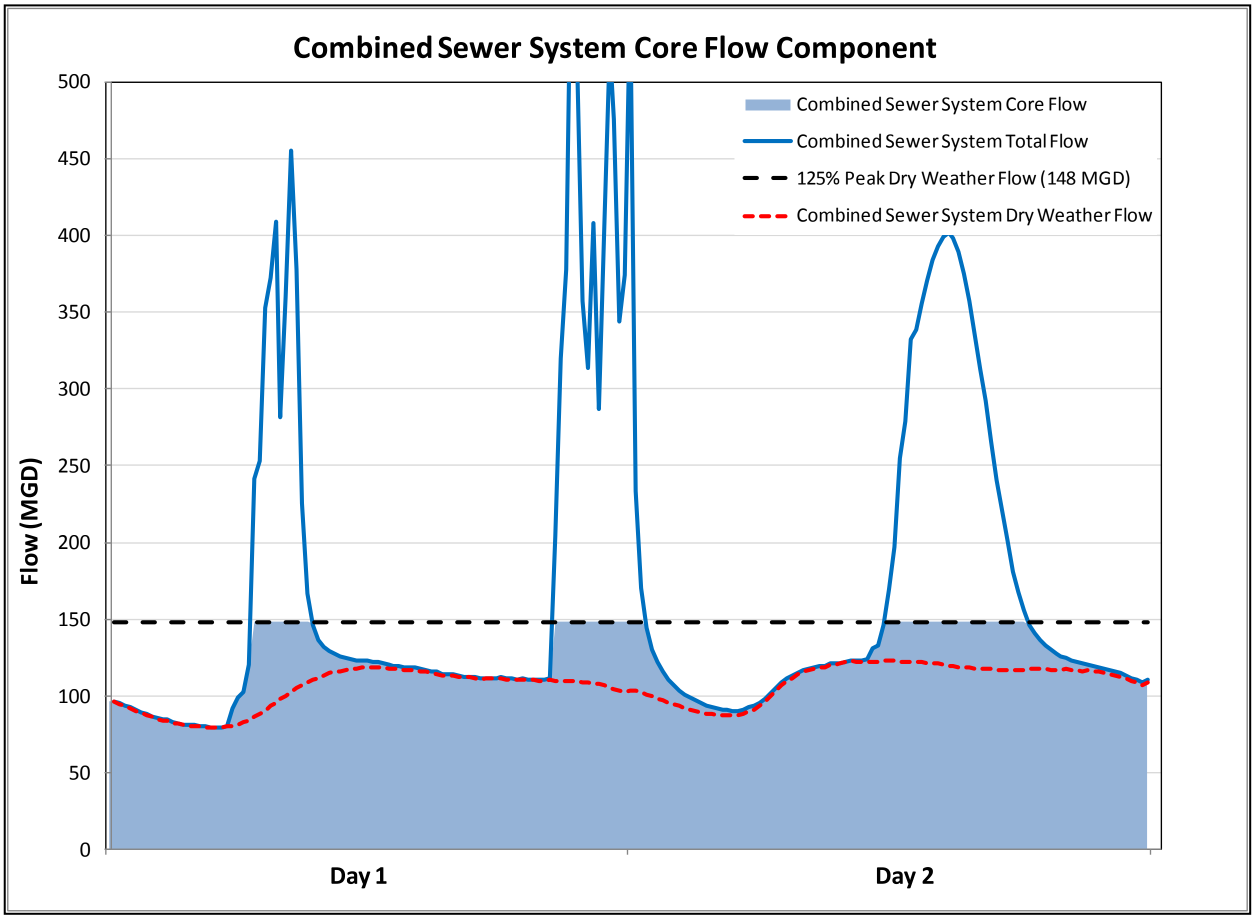


Table 9-73: Total Core Flow Volume Requiring Secondary Treatment

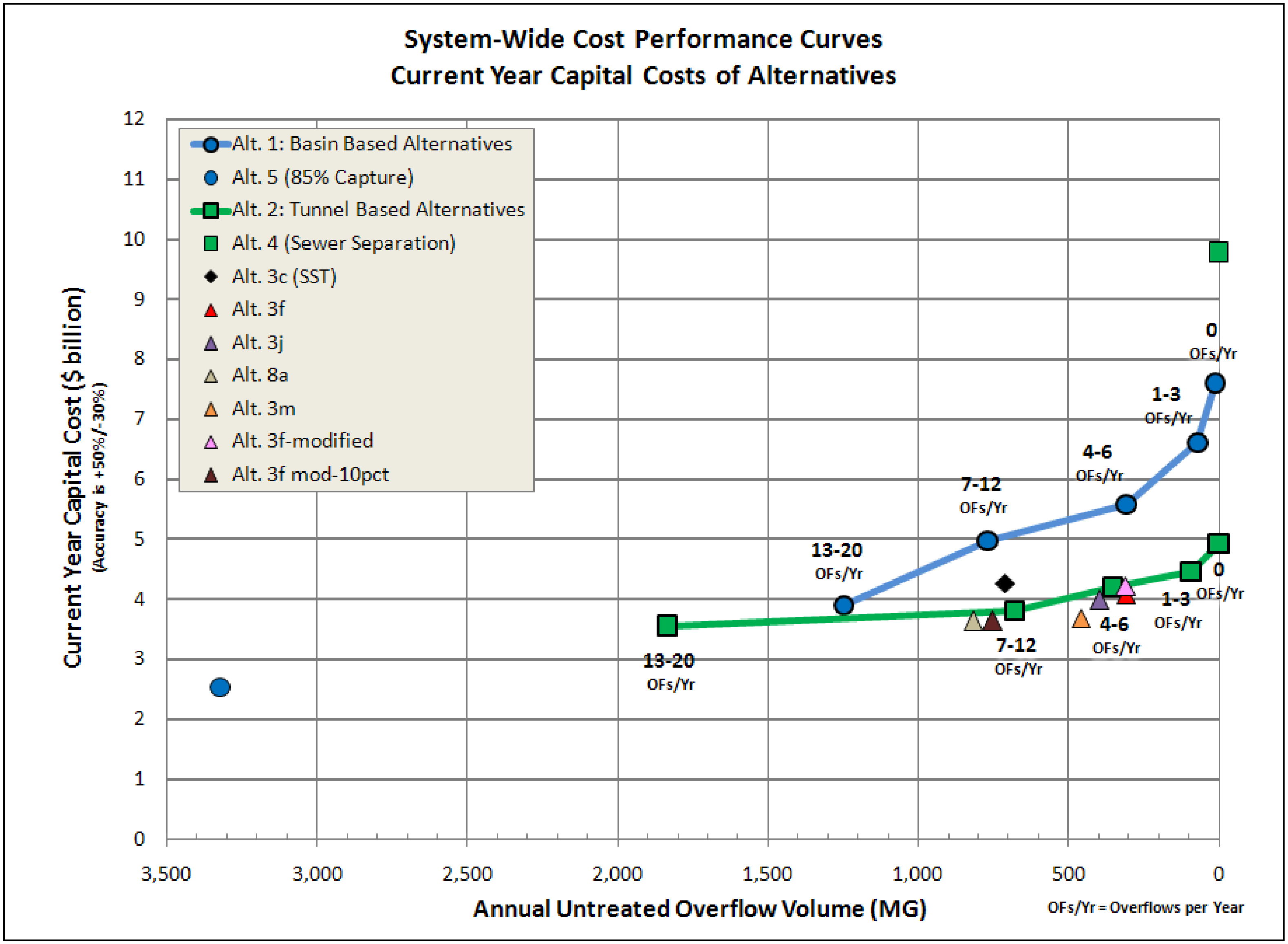
Flows From Typical Year Model Simulation of Alternatives 3f-modified and 3f-modified-10pct	Annual Volume (MG)	Equivalent Annual Average Flow Rate (MGD)
Total Sanitary Sewer System flow generated in the Regional Collection System	42,000	115
Volumetric equivalent of 125% Peak Dry Weather Flow that is generated in the Combined Sewer System	39,700	109
Total Volume Requiring Secondary Treatment:	**81,700**	Not applicable

9.5.6.4 Knee-of-the Curve Analysis

Section 9.5.3 presented the results of the preliminary knee-of-the-curve (KOC) analysis that was conducted for the BBS and RBS alternatives. The BBS and RBS alternatives bounded the range of potential control options and provided preliminary findings that guided the regional integration process and convergence towards identifying the most cost effective suite of facilities for the service area. The additional hybrid alternatives presented in this section, including Presumption and Demonstration Approach options, as well as the satellite sewage treatment alternative described in Sections 9.5.2.3 and 9.5.4, were derived from this process and represent potential WWP control strategies. Performance values were computed from H&H model simulation runs and capital cost estimates were generated using the ACT. Using these data, the preliminary KOC plot was updated to include these additional hybrid alternatives to serve as guidance for selecting a recommended wet weather plan.

Figure 9-89 reflects the updated KOC analysis plot. Each of the points on the plot were determined by two values: a performance value (annual untreated overflow volume) and a capital cost estimate for that alternative. The capital cost estimates reflect the total basin planner, regional conveyance, WWTP expansion, and municipal costs associated with each alternative. The municipal capital costs included in the totals for each alternative reflect the preferred and/or assumed preliminary municipal control strategies (as described in Section 9.3). This analysis was updated to serve as guidance for selecting a recommended wet weather plan (as described in Section 9.6) as well as to meet the requirements of Paragraph D of Appendix U of the ALCOSAN CD.

Figure 9-89: Knee-of-the-Curve Analysis for System-Wide Alternatives



9.5.6.5 Water Quality Benefits Analysis

A primary objective of the National CSO Control Policy is to develop and implement long term CSO control plans that will meet the water quality based requirements of the CWA with an ultimate goal of implementing practices such that CSO discharges "will not preclude attainment of water quality standards or the receiving waters' designated uses or contribute to their impairment."

This goal recognizes that CSO discharges may not be the only pollution source limiting attainment with water quality standards and that the objective of the CSO Policy is to address the CSO share of the problem. To this end, water quality models were used to determine the level of CSO control required to not preclude attainment with applicable water quality standards and to predict anticipated water quality benefits for analyzed overflow control alternatives. The receiving water quality benefits of each alternative were quantified by evaluating:

- Existing water quality conditions
- Causes for non-attainment with water quality standards
- Probability of attainment with water quality standards
- Pollutant load reduction projections
- Projected improvement in receiving water quality
- Water quality improvement cost benefit analyses

Existing Water Quality Conditions: Section 5.4 reports on receiving water quality monitoring results and provides an assessment of attainment with applicable water quality standards (described in Section 5.2), concluding that fecal coliform bacteria is the primary CSO and SSO discharge constituent of concern. Section 5.5.3 presents water quality model results showing the probability of attainment with the fecal coliform water quality standard during the typical year under existing conditions. Under existing conditions, none of the receiving waters were predicted to achieve attainment with the fecal coliform criteria applicable to the recreation season of May through September (Figures 5-69 and 5-70). Whereas, most receiving waters currently meet the non-recreational season criterion (Figure 5-71). The downstream end of Chartiers Creek is the only exception with the probability of non-attainment at just 1%.

Causes for Non-attainment with Water Quality Standards: Non-attainment with the recreational season criteria is caused by a combination of pollution sources, with CSO and SSO discharges representing only a part of the problem. Other contributors might include: upstream flows entering the service area with pollutant concentrations oftentimes exceeding water quality standards; non-point source pollution entering receiving waters through stormwater outfalls and direct runoff; illicit connections; and failing on-lot disposal systems. Figure 9-90 presents the relative fecal coliform loads originating from various sources under existing conditions for the typical year, including dry and wet weather days. The Allegheny and Monongahela upstream boundary flows (shown on the figure as *Main Rivers Boundary*) to the service area are responsible for the majority (66%) of the pollutant mass observed within and ultimately transported through the service area. Discharges from the Conveyance and Treatment System, in the form of ALCOSAN and municipal CSO and SSO discharges, account for most of the remainder of the typical year load. Figure 9-91 shows the typical year existing condition fecal coliform loads for ALCOSAN and municipal CSO and SSO discharges, with ALCOAN CSO representing 86% of the total load.

Water quality sampling results indicate that pollution sources other than wet weather overflows are alone causing non-attainment with water quality standards. More than 50% of measured base flow (dry weather) concentrations exceeded the 200 cfu/100 ml threshold for all receiving waters and the 400 cfu/100 ml threshold for all receiving waters except Turtle Creek. Additionally, fecal coliform levels in stormwater runoff typically far exceed recreational season criteria thresholds. As a result, controlling wet weather discharges will not achieve attainment with water quality standards unless other pollution sources are also controlled.

Figure 9-90: Existing Conditions Fecal Coliform Loadings by Source

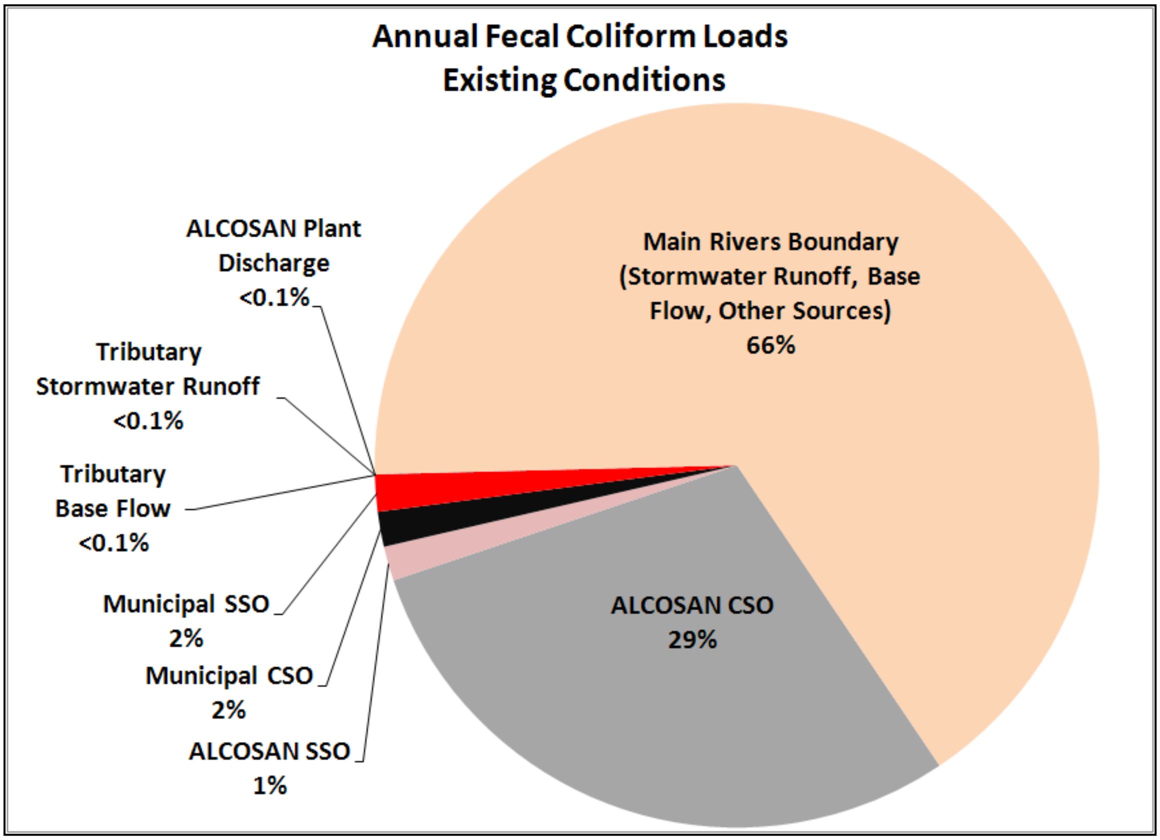
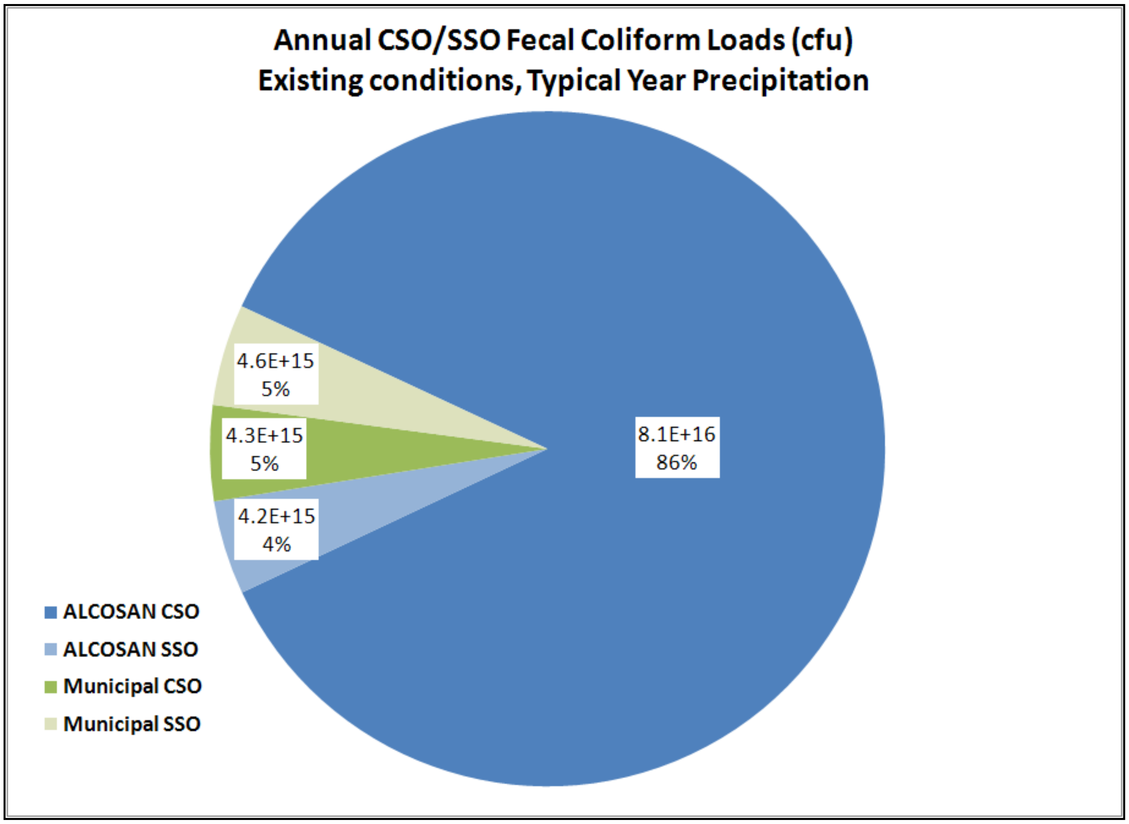


Figure 9-91: Existing Conditions Fecal Coliform Loadings from CSO and SSO Discharges



Evaluating Attainment with Water Quality Standards: Since pollution sources other than CSO and SSO discharges are causing non-attainment with water quality standards, evaluating the level of CSO control necessary to not preclude attainment requires an assumption that baseflow and stormwater fecal coliform concentrations have been improved through remediation and control measures beyond the scope of this Wet Weather Plan. This was accomplished in the water quality models by reducing the background baseflow concentration in the receiving waters to a maximum of 100 cfu / 100 ml and the stormwater EMC to 50 cfu/100 ml.

The probability of attaining water quality standards was assessed using the methodology described in Section 5.5.3. Because impairments are principally occurring during the recreational season, assessments were conducted for the applicable recreational season criteria:

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

The recreational season water quality assessment results for existing overflows with improved baseflow and stormwater are presented in Figure 9-92 and Figure 9-93, for the geometric mean and 10% criteria, respectively. The results show that the receiving waters upstream of CSO and SSO discharges are predicted to meet the fecal coliform water quality criteria due to the assumption that baseflow and stormwater improvements have been implemented. Areas influenced by CSO and SSO discharges do not attain standards a significant percentage of the time, with these figures representing the CSO and SSO share of the problem. The assumption of improved baseflow and stormwater is maintained throughout the remaining alternatives analyses discussed in this Section.

Basin and Regional Based Control Alternatives: Water quality assessments were initially conducted for the BBS and RBS series of system-wide alternatives described in Section 9.5.2 for CSO levels of control of 0, 1-3, 4-6, 7-12, and 13-20 overflows/year. Consequently the water quality results of System-Wide Alternative 1, 2 and 5 were used to assess the level of CSO control required to not preclude attainment with fecal coliform water quality standards in each receiving waterbody. Figures 9-94 and 9-95 provide the recreational season water quality assessment results for the BBS 13-20 overflows/year scenario, for the geometric mean and 10% criteria, respectively. The results show that at this level of control all receiving waters meet both criteria. Attainment assessment results for System-Wide Alternative 5, targeting 85% capture by receiving stream, are shown in Figures 9-96 and 9-97. The results predict that attainment with the geometric mean and 10% criteria is achieved on Chartiers Creek, Saw Mill Run, and Turtle Creek. The geometric mean is also met on the Allegheny, Monongahela and Ohio Rivers but they do not reach attainment with the 10% criterion.

Figure 9-92: Existing Overflows With Improved Baseflow and Stormwater Fecal Coliform Geometric-Mean Water Quality Criterion

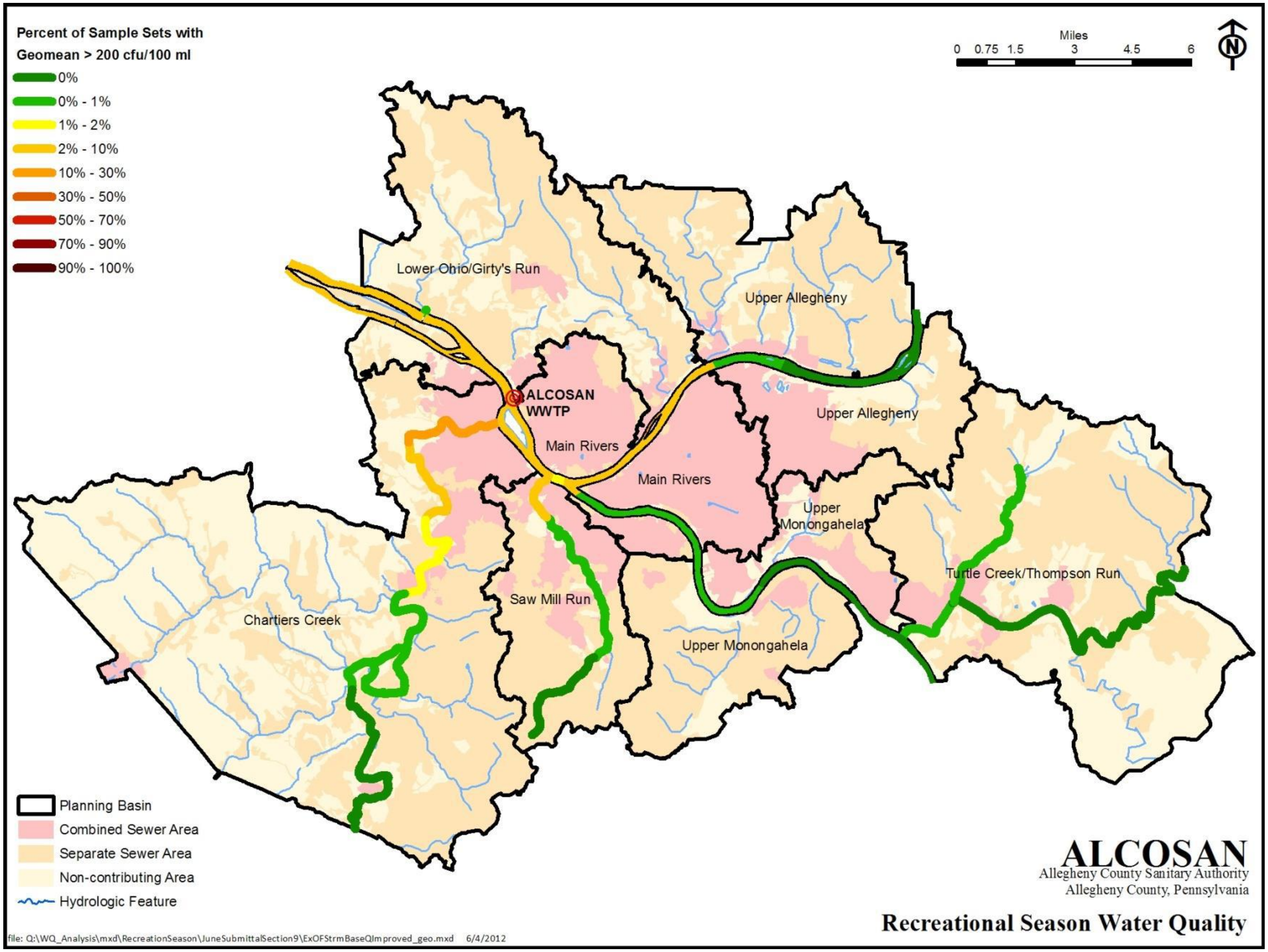


Figure 9-93: Existing Overflows with Improved Baseflow and Stormwater Fecal Coliform 10% Water Quality Criterion

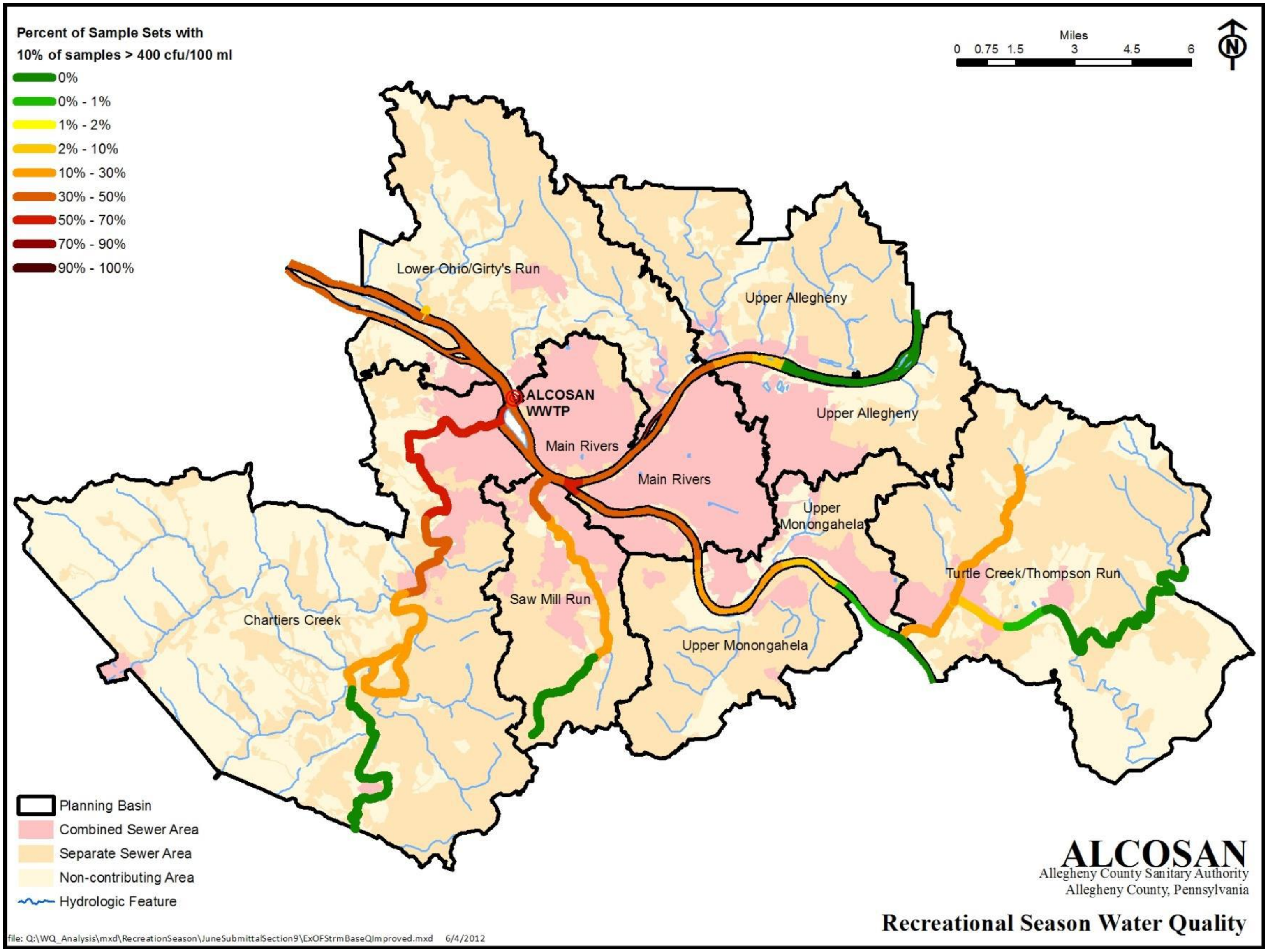


Figure 9-94: System-Wide Alternative 1: Basin-Based Control (13-20 OFs/year) Fecal Coliform Geometric-Mean Water Quality Criterion

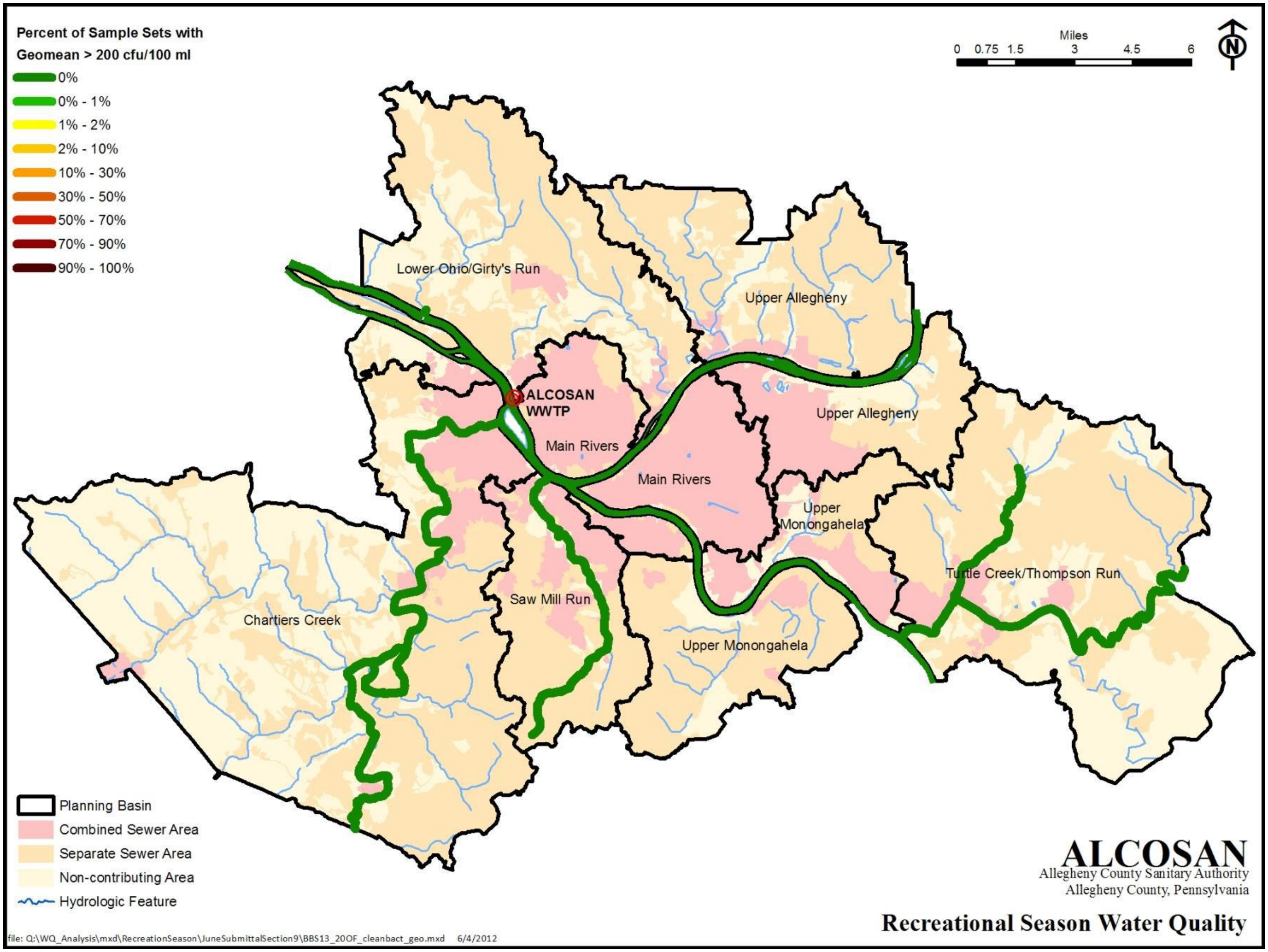


Figure 9-95: System-Wide Alternative 1: Basin-Based Control (13-20 overflows/year) Fecal Coliform 10% Water Quality Criterion

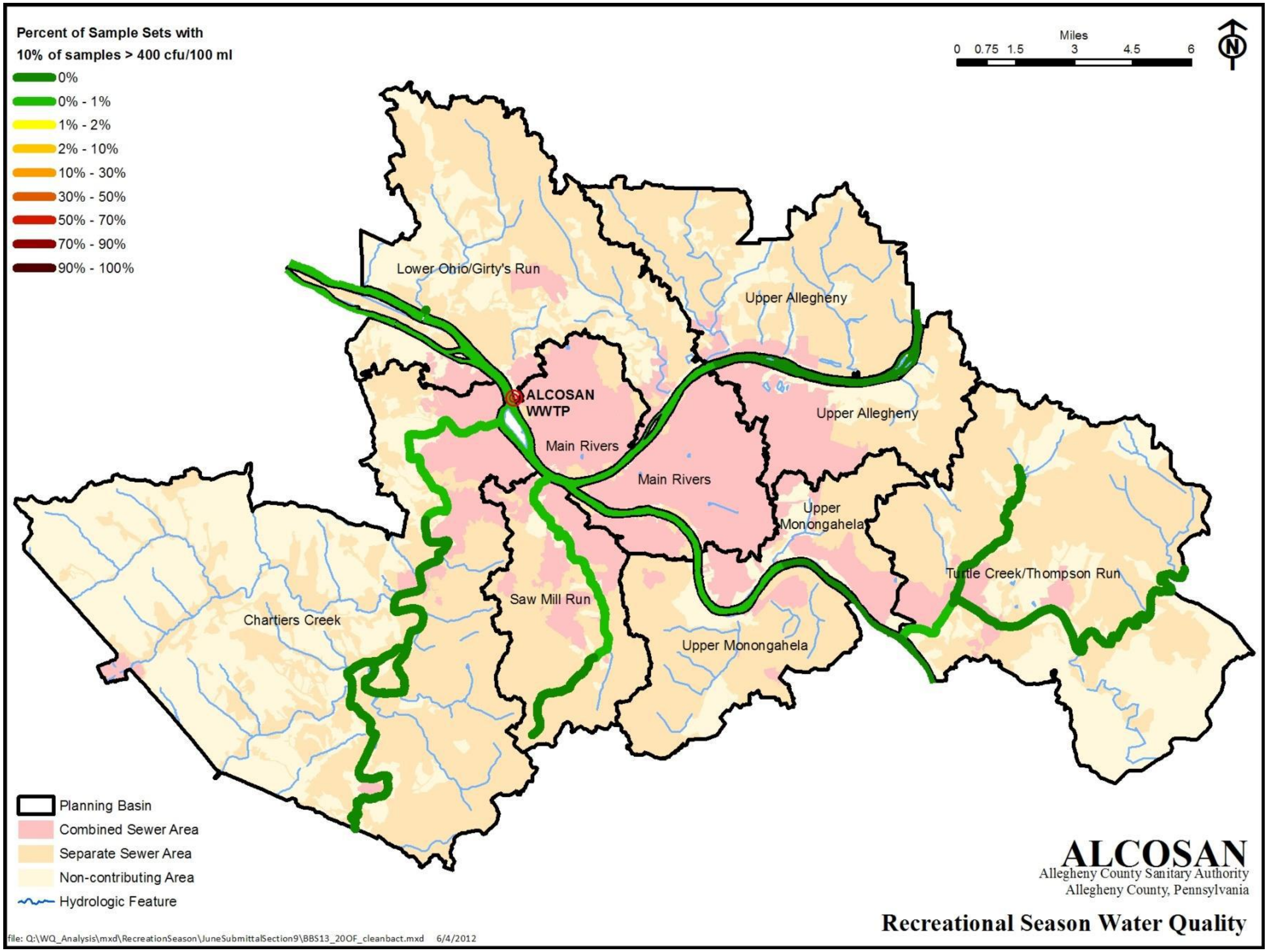


Figure 9-96: System-Wide Alternative 5: 85% CSO Capture Fecal Coliform Geometric-Mean Water Quality Criterion

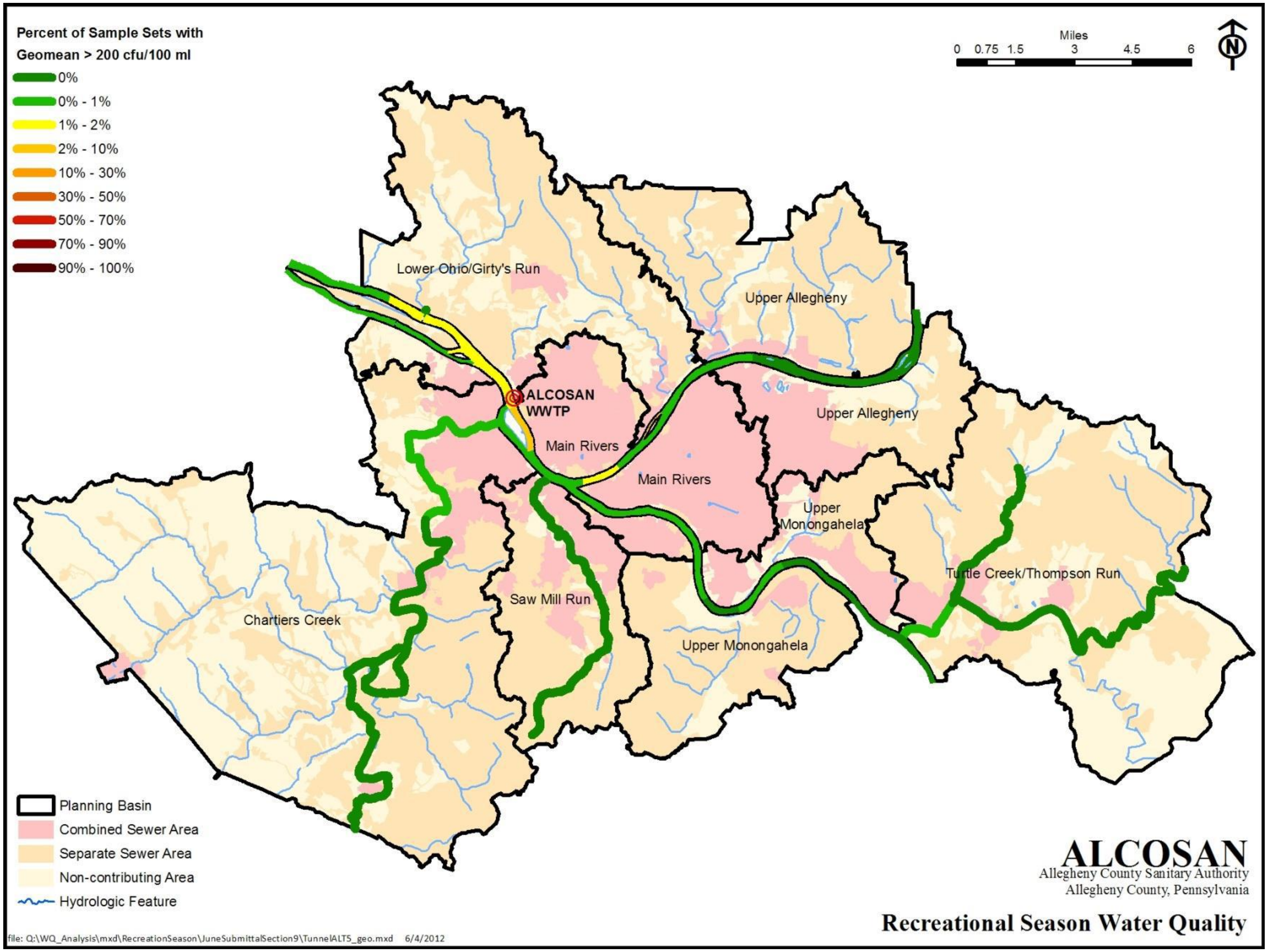
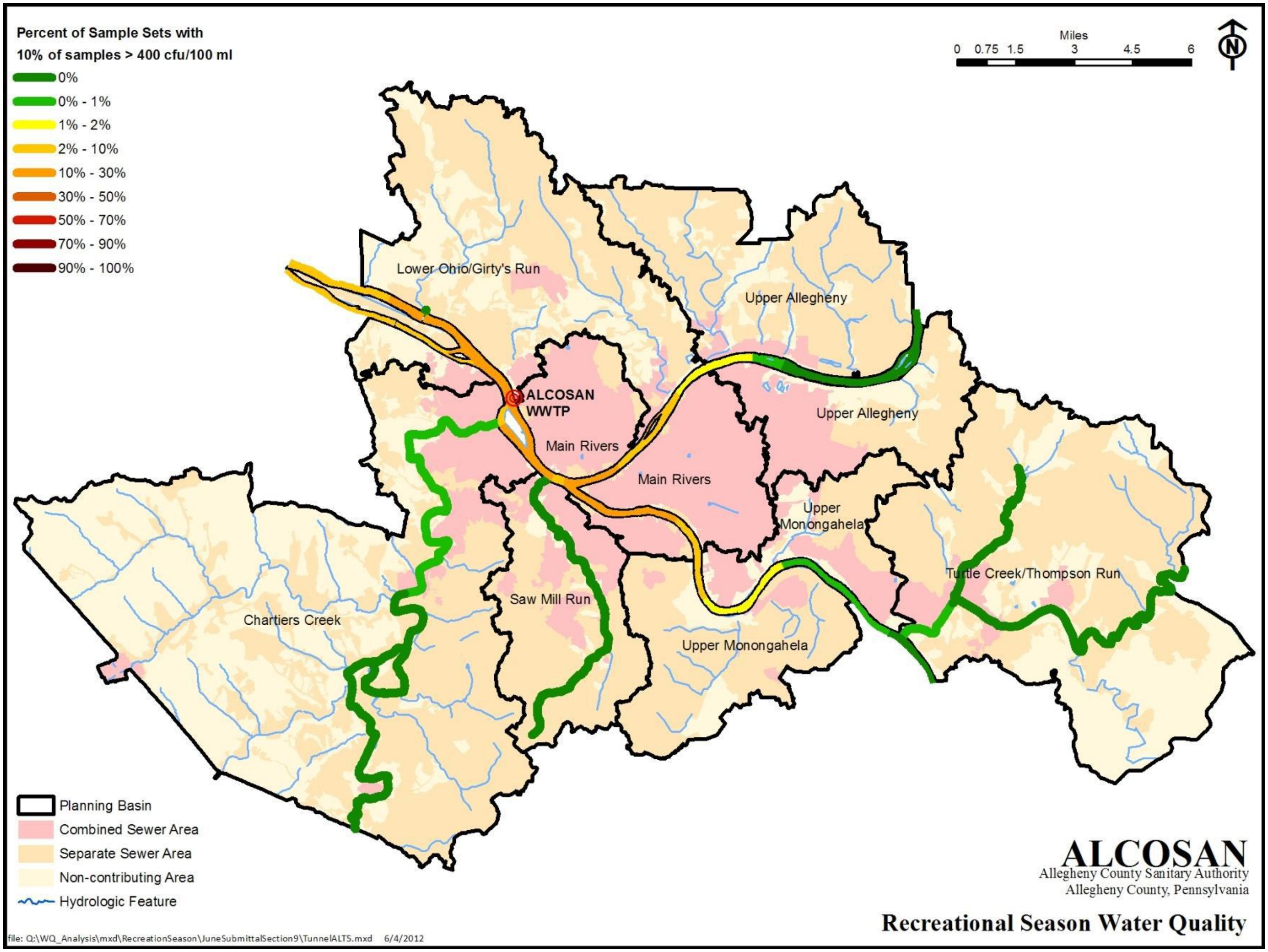


Figure 9-97: System-Wide Alternative 5: 85% CSO Capture Fecal Coliform 10% Water Quality Criterion



Figures 9-98 and 9-99 provide the attainment assessment results for the RBS System-wide Alternative 2 at 13 to 20 overflows per year. Figure 9-99 shows that at this level of control all receiving waters meet the geometric mean water quality criterion, but the Allegheny, Monongahela and Ohio Rivers do not reach attainment with the 10% criterion. Figure 9-100 provides the assessment results for the RBS 7 to 12 overflows per year scenario. The results show that at this level of control all receiving waters meet the 10% criterion. Assessment results for the remaining RBS and BBS alternatives are not presented via a map because they all meet both criteria. The results for all system-wide alternatives evaluated are summarized in Table 9-74. This water quality standard attainment assessment for the BBS and RBS system-wide alternatives provided a general understanding of the CSO level of control necessary to not preclude attainment with water quality standards and guided the development of the additional hybrid alternatives targeting the Demonstration Approach.

Hybrid Alternatives: To confirm that the six additional hybrid alternatives that were evaluated as candidates for selection as the long term control plan achieved compliance requirements to not preclude attainment with water quality standards, the attainment probability assessment was conducted for these system-wide alternatives. The results confirmed that all three 4 to 6 overflows per year Presumption Approach alternatives (3f, 3j and 3f-modified) achieved attainment with both criteria for all receiving waters. The three Demonstration Approach alternatives (8a, 3m and 3f-modified-10pct) achieved attainment with the geometric mean water quality criteria for all receiving waters. Alternative 3f-modified-10pct achieved attainment with the 10% criteria for all receiving waters. Alternatives 3m and 8a do not reach attainment with the 10% criterion on Turtle Creek. In addition, the assessment was conducted for Alternative 3c, the alternative with a satellite WWTP serving M-30 and upstream. These results showed that this alternative also achieves attainment with both criteria for all receiving waters.

Figure 9-98: System-Wide Alternative 2: Regional-Based Control (13-20 OFs/yr) Fecal Coliform Geometric-Mean Water Quality Criterion

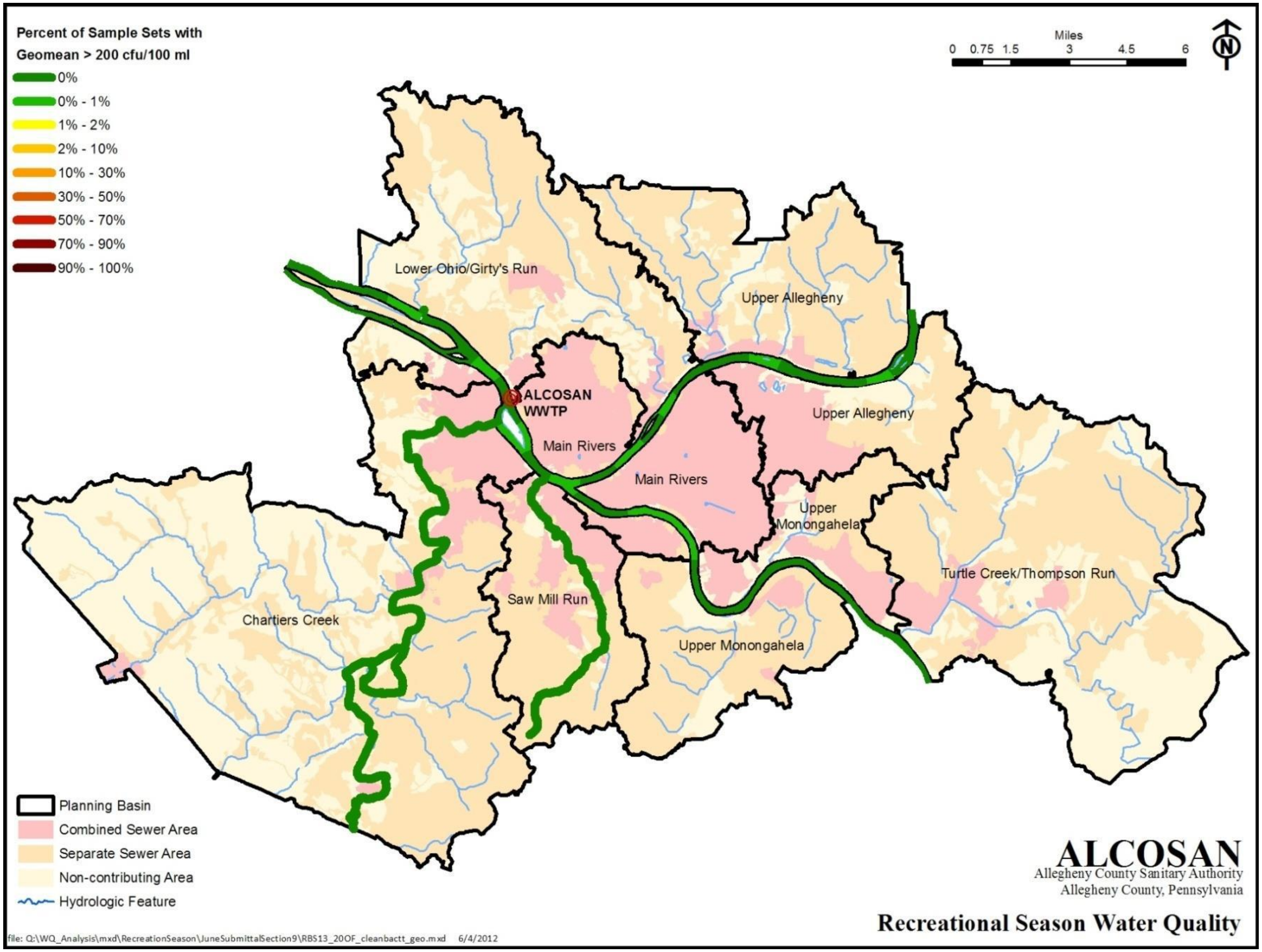


Figure 9-99: System-Wide Alternative 2: Regional Based-Control (13-20 overflows/year) Fecal Coliform 10% Water Quality Criterion

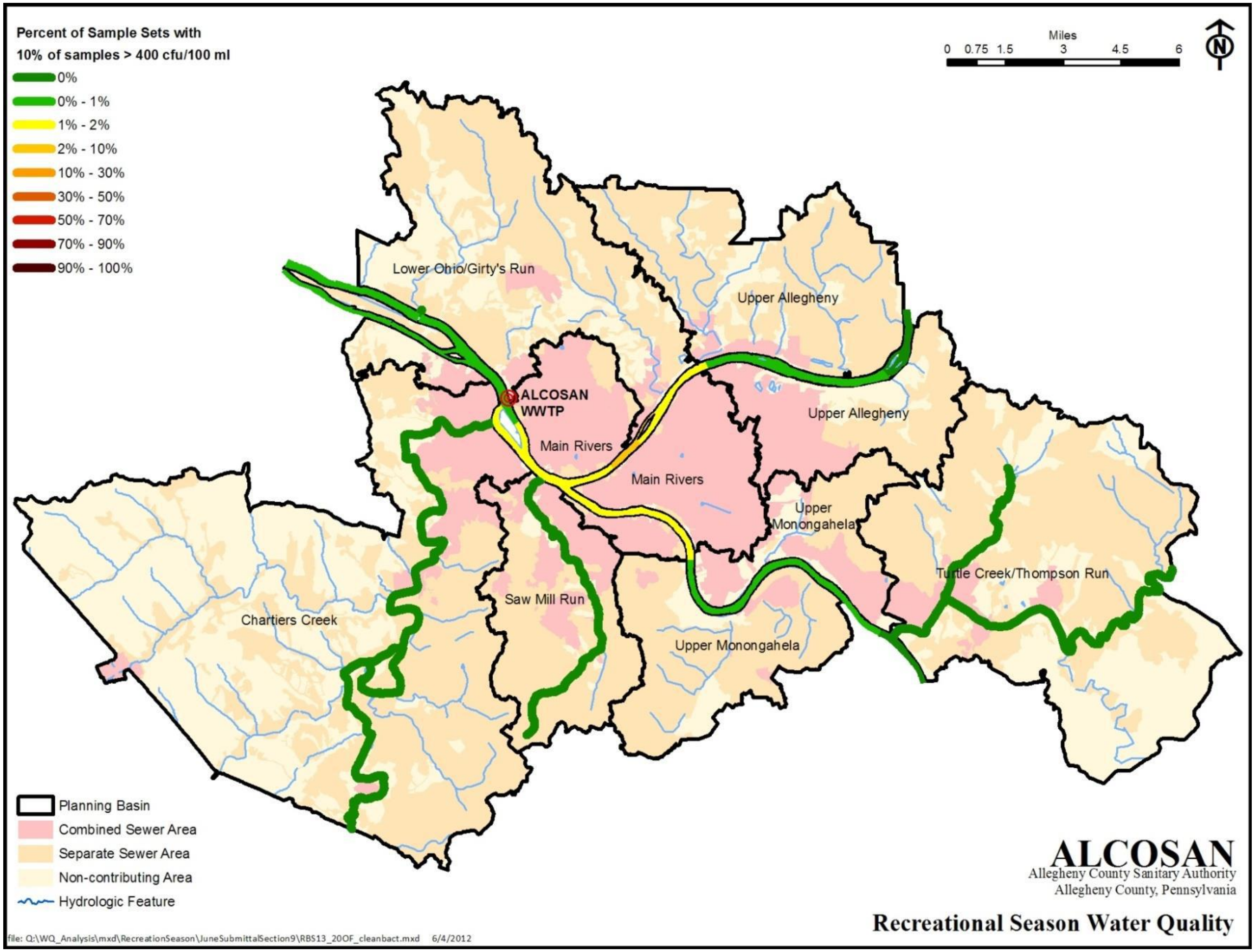


Figure 9-100: System-Wide Alternative 2: Regional Based Control (7-12 overflows/year) Fecal Coliform 10% Water Quality Criterion

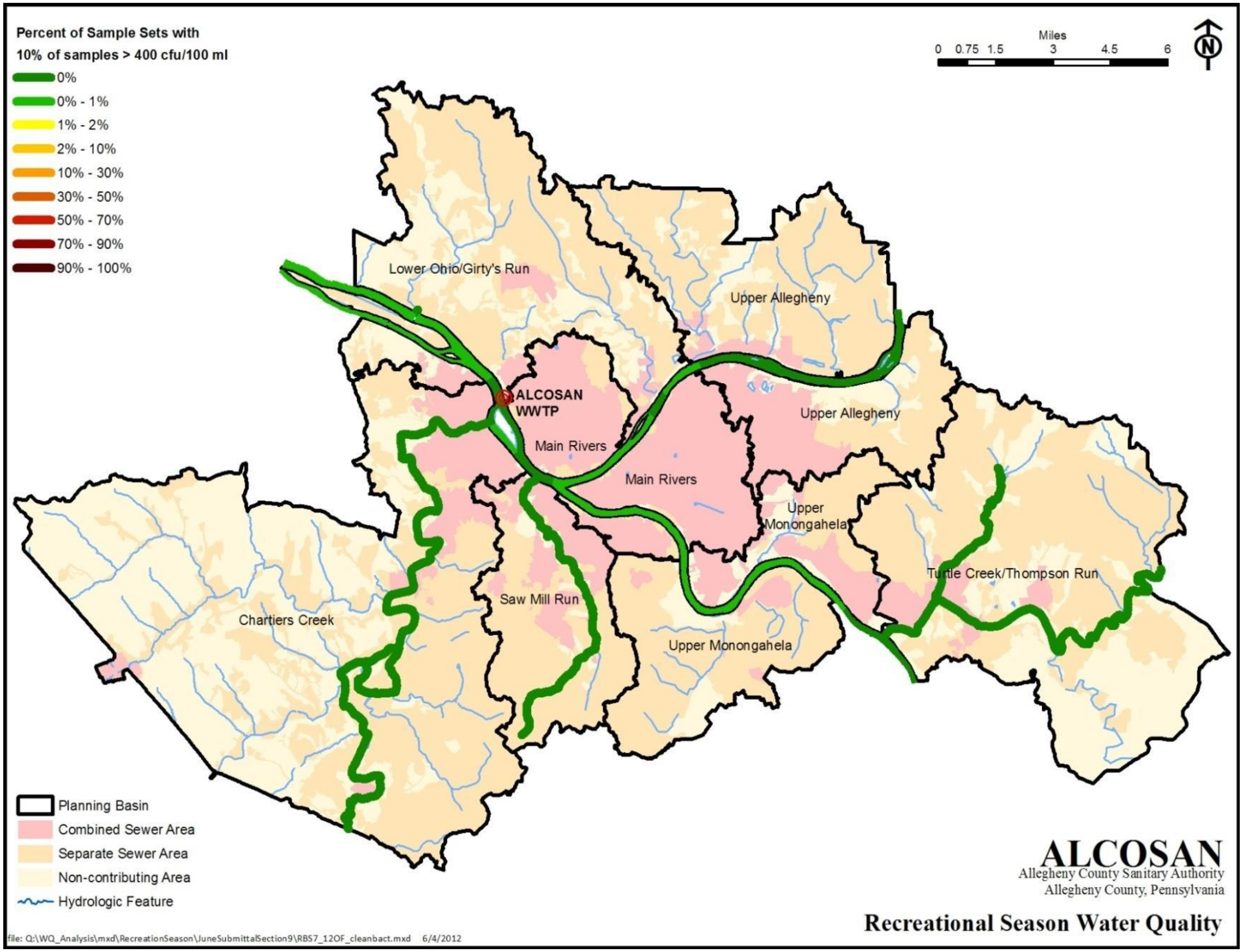


Table 9-74: Water Quality Standard Attainment Assessment Matrix

	Allegheny River		Monongahela River		Ohio River		Chartiers Creek		Saw Mill Run		Turtle Creek	
	Geomean Criterion	10% Criterion	Geomean Criterion	10% Criterion	Geomean Criterion	10% Criterion	Geomean Criterion	10% Criterion	Geomean Criterion	10% Criterion	Geomean Criterion	10% Criterion
BBS 0 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BBS 1-3 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BBS 4-6 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BBS 7-12 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
BBS 13-20 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RBS 0 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RBS 1-3 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RBS 4-6 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RBS 7-12 OF	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
RBS 13-20 OF	✓		✓		✓		✓	✓	✓	✓	✓	✓
Alt 5	✓		✓		✓		✓	✓	✓	✓	✓	✓
Alt 3c	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alt 3f	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alt 3j	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alt 3f modified	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Alt 8a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Alt 3m	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Alt 3f modified 10pct	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Pollutant Load Reductions: System-wide alternatives were analyzed to assess projected CSO and SSO discharge load reductions and to develop corresponding cost performance curves. The load reduction cost performance curves are presented in Figures 9-101 through 9-105 for BOD, NH3, TSS, TP, and fecal coliform, respectively. In general, the results echo those observed with the untreated overflow volume cost performance curves presented in Section 9.5.6.4.

Reductions of untreated CSO and SSO discharges achieved by control alternatives result in additional volume and pollutant mass reaching the Wood's Run WWTP or proposed satellite treatment facilities. The total pollutant load reductions from discharges from the conveyance and treatment system are therefore a function of the treatment performance at these facilities. Table 9-75 presents the treatment facility performance assumptions used for projecting pollutant load reductions from the Wood's Run WWTP and satellite RTB treatment facilities. The Wood's Run WWTP is assumed to provide primary and secondary treatment and disinfection up to 295 MGD, and primary treatment and disinfection to flows above 295 MGD, up to 600 MGD. Satellite RTB facilities assume effluent concentrations for bacteria, and percent reductions for the remaining parameters. The percent reductions are applied as annual average reductions to the pre-treated influent at the satellite facilities.

Table 9-76 presents the projected pollutant percent loading reductions from discharges from the conveyance and treatment system for each of the six additional hybrid alternatives that were evaluated as candidates for selection as the long term control plan as well as Alternative 3c (the most promising SST alternative). The reductions are relative to future baseline conditions, which reflect the potential future overflow conditions in 2046 if no overflow remediation controls are implemented. In addition to the significant load reduction (over 95%) for fecal coliform, the primary constituent of concern, for the six additional hybrid alternatives, the projected loads for BOD, ammonia, total suspended solids are projected to decrease by approximately 14%, 9%, and 20%, respectively.

Figure 9-101: BOD Overflow Loading Reduction Cost Performance Curve

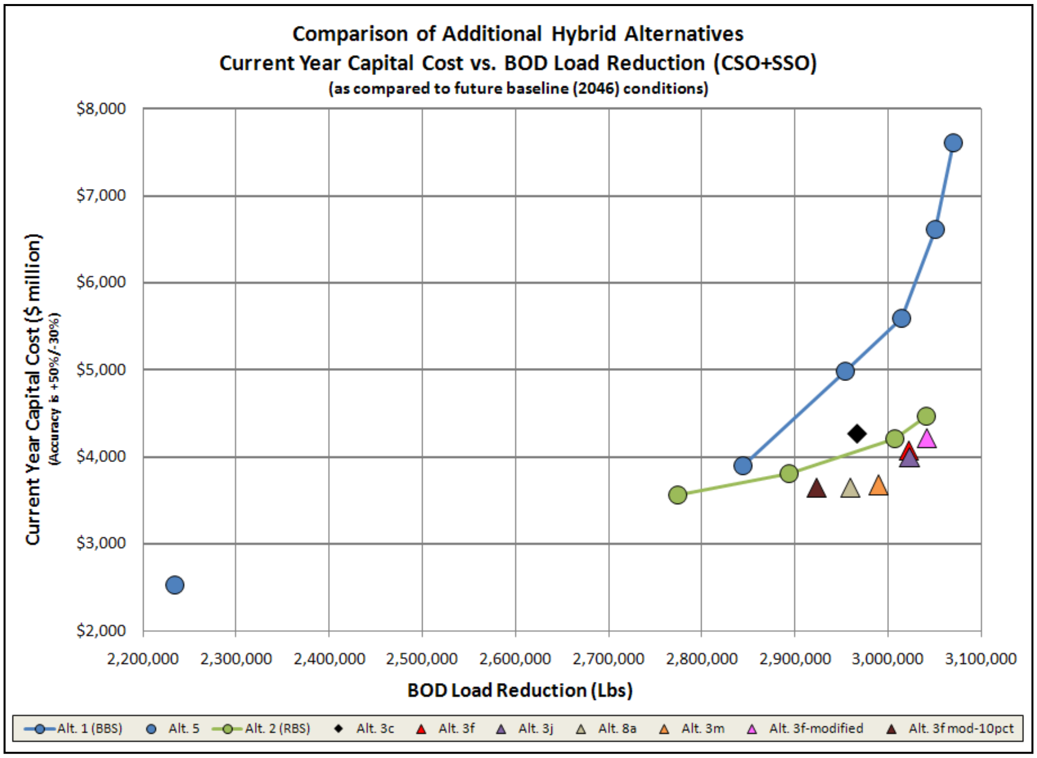


Figure 9-102: NH3 Overflow Loading Reduction Cost Performance Curve

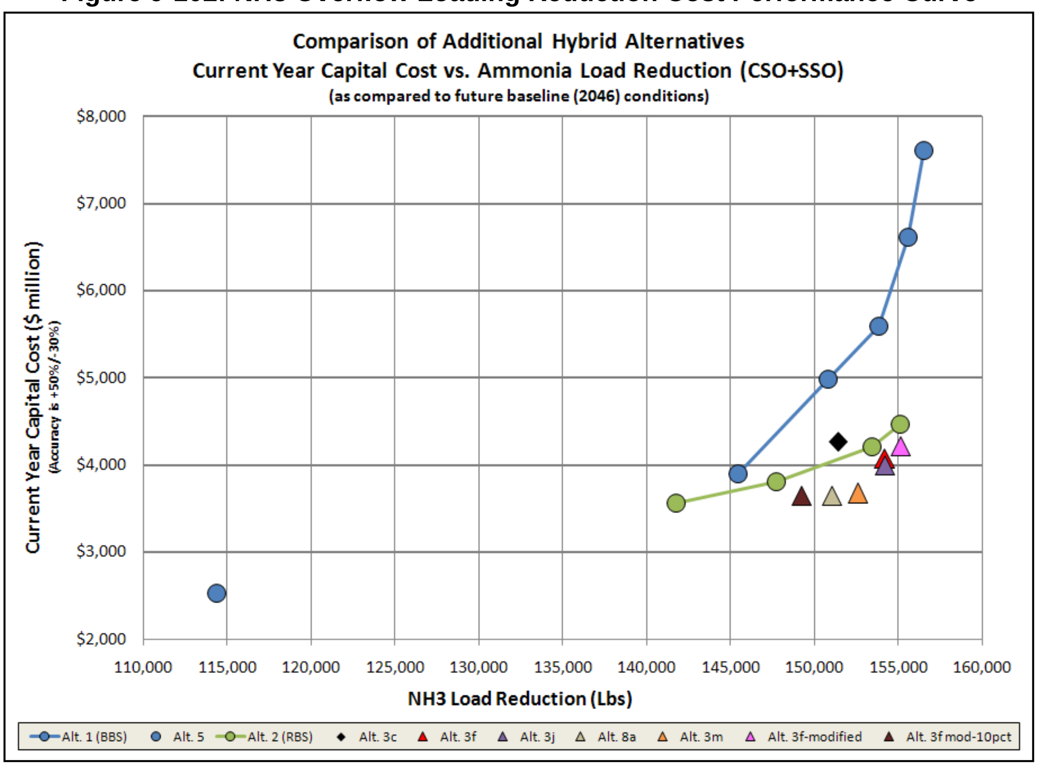


Figure 9-103: Total Suspended Solids Overflow Loading Reduction Cost Performance Curve

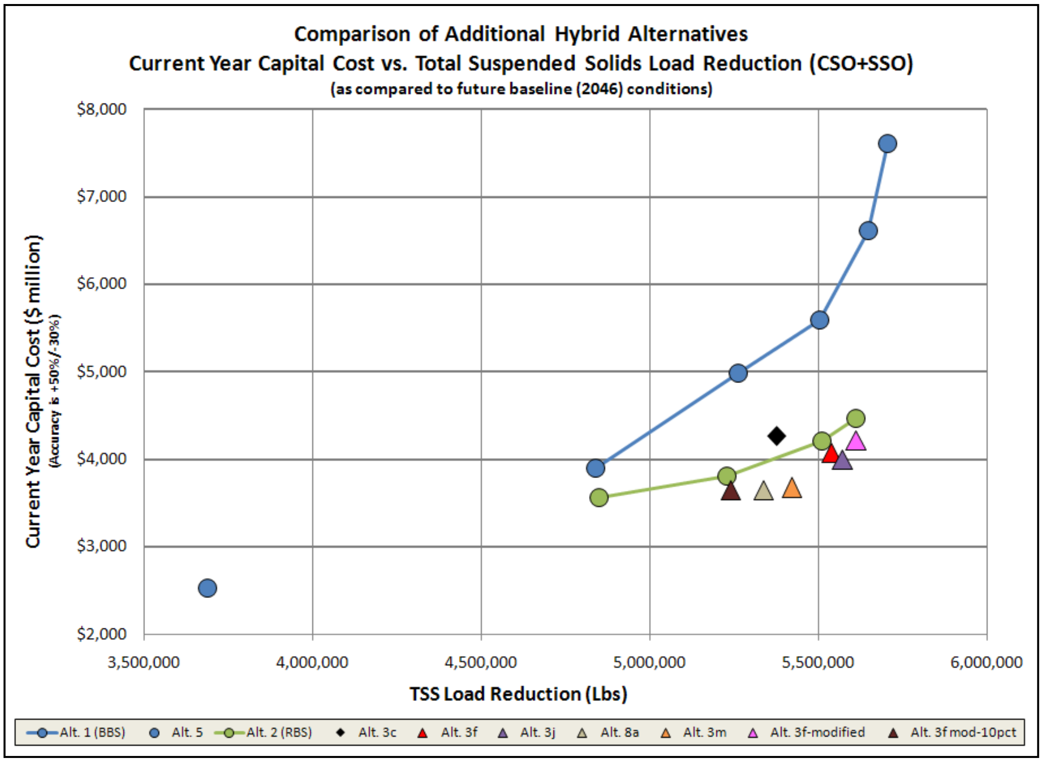


Figure 9-104: Total Phosphorus Overflow Loading Reduction Cost Performance Curve

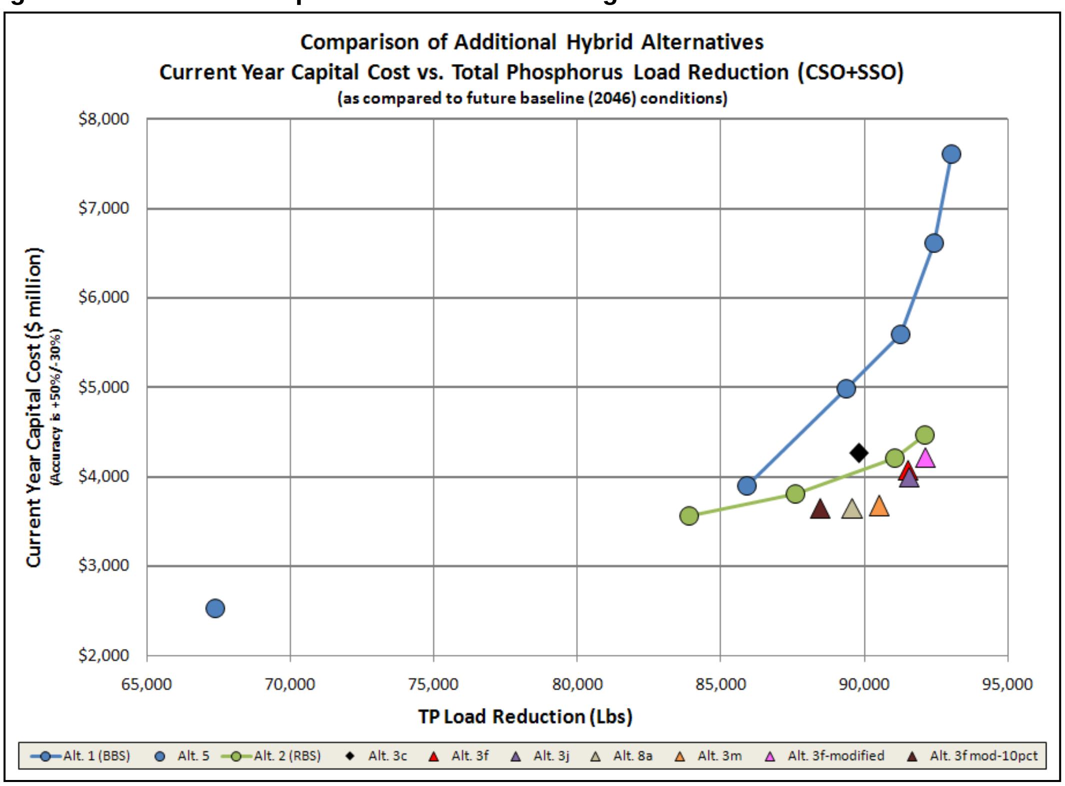


Figure 9-105: Fecal Coliform Overflow Loading Reduction Cost Performance Curve

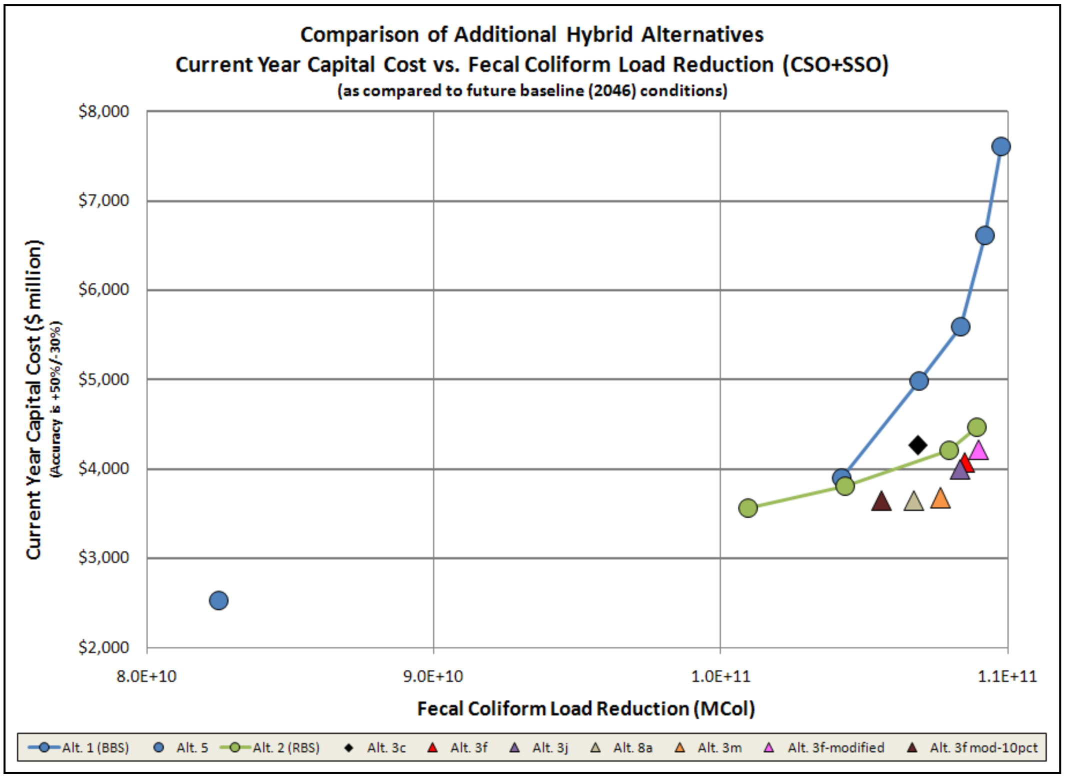


Table 9-75: Treatment Facility Performance Assumptions

Performance Parameter	Wood's Run WWTP		Satellite RTB Facilities
	Primary Treatment	Primary and Secondary Treatment	
BOD5	49 mg/L effluent	15 mg/L effluent	30% reduction
Ammonia	7.3 mg/L effluent	1 mg/L effluent	5% reduction
Nitrite Nitrate	8.98 mg/L effluent	6.53 mg/L effluent	5% reduction
Total Phosphorus	1.98 MG/L effluent	1.21 mg/L effluent	5% reduction
Total Suspended Solids	53 mg/L effluent	20 mg/L effluent	35% reduction
Fecal coliform	60 cfu/100 ml effluent	60 cfu/100 ml effluent	200 cfu/100 ml effluent

Table 9-76: Pollutant Loading Reductions for Discharges from the Conveyance and Treatment System

	Alt3c			Alt3f			Alt3j			Alt3f-modified		
	CSO	SSO	Total	CSO	SSO	Total	CSO	SSO	Total	CSO	SSO	Total
BOD5	96%	100%	18%	98%	100%	14%	98%	100%	14%	99%	100%	14%
Ammonia	96%	100%	14%	98%	100%	8%	98%	100%	8%	99%	100%	9%
Total Phosphorous	96%	100%	5%	98%	100%	0%	98%	100%	0%	99%	100%	0%
Total Suspended Solids	94%	100%	24%	97%	100%	20%	97%	100%	21%	98%	100%	21%
Fecal coliform	97%	100%	97%	99%	100%	99%	98%	100%	99%	99%	100%	99%

Notes: Based on reductions from Future Baseline conditions

Table 9-76 (cont.): Pollutant Loading Reductions for Discharges from the Conveyance and Treatment System

	Alt8a			Alt3m			Alt3f-modified-10pct		
	CSO	SSO	Total	CSO	SSO	Total	CSO	SSO	Total
BOD5	96%	100%	14%	97%	100%	13%	94%	100%	14%
Ammonia	96%	100%	9%	97%	100%	8%	94%	100%	9%
Total Phosphorous	96%	100%	0%	97%	100%	0%	94%	100%	0%
Total Suspended Solids	93%	100%	20%	95%	100%	20%	91%	100%	20%
Fecal coliform	97%	100%	97%	98%	100%	98%	95%	100%	96%

Notes: Based on reductions from Future Baseline conditions

Projected Water Quality Improvements and Cost-Benefit Analysis: Projected water quality improvements were assessed using the receiving water quality model by comparing predicted hourly in-stream fecal coliform concentrations to the 200 cfu/100ml and 400 cfu/100ml thresholds that are a part of the fecal coliform water quality standards. Because predicted water quality conditions for each system-wide alternative vary spatially by receiving water and along the length of each waterbody, as well as temporally throughout the recreational season, a system-wide performance metric was required to compare alternatives against one another. The "river-mile-hour", which combines both the spatial and temporal variations throughout the service area, was selected for this purpose.

The ALCOSAN receiving waters are approximately 91.2 miles in length, within the ALCOSAN service area. The recreational season, as defined by Pennsylvania Code is 153 days (May 1 through September 30). Therefore there are approximately 334,960 (91.2 x 153 x 24) "river-mile-hours" in the recreational season. The model results for each of these "river-mile-hours" were compared against fecal coliform concentration thresholds to determine the percentage of system-wide "river-mile-hours" in the recreational season below the threshold. This approach provides a metric for objectively comparing the water quality benefit of system-wide alternatives.

Although this analysis is not a direct measure of attainment with the applicable water quality standards, it offers the benefit of utilizing the detailed information provided by the model to assess potential recreational contact conditions more frequently than using the sampling program approach that is a part of the bacteria water quality standard. In this way alternatives can be compared with one another to evaluate the additional recreational contact time that can be achieved along with the costs associated with such improvements.

Figure 9-106 presents a water quality cost-benefit analysis using the "river-mile-day" metric including the BBS System-wide Alternative 1, Alternative 3c, and the additional hybrid alternative results. Please note that the results of the analysis are presented in "river-mile-days", which is simply the "river-mile-hours" divided by 24. The green dashed vertical line references the total river-mile-days in the recreational season. This analysis indicates that Alt-3f-mod-10pct is the most cost effective from a water quality benefit perspective, in terms of both the 200 cfu/100 ml and 400 cfu/100 ml thresholds.

Figure 9-107 presents a water quality improvement projection along a non-descript timeline, illustrating a broad-based view of the impacts of ALCOSAN and potential overflow control alternatives in terms of the "river-mile-day" metric. The origin of the horizontal axis represents "pre-ALCOSAN" conditions, when sanitary sewage was routed directly to receiving waters. It can be assumed that under those conditions the receiving waters were never below the 400 cfu/100ml threshold. Following the inception of wastewater treatment by ALCOSAN, triggered by the Clean Water Act and Clean Streams Law, approximately half of the "river-mile-days", primarily those outside of the influence of the conveyance system overflow points, are below the 400 cfu / 100 ml threshold. On-going improvements will take the form of SSO elimination, CSO control and non-point source (NPS) pollution control. As discussed previously, control of NPS pollution will be necessary before the elimination of SSOs and control of CSOs will result in appreciably more river-mile-hours less than 400 cfu/100 ml.

Figure 9-106: Water Quality Cost-Benefit Analysis

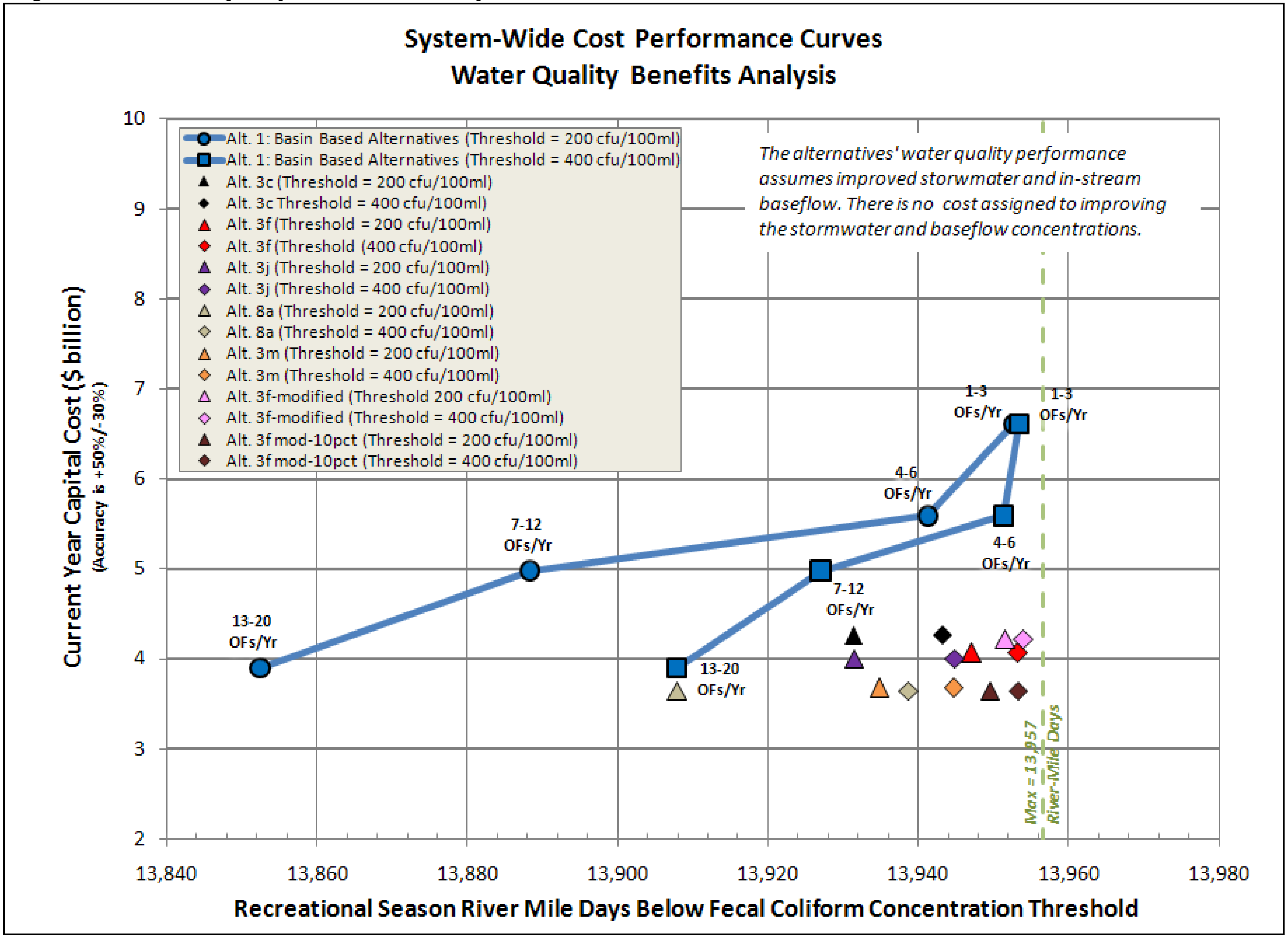
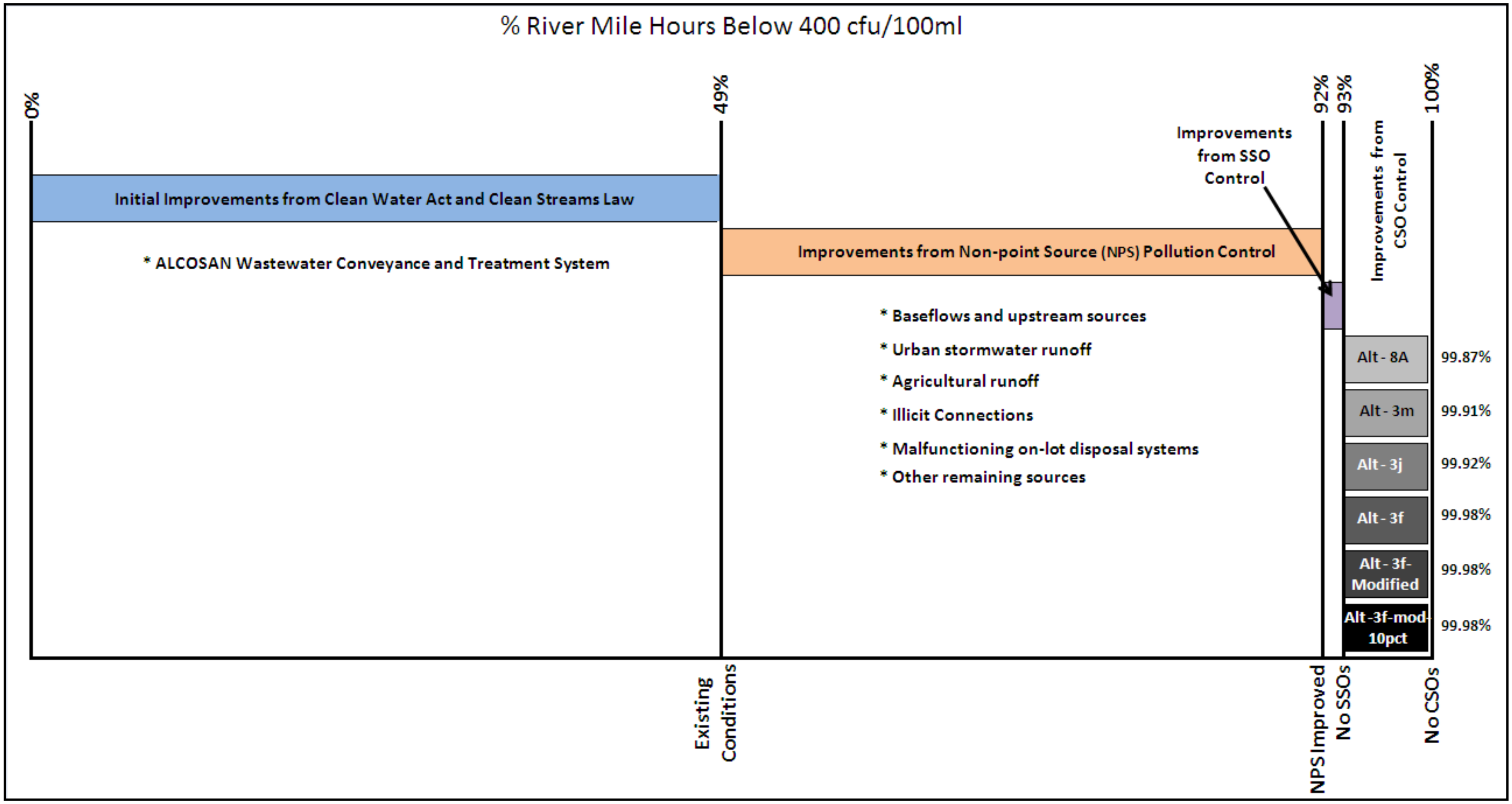


Figure 9-107: Water Quality Improvement Projection



As a result, the timeline shows NPS pollution improvements in advance of SSO and CSO control improvements for the purposes of this illustration - even though these improvements will more likely occur in parallel. Improvements from NPS pollution control are projected to advance water quality improvements by another 43% from existing conditions to achieve 92% of the goal. SSO control will advance progress another 1% or an average of 2 days in the recreational season for each river mile. CSO control advances progress another 7% towards the ultimate goal of 100%. A similar analysis using the 200 cfu/100 ml threshold results in 23% of river-mile-hours below this threshold under existing conditions, NPS pollution controls bringing 65% improvement, SSO control 2%, and CSO control 10%.

This improvement projection demonstrates the magnitude of the pollution control efforts needed before fecal coliform bacteria criteria can hope to be achieved in all receiving waters all the time. It also provides a perspective on the relative contribution of pollution sources over a typical recreational season. A key observation is that although bacteria loads from CSO and SSO discharges represent a very significant percentage of the total load received in a typical year (34% from Figure 9-93), the fact that they discharge for a relatively small percentage of the time (during wet weather) limits the progress that can be achieved towards the water quality standard attainment goal without other improvements taking place in parallel.

9.5.6.6 Sensitive Areas Analysis

As described in Section 9.1.2, alternatives were evaluated that provided a higher level of control to sensitive areas as defined in the CD. These CD defined sensitive areas include drinking water intakes, marinas, boat ramps, and parks along the Allegheny, Monongahela, and Ohio Rivers. In a manner consistent with the CSO Policy[9-13], higher priority was given to sensitive areas as part of the alternatives development and analysis process. Alternatives were evaluated to provide a higher level of control to CSOs that discharge directly to sensitive areas plus a fixed distance upstream on the same river bank.

Guidance was provided to the basin planners to evaluate alternatives for varying levels of enhanced control to sensitive areas. For basin alternatives in support of select system-wide alternatives targeting 13-15 overflows per year for all CSOs (Alternatives 8a and 3m), outfalls directly impacting sensitive areas were analyzed to receive a higher level of control at 4-6 overflows per year. For basin Alternatives 3f-modified and 3f-modified-10pct, basin planners evaluated various elimination and re-location alternatives for providing a 1-year level of control (zero overflows in the typical year) for outfalls directly impacting sensitive areas. Basin-specific sensitive area analysis results are described in Sections 9.4.3, 9.4.4 and 9.4.8 for the Lower Northern Allegheny, Main Rivers and Upper Monongahela basins. The other ALCOSAN planning basins do not contain any CSO outfalls directly impacting sensitive areas.

Following the analysis by basin planners, sensitive area controls were incorporated into evolving system-wide control strategies, leading up to and including the selected regional plan (as described in Section 9.6). Figures 9-108 through 9-110 provide summaries of the overflow

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[9-13] EPA (U.S. Environmental Protection Agency). 1994. Combined Sewer Overflow (CSO) Control Policy. FRL-4732-7. Federal Register 59(75).

reductions for the system-wide alternatives that provide enhanced control to sensitive areas. Shown are the outfalls discharging to sensitive areas and the frequency, volume, and duration of overflows associated with these outfalls. The existing and future baseline (2046) overflow statistics are provided as well to illustrate the overflow control benefits associated with these alternatives that provide enhance control to sensitive areas. It should be noted that the A-63 and A-66 outfalls will be eliminated during the construction of the Route 28 Improvement Project. The elimination of these outfalls is represented in the Future Baseline model and therefore was not considered as part of the alternatives developed herein.

Figure 9-108: Sensitive Areas Analysis – CSO Frequency Comparison

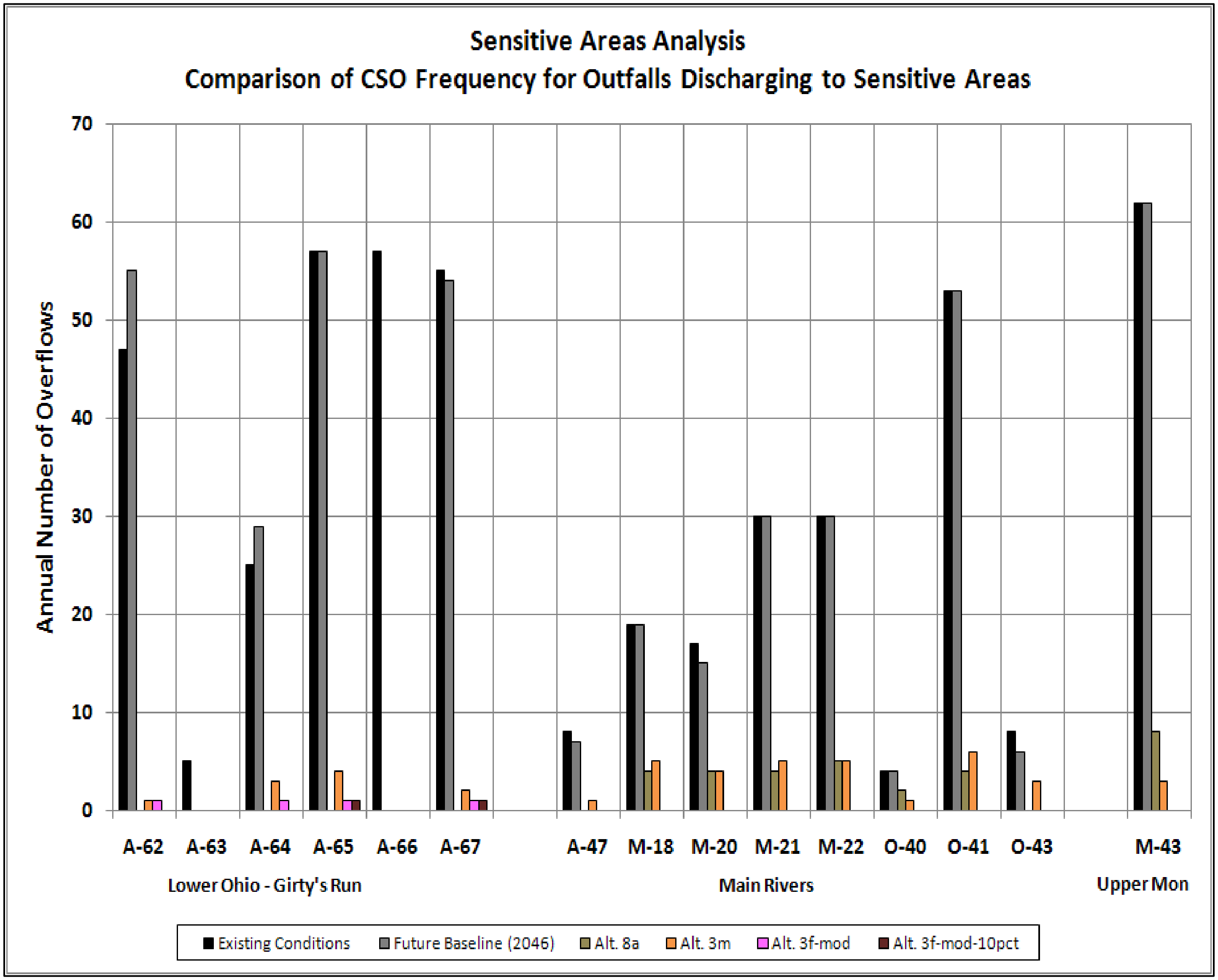


Figure 9-109: Sensitive Areas Analysis – CSO Volume Comparison

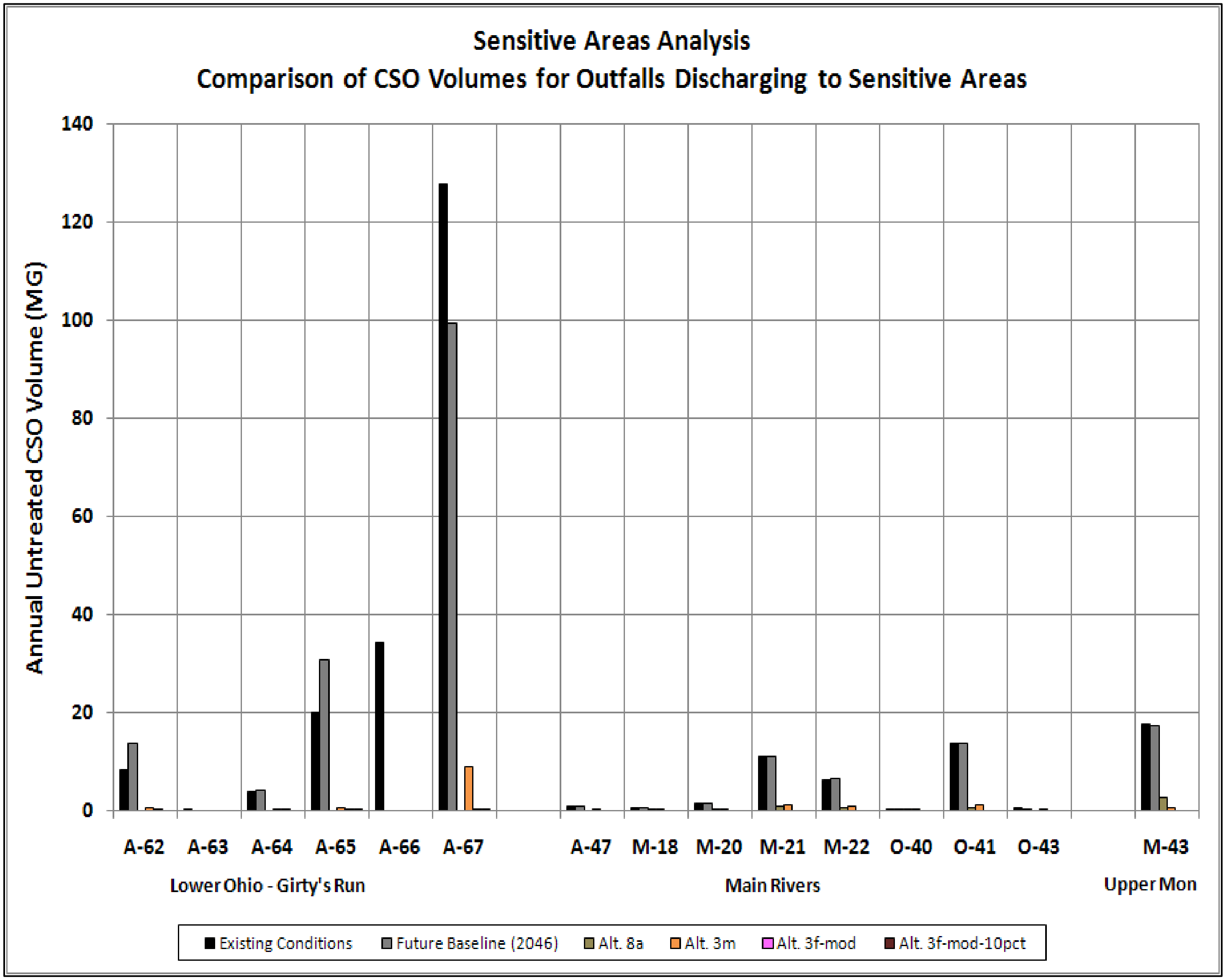
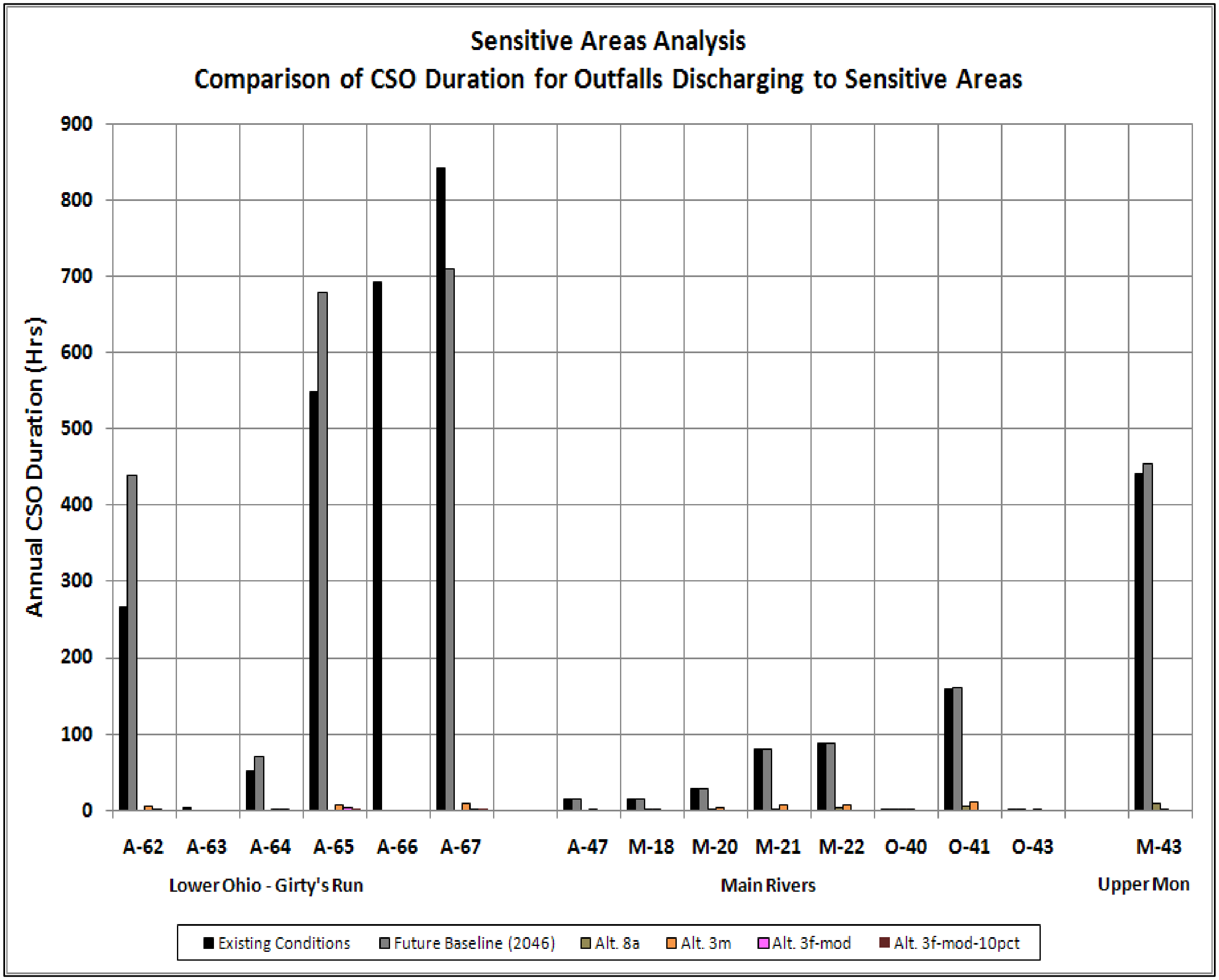


Figure 9-110: Sensitive Areas Analysis – CSO Duration Comparison



9.5.7 System-Wide Alternatives Ranking Analysis

Section 9.5.6 presented various performance results for system-wide alternatives being considered for selection as the long term control plan for the region, including cost-benefit analyses using the knee-of the curve (KOC) approach. While the KOC analyses evaluate arguably the two most important criteria (cost and performance) for each of the system-wide alternatives, they do not account for other considerations such as public factors, operational impacts, and implementation concerns. As a result, a system-wide alternatives ranking analysis was conducted to take those criteria into account. This section describes the system-wide alternatives ranking process and presents the results. The results of this ranking served to guide the identification of the selected plan described in Section 9.6.

The categories, criteria, and weighting for the ranking of system-wide alternatives were the same as those utilized in the Basin Alternative Ranking and Assessment Tool that was described in Section 9.4. Input on these factors was solicited from each of the seven Basin Planning Committees, the Customer Municipality Advisory Committees (CMAC), and the Regional Stakeholders Group (RSG) and were finalized based on incorporating recommendations made by ALCOSAN department representatives. The categories and weightings assigned in the ranking of system-wide alternatives are shown on Table 9-77. The system-wide alternative scoring was based upon a potential maximum total score of 100 points.

For the system-wide alternatives described in Section 9.5.2 (excluding the preliminary hybrid alternatives developed for the regional tunnel extents analysis, except for Alternative 3c), information was collected for the various ranking criteria from H&H modeling results, ACT costing summaries, and the basin alternative ranking results. Using these data, an alternatives ranking software program was developed and used to assign scoring to the various criteria. Note that, unlike the basin alternative ranking, system-wide alternatives comprise a complete service area control strategy and therefore were formally ranked against one another irrespective of control strategy (basin-based, regional-based, hybrid). Below is brief summary of how scoring was assigned for each of the categories; with particular attention called to scoring approaches that differed from the basin alternative ranking.

Economic Factors (30 points) – The estimated total present worth (TPW) cost for each alternative was entered into the ranking tool. The TPW costs included the capital, operation and maintenance (O&M), and renew and replacement (R&R) costs related to the planning basin, regional conveyance, WWTP expansion, and municipal costs associated with each alternative. The municipal costs included reflected the capital costs only and represent the preferred and/or assumed municipal control strategies (as described in Section 9.3). Once this information was entered for each alternative, the alternative with the lowest cost was assigned the full 30 points. Scoring for other alternatives was calculated as a ratio of the lowest cost of all system-wide alternatives to the individual system-wide alternative cost.

Table 9-77: System-Wide Alternative Ranking Categories and Weighting

Category		Criteria	System-Wide Alternative Ranking (Points)
Economic Factors	1	Total Present Worth Cost	30
Public Factors	2	Community Disruption	2
	3	Potential for Nuisances (odor, noise, aesthetic)	6
	4	Multiple Benefit Opportunities	6
	5	Environmental Justice	6
Water Quality, Public Health, and Environmental Impacts	6	Untreated Overflow Volume Reduction	5
	7	Bacteria Discharge Reduction	5
	8	Floatables Capture	1.5
	9	Suspended Solids Reduction	1.5
	10	BOD Control	3
	11	Nutrient Control	3
	12	Control of Discharges to Sensitive Areas	4
	13	Impacts to Slopes, Shorelines, Wildlife	2
Operation Impacts	14	Ease of Operation	4
	15	Ease of Maintenance	4
	16	Reliability / Redundancy	4
	17	O&M Consistency with Existing Practices	3
Implementation Impacts	18	Constructability	4
	19	Ability to Expand Capacity	3
	20	Land Acquisition	3
		TOTAL	**100**

Public Factors (20 points) – Scoring assigned to the 4 criteria comprising this category were based on the scoring associated with each of the basin alternatives comprising the system-wide alternative (provided by the BPs using the Basin Alternative Ranking and Assessment Tool) and professional judgment. Note that this approach differs somewhat from the scoring assigned to the answers to qualitative questions to these criteria in the ranking of basin alternatives, as a broader range of values were assigned in the system-wide alternative ranking.

Water Quality, Public Health, and Environmental Factors (25 points) - Scoring for untreated overflow volume reduction was determined by calculating the reduction in the annual CSO and SSO overflow volumes resulting from the implementation of the proposed system-wide alternative as compared to the future baseline (2046) CSO and SSO volumes. These annual overflow volumes for future baseline (2046) conditions, and for each alternative, were based on the results of H&H model simulation runs of these conditions. Using these results, a percent reduction of untreated overflow volume was computed for each alternative. These percent reductions were then applied to the maximum points assigned to this category (5). For example, if the implementation of an alternative would result in a 90% reduction in untreated overflow volume discharged from CSOs and SSOs, the alternative would have been assigned 4.5 points (0.9 x 5 = 4.5).

For bacteria discharge reduction, suspended solids reduction, BOD control, and nutrient control, the CSO load reductions to receiving streams for these water quality parameters resulting from the implementation of the system-wide alternative were determined using the ALCOSAN water quality models (as described in Section 5.5). Only CSO load reductions were evaluated for these categories as the SSO control level (elimination of SSOs up to a 2-year design storm) were the same for all the alternatives that were ranked. As compared to future baseline (2046) conditions, percent reductions in CSO pollutant loads were computed using the models. Similar to the scoring assigned to the Untreated Overflow Volume Reduction category, these percent reductions were then multiplied by the maximum points assigned to the water quality category. Note that, in the ranking of basin alternatives, the results were not based on the water quality modeling of each alternative. Rather, they were based on average pollutant concentrations derived from existing conditions water quality model runs, untreated and treated overflow volumes based on H&H model runs, and representative pollutant removal efficiencies of various control technologies. Using the water quality modeling results associated with each system-wide alternative allowed for a more representative approach to assigning scoring to these various water quality related categories.

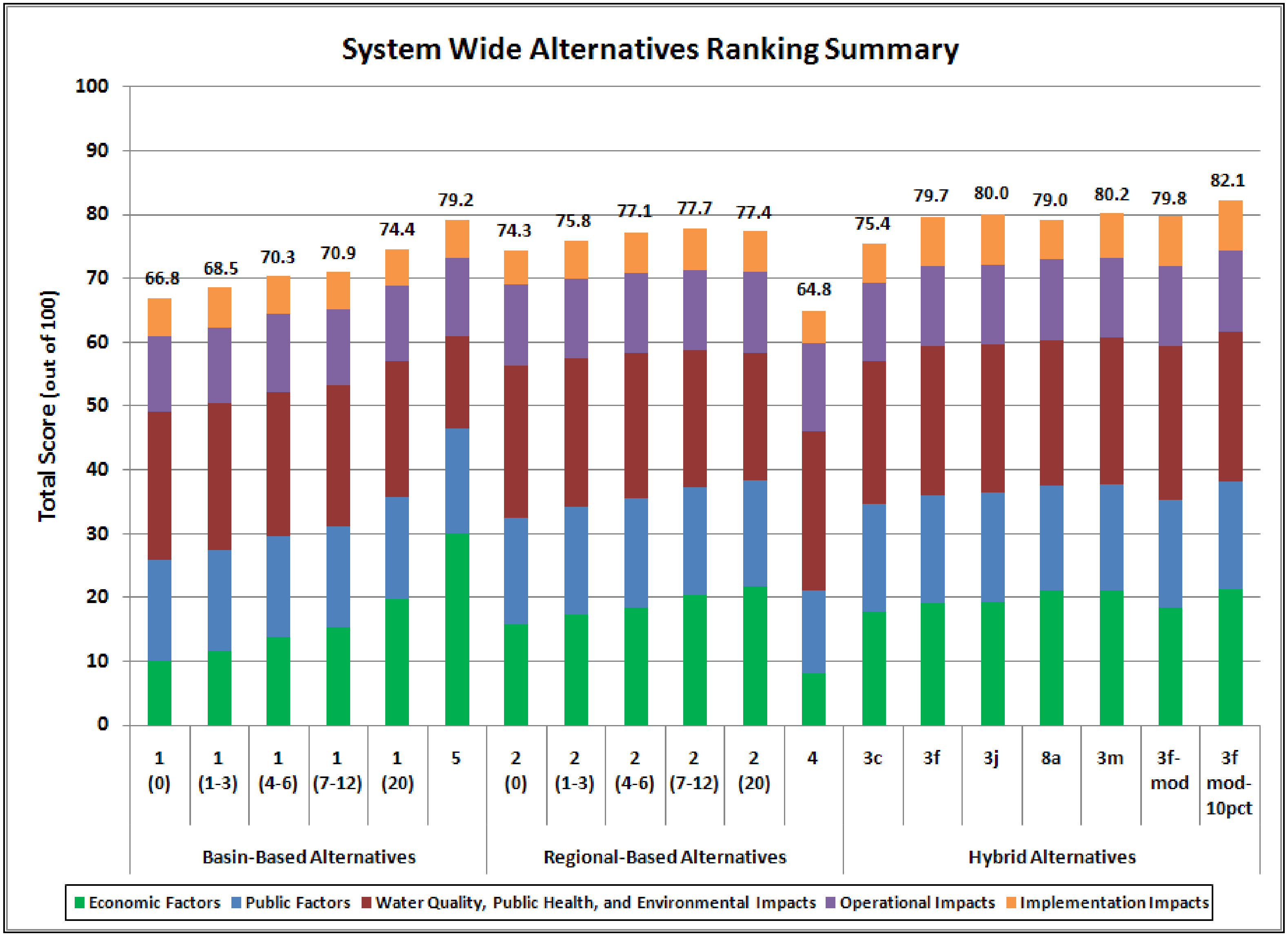
For the Enhanced Level of Control to Sensitive Areas and Minimal Adverse Impacts to Slopes, Shorelines, and Wildlife categories, scores were assigned based on the scoring associated with each of the basin alternatives comprising the system-wide alternative as well as best professional judgment.

Operational Impacts (15 points) - Scoring applied to the 4 operational impacts categories consisted of weighting the standardized answers assigned to each control technology comprising the system-wide alternative by the area served by each facility. Total area served for each control technology was determined using the ALCOSAN GIS with the results being applied to the standardized points regarding operational impacts of various control technologies. These 'standardized answers' were derived by the Basin Coordinator and Program Manager to ensure consistency in the screening and ranking of site alternatives and basin alternatives. Note that this scoring approach differs from the Basin Alternative Ranking & Assessment Tool as the basin alternative ranking utilized weighting based on the number of each control technology comprising the alternative, not area served.

Implementation Factors (10 points) - Scoring assigned to the 3 criteria under this category are based on the scoring associated with each of the basin alternatives comprising the system-wide alternative and professional judgment. Note that this approach differs somewhat from the scoring assigned to the qualitative questions to these criteria in the ranking of basin alternatives as a broader range of values were assigned in the system-wide alternative ranking.

Figure 9-111 presents the results of the system-wide alternatives ranking analysis. Shown are the total scores assigned to each alternative as well as the totals for each of the five scoring categories described above. As the figure shows, System-Wide Alternative 3f modified-10pct was the highest ranked alternative (82.1) with Alternative 3m (80.2) being the second highest ranked alternative.

Figure 9-111: Summary of System-Wide Alternatives Ranking Results



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9.6 Selected Plan

Section 9.5 described the system-wide alternatives development and analysis process, and presented the results. Each system-wide alternative presented represents a complete plan to control ALCOSAN and municipal CSOs and SSOs, to a selected level of control. As prescribed by the EPA's Combined Sewer Overflow Policy[9-14], a range of CSO levels of control were evaluated, including alternatives targeting the "Presumption" and "Demonstration" approach criteria. A range of SSO control levels were also considered, including the 2-year and 10-year level of control as indicated in ALCOSAN's Consent Decree (CD). Presented throughout the section were various analyses such as a regional tunnel extents, knee-of-the-curve, water quality benefits, sensitive areas, and system-wide alternatives ranking analysis. These analyses supported the decision making as to how ALCOSAN proposes to eliminate sanitary sewer overflows from the ALCOSAN Conveyance and Treatment System and to control combined sewer overflows in compliance with the Clean Water Act (CWA), consistent with the National CSO Policy.

This section presents the recommended system-wide alternative, also referred to as the Selected Plan. Section 9.6.1 provides a description of the selected alternative, the basis for the plan selection, and the performance statistics associated with the selected alternative. Section 9.6.2 analyzes the technical feasibility of implementing the Selected Plan by the 2026 CD implementation schedule. Section 9.6.3 includes an affordability assessment of the recommended alternative utilizing the methodology outlined in the 1997 USEPA guidance document[9-15].

9.6.1 Description

System-Wide Alternative 3f-modified-10pct has been chosen as ALCOSAN's Selected Plan. This alternative represents the most cost-effective system-wide solution to achieving compliance with ALCOSAN's CD and the National CSO Control Policy. As demonstrated in the alternative ranking process in Section 9.5.7, the Selected Plan was the highest ranked alternative, based on economic and non-economic criteria, among the many that were developed and analyzed by ALCOSAN. This sub-section provides a description of the alternative, the basis for choosing this alternative as the Selected Plan, and a summary of the hydrologic/hydraulic and water quality performance related benefits associated with this solution.

Description of Selected Plan: ALCOSAN has determined that the most cost-effective means of complying with the Consent Decree and CSO Policy requirements is via the Demonstration Approach. System-Wide Alternative 3f modified-10pct has been shown to achieve the key goal of not precluding the attainment of water quality standards through a control strategy based on expanded treatment capacity at the Wood's Run plant, new regional conveyance/storage tunnel, and several remote storage facilities. This alternative utilizes the most cost-effective site alternatives evaluated in terms of cost per million gallons removed and facilities necessary to

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9-14 EPA (U.S. Environmental Protection Agency). 1994. Combined Sewer Overflow (CSO) Control Policy. FRL-4732-7. Federal Register 59(75).

9-15 Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development, EPA March 832-B-97-004 control the largest outfalls in terms of CSO volume. Under this alternative, facilities and site alternatives controlling the larger outfalls are used to convey excess wet weather flows to new conveyances or a new regional tunnel while all outfalls – including the smaller outfalls - remain served by the existing deep tunnel interceptor. Overflows from these smaller outfalls would be reduced to the extent possible with minor regulator modifications, but without changes to the existing tunnel drop shafts. Several cross connections would be placed between the new and existing tunnel systems to relieve the existing tunnel to the new tunnel when a certain hydraulic grade line is exceeded, thereby freeing up capacity in the existing deep tunnel.

Under this alternative, larger ALCOSAN CSOs served by the new regional tunnel are controlled to 6 or less annual overflow events for all CSOs controlled by the tunnel. Similarly, each grouping of ALCOSAN CSOs served by a single storage tank is controlled to 6 or less unique annual overflow events for all CSOs. ALCOSAN CSOs discharging to sensitive areas are controlled to zero overflows per year or re-located downstream of the sensitive area, with the exception of one event in Allegheny River Area No. 1. For the remaining ALCOSAN CSOs which are served only by the existing tunnel, overflow frequency will vary by outfall and will depend on the existing drop shaft capacity and the nature of the regulator modifications. The alternative eliminates ALCOSAN SSOs up to a 2-year level of control. The municipal levels of CSO and SSO control vary by municipality, but reflect the incorporation of the latest municipal planning information as described in Section 9. A map of the preliminary locations/alignments of the ALCOSAN facilities for this alternative is included as Figure 9-112.

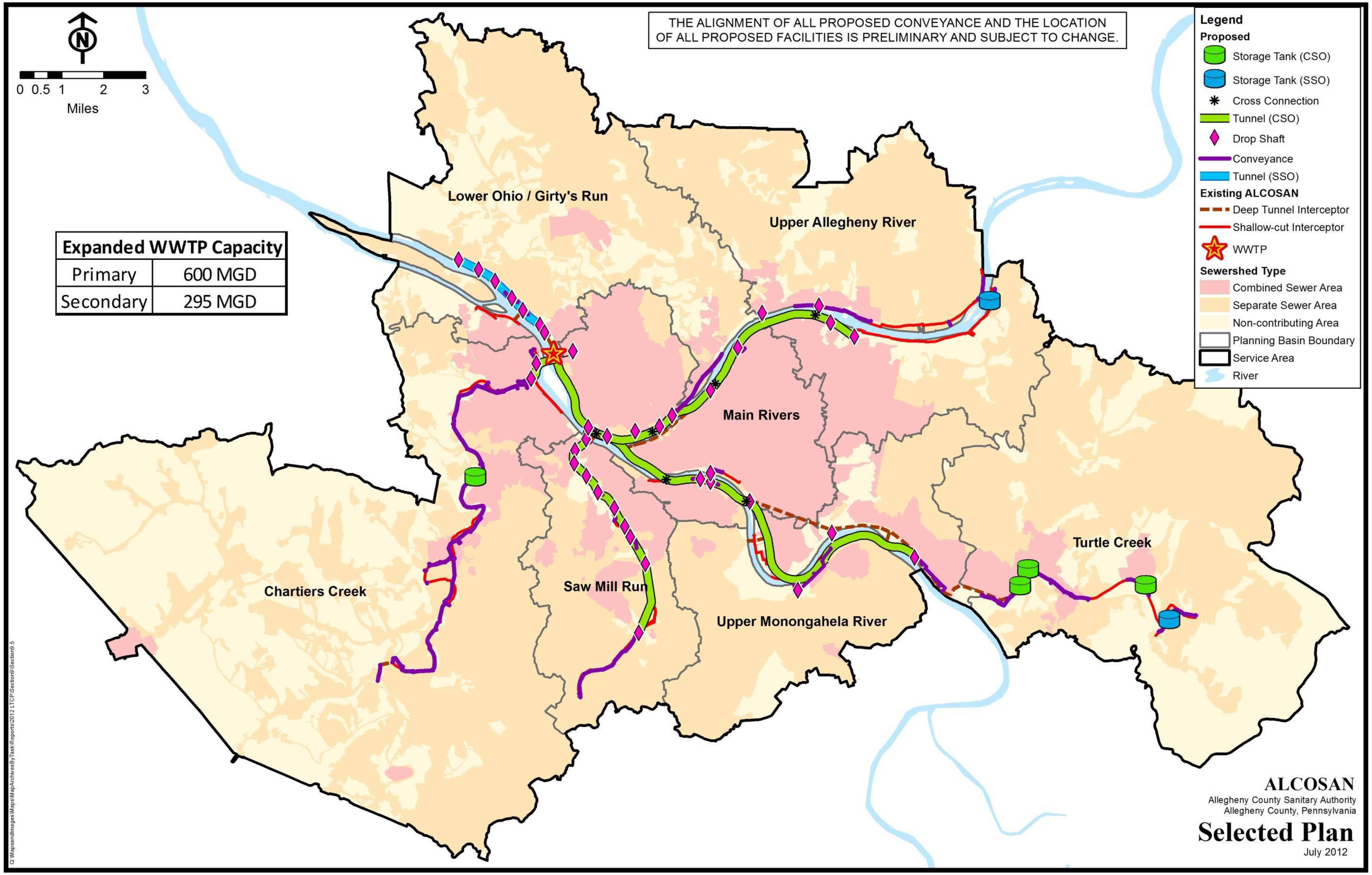
The major facilities that comprise the Selected Plan are summarized below:

Regional Storage/Conveyance Tunnel – A regional CSO tunnel is proposed along the main rivers and a short portion of Chartiers Creek – paralleling the existing deep tunnel - to convey captured wet weather flows to the Woods Run WWTP, and to store the captured flow until it can be treated. A 120 MGD deep tunnel dewatering pump station will pump these captured wet weather flows for treatment both during and after wet weather events. The tunnel will receive flow from a proposed Chartiers Creek connector tunnel, a new Saw Mill Run tunnel, numerous other drop shaft connections, and six cross-connections from the existing deep tunnel interceptor system.

Planning Basin Improvements **–** The most prominent elements of the planning basin improvements associated with the Selected Plan, including regional tunnel segments, are:

- A relief interceptor, other CSO and SSO control conveyance, and an above ground CSO storage tank in the Chartiers Creek planning basin.
- Consolidation and connector sewers to convey flow from some of the largest CSO outfalls in the Lower Northern Allegheny planning basin to the regional tunnel drop shafts.

Figure 9-112: Map of Selected Plan



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- A SSO storage tunnel in the Lower Ohio planning basin with 7 drop shafts. This tunnel also is used to control two small CSOs. Also included, but not depicted, are the upsizing of a portion of the Lower Ohio South interceptor and associated regulator structure modifications.
- Consolidation and connector sewers along the Ohio, Allegheny and Monongahela Rivers and a short portion of Chartiers Creek to convey excess wet weather flows to the regional storage/conveyance tunnel via 21 drop shafts and six cross-connections to the existing tunnel.
- A relief interceptor for SSO control and a CSO conveyance tunnel with 9 drop shafts in the Saw Mill Run planning basin.
- CSO and SSO storage facilities and associated consolidation sewers in the Turtle Creek/Thompson Run planning basin.
- A SSO storage facility, SSO conveyance improvements, and CSO consolidation sewers in the Upper Allegheny basin.

Woods Run WWTP Improvements - The Selected Plan includes expansion of the Woods Run WWTP wet weather treatment capacity to 600 mgd with a secondary treatment capacity of 295 mgd from its currently permitted full treatment capacity of 250 mgd. As proposed, peak wet weather flows in excess of 295 mgd, up to a total of 600 mgd, would receive primary treatment and disinfection prior to discharge.

Preferred/Assumed Municipal Improvements – The preferred and/or assumed preliminary municipal control strategies are described in Section 9.3.3. Many municipalities indicated the capacity of their existing system is adequate to convey predicted flows through 2046. Of the remaining municipalities that have indicated the need for improvements, the great majority of the municipal control strategies reflect new conveyance for sending more flow to the ALCOSAN system for treatment. However, the strategies also employ other approaches including tank storage, sewer separation, sewer system optimization, stream removal pump station upgrades, inflow/infiltration removal, stream removal and storm water removal.

Profiles of major conveyance elements of the Selected Plan are displayed in Figures 9-113 through 9-125. The wide range of depths in these profiles illustrates the complexity associated with constructing the proposed improvements.

It should be noted that the capacities, locations and configurations shown on Table 9-78 and the profile drawings on Figures 9-113 through 9-125 are subject to revision and refinement as the draft WWP is finalized for submission to the Agencies (including revisions to address comments), and ultimately when the approved plan moves into advanced facilities planning and design.

Table 9-78 provides a summary of the major components of the Selected Plan. Shown are the regional tunnel, planning basin, Woods Run WWTP, and preferred/assumed municipal improvements associated with this alternative. Also shown are the sizes/capacities of these improvements and the associated estimated capital costs.

Table 9-79 provides a summary of the life cycle costs associated with the Selected Plan. Shown are the capital, operation and maintenance (O&M), renew and replacement (R&R), and total present worth (TPW) costs associated with the alternative. The summary provides a breakdown of the regional conveyance, planning basin, WWTP expansion, and municipal costs for both CSO and SSO control. The planning basin costs include a breakdown of these costs associated with each of the seven individual ALCOSAN planning basins. The municipal costs reflect the preferred and/or assumed municipal control strategies and reflect the best available information at the time of this submission.

Figure 9-113: Regional Tunnel Profile (Ohio / Allegheny Rivers)

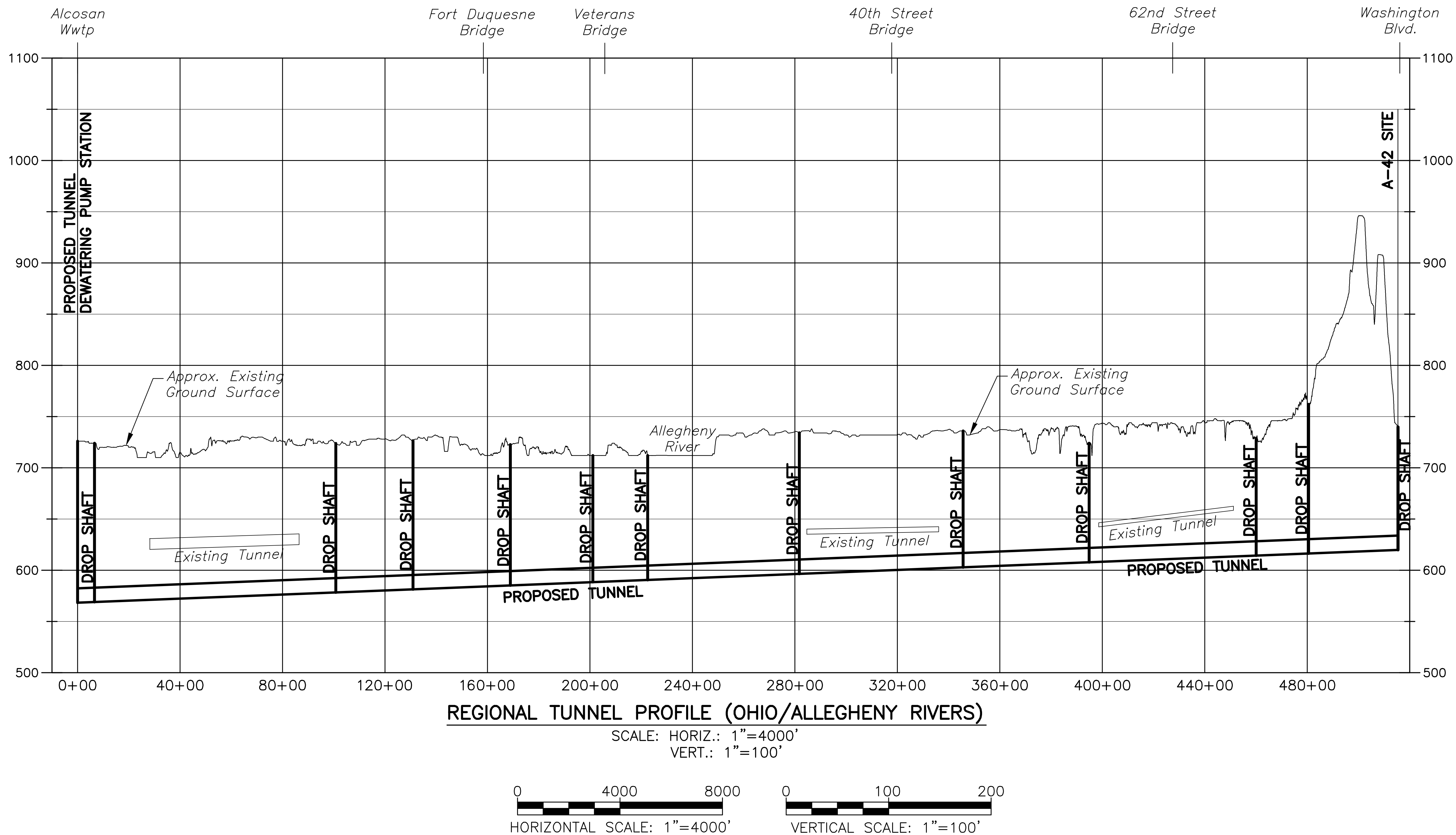

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Figure 9-114: Regional Tunnel Profile (Monongahela River)

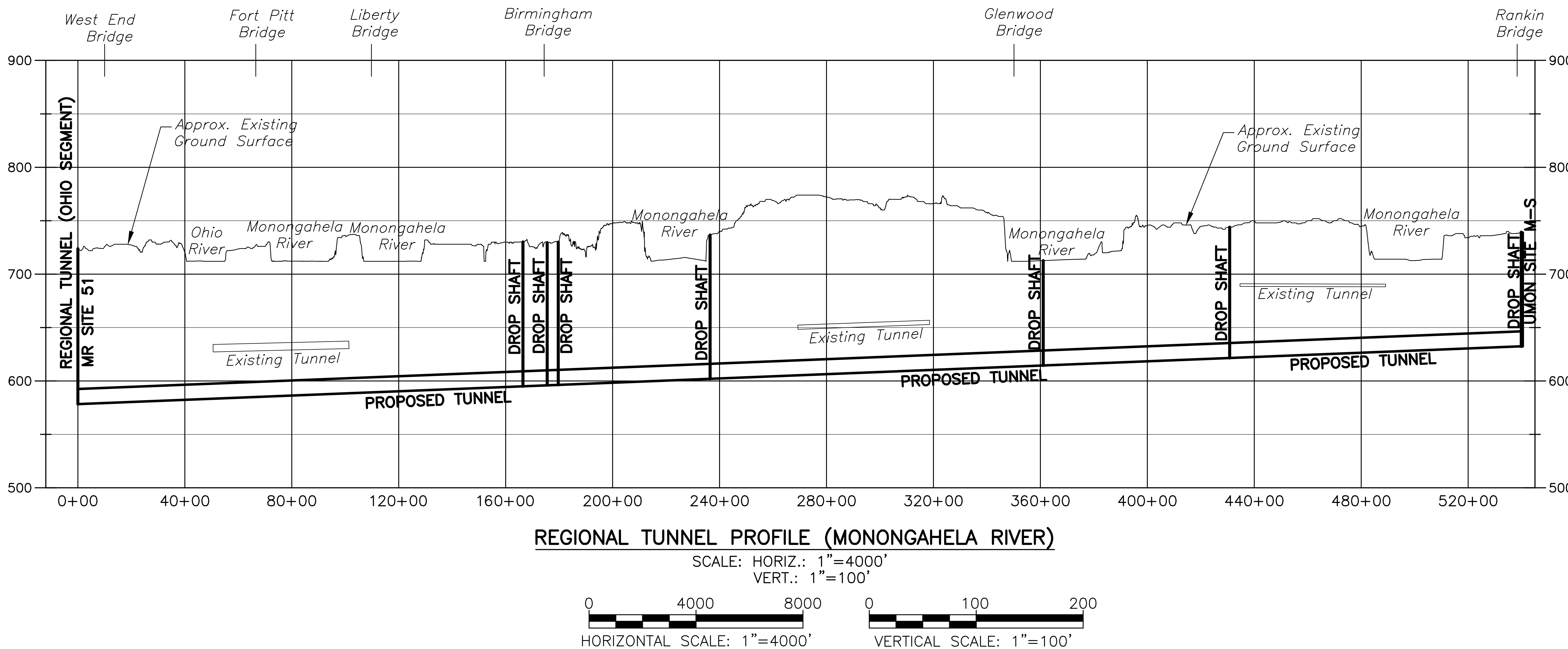

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Figure 9-115: Chartiers Creek Relief Interceptor Profile

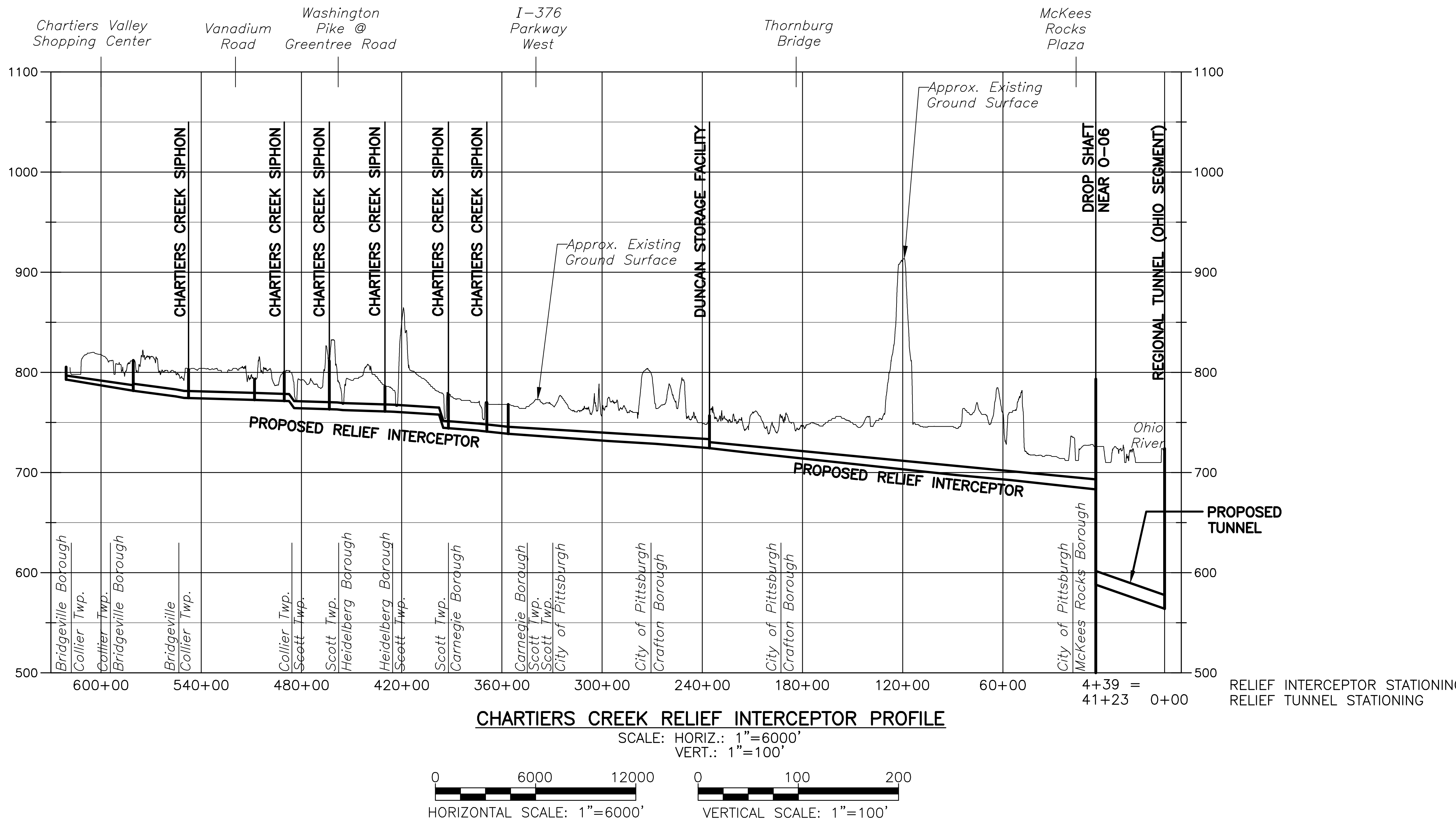

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Figure 9-116: Lower Ohio Tunnel Profile

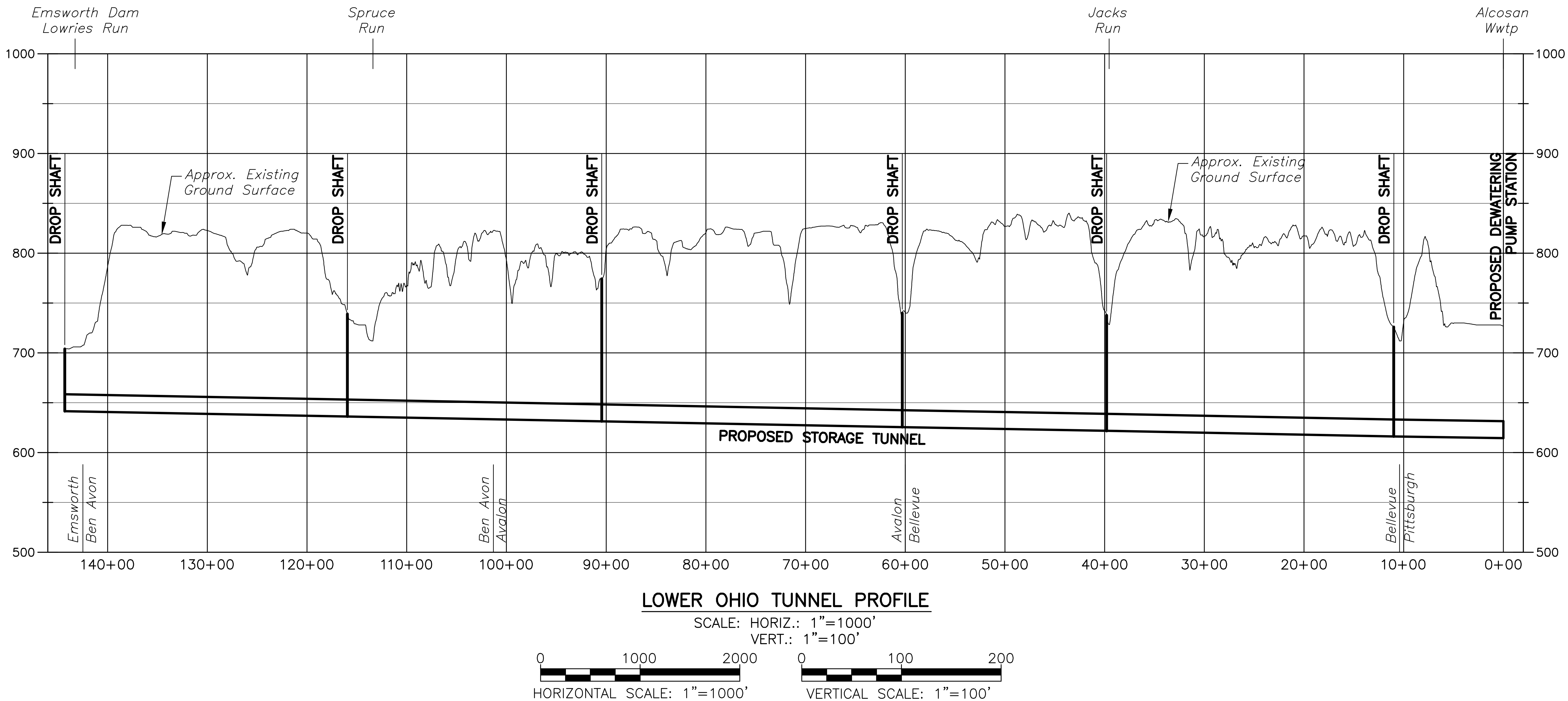

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Figure 9-117: Lower Northern Allegheny Consolidation Sewer Profile

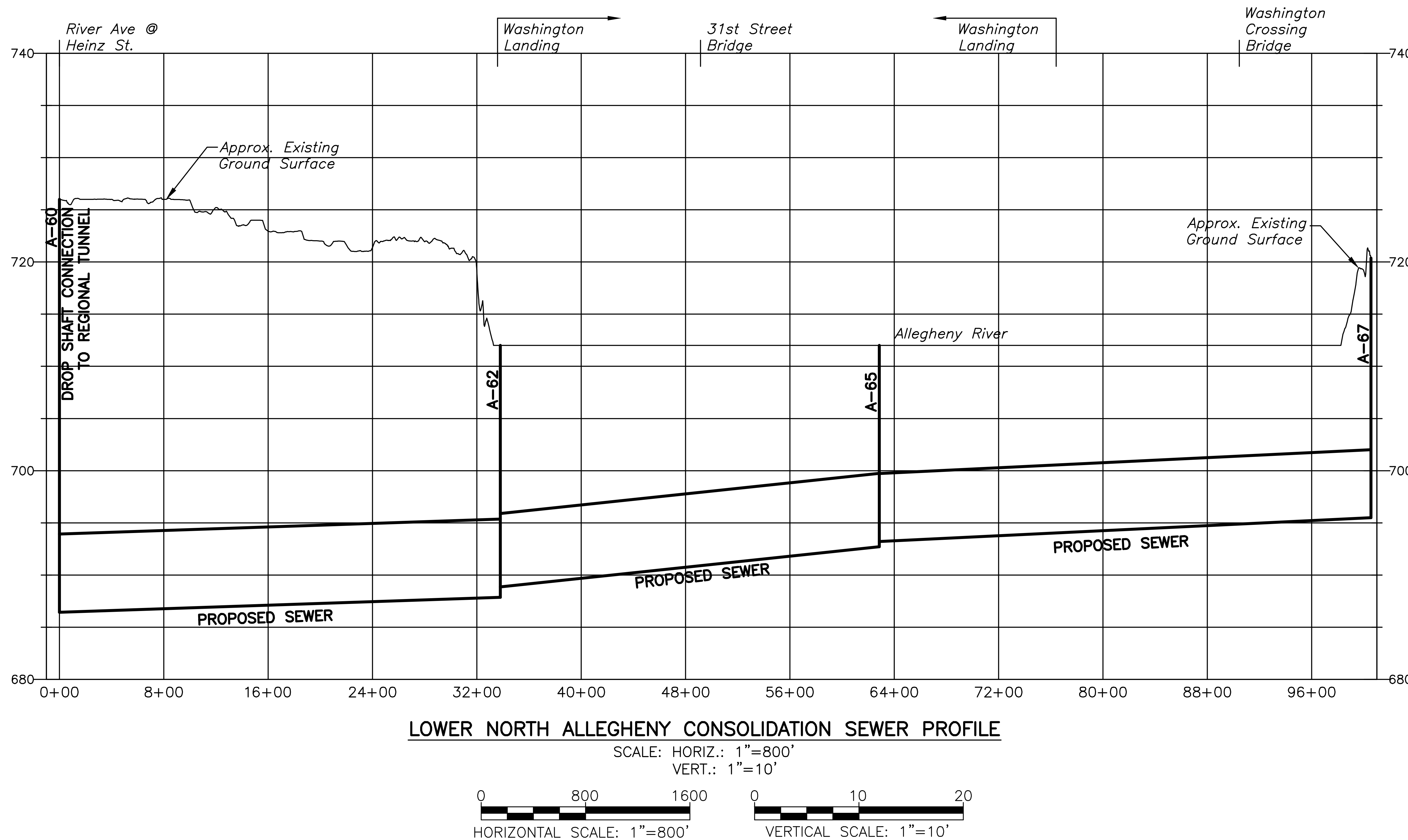

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Figure 9-118: Saw Mill Run Tunnel & Relief Interceptor Profile

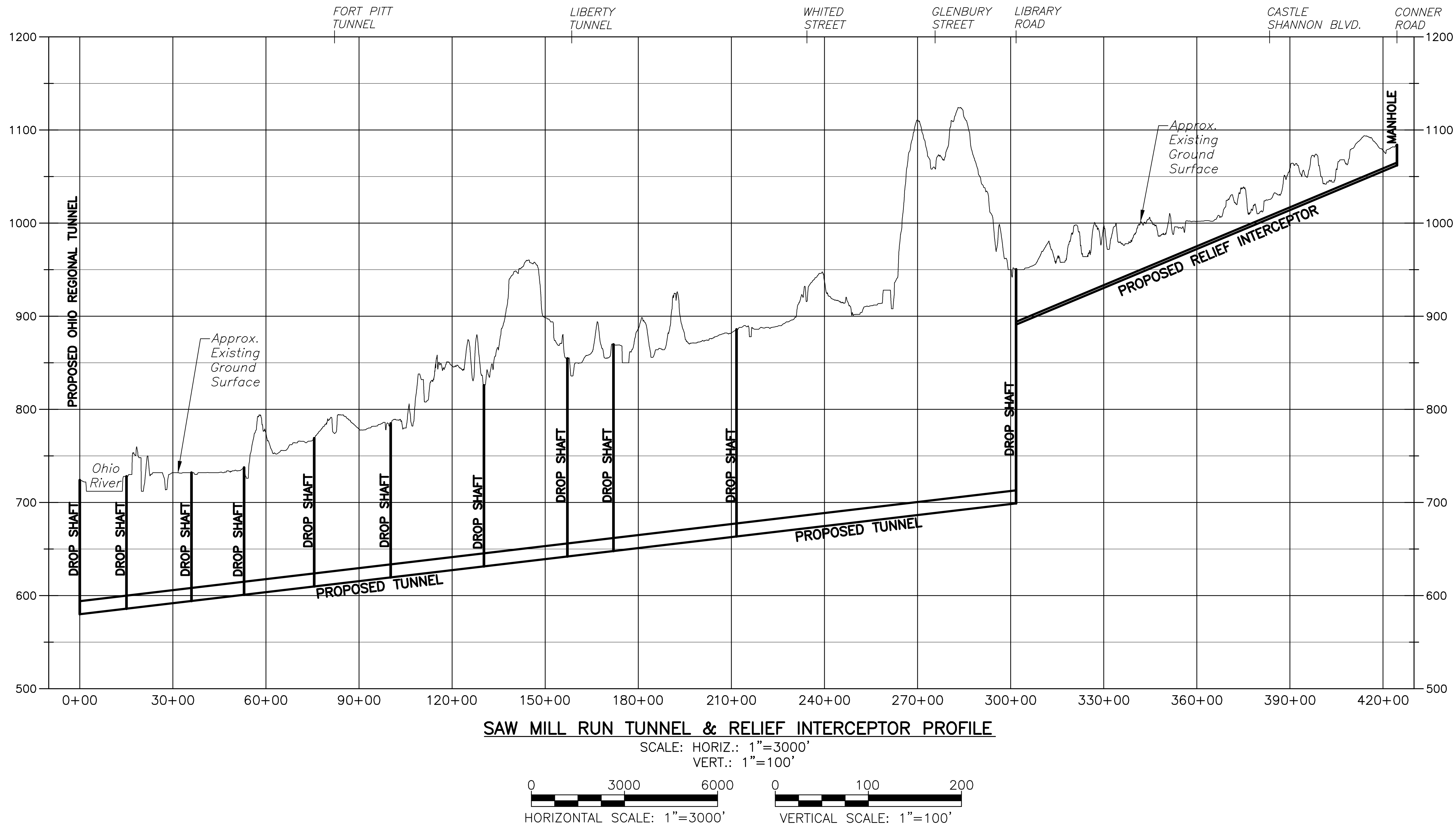

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Figure 9-119: Turtle Creek Consolidation Sewers TC_CF01 & TC_CF02

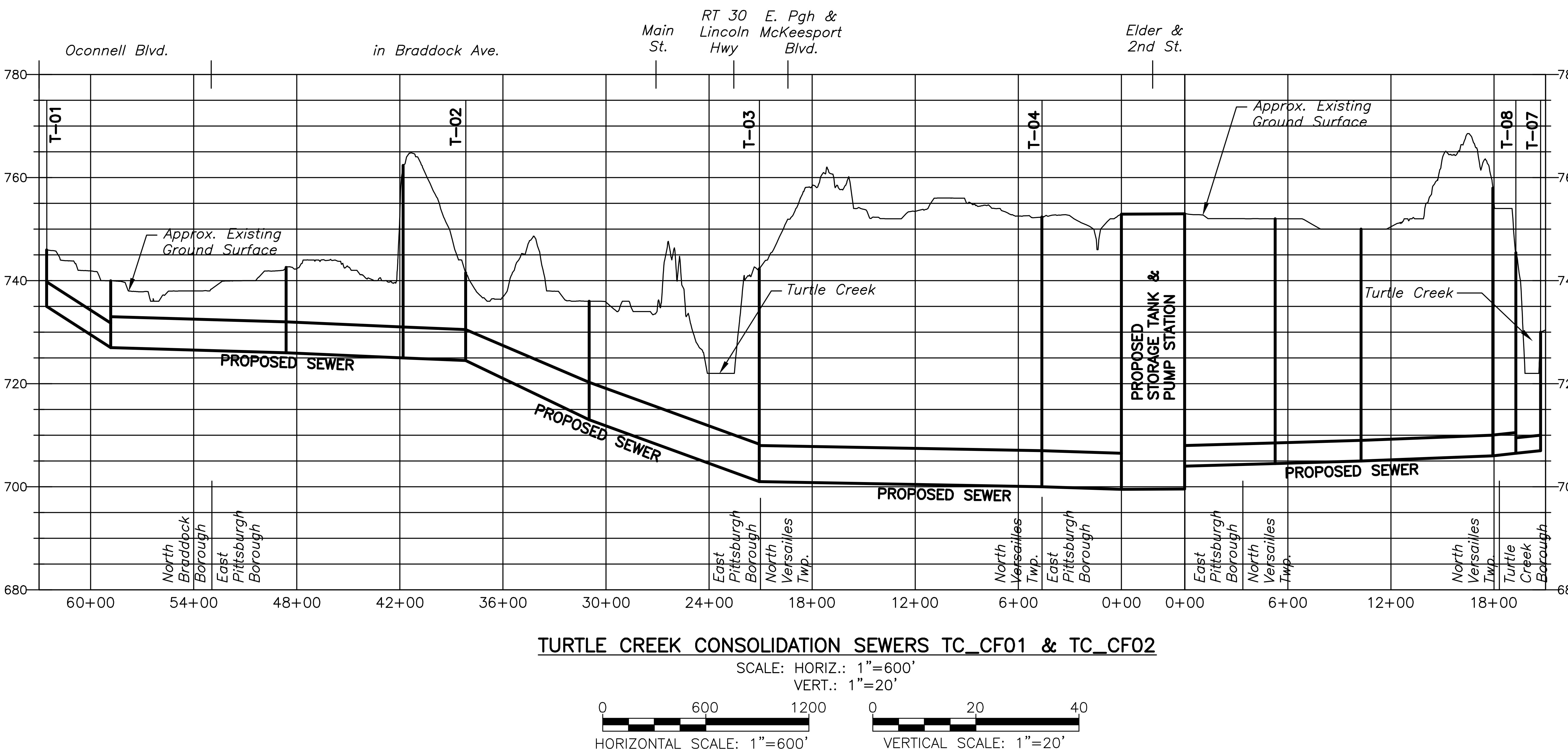
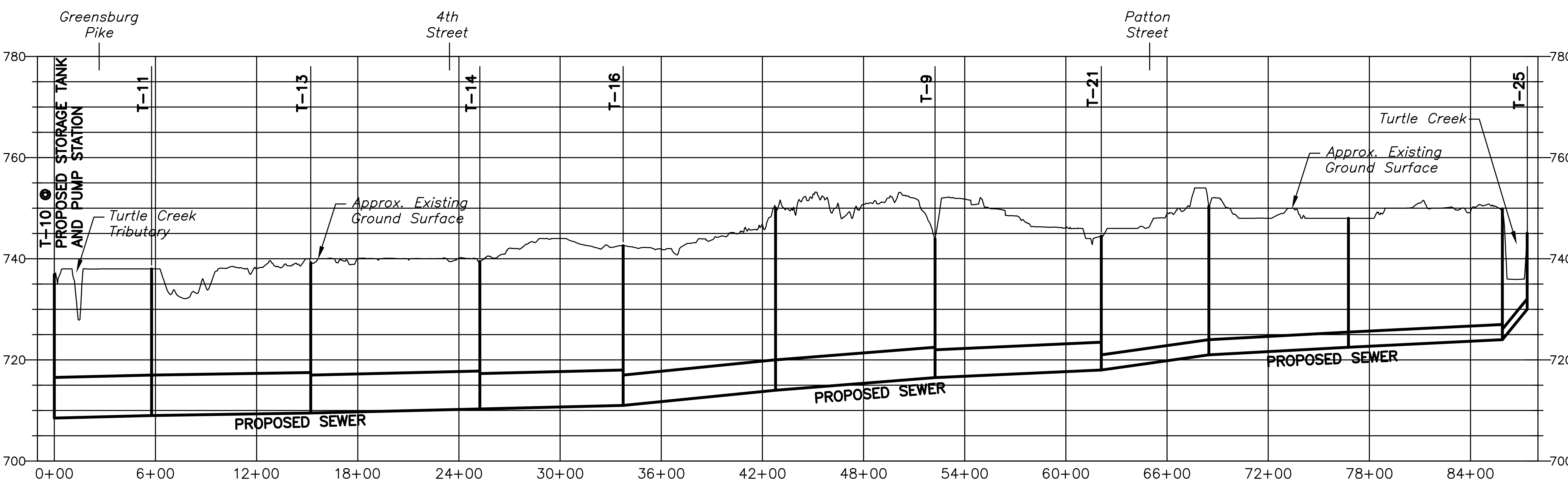


Figure 9-120: Turtle Creek Consolidation Sewer TC_CF03



TURTLE CREEK CONSOLIDATION SEWERS TC_CF03

SCALE: HORIZ.: 1"=600'
VERT.: 1"=20'

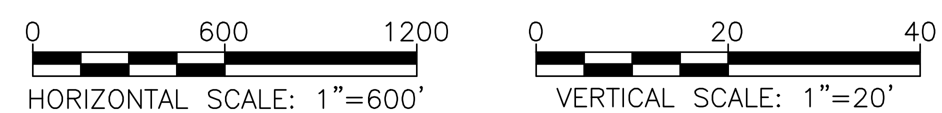


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Figure 9-121: Turtle Creek Consolidation Sewrs TC_CF04

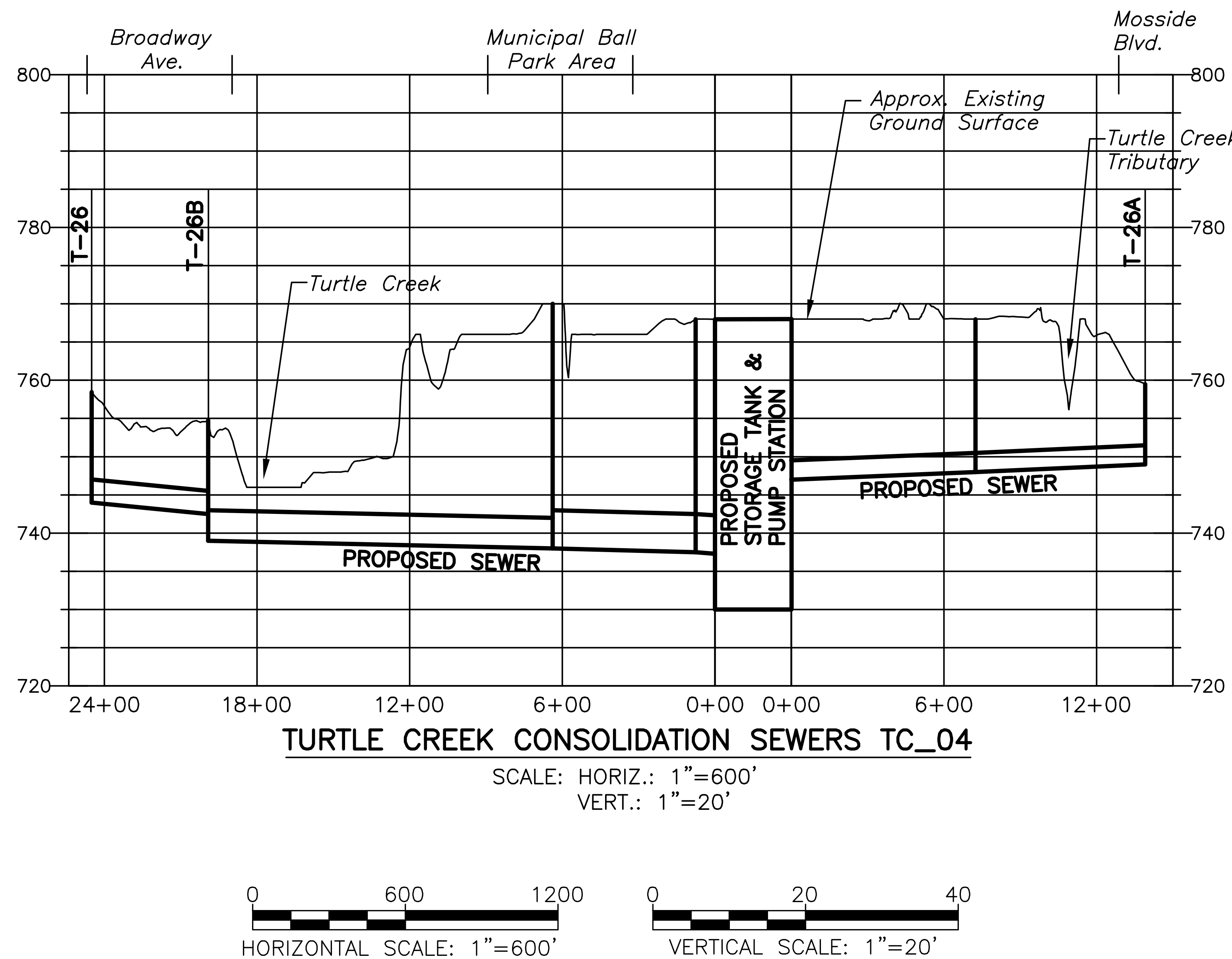

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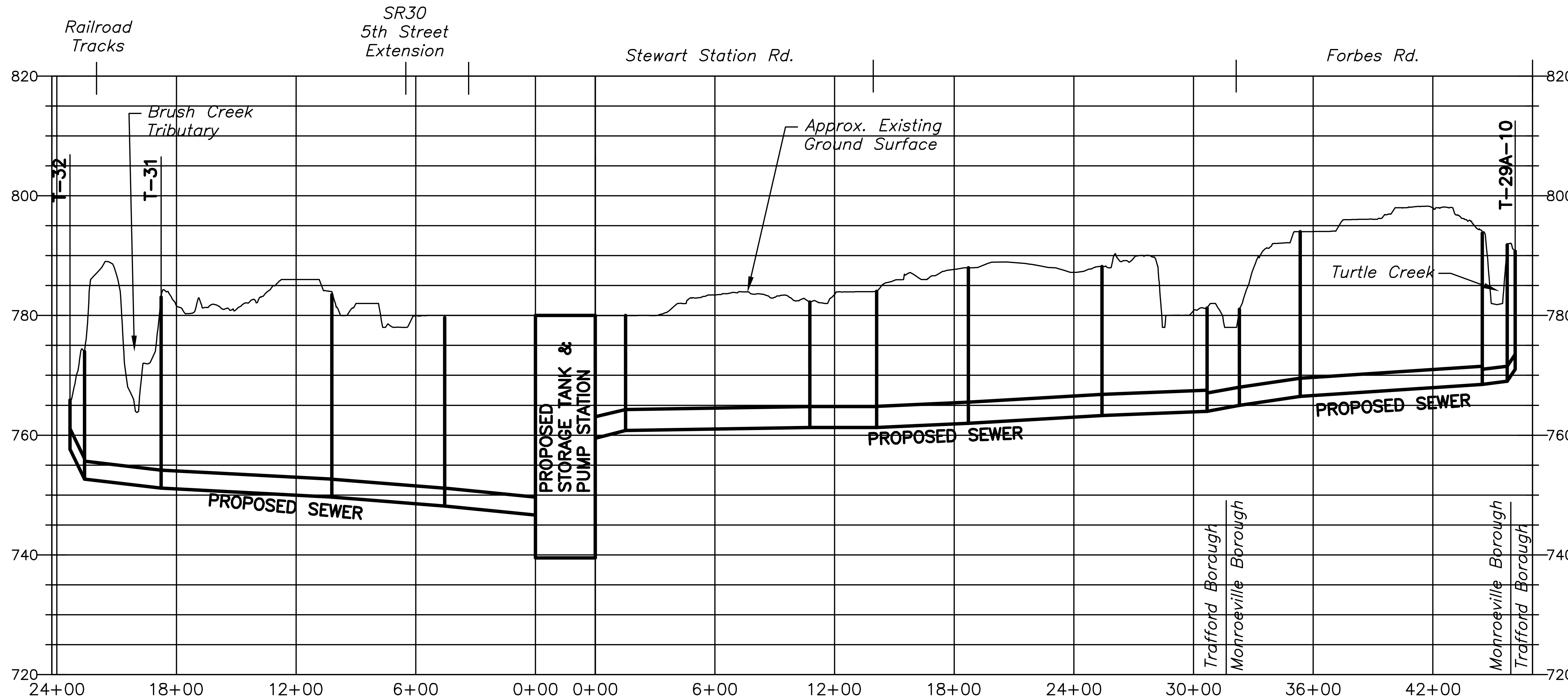
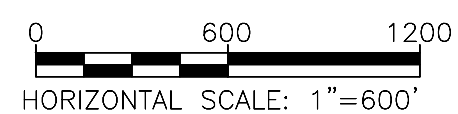
Figure 9-122: Turtle Creek Consolidation Sewers TC_CF05 & TC_CF06



TURTLE CREEK CONSOLIDATION SEWERS TC_05 & TC_06

SCALE: HORIZ.: 1"=600'
VERT.: 1"=20'



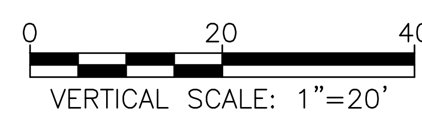


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Figure 9-123: Upper Allegheny Consolidation Sewer Profile

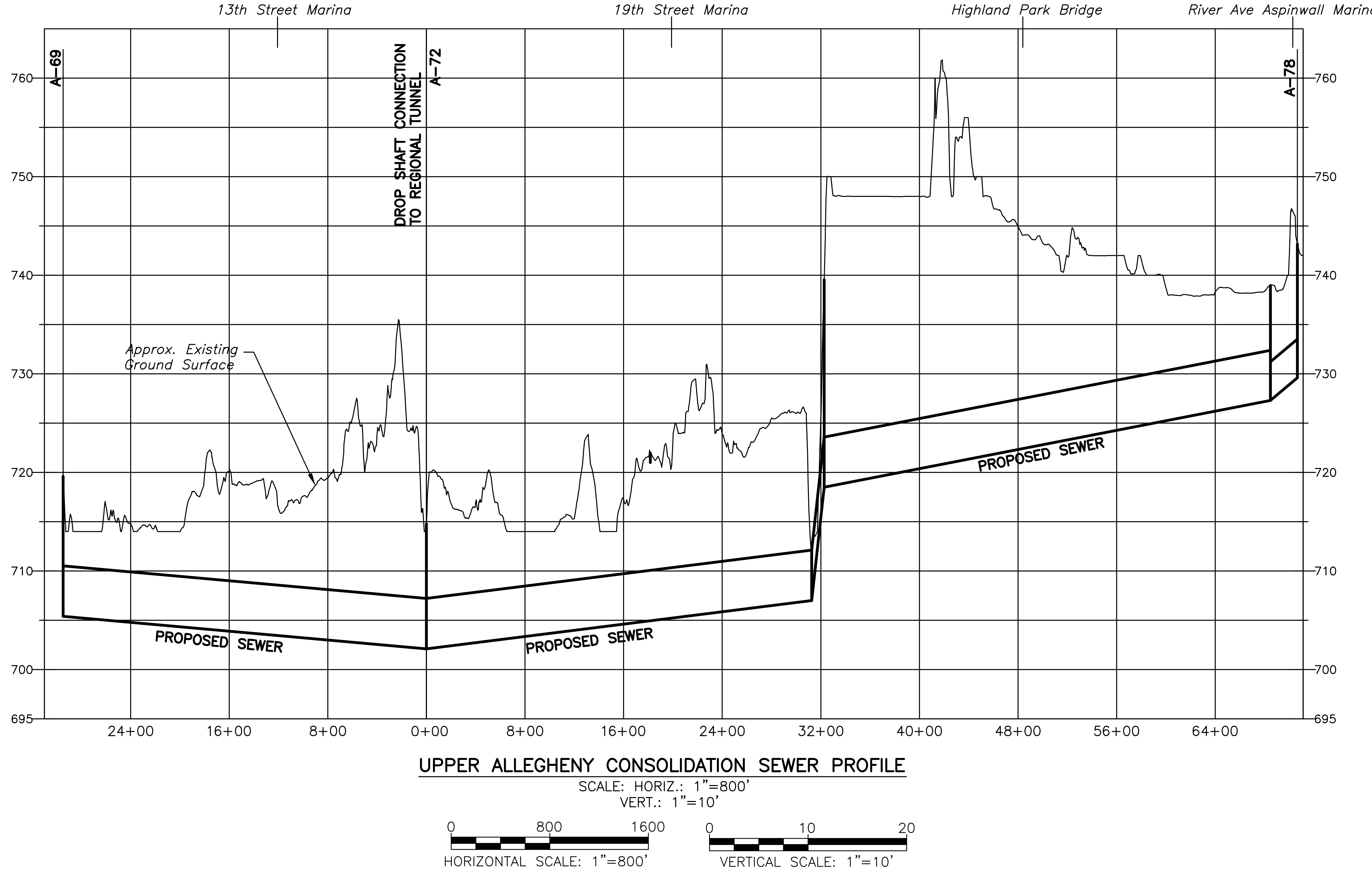

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Figure 9-124: Upper Monongahela Consolidation Sewer Profile (M-42 to M-45)

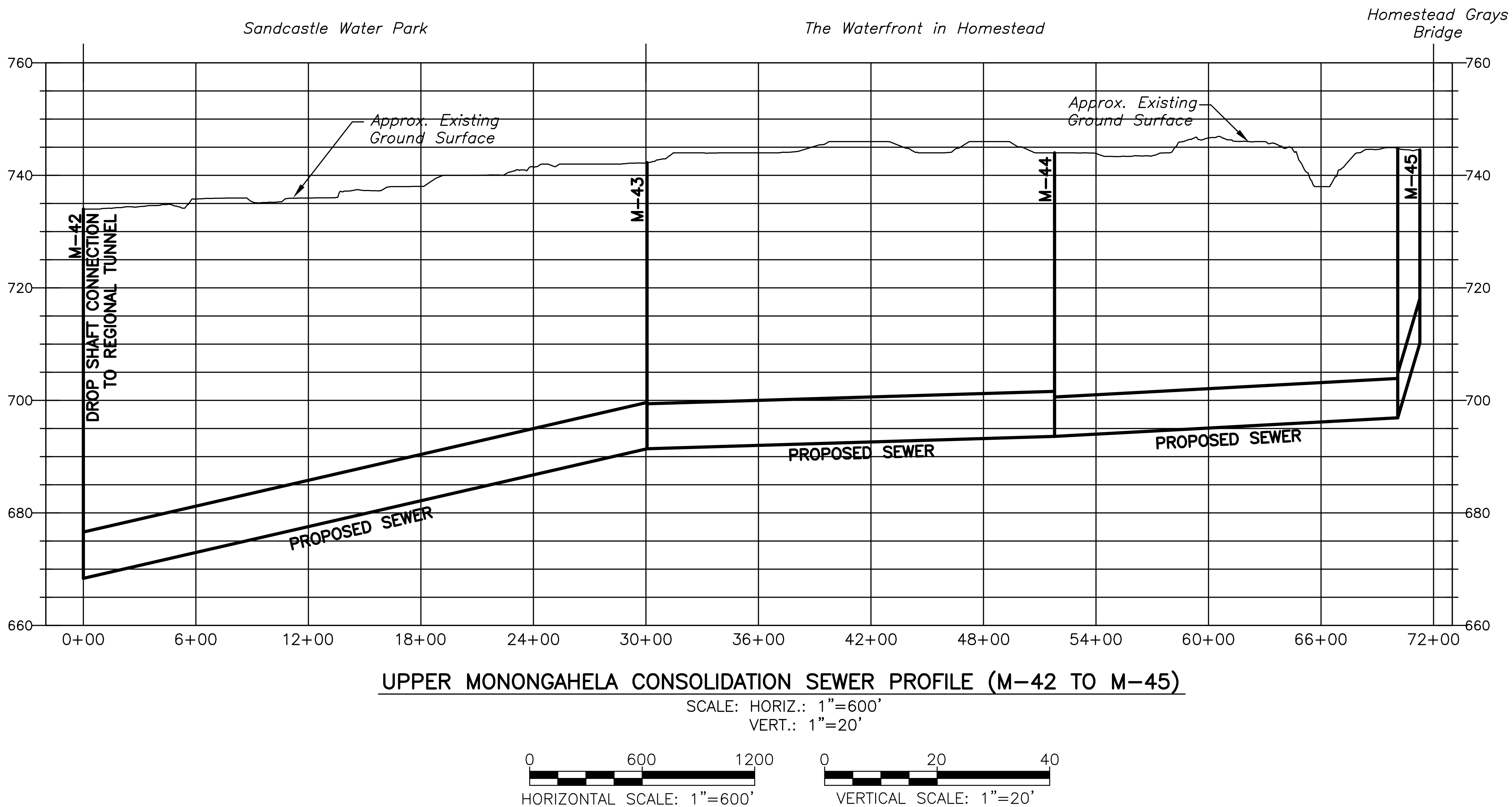

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Figure 9-125: Upper Monongahela Consolidation Sewer Profile (M-51 to M-60)

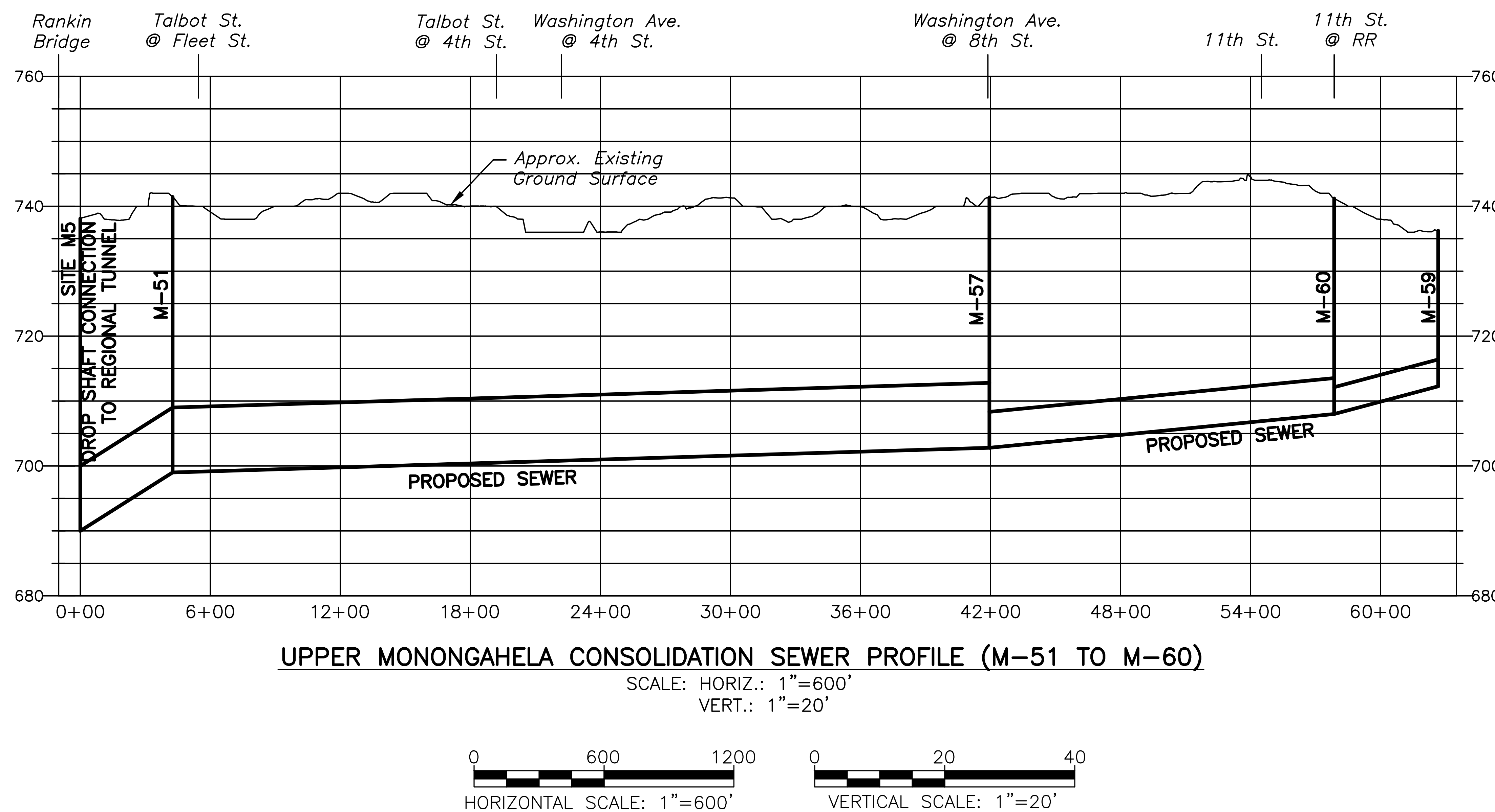

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Table 9-78: Summary of Capital Improvements Associated with Selected Plan

Capital Improvements	Size / Capacity	Estimated Capital Cost (millions)
Regional Storage/Conveyance Tunnel		
Ohio River segment	8-12 MG / 1.9 miles / 12 or 14 ft. diameter / 2 drop shafts	$ 84
Allegheny River segment	35-48 MG / 7.9 miles / 12 or 14 ft. diameter / 10 drop shafts	$ 305
Monongahela River segment	45-63 MG / 10.2 miles / 12 or 14 ft. diameter / 7 drop shafts	$ 352
Chartiers Creek segment	4-5 MG / 0.8 miles / 12 or 14 ft. diameter / 2 drop shafts	$ 39
Tunnel dewatering pump station at Woods Run WWTP	120 MGD	$ 150
Tunnel Cross Connections		$ 85
Subtotal		**$ 1,015**
Planning Basin Improvements		
Chartiers Creek		
Relief interceptor (CC_CF08)		$ 5
Relief interceptor (CC_CF02)		$ 44
Relief interceptor (CC_CF03)		$ 87
Relief interceptor (CC_CF04)		$ 80
Relief interceptor & CSO storage tank (CC_CF05)	1.2 MG tank / 300 MGD screening / 300 MGD influent PS	$ 132
Relief interceptor (CC_CF07)		$ 226
Subtotal		**$ 573**
Lower Ohio / Girty's Run		
SSO storage tunnel (LO_CF20) & dewatering Pump Sta	25 MG / 2.7 miles / 17 ft. diameter / 7 drop shafts / 12.2 MGD PS	$ 157
CSO consolidation sewer to Allegheny tunnel (LNA_CF10)		$ 45
Subtotal		**$202**
Main Rivers		
CSO consolidation sewer to Ohio tunnel (O-27, MR_CF11)		$ 13
CSO consolidation sewer to Allegheny tunnel (A-22, MR_CF04, MR_CF32, MR_CF34, MR_CF36, O-43)		$ 45
CSO consolidation sewer to Monongahela tunnel (MR_CF07, MR_CF19, MR_CF20, M-29)		$ 47
Subtotal		**$ 105**
Saw Mill Run		
CSO Storage/Conveyance Tunnel (SMR_CF04) & consolidation sewers	26 MG / 5.8 miles / 12 ft. diameter / 9 drop shafts	$ 204
Relief interceptor (SMR_CF03)		$ 23
Subtotal		**$ 227**
Turtle Creek / Thompson Run		
CSO storage tank & consolidation sewers (TC_CF01/CF02)	4.6 MG tank / 180 MGD screening / 5 MGD dewatering PS	$ 77
CSO storage tank & consolidation sewers (TC_CF03)	16.1 MG tank / 212 MGD screening / 9 MGD dewatering PS	$ 138
CSO storage tank & consolidation sewers (TC_CF04)	1.1 MG tank / 72 MGD screening / 2.5 MGD dewatering PS	$ 25
SSO storage tank & consolidation sewers (TC_CF05/CF06)	15.3 MG tank / 38 MGD screening / 10 MGD dewatering PS	$ 88
Subtotal		**$ 328**
Upper Allegheny		
SSO storage tank & relief sewer (A-45)	0.3 MG tank / 5.5 MGD screening / 0.2 MGD PS	$ 14
SSO conveyance improvements (A-82)		$ 2
SSO conveyance improvements (A-85)		$ 3
SSO consolidation sewers to Allegheny tunnel (A-41, A-42, A-68, UA_CF04)		$ 54
Subtotal		**$ 73**
Upper Monongahela		
CSO consolidation sewers to Monongahela tunnel (UM_CF01, UM_CF17, M-47)		$ 119
Subtotal		**$ 119**
Subtotal of Planning Basin Improvements		**$ 1,628**
Woods Run WWTP Expansion		
Early action projects	Expand main pump station capacity to 480 MGD	$ 31
Secondary expansion / disinfection	Expand total secondary capacity to 295 MGD	$ 96
Wet weather headworks	400 MGD	$ 105
Major on site conveyance		$ 63
Wet weather disinfection	305 MGD	$ 31
Sludge thickening facilities		$ 9
Primary sedimentation tanks	Expand total primary capacity to 600 MGD	$ 44
Subtotal		**$ 378**
Preferred and Assumed Municipal Improvements		
CSO control improvements		$ 260
SSO control improvements		$ 270
Subtotal		**$ 530**
TOTAL		**$ 3,552**

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Table 9-79: Cost Breakdown for Selected Plan

Cost Component	CSO Control				SSO Control				Combined TPW Cost ($ million)
	Capital Cost ($ million)	TPW O&M Cost ($ million)	TPW R&R Cost ($ million)	TPW Cost CSO Control ($ million)	Capital Cost ($ million)	TPW O&M Cost ($ million)	TPW R&R Cost ($ million)	TPW Cost SSO Control ($ million)	
Regional Conveyance	**$1,015**	**$11**	**$2**	**$1,029**	**-**	**-**	**-**	**-**	**$1,029**
Planning Basin	**$1,087**	**$19**	**$6**	**$1,112**	**$541**	**$12**	**$8**	**$561**	**$1,673**
Chartiers Creek	$395	$6	$1	$402	$178	$0.6	$0.5	$180	$581
Lower Ohio – Girty's Run	$45	$0.3	-	$45	$157	$4	$3	$164	$209
Main Rivers	$106	$0.4	-	$106	-	-	-	-	$106
Saw Mill Run	$204	$5	-	$209	$23	$0.4	-	$23	$233
Turtle Creek – Thompson Run	$164	$6	$5	$175	$164	$6	$5	$174	$349
Upper Allegheny	$54	$0.3	$0.1	$54	$19	$2	-	$21	$75
Upper Monongahela	$119	$0.5	$0.7	$120	-	-	-	-	$120
WWTP	**$282**	**$61**	**$22**	**$365**	**$96**	**$21**	**$7**	**$123**	**$488**
Municipal	**$260**	**$13**	**$4**	**$277**	**$270**	**$10**	**$37**	**$317**	**$595**
TOTAL	**$2,644**	**$104**	**$35**	**$2,783**	**$907**	**$42**	**$53**	**$1002**	**$3,785**

Basis for Plan Selection: Section 9.5 described various hybrid alternatives (mix of basin-based and regional-based facilities) that were compiled and evaluated in order to converge on a recommended wet weather plan that most cost effectively achieves compliance requirements. These alternatives targeted the most cost-effective means of achieving the Presumption Approach criterion of 4-6 overflows per year and the Demonstration Approach such that an evaluation of the most cost-effective compliance solution could be identified. While all of these hybrid alternatives are effective solutions to eliminate sanitary sewer overflows from the ALCOSAN Conveyance and Treatment System and to control combined sewer overflows in compliance with the Consent Decree and National CSO Control Policy, this section presents the reasons why System-Wide Alternative 3f-modified-10pct was chosen as ALCOSAN's Selected Plan.

- Meets all compliance requirements

  The Selected Plan effectively eliminates sanitary sewer overflows from the ALCOSAN Conveyance and Treatment System up to a 2-year level of control and controls combined sewer overflows to not preclude attainment with water quality standards. The Selected Plan reduces CSOs to the extent needed to comply with the CWA and to address the region's wet weather pollution problem. The selected Plan also meets the secondary treatment requirements and other bypass requirements of Appendix T of the ALCOSAN CD.

- Highest ranked system-wide alternative

  As described in Section 9.5.7, a system-wide alternatives ranking analysis was conducted that evaluated 20 criteria related to economic factors, public factors, water quality, public health, and environmental impacts, operational impacts, and implementation concerns. System-Wide Alternative 3f-modified-10pct, the Selected Plan, received the highest score from the ranking process.

- Provides enhanced control to sensitive areas

  The Selected Plan provides a higher level of control to CSOs that discharge directly to sensitive areas than those that discharge to other areas. CSOs discharging to these areas are controlled to zero overflows in the typical year or re-located downstream of the sensitive area, with the exception of one overflow event in the typical year for Allegheny River Area No. 1.

- Best water quality benefit / cost performance

  Figure 9-106 in Section 9.5.6.5 identifies the Selected Plan as the most cost effective in terms of river-mile-days less than key fecal coliform bacteria (the primary constituent of concern) concentration targets. The Selected Plan's regional conveyance and treatment based approach also has the added benefit of greater pollutant load reductions for other parameters such as total suspended solids (TSS) biochemical oxygen demand (BOD) and total phosphorus (TP) by receiving treatment at an expanded Wood's Run WWTP rather than alternative remote treatment facilities.

- Increased ability to expand capacity

  The Selected Plan supports a key requirement of the Demonstration Approach to "allow cost effective expansion or cost-effective retrofitting if additional controls are subsequently determined to be necessary to meet water quality standards or designated uses."

  Sizing of consolidation sewers from combined sewer points of connection to control facilities/conveyances is based on the peak flow in the typical year. This will provide the flexibility to send more flow to the proposed facilities in the future, if ever required. This also minimizes the likelihood of localized overflows caused by the inability to convey flows to proposed conveyance and storage facilities, which could occur even when the facilities have available capacity if a lesser basis of design was used for the consolidation sewers.

  A regional conveyance and treatment based approach allows for more cost-effective retrofitting to address potentially more stringent pollutant discharge regulations in the future, by upgrading the main WWTP rather than rehabilitating or expanding numerous remote facilities.

- Overall most cost-effective system-wide solution

  The current conveyance and treatment system's many geographically distributed outfalls and limited conveyance capacity led to the determination that a regional tunnel based solution is more cost effective, particularly as the level of control increases. As described in Section 9.5.4, a tunnel based approach is a more cost-effective solution up the Allegheny River due to high overflow volumes, existing system restrictions, and limited sites for remote facilities. For the Monongahela River, tunnel and basin-based approaches had similar costs, so non-economic factors such as lower operational complexity and enhanced water quality benefits in terms of pollutant load reductions brought a regional tunnel along the Monongahela into favor.

  As described in Section 9.2and 9.5, a new satellite WWTP was determined to not be a cost competitive solution. As a result, the Selected Plan focuses on increasing treatment capacity at the Woods Run WWTP and delivering the flows there through new regional conveyance.

  Water quality analysis results showed that maximizing volume reduction is more cost efficient and results in greater water quality benefits than controlling all overflows to a common overflow frequency. As a result, the most cost-effective plan is to control the outfalls generating the largest overflow volumes, while allowing outfalls with smaller overflow volumes to discharge more frequently. It was determined that remaining CSOs will not cause or contribute to water quality non-attainment.

- Municipal and public participation influenced decision for Selected Plan

  Municipal and public input helped guide the decision-making process for the Selected Plan. For example, ALCOSAN established a Basin Planning Committee (BPC) in each of the seven planning basins that fostered a collaborative process of alternatives identification and analysis among the municipal stakeholders and ALCOSAN. Pursuant to the CD, ALCOSAN established the Customer Municipality Advisory Committee (CMAC). Key topics discussed included coordination of ALCOSAN's planning process and its impacts on its Customer Municipalities. In addition, ALCOSAN established a Regional Stakeholder Group (RSG) to receive input from a broad range of stakeholders. The role of the stakeholder group was to advise ALCOSAN in the development of the WWP and to inform ALCOSAN as to interests and concerns of the public and the various constituencies. These collective coordination efforts influenced the evaluation of alternatives and Plan Selection, particularly input from customer municipalities through the municipal planning information provided (as described in Section 9.3).

Performance Benefits of Selected Plan: This section presents the H&H and water quality performance benefits associated with the Selected Plan. In addition, Appendix C includes the predicted peak flow rate at each point of connection to the ALCOSAN system based upon the H&H Model of the Selected Plan. For the portions of the system not owned or operated by ALCOSAN, the predicted performance is completely dependent on the preferred/assumed municipal planning information previously described in Section 9.3.3.

- <u>Controls CSO discharges to the extent that they do not preclude the attainment of water quality standards or the receiving waters' designated uses</u>

  The recreational season water quality assessment results for the Selected Plan with improved baseflow and stormwater are presented as Figure 9-126 and Figure 9-127, for the geometric mean and 10% criteria, respectively. The results were used to assess if the Selected Plan does not preclude attainment with fecal coliform water quality standards in each receiving water body. The results show that, for the Selected Plan, all receiving waters meet both criteria.

  Section 9.5.6.5 presented the relative fecal coliform loads originating from various sources under existing conditions for the typical year. The results showed that the ALCOSAN combined and sanitary sewer overflows account for around 30% of the annual fecal coliform loading to the ALCOSAN receiving waters, with sources beyond ALCOSAN's control responsible for the remaining 70% of the pollutant load. Shown on Figure 9-128 is ALCOSAN's projected share of fecal coliform loadings after implementation of the Selected Plan, assuming that other sources are not controlled. Figure 9-129 shows the existing conditions fecal coliform loading sources as a basis of comparison. As the figures show, implementation of the Selected Plan would reduce ALCOSAN's CSO and SSO share from around 30% to approximately 2%.

Figure 9-126: Selected Plan Attainment with Fecal Coliform Geometric-Mean Water Quality Criterion

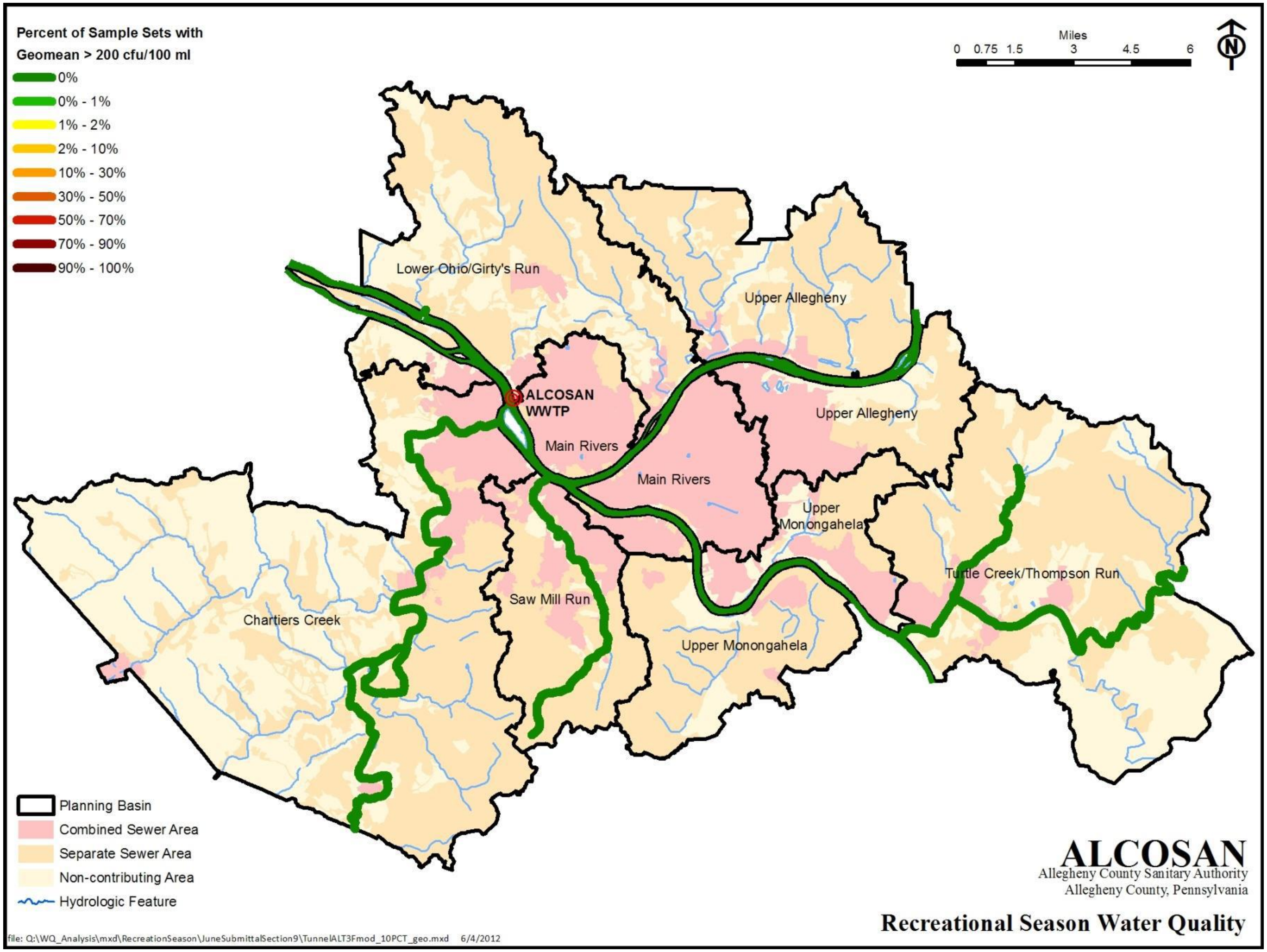


Figure 9-127: Selected Plan Attainment with Fecal Coliform 10% Water Quality Criterion

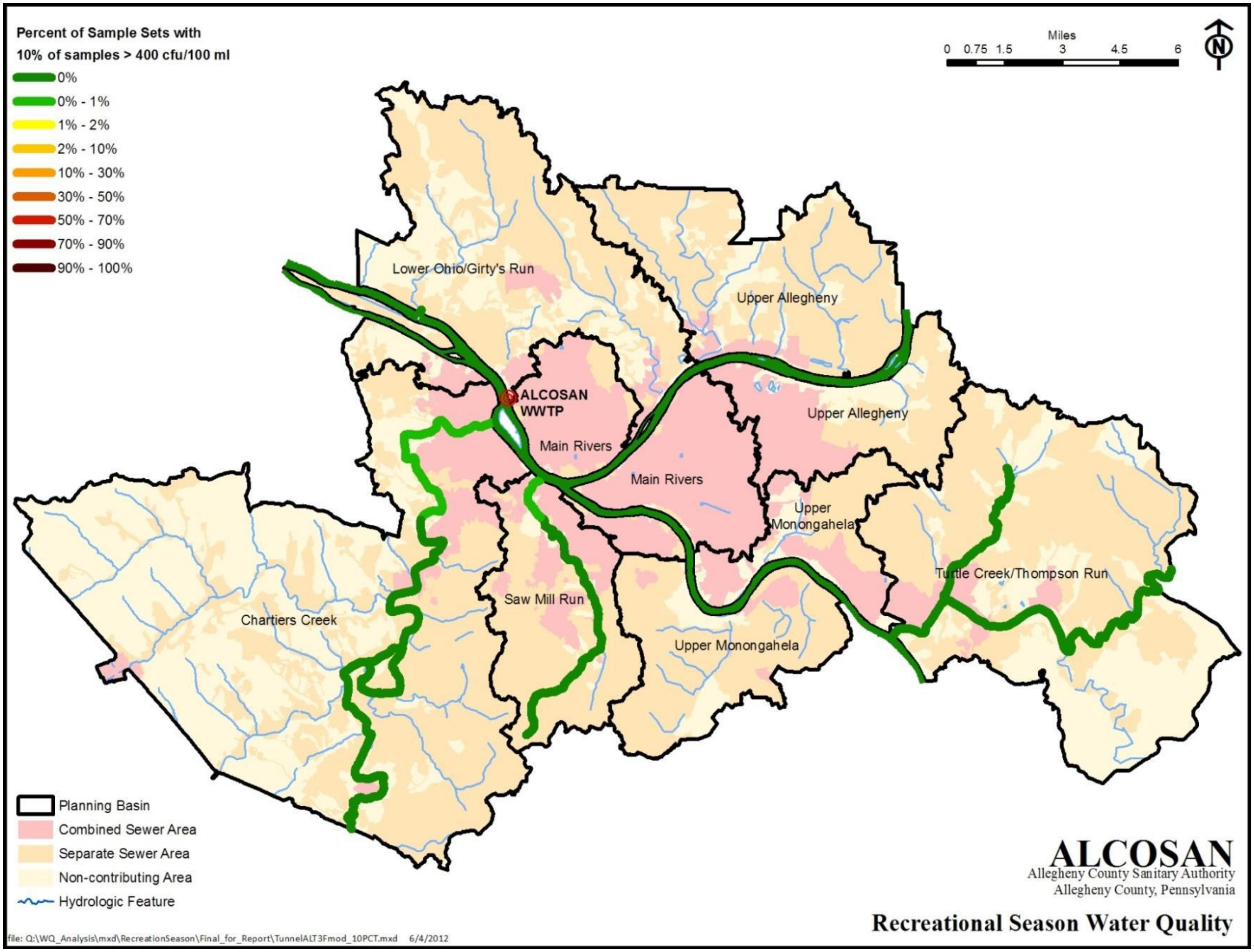


Figure 9-128: Typical Year Fecal Coliform Loads After Implementation of the Selected Plan

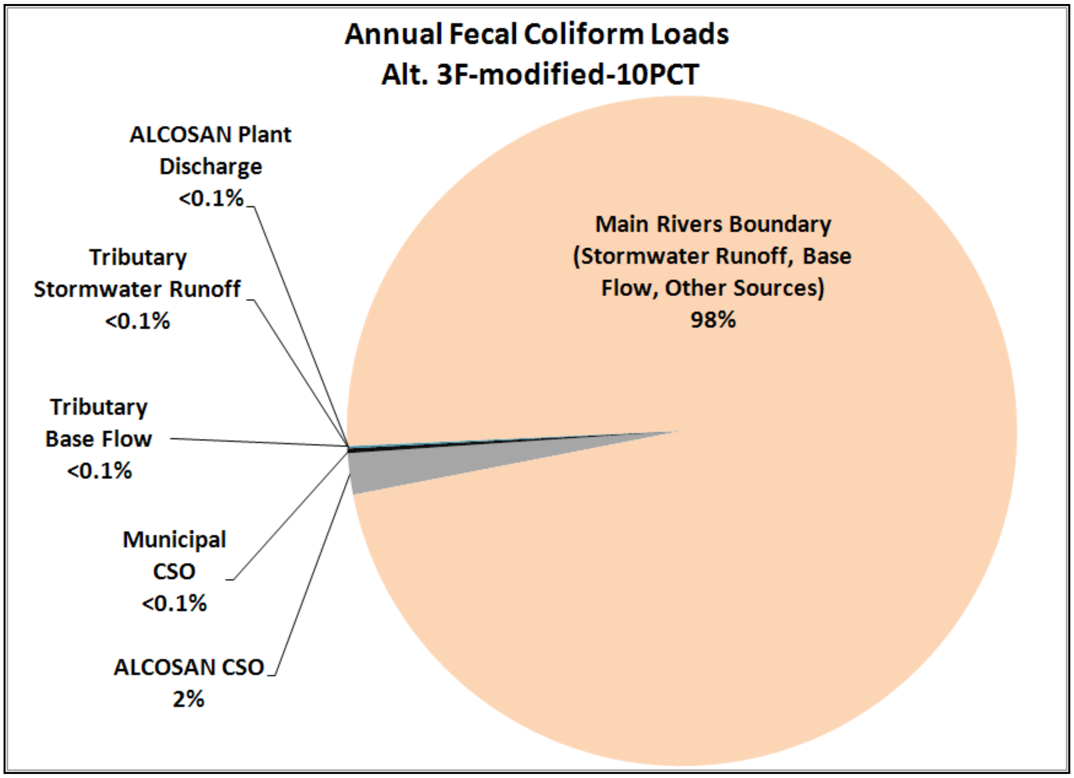
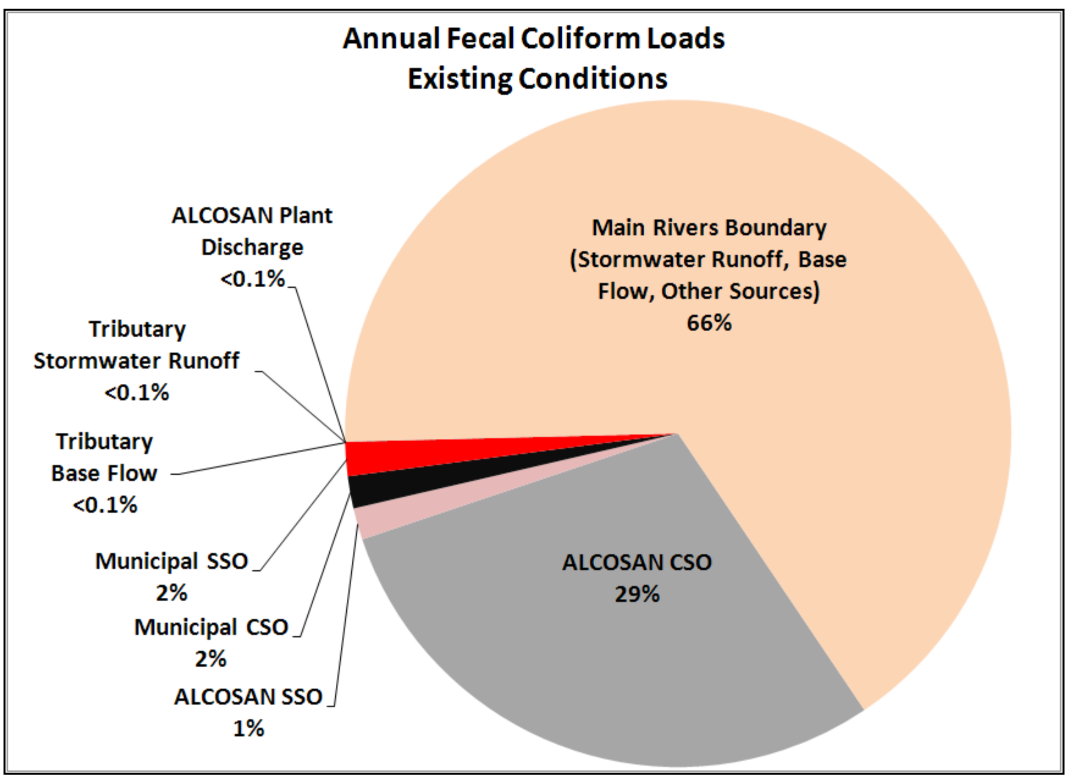


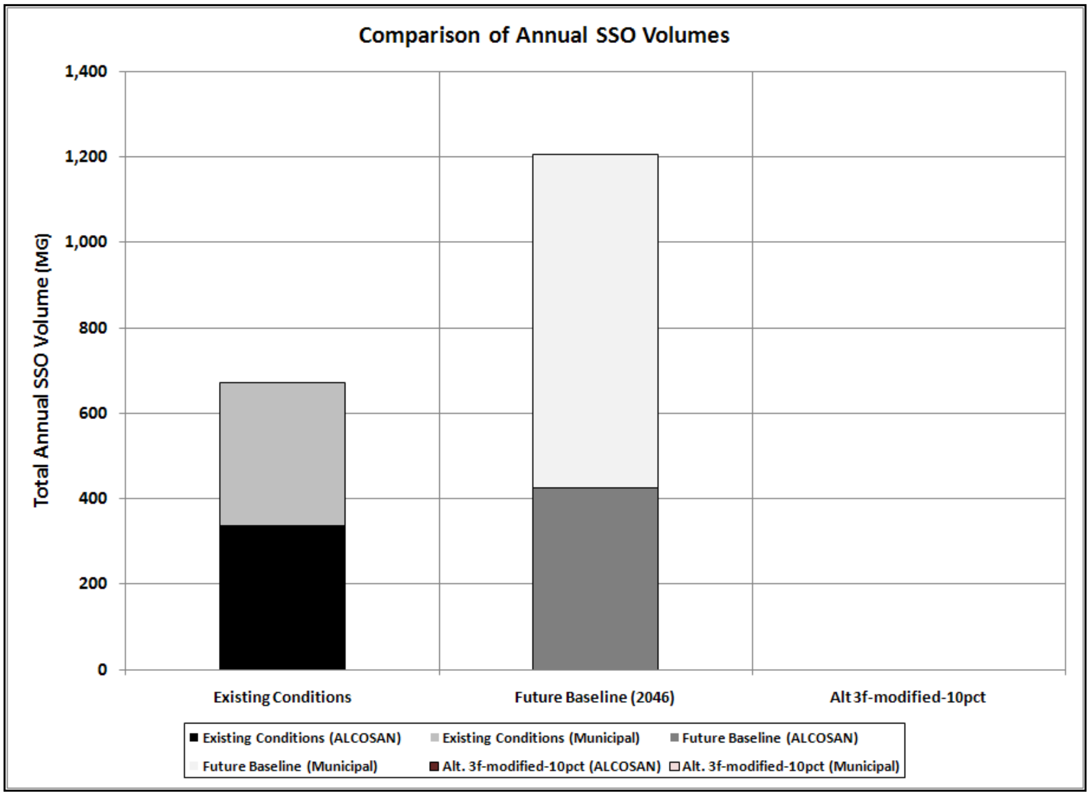
Figure 9-129: Existing Conditions Fecal Coliform Loadings by Source



- Eliminates sanitary sewer overflows from the Collection and Treatment System in conformance with the Clean Water Act

  The Selected Plan effectively eliminates all SSOs from the Conveyance and Treatment System up to a 2-year level of control. Figure 9-130 shows a comparison of the total annual ALCOSAN and municipal SSO discharge volumes as compared to existing and future baseline conditions.

Figure 9-130: Annual SSO Volume Comparison for Selected Plan



- Improves water quality conditions in receiving waters

  Figure 9-106 in Section 9.5.6.5 presented a water quality cost-benefit analysis using the "river-mile-day" metric. As the figure shows, implementation of the Selected Plan would result in 13,950 river-mile-days (out of a maximum of 13,957) below the 200 cfu/100ml threshold. This results in the fecal coliform concentrations being less than 200 cfu/100ml for 99.9% of the total system-wide river-mile-days during the recreational season.

- Reduces untreated CSO volumes discharged to receiving waters

  Implementation of the Selected Plan would result in a 92% reduction in annual untreated CSO volumes discharged to receiving waters from ALCOSAN and municipal CSOs as compared to future baseline conditions. Figure 9-131 shows a comparison of the total annual untreated ALCOSAN and municipal CSO discharge volumes by planning basin as compared to existing and future baseline conditions.

- Provides a reduction in total suspended solids (TSS), total phosphorus (TP), biochemical oxygen demand (BOD), and solids and floatables discharged from wet weather overflows

  Figure 9-132 shows the reduction in TSS as compared to existing and future baseline (2046) conditions. Implementation of the Selected Plan would result in a 92% reduction in TSS discharged from CSOs and SSOs as compared to future baseline conditions. Figure 9-133 shows the reduction in TP as compared to existing and future baseline conditions. Implementation of the Selected Plan would result in a 95% reduction in TP discharged from CSOs and SSOs as compared to future baseline conditions. Figure 9-134 shows the reduction in BOD as compared to existing and future baseline (2046) conditions. Implementation of the Selected Plan would result in a 95% reduction in BOD discharged from CSOs and SSOs as compared to future baseline conditions. Significant reductions in discharges of solids and floatables will also be realized.

Figure 9-131: CSO Volume Comparison for Selected Plan

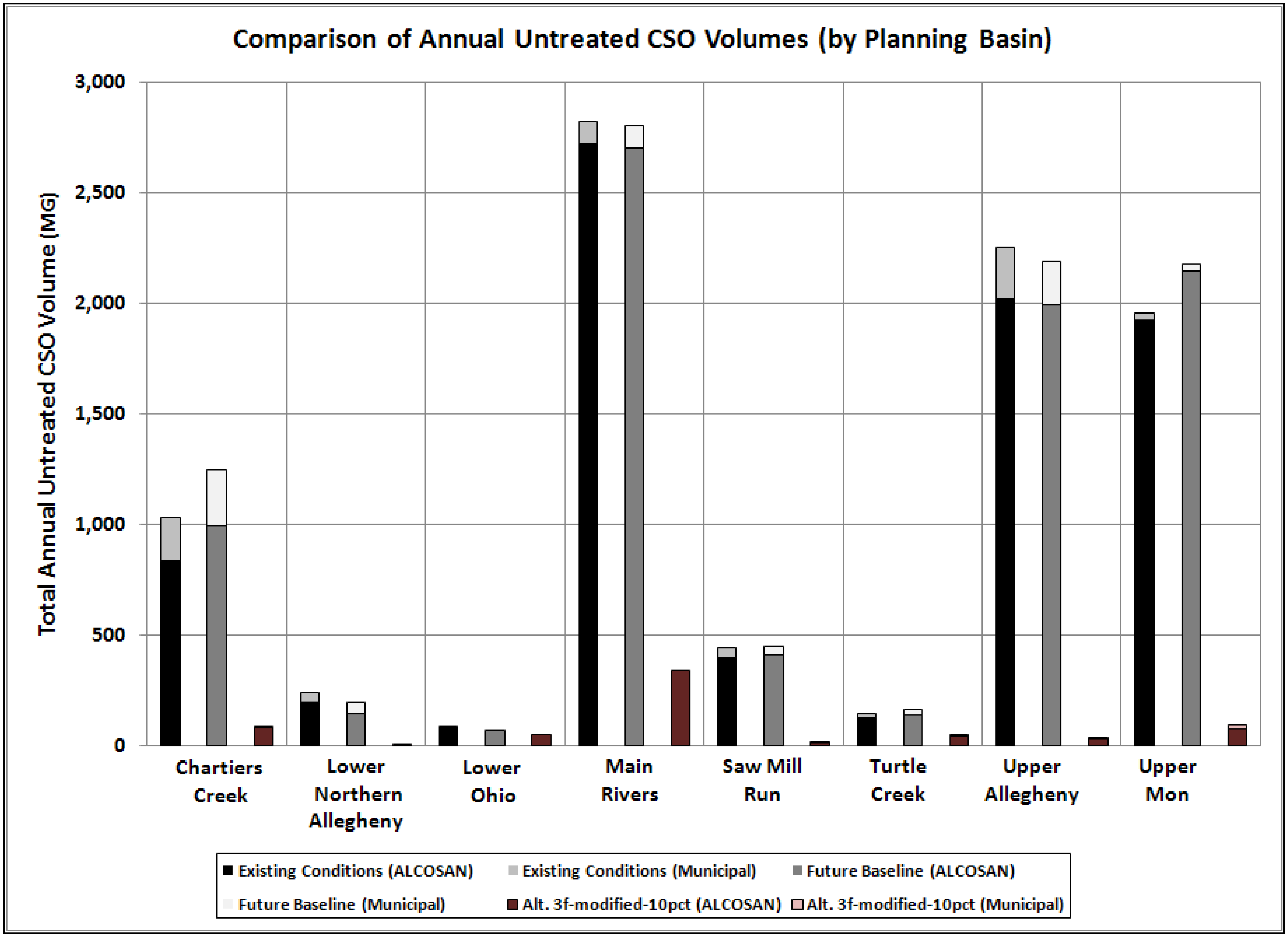


Figure 9-132: Total Suspended Solids Discharge Loads for Selected Plan

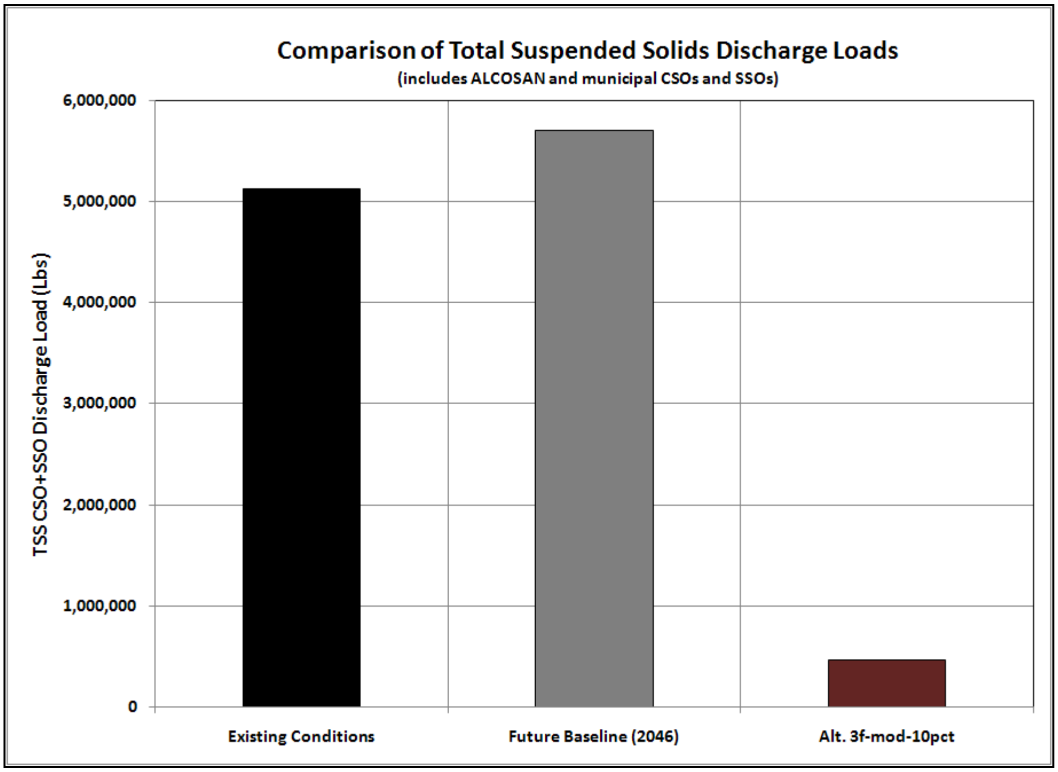


Figure 9-133: Total Phosphorus Discharge Loads for Selected Plan

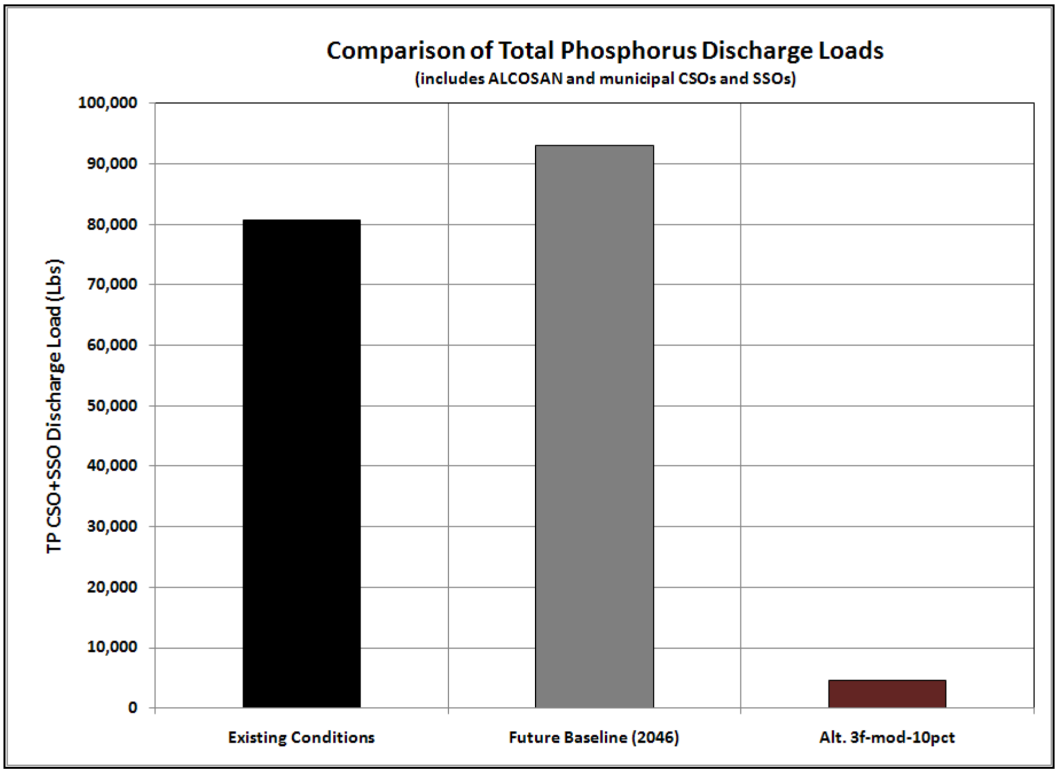
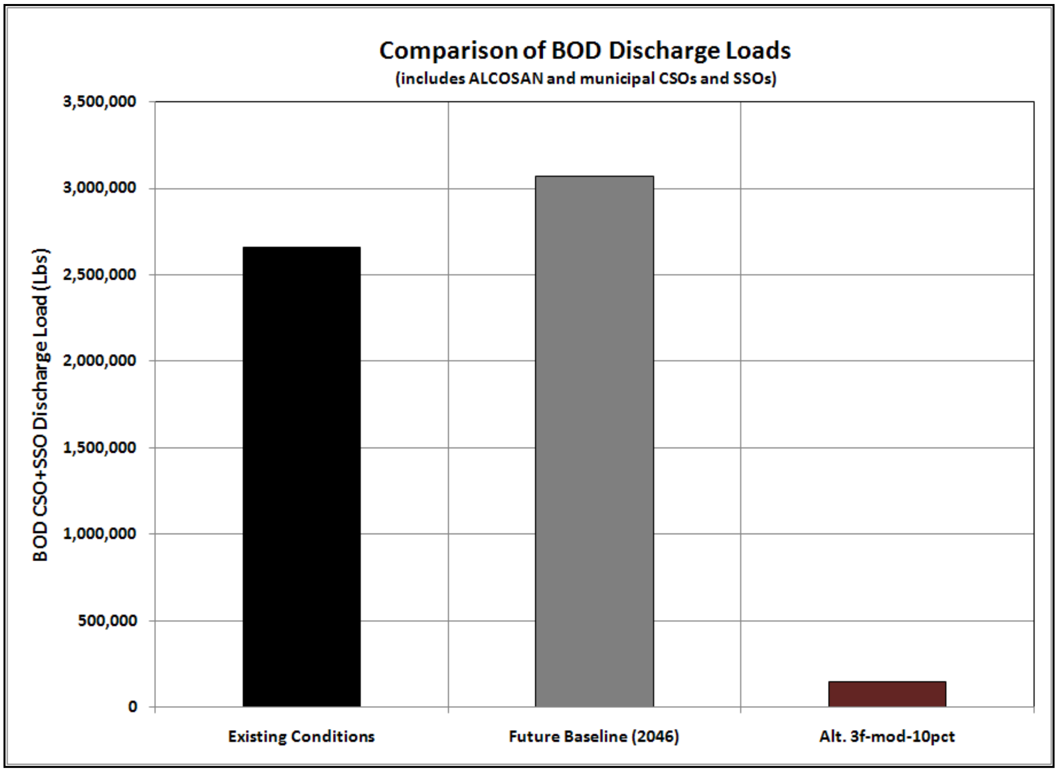


Figure 9-134: BOD Discharge Loads for Selected Plan



- <u>Provides an increase in the capture of combined sewage</u>

  The combined sewage volume captured for treatment during wet weather events with implementation of the Selected Plan is approximately 96% on a system-wide annual average basis. Figure 9-135 shows the resulting percent capture by planning basin as compared to existing and future baseline (2046) conditions.

- <u>Provides enhanced control to CSO outfalls directly impacting sensitive areas</u>

  The Selected Plan provides a higher (as compared to other CSOs) level of control to fifteen CSOs that directly impact CD-defined sensitive areas. CSOs discharging to these areas are controlled to zero overflows in the typical year or re-located downstream of the sensitive area, except for one overflow event in the typical year for Allegheny River Area No. 1. Figures 9-136 and 9-137 show the outfalls which directly impact sensitive areas and the frequency and volume of overflows associated with these outfalls. The existing and future baseline (2046) overflow statistics are provided as well to illustrate the overflow control benefits associated with the Selected Plan. The one overflow event in the Allegheny River Area No. 1 sensitive area occurs at outfalls A-65 and A-67. None of the corresponding discharge volumes exceed 0.11 million gallons.

Figure 9-135: Percent Capture for Selected Plan

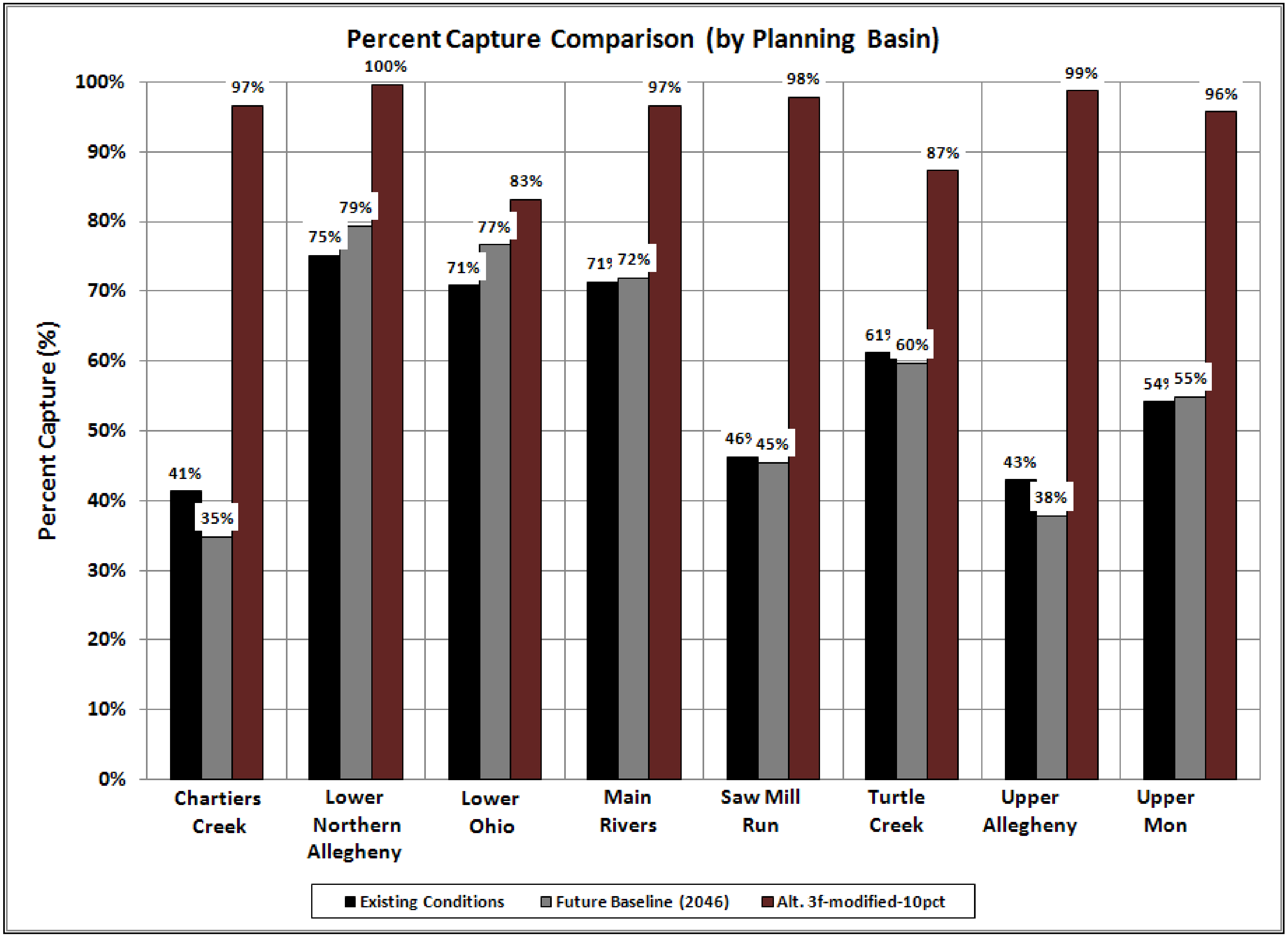


Figure 9-136: Sensitive Areas CSO Frequency Analysis for Selected Plan

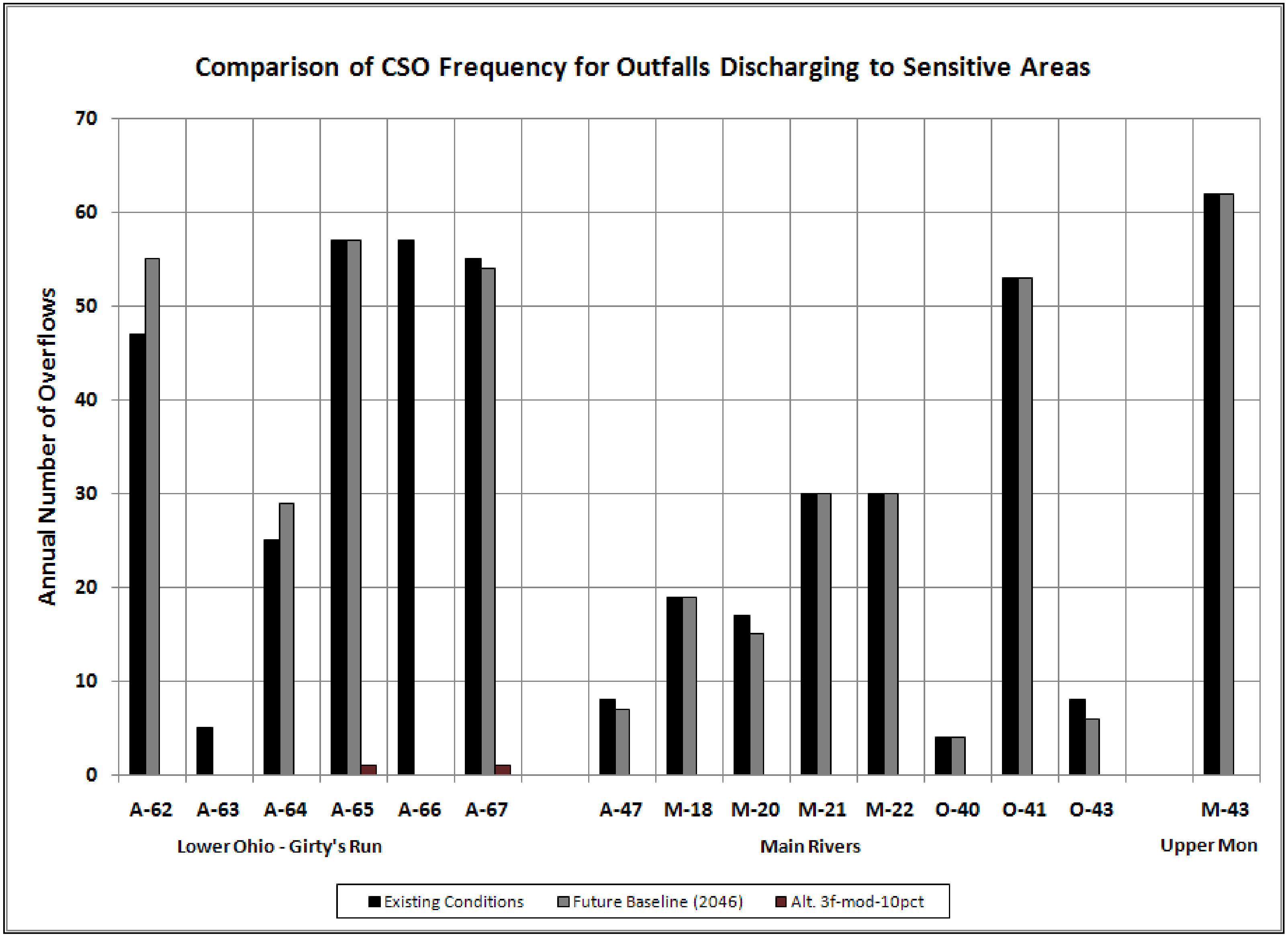
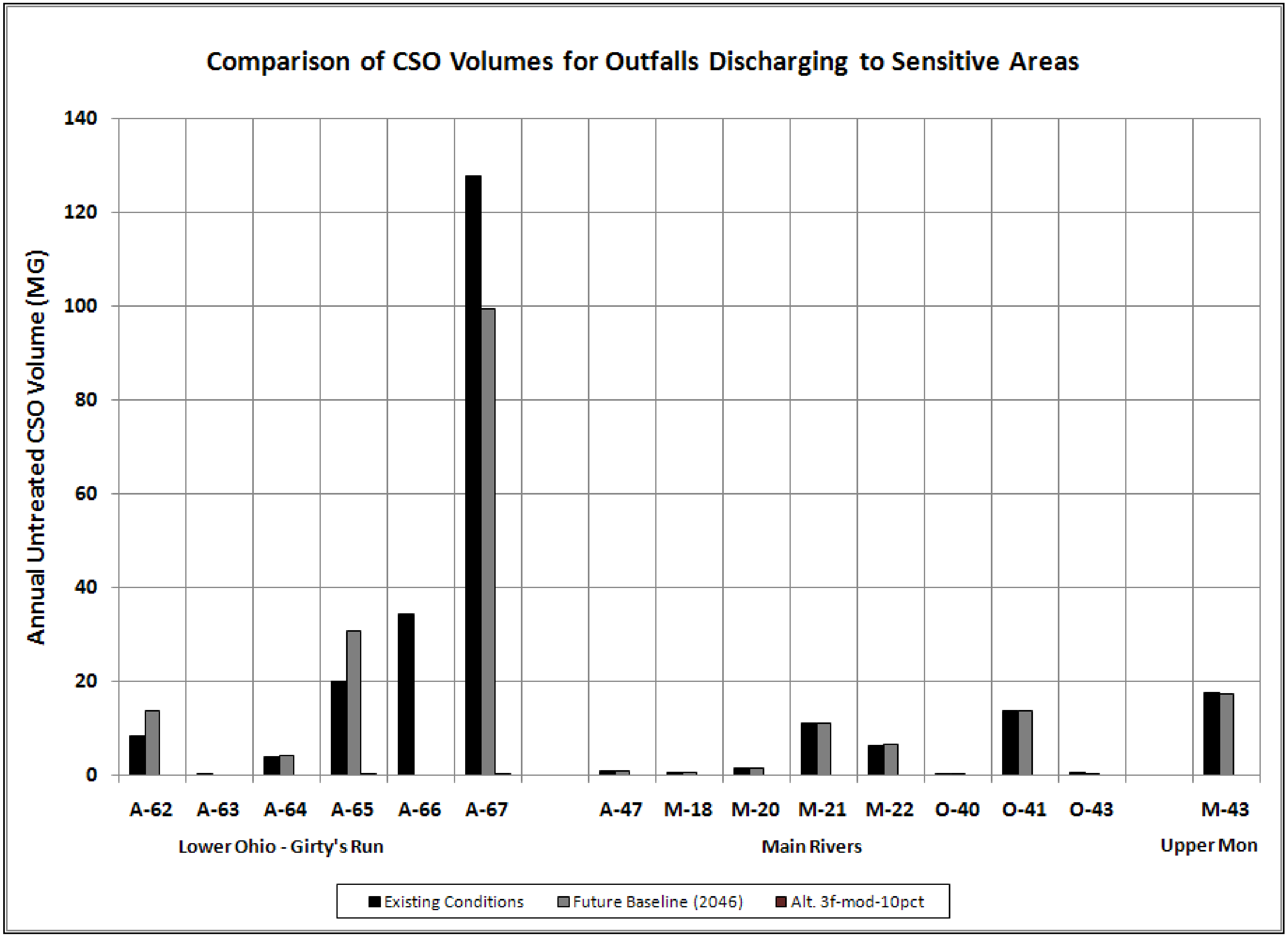


Figure 9-137: Sensitive Areas CSO Volume Analysis for Selected Plan



9.6.2 Schedule Analysis

Section 9.6.1 presented the selected alternative (Alternative 3f mod 10 pct), also referred to as the Selected Plan. This section analyzes the technical feasibility of completing the Selected Plan by the 2026 CD implementation schedule which, assuming a January 2014 WWP approval, means the program must be completed within 12 years. The financial feasibility of the selected alternative is addressed in Section 9.6.3.

The proposed regional storage/conveyance tunnel system is the backbone of the ALCOSAN WWP and its construction dictates the critical path for the overall implementation schedule. As noted previously in Section 9.5, the regional tunnels are likely to be constructed in reaches that generally follow the three rivers and flow towards the Woods Run WWTP. The first reach would be constructed from the WWTP up gradient along the Ohio River to the North Shore area in the vicinity of the Point. From the North Shore the tunnel is divided into two reaches; one reach would be constructed from near the Point up gradient along the Allegheny River and the other would be constructed from the same location but up gradient along the Monongahela River. The regional tunnels total approximately 20 miles in length.

In addition, the WWP includes approximately six miles of tunnel construction in the Saw Mill Run planning basin and three miles in the Lower Ohio (North) planning basin. The tunnel sizes range from 12 to 17 feet in diameter. It is estimated that if all the tunnels were constructed in series it would take about 20 years to complete. In order to complete the overall WWP by 2026, allowing for design and post-tunnel construction work in the planning basins, the tunnels would need to be constructed in approximately seven years. Therefore, the regional tunnels and planning basins tunnels would need to be constructed concurrently.

Furthermore, to ensure that tight compliance schedules can be met, it may be necessary to revisit a fundamental assumption regarding how the tunnels would be constructed. The estimated tunnel construction costs assume TBM tunnels will be constructed with a two-pass system, consisting of initial support of the rock as needed during tunneling followed by a cured-in-place concrete lining once the tunnel section is completed. If the overall construction schedule is a concern, it may be necessary to use the more schedule efficient one-pass method of tunnel construction, which involves boring and lining the tunnel in a single pass. The one-pass system is a more expensive method of construction and would further increase the costs of the Selected Plan. This method is more expensive because the entire alignment is supported with a liner designed for the critical conditions. It does not take advantage of rock quality that the two-pass system offers.

Completing construction of the Selected Plan by 2026 would require four or five concurrent TBM tunneling contracts with individual contract costs ranging from $100 to $300 million. There are a limited number of tunnel construction firms operating in the United States that have the capability and financial capacity to construct TBM tunnels of the size proposed in the ALCOSAN WWP. Moreover, there is an increasing use of tunneling technology nationwide not only for wastewater tunnel but for water supply systems and transportation programs. Multiple concurrent tunneling projects would limit the ability to obtain competitive bids as tunnel contractors reach their maximum bonding capacity and available resources to work on concurrent projects. This will also result in paying a premium on multiple projects as the contractors must assume higher risks for the large projects and the loss of competitive bidding.

Ongoing and upcoming CSO and transit tunneling programs in other large metropolitan areas including Cleveland and Columbus, OH; Indianapolis, IN; Hartford, CT; Boston, MA; Baltimore, MD; New York, NY; Washington, DC and St. Louis, MO will also compete for these services during similar time frames as the ALCOSAN program.

The implementation schedule for the ALCOSAN wet weather program is extremely compressed with respect to the anticipated size of the program and in comparison with other recently approved long term control plans (LTCP). Table 9-80 provides a summary of LTCP implementation periods in other metropolitan areas. It is typical for large LTCPs to have implementation periods of 25 to 40 years which is two to three times the length of time in the ALCOSAN CD.

Table 9-80: Implementation Schedule for Long Term Control Plans in Other Metropolitan Areas

City	LTCP Approval (Year)	Estimated Program Cost ($ Billion)	Implementation Period (Years)
Cleveland, OH	2010	$3.0	25
St. Louis, MO	2009	$1.9	25
Washington, DC	2002	$2.6	40
Columbus, OH	2006	$3.1	40

Other factors impacting the program schedule include the following:

1. In addition to the TBM tunnel projects described above, it would be necessary to overlap numerous conveyance projects and storage and treatment facilities requiring extensive coordination and increased risk. The volatile nature of overlapping activities across several construction projects increases the risk for, and impact of, delays and increases exposure to change orders and claims. For example, delays due to unforeseen conditions on one of the tunnel construction contracts can have a ripple effect of delays to consolidation projects in the planning basins and other tunnel construction contracts.

2. There are extensive property acquisitions needed for the WWP which is a volatile activity that can have dramatic impacts on construction scheduling, causing delays as a result of legal disputes or negotiations over property values.

3. The Selected Plan includes over 20 miles of trenchless pipeline construction (e.g., microtunneling and pipe jacking) across the service area that would be distributed among dozens of individual construction contacts. There are a limited number of contractors in the region that are currently skilled in performing this specialized construction. Thus, the trenchless pipeline construction risks for delays and higher costs

are similar to the TBM tunneling risks described above regarding overlapping construction contracts and limiting competition.

4. The interdependency of the program on completion of preceding activities provides inherent risks for delays. For example, a delay in completing the WWTP expansion will delay initiation of operation of subsequent conveyance projects.

5. ALCOSAN has historically performed around $50 million in capital improvement annually. The impact of significant increases in annual capital expenditures ($200 to $300 million per year) necessary to complete the program on an accelerated schedule will place an excessive burden on ALCOSAN management and engineering staff and increase reliance on outside consultants for professional services. Accelerating design and construction management services can also have a significant impact on the ability to maintain adequate quality control and quality assurance (QA/QC) for the contract documents (plans and specifications) and for inspection of the construction work. This increases the risk of extra costs for change orders and claims during construction.

6. Traffic increases, disruption and congestion will be compounded by multiple overlapping projects causing delays, increased pollution emission and public irritation resulting in loss of public support for the program. Coordination with other transportation and utility construction projects will present greater challenges to overlapping projects among several sites in the service area.

The conclusion of the scheduling analysis is that completion of the Selected Plan by 2026 is impractical. A more linear, or phased program has greater flexibility to absorb and react to unforeseen delays with less impact on the overall program. Refer to Section 11.1 for the proposed implementation schedule for the Recommended 2026 Plan.

9.6.3 Selected Alternative Affordability Assessment

9.6.3.1 Summary of Costs

The Selected Alternative as detailed in Section 9.6.1 has a planning level estimated capital cost totaling approximately $3.6 billion in 2010 dollars. This cost includes $3.02 billion for ALCOSAN's regional controls and $0.53 billion of municipal capital costs for the control of municipal collection system overflow controls and increased conveyance capacities to the respective points of connection with ALCOSAN. See Table 9-81 below for a summary of these costs. Using an annual capital cost inflation rate of 3.1% (Section 7.3.1), the current year (2012) costs for the Selected Alternative are projected to be $3.2 billion for ALCOSAN and $0.56 billion for the municipalities for a total of $3.8 billion.

**Table 9-81: Selected Alternative Cost Summary
Current (2012) Dollars**

Owner	Total Capital Costs ($ billions)		Incremental Annual Costs ($ millions)		
	2010	2012	O&M	Debt Service	Total
ALCOSAN	$3.02	$3.21	$32	$233	$266
Municipal	$0.53	$0.56	$17	$41	$58
Total	$3.55	$3.77	$49	$274	$324

Estimated annual costs for the Selected Alternative total to $324 million based upon implementation through 2026. This figure includes $274 million in debt service payments based upon the financing of the capital costs using revenue bonds with 30-year terms and at a nominal interest rate of six percent. (See section 7.3 for the basis of these assumptions). The estimated annual costs also include approximately $49 million in incremental operation and maintenance costs (including renewal and replacement).

The projected $530 million in municipal capital improvements is based upon data provided by the municipalities in coordination with and supplemented as necessary by ALCOSAN. The basis for this figure is detailed in Section 9.3 of this document. As described in Section 3 of this document, there are numerous inter-municipal trunk sewers through which up-stream municipalities convey their sewage via downstream municipalities to the points of connection with ALCOSAN's Regional Conveyance System. The inter-municipal allocations of costs related to multi-municipal improvements are unknown. For purposes of this affordability assessment, the municipal costs have been allocated across the ALCOSAN service area. ALCOSAN may refine the following affordability assessment as more information becomes available, e.g. upon completion of the municipal feasibility studies required by the municipal Consent Order and Agreements with PaDEP or the Administrative Consent Orders issued by the ACHD.

9.6.3.2 Affordability Assessment

EPA Methodology: ALCOSAN has conducted an Affordability Assessment of the Selected Alternative utilizing the methodology outlined in the 1997 USEPA guidance document.[9-15] The results of this analysis, summarized on worksheets 1 and 2 of the EPA guidance, Tables 9-82 and 9-83 of this report, are provided on the following pages.

EPA Worksheet 1 - ALCOSAN's 2012 budget totals $113 million, as shown on Worksheet 1 (line 102). As also shown on Worksheet 1, the annual current (2012) ALCOSAN system costs, plus

[9-15] Combined Sewer Overflows Guidance for Financial Capability Assessment and Schedule Development, EPA March 832-B-97-004

the incremental ALCOSAN and municipal costs related to the WWP and the municipal improvements respectively, combine to a total estimated annual cost of $440 million (line 106). In line with EPA's recommended methodology, 75% of system costs have been allocated to residential users based upon billable wastewater flow. Therefore, the residential users within the ALCOSAN service area may be assigned a cost of $327 million out of the $440 million total.

The $335 million in residential class costs is divided by the number of households to derive an estimated cost per household. ALCOSAN has estimated that there are 327,500 households represented by the residential user class, including multi-unit residential accounts. This number of households compares with the 301,000 residential accounts (Section 7.3.4) and the 351,000 Census households (Section 6.1) within the ALCOSAN service area. The differences between the three numbers are attributable to the unknown number of Census households occupying dwellings that receive water and sewer services through commercial or public user class accounts.

Using 327,500 households as the denominator, and the combined current ALCOSAN, ALCOSAN WWP and municipal wet weather control costs; a cost per household of $1,010 may be derived. The ALCOSAN service-area wide weighted average cost per household for the current municipal wastewater services of $183 (Section 6.2.1) is then added to the $1,010 for a total cost per household of $1,193 (Worksheet 1, line 109).

EPA Worksheet 2 – Residential Indicator - As detailed in Section 6.2.2 of this document, ALCOSAN estimated a service-area-wide (regional) median household income of $46,400 for 2012 (line 203). Dividing the annual cost per household of $1,193 by $46,400 yields a **Residential Indicator of 2.6%** (line 205). This RI indicates a ***High Burden*** (Residential Indicators greater than 2.0%) under the EPA Guidance.

Table 9-82: EPA Worksheet 1 – Cost per Household

COST PER HOUSEHOLD
Worksheet 1
Current (2012) Dollars

				Line Number
Current ALCOSAN Costs (2012)				
• Annual Operations and Maintenance Expenses (Excluding Depreciation)		$64,832,500		100
• Annual Debt Service (Principal,Interest & Coverage)		$47,725,057		101
• Subtotal* (Line 100 + Line 101)		$112,557,557		102
Projected ALCOSAN and Municipal WWT and CSO Costs (Current $)				
• Incremental Annual Operations and Maintenance Expenses (Excluding Depreciation)				
	ALCOSAN	$32,526,452		103(a)
	Municipal	$17,119,185		103(b)
	Sub-Total ALCOSAN and Municipal	$49,645,638		103
• Annual Debt Service (Principal & Interest)				104
	ALCOSAN	$236,301,135		104(a)
	Municipal	$41,456,339		104(b)
	Sub-Total ALCOSAN and Municipal	$277,757,474		104
• Subtotal* (Line 103 + Line 104)		$327,403,112		105
Total Current and Projected WWT and CSO Costs (Line 102 + Line 105)		$439,960,669		106
Residential Share of Total WWT and CSO Costs		$330,806,427	75%	107
Total Number of Households in Service Area		327,485		108
Cost per Household (Line 107 / Line 108)		$1,010		109(a)
Current Municipal (Weighted Average)		$183		109(b)
Total Cost per Household (Line 109(a) + Line 109(b))		$1,193		109

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Table 9-83: EPA Worksheet 2 – Residential Indicator

RESIDENTIAL INDICATOR
Worksheet 2
Current (2012) Dollars

		Line Number
Median Household Income (MHI)		
• Census Year MHI	$44,600	201
• MHI Adjustment Factor	1.04	202
• Adjusted MHI	$46,400	203
Annual WWT and CSO Control Cost per Household (CPH) (Line 109)	$1,193	204
Residential Indicator		
Annual Wastewater and CSO Control Coster per Household as a percent of Adjusted Median Household Income (CPH as % MHI) (Line 204 / Line 203)	**2.6%**	205

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Political and Geographic Distribution of Residential Indicators: The annual typical household costs generated by the Selected Alternative would vary widely between and within the 83 municipalities served by ALCOSAN. The inter- and intra-municipal (Census block group) residential burden distributions are shown on Figures 9-138 and 9-139 respectively. As shown on Table 9-84, the population weighted Residential Indicator for the Selected Alternative is 2.7%. Fifty-six of the municipalities would have typical household wastewater costs exceeding 2% of the municipalities' median household incomes. The Residential Indicators in forty-two of the municipalities would be 2.5% or greater, and the Residential Indicator would exceed 3% in 26 municipalities, including the City of Pittsburgh at 3.1%. Nine municipalities would have a Residential Indicator exceeding 4% of MHI and four municipalities would exceed 5% of their respective MHI.

9.6.3.3 Financial Capability Implications

Based upon the limited availability of grants, state revolving fund (PennVEST) loans and other sources of capital, ALCOSAN anticipates that the implementation of the WWP will be primarily funded through a combination of pay-as-you-go cash funding and the issuance of municipal revenue bonds.

ALCOSAN's current revenue bond ratings are "A" from Standard & Poor's and "A1" from Moody's. These ratings put ALCOSAN into the lower end of a "strong" financial capability rating under the EPA criteria. Based upon a 2026 completion date, implementation of the Selected Alternative could require around $4.7 billion in new borrowings by ALCOSAN. This does not include the financing of related new municipal capital costs. ALCOSAN's projected debt service payments in 2027 would be roughly $350 million or an eight-fold increase over ALCOSAN's 2012 debt service payments of $42 million.

Projected annual debt service payments through the year 2050 are shown on Figure 9-140. ALCOSAN's outstanding debt is scheduled to be retired in 2040; however even without the WWP, ALCOSAN would likely incur new debt periodically as market conditions are favorable to financing its ongoing Capital Improvement Program.

Figure 9-138: ALCOSAN Selected Alternative – Residential Indicators by Municipality

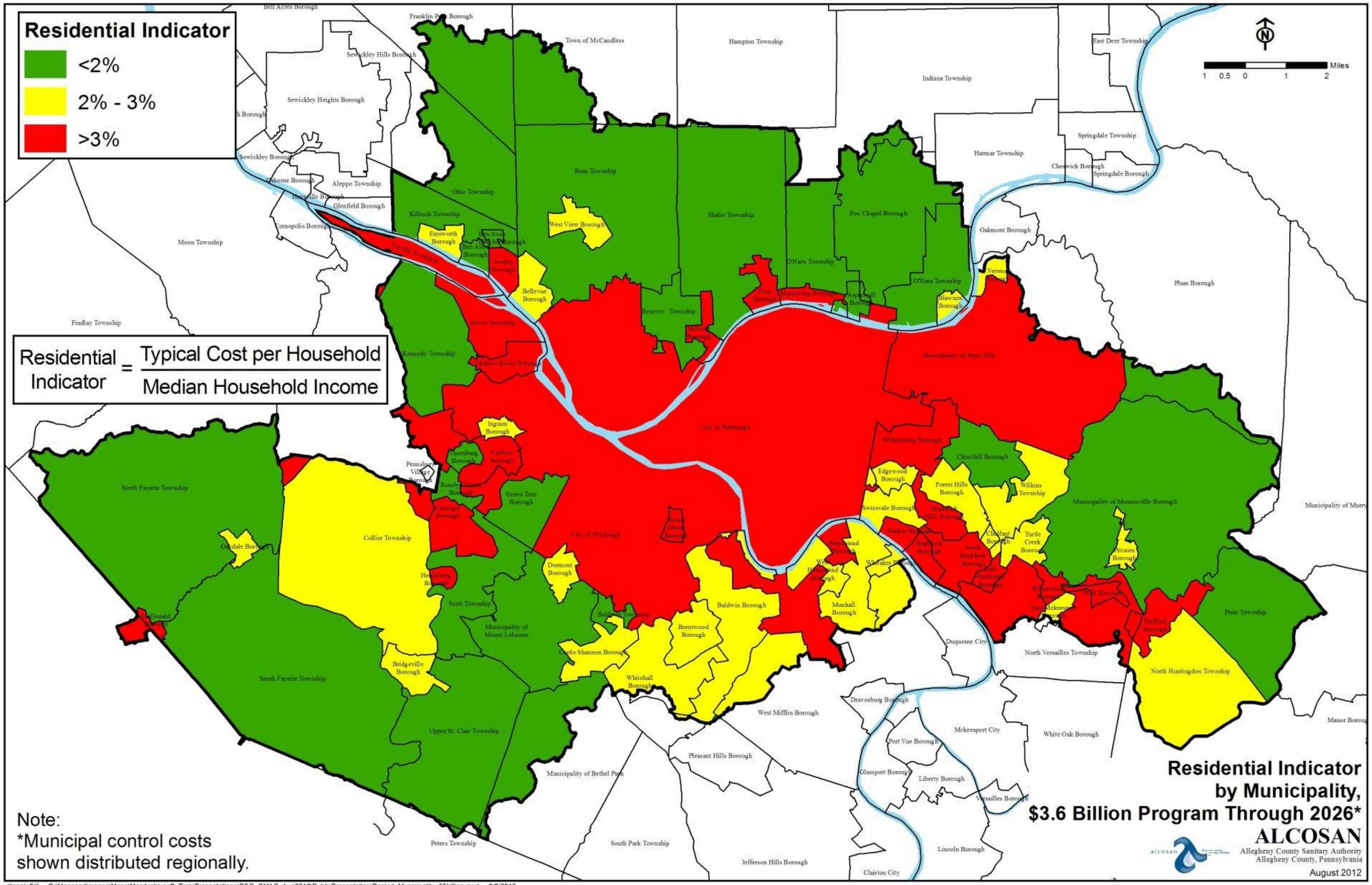

Figure 9-139: ALCOSAN Selected Alternative – Residential Indicators Showing Intra-Municipal Variations

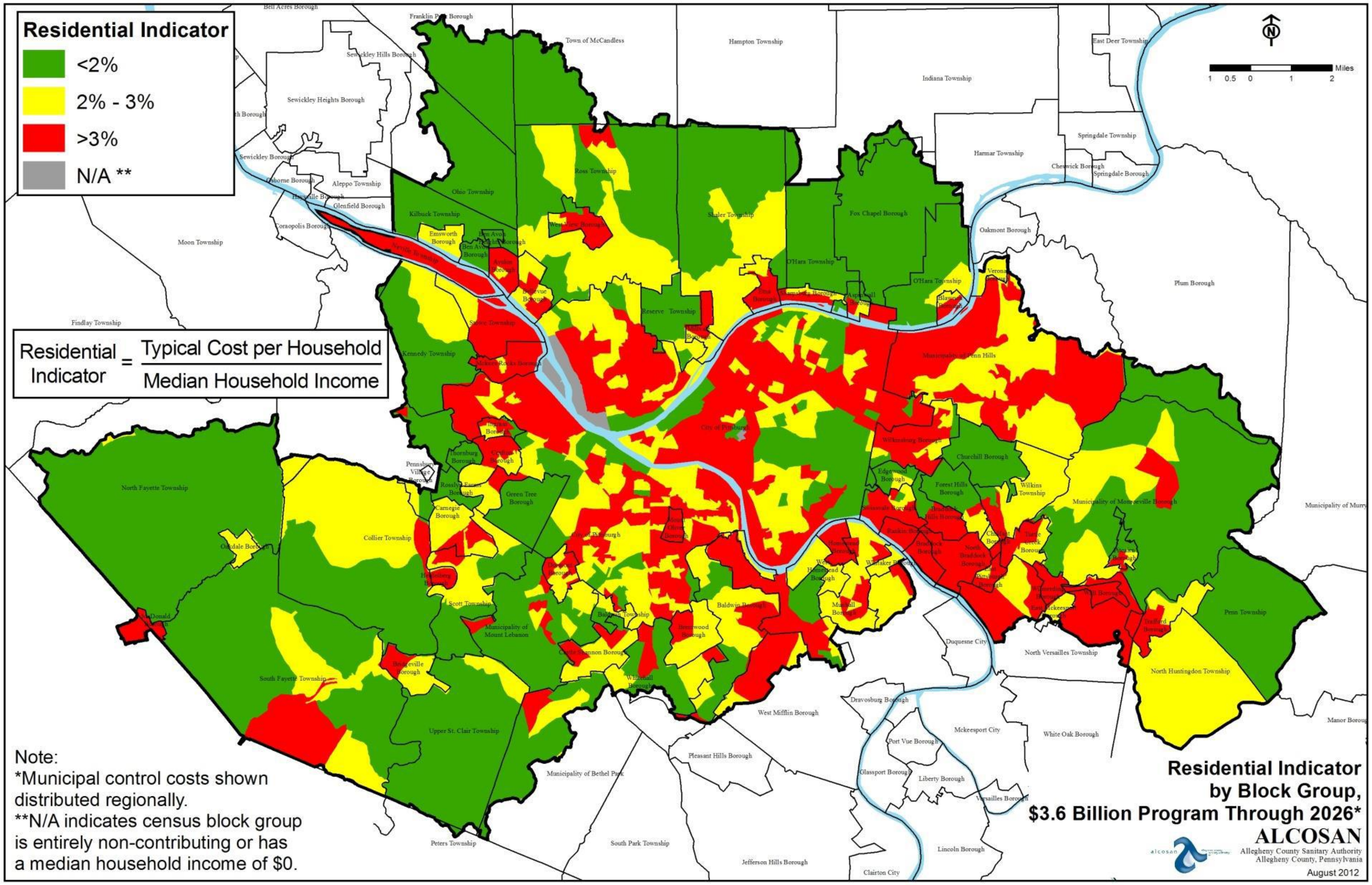

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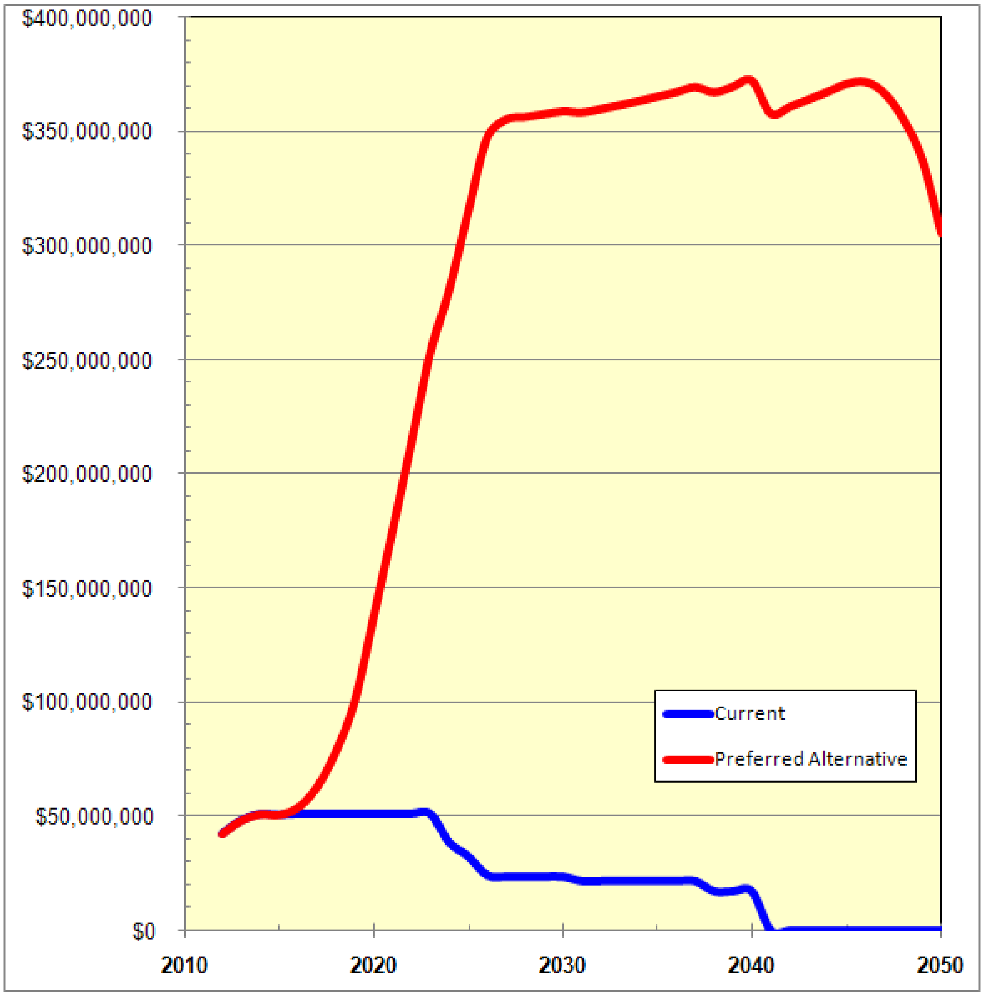
Table 9-84: ALCOSAN Selected Alternative - Residential Indictors by Municipality

Municipality		Residential Indicator	EPA Score	Municipality		Residential Indicator	EPA Score
1	Aspinwall	2.0%	High	43	Munhall	2.7%	High
2	Avalon	3.2%	High	44	Neville	3.2%	High
3	Baldwin	2.3%	High	45	North Braddock	5.2%	High
4	Baldwin	1.9%	Mid-Range	46	North Fayette	1.5%	Mid-Range
5	Bellevue	2.9%	High	47	North Huntingdon	2.5%	High
6	Ben Avon	1.3%	Mid-Range	48	North Versailles	5.9%	High
7	Ben Avon Heights	0.9%	Low	49	Oakdale	2.1%	High
8	Bethel Park	1.8%	Mid-Range	50	O'Hara	1.3%	Mid-Range
9	Blawnox	3.0%	High	51	Ohio	1.2%	Mid-Range
10	Braddock	4.8%	High	52	Penn Hills	3.3%	High
11	Braddock Hills	3.5%	High	53	Penn	1.9%	Mid-Range
12	Brentwood	2.8%	High	54	Peters	1.5%	Mid-Range
13	Bridgeville	2.9%	High	55	Pitcairn	2.7%	High
14	Carnegie	3.2%	High	56	Pittsburgh City	3.1%	High
15	Castle Shannon	2.6%	High	57	Pleasant Hills	1.5%	Mid-Range
16	Chalfant	2.6%	High	58	Plum	1.6%	Mid-Range
17	Churchill	1.4%	Mid-Range	59	Rankin	6.1%	High
18	Collier	2.2%	High	60	Reserve	1.9%	Mid-Range
19	Crafton	3.2%	High	61	Robinson	3.3%	High
20	Dormont	2.7%	High	62	Ross	1.9%	Mid-Range
21	East McKeesport	2.7%	High	63	Rosslyn Farms	1.1%	Mid-Range
22	East Pittsburgh	4.7%	High	64	Scott	2.0%	High
23	Edgewood	2.0%	High	65	Shaler	1.8%	Mid-Range
24	Emsworth	2.3%	High	66	Sharpsburg	3.2%	High
25	Etna	3.3%	High	67	South Fayette	1.8%	Mid-Range
26	Forest Hills	2.2%	High	68	Stowe	3.8%	High
27	Fox Chapel	0.5%	Low	69	Swissvale	2.7%	High
28	Franklin Park	1.1%	Mid-Range	70	Thornburg	0.8%	Low
29	Green Tree	1.7%	Mid-Range	71	Trafford	3.2%	High
30	Heidelberg	3.7%	High	72	Turtle Creek	2.9%	High
31	Homestead	5.0%	High	73	Upper St. Clair	1.4%	Mid-Range
32	Indiana	1.6%	Mid-Range	74	Verona	2.2%	High
33	Ingram	2.6%	High	75	Wall	3.5%	High
34	Kennedy	1.8%	Mid-Range	76	West Homestead	2.2%	High
35	Kilbuck	1.4%	Mid-Range	77	West Mifflin	2.9%	High
36	McCandless	1.5%	Mid-Range	78	West View	2.8%	High
37	McDonald	3.1%	High	79	Whitaker	3.0%	High
38	McKees Rocks	5.0%	High	80	Whitehall	2.0%	High
39	Millvale	3.2%	High	81	Wilkins	2.4%	High
40	Monroeville	2.0%	High	82	Wilkinsburg	3.5%	High
41	Mount Lebanon	1.6%	Mid-Range	83	Wilmerding	4.8%	High
42	Mount Oliver	4.7%	High		**Weighted Average**	**2.7%**	**High**

Figure 9-140: Annual Debt Service Costs for the Selected Alternative



The projected payments resulting from the Selected Alternative are based on annual bond sales to meet capital expenditures; and the repayments are based upon uniform amortization. In practice, ALCOSAN's financial advisors would likely develop more sophisticated debt structures intended to smooth payments. In any event, the magnitude and relatively short time-frame (2014 – 2026) for the WWP expenditures would lead to annual debt payment obligations similar to those shown in the graph. The reaction of the municipal bond market and the consequences for ALCOSAN's ability to obtain financing for the Selected Alternative within the 2026 timeframe cannot be known as of the writing of this document.

Paralleling uncertainty as to ALCOSAN's financial capability to implement a $3.2 billion (2012 dollars) program through 2026 is the uncertainty as to the collective financial capabilities of the municipalities to implement the estimated $560 million (2012 dollars) in related upgrades to the municipal collection sewerage and source reduction projects. Further analysis of the municipal financial capabilities must be deferred until the completion of the municipal Feasibility Studies in 2013 and the inter-municipal cost allocation of multi-municipal trunk sewer upgrades and related costs.

The current conditions financial capability assessment score was determined to be 1.67 (previous Section 6 Table 6-20). Financial capability scores ranging from 1.5 to 2.5 are considered to be "midrange" under the EPA guidance.[9-16] The 1.67 current conditions score for the ALCOSAN service area is within the lower one-third of the EPA mid-range. It is likely that the additional ALCOSAN and municipal debts described above would push the financial capability score to less than 1.5 into the "weak" range.

9.6.3.4 Additional Documentation

Annual Capital Expenditures: The scheduling implications of completing a $3.8 billion program by September 30th, 2026 are documented in Section 9.6.2. The concerns raised in that analysis are reinforced by an estimation of the average capital expenditures during plan implementation. Assuming regulatory approval of ALCOSAN's WWP on or before January 1st, 2014 ALCOSAN and its municipalities would have less than thirteen years for full implementation. Based upon the current (2012) cost estimate of $3.8 billion, average annual capital expenditures of more than $300 million would be required. This average annual construction expenditure can be compared with analogous wet weather programs as shown on Table 9-85.

Table 9-85: Typical Average Annual Capital Expenditures for Approved Long-Term Control Plans

Permittee	LTCP	Planning Level Estimated Program Cost	Implementation Period (years)	Approximate Average Cost Per year (Millions)
Cincinnati, OH	2010	$1.145B (Phase 1)	12	$93
Columbus, OH	2006	$3.1 Billion	40	$78
Ft. Wayne, IN	2007	$240 Million	18	$13
Indianapolis, IN	2006	$1.8 Billion	20	$90
NEORSD (Cleveland)	2010	$3.0 Billion	25	$120
St. Louis, MO	2009	$1.9 Billion	25	$76
Toledo, OH	2010	>$500 Million	6	$83
ALCOSAN	2013	$3.8 Billion	12.75*	$298

* January 1, 2014 through September 30, 2026

9-16 See Table 3 of the 1997 Guidance, page 41.

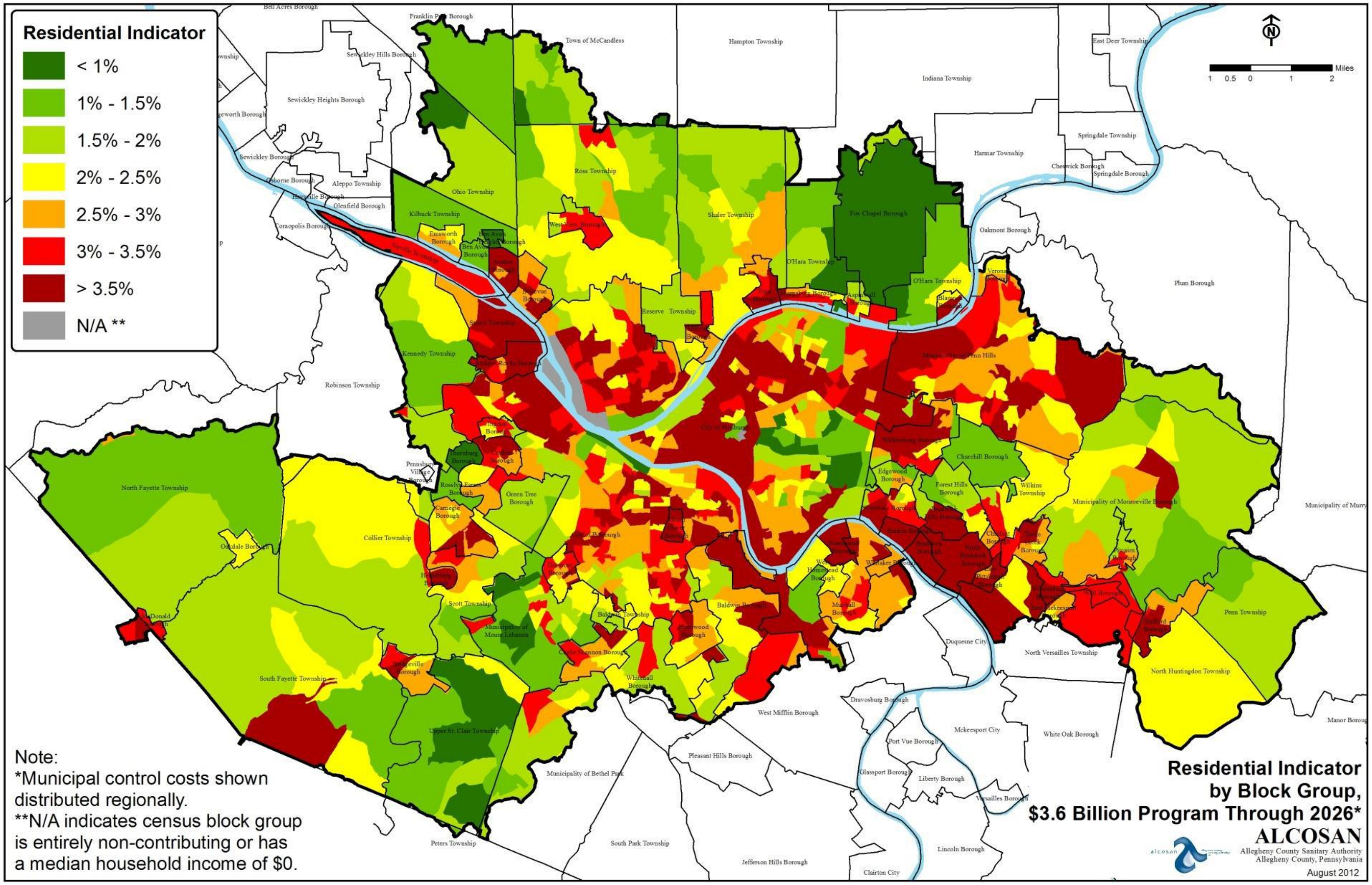
As may be noted, the annual expenditure that would be required to fully implement ALCOSAN's Selected Alternative would be far more than that required to implement analogous approved LTCPs.

Low Income Impacts: USEPA's residential indicator is based upon the MHI within the ALCOSAN service area. By definition, one half of the households have household incomes that are less than the median household income. The lower half of the MHI population for the ALCOSAN service area is estimated to be approximately 394,000. Therefore, a group that would comprise the 46th largest city within the U.S., (exceeding major cities such as Minneapolis, New Orleans, and St. Louis, would be paying more than 2.6% (2012 dollars) or more than 2.8% (inflated dollars) of their incomes for wastewater services in 2027.

The financial impact of the WWP on the lower income population of ALCOSAN's service area will be significant. The projected 2027 MHI for the lowest 20% MHI group is less than $43,750. This group would be paying between 4.11% of their MHI (upper limit of the second quintile) to 15.71% MHI (first quintile) in 2027. This group includes almost 66,000 households representing a population of nearly 160,000. This number is larger than the populations of cities such as Pasadena, CA; Syracuse, NY; and Dayton, OH. The disparate impact of the implementation of the WWP upon ALCOSAN's varying income areas is shown on Figure 9-141 which includes gradations of residential burdens from less than 2% of household income to more than 4%. The map shows the projected Residential Indicators for the 852 census block groups within the ALCOSAN service area in 2027.

It can also be noted from Table 9-82 that the projected Residential Indicator for the City of Pittsburgh with a 2010 Census population of approximately 306,000 and comprising 37% of the ALCOSAN service population would be 3.1% for the Selected Alternative. It would be unreasonable to suggest that a Long-Term Control Plan for the City of Pittsburgh with a 3.1% residential indicator, or which imposes a residential burden of nearly 16% on a sizable population would be tenable.

Figure 9-141: ALCOSAN Selected Alternative – Residential Indicators by Census Block Groups



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9.6.3.5 Alternative Affordability Conclusions

Financial Capability Matrix: As detailed above, the Residential Indicator resulting from the Selected Alternative being implemented through 2026 is projected to be 2.6%. These Residential Indicators are well over the 2.0% EPA threshold for high financial impact. The *current condition* Financial Capability score of 1.67, which is barely above the 1.5 threshold for a weak score, is certainly not going to improve as a result of the additional billions in new debt. Based upon the incremental debt, particularly the financial capability implications of the estimated $560 million in new municipal capital expenses, it is reasonable to project that the Financial Capability score would fall into the weak category. In any event, the EPA Financial Capability Matrix, provided in Table 9-86, indicates that the Selected Alternative would result in an unequivocally high burden.

Implications: The Selected Alternative is cost prohibitive under a 2026 timeframe. The CSO Control Policy includes provisions for the phased implementation of a long-term control plan based upon the relative importance of adverse impacts upon water quality standards and on financial capability.[9-17]

Table 9-86: Selected Alternative Financial Capability Matrix

	Residential Indicator (Cost Per Household as a % MHI)		
Financial Capability Indicators	**Low (<1.0%)**	**Mid-Range (1.0 - 2.0%)**	**High (>2.0%)**
Weak (<1.5)	Medium Burden	High Burden	**High Burden**
Mid-Range (1.5 - 2.5)	Low Burden	Medium Burden	High Burden
Strong (>2.5)	Low Burden	Low Burden	Medium Burden

As detailed in Section 9.7, ALCOSAN has identified a phased implementation approach that includes implementing a prioritized Phase 1 program comprised of key portions of the Selected Alternative in conformance with the consent decree deadline of September 30th, 2026. Phase 1 will provide a balance of SSO and CSO improvements with emphasis upon key impacts such as overflows discharging to sensitive areas. The proposed 2026 Wet Weather Plan is described in Section 10. This phased implementation approach calls for the continued implementation of the Selected Alternative beyond 2026, as evolving financial capability indicators will support, and as further described in Section 11 of this document.

[9-17] 59 FR 18688.

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9.7 Affordable 2026 Alternatives

Section 9.6 describes a Selected Plan that would meet the water quality based requirements of the CWA using the Demonstration Approach described in the National CSO Control Policy. The financial impact analysis presented in Section 9.6.3, however, demonstrates that the implementation of this Selected Alternative by the Consent Decree established schedule of September 30, 2026 is cost prohibitive. Additionally, the schedule and constructability analysis presented in Section 9.6.2 indicates that attempting such an aggressive implementation schedule poses unacceptable risk of cost inefficiencies and quality control concerns.

The CSO Control Policy identifies four key principles to "ensure that CSO controls are cost-effective and meet the objectives of the CWA." Principle 3 allows "a phased approach to implementation of CSO controls considering a community's financial capability." Given the severe financial burden that implementation of the Selected Plan would have on the Pittsburgh region, ALCOSAN must consider priority improvements and control strategies that can be afforded by the Consent Decree established 2026 timeframe. In this effort, a key objective was established to evaluate 2026 control strategies that set the foundation for cost effective implementation of the longer term Selected Plan, or cost-effective variations thereof. Affordable 2026 alternatives were therefore developed as sub-sets of the Selected Plan, such that they could serve as an initial phase of improvements towards the longer term plan. A second key objective was to keep the total capital cost planning estimate near the regional residential indicator high burden threshold of 2% of median household income. This results in targeting $2 Billion (2010 dollars) in capital expenditures by 2026. In developing affordable alternatives, ALCOSAN budgeted for all preferred and assumed municipal overflow control improvements, as presented in Section 9.3.3, to be implemented by 2026.

In considering priority improvements for an affordable 2026 implementation phase, ALCOSAN evaluated three prioritization alternatives. One prioritized SSO controls and another water quality benefit, targeting control of the largest overflows. The third prioritization alternative targeted a balance of the SSO and water quality priority schemes. All three alternatives give a high priority to controlling CSOs which are directly impacting sensitive areas, to the degree possible based on the portion of the regional tunnel constructed for each alternative. Each alternative is described further within this section including a comparison of the three in Section 9.7.4.

It should be noted that the ultimate levels of CSO and SSO control for each alternative are still as described for the Selected Plan in Section 9.6.1. However, each of the alternatives discussed below will achieve a different portion of the full set of performance objectives of the Selected Plan. Furthermore, since only a portion of the ultimate improvements would be in place for any alternative, the predicted overflow performance for individual CSO outfalls will differ from the performance expected for these same outfalls once the Selected Plan is implemented.

9.7.1 SSO Control Priority

The first alternative places priority on eliminating all SSOs in the ALCOSAN system. The alternative also includes some CSO control projects which can be implemented without a regional conveyance tunnel. The major elements of the SSO Control Priority Alternative and associated capital costs are summarized in Table 9-87, with an accompanying map in Figure 9-142.

The most prominent elements of the SSO Control Priority Alternative are:

- Expansion of the Woods Run WWTP to 480 MGD primary capacity and 295 MGD secondary capacity
- A SSO capture tunnel in the Lower Ohio planning basin. This tunnel also is used to control two small CSOs. Also included, but not depicted, are the upsizing of a portion of the Lower Ohio South interceptor and associated regulator structure modifications.
- A relief interceptor and other associated conveyance in the Chartiers Creek planning basin.
- An interim CSO retention treatment basin in the Chartiers Creek planning basin.
- A relief interceptor for SSO control in the Saw Mill Run planning basin
- CSO and SSO storage facilities and associated consolidation sewers in the Turtle Creek/Thompson Run planning basin
- A SSO storage facility and other SSO control conveyance in the Upper Allegheny basin
- Two CSO retention treatment basins in the Upper Monongahela planning basin
- Controls to eliminate or relocate discharges from all fifteen of the CSO outfalls which directly impact sensitive areas. Outfall relocation of M-43 can be considered an interim control, as it will become part of a larger consolidation flow group once the tunnel is extended per the alignment of the Selected Plan.
- Implementation of all preferred and assumed municipal improvements as summarized in Section 9.3.3.

Placing the priority on SSO control limits the ability to significantly reduce CSO discharges, and provides limited water quality benefit within the areas where the greatest recreational use has been observed. These limitations led to the development of a second affordable alternative which targeted water quality improvements along the main rivers.

Figure 9-142: SSO Control Priority Alternative

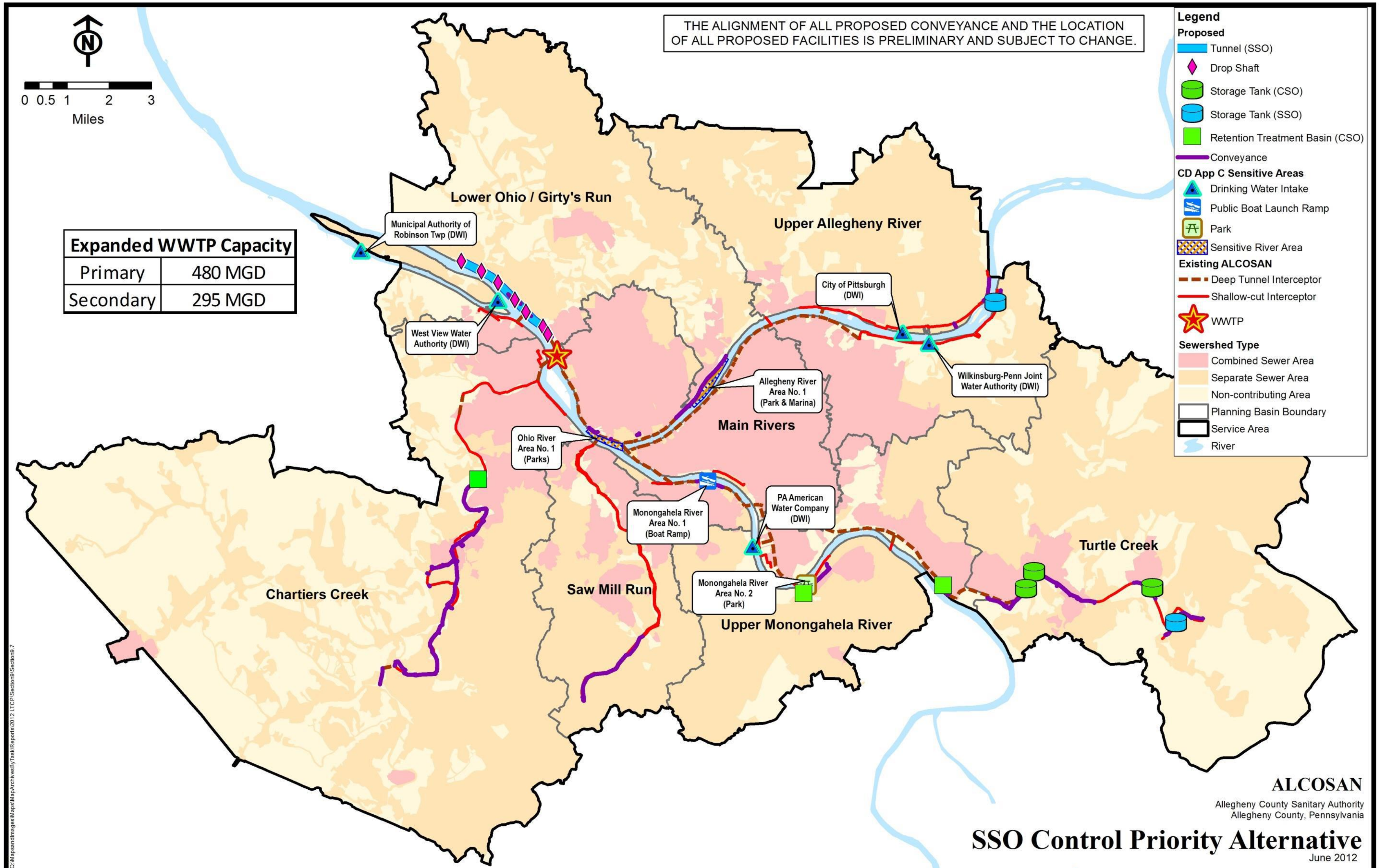

Table 9-87: Summary of Capital Improvements Associated with SSO Priority Plan

Capital Improvements	Size / Capacity	Estimated Capital Cost (millions)
Regional Storage/Conveyance Tunnel		
N/A	N/A	$ -
Subtotal		**$ -**
Planning Basin Improvements		
Chartiers Creek		
Relief interceptor (CC_CF08)		$ 5
Relief interceptor (CC_CF02)		$ 44
Relief interceptor (CC_CF03)		$ 87
Relief interceptor (CC_CF04)		$ 80
Relief interceptor & interim RTB (CC_CF05)	118 mgd interim RTB / 300 MGD influent PS	$ 136
Regulator modifications for C-21 only (CC_CF07)		$ 2
Subtotal		**$ 354**
Lower Ohio / Girty's Run		
SSO storage tunnel (LO_CF20)	25 MG / 2.7 miles / 17 ft. diameter / 7 drop shafts / 12.2 MGD PS	$ 157
CSO consolidation sewer (LNA_CF10)		$ 45
Subtotal		**$ 202**
Main Rivers		
CSO consolidation sewer (MR_CF11, MR_CF32, O-43)		$ 22
CSO consolidation sewer (MR_CF19, MR_CF20, MR_CF36)		$ 30
Subtotal		**$ 52**
Saw Mill Run		
Relief interceptor (SMR_CF03)		$ 23
Subtotal		**$ 23**
Turtle Creek / Thompson Run		
CSO storage tank & consolidation sewers (TC_CF01/CF02)	4.6 MG tank / 180 MGD screening / 5 MGD dewatering PS	$ 77
CSO storage tank & consolidation sewers (TC_CF03)	16.1 MG tank / 212 MGD screening / 9 MGD dewatering PS	$ 138
CSO storage tank & consolidation sewers (TC_CF04)	1.1 MG tank / 72 MGD screening / 2.5 MGD dewatering PS	$ 25
SSO storage tank & consolidation sewers (TC_CF05/CF06)	15.3 MG tank / 38 MGD screening / 10 MGD dewatering PS	$ 88
Subtotal		**$ 328**
Upper Allegheny		
SSO storage tank & relief sewer (A-45)		$ 14
SSO conveyance improvements (A-82)		$ 2
SSO conveyance improvements (A-85)		$ 3
Subtotal		**$ 19**
Upper Monongahela		
Sensitive Area Outfall Relocation (UM_CF01)		$ 27
CSO RTB & consolidation sewers (UM_CF02)		$ 79
CSO RTB & consolidation Sewers (M-59)		$ 76
Subtotal		**$ 182**
Subtotal of Planning Basin Improvements		**$ 1,160**
Woods Run WWTP Expansion		
Early action projects	Expand main pump station capacity to 480 MGD	$ 31
Secondary expansion / disinfection	Expand total secondary capacity to 295 MGD	$ 96
Wet weather headworks	400 MGD	$ 105
Major on site conveyance		$ 63
Wet weather disinfection	305 MGD	$ 31
Sludge thickening facilities		$ 9
Subtotal		**$ 334**
Preferred and Assumed Municipal Improvements		
CSO control improvements		$ 260
SSO control improvements		$ 270
Subtotal		**$ 530**
	TOTAL	**$ 2,025**

9.7.2 Water Quality Priority

Acknowledging that affordability limits the ability to provide full SSO control and meet CSO water quality goals, the Water Quality Priority Alternative gives highest priority to controls which will most significantly increase the number of days meeting water quality standards within the areas of highest recreational use. Section 5.1.4 of this report discusses the results of the *ALCOSAN Recreational Users Assessment*. This study determined that areas along the Allegheny and Monongahela Rivers and at Point State park were the most popular for recreation, with over 90% of all observed recreation, and these areas also had the highest concentration of primary and secondary contact of any waterway. Furthermore, there was no observed recreation along Turtle Creek or Saw Mill Run waterways.

Figure 9-143 displays the Water Quality Priority Alternative and Figure 9-144 shows this same alternative overlaid with recreational use survey results. The backbone of this alternative is a regional storage/conveyance tunnel which controls the largest outfalls along the main rivers. This tunnel is expected to provide the most cost-effective reduction of CSO volume, and the commensurate increase in the hours of water quality standards attainment within high recreational use areas along the main rivers.

The most prominent elements of the Water Quality Priority Alternative are:

- Expansion of the Woods Run WWTP to 600 MGD primary capacity and 295 MGD secondary capacity
- A regional CSO storage/conveyance tunnel along the Ohio, Allegheny and Monongahela Rivers with 15 drop shafts, six cross-connections to the existing tunnel, and up to three tunnel relief outfalls
- A 120 MGD regional tunnel dewatering pump station located at the Woods Run WWTP
- A SSO storage facility and other SSO control conveyance in the Upper Allegheny basin
- Consolidation and connector sewers to convey flow from some of the largest CSO outfalls in the Main Rivers, Lower Ohio/Girty's Run and Upper Allegheny planning basins to the regional tunnel drop shafts.
- One CSO retention treatment basin in the Upper Monongahela planning basin
- Controls to eliminate or relocate discharges from all fifteen of the CSO outfalls which directly impact sensitive areas. Outfall relocation of M-43 can be considered an interim control, as it will become part of a larger consolidation flow group once the tunnel is extended per the alignment of the Selected Plan.
- Implementation of all preferred and assumed municipal improvements as summarized in Section 9.3.3.

Controls along the tributaries are deferred for this alternative since the available $2 Billion in capital expenditures by 2026 would not be sufficient after prioritizing improvements along the main rivers. A summary of the potential improvements and associated capital costs of the Water Quality Priority Alternative is contained within Table 9-88.

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Figure 9-143: Water Quality Priority Alternative

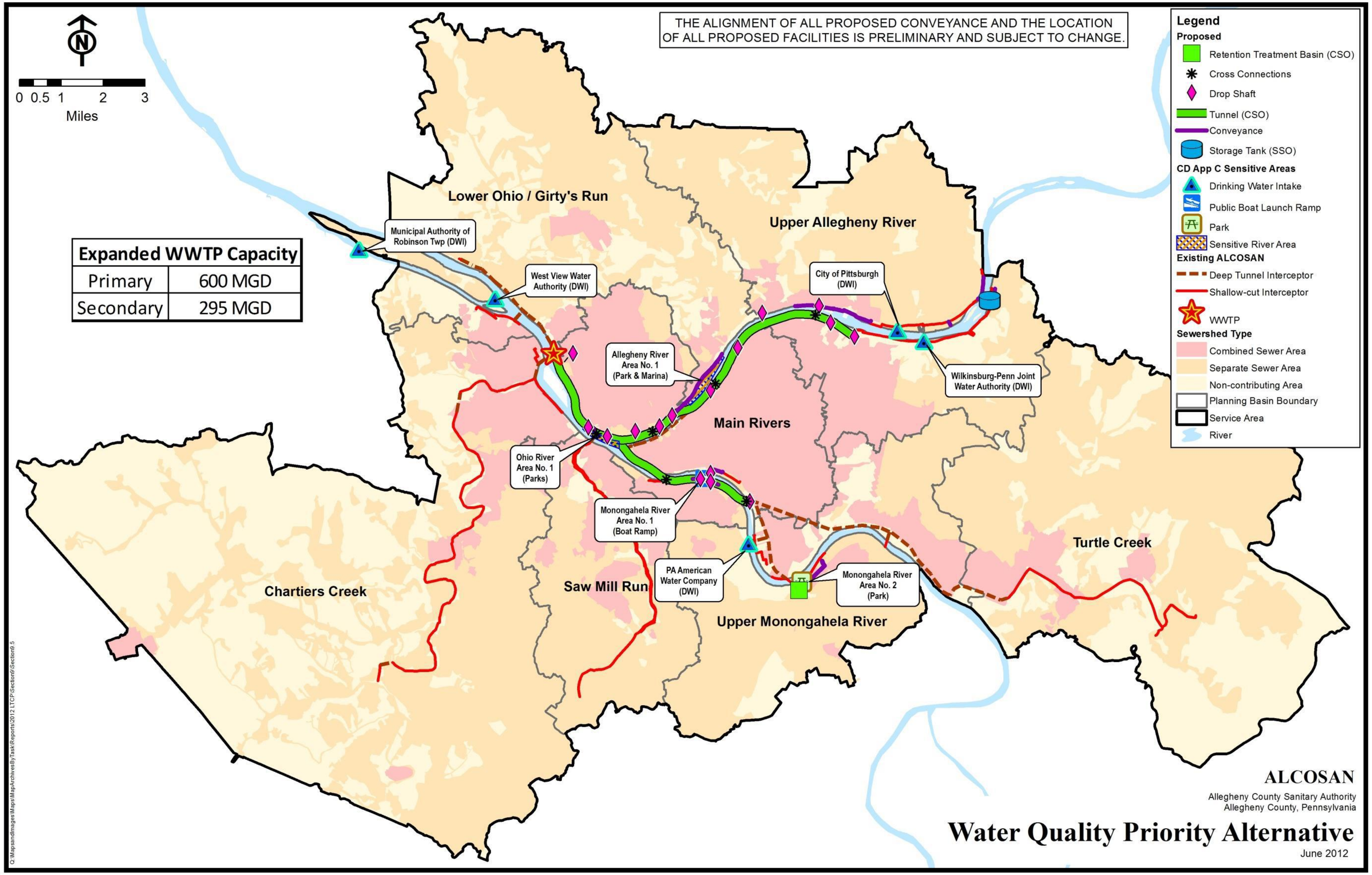

Figure 9-144: Water Quality Priority Alternative with Recreational Use Survey Results

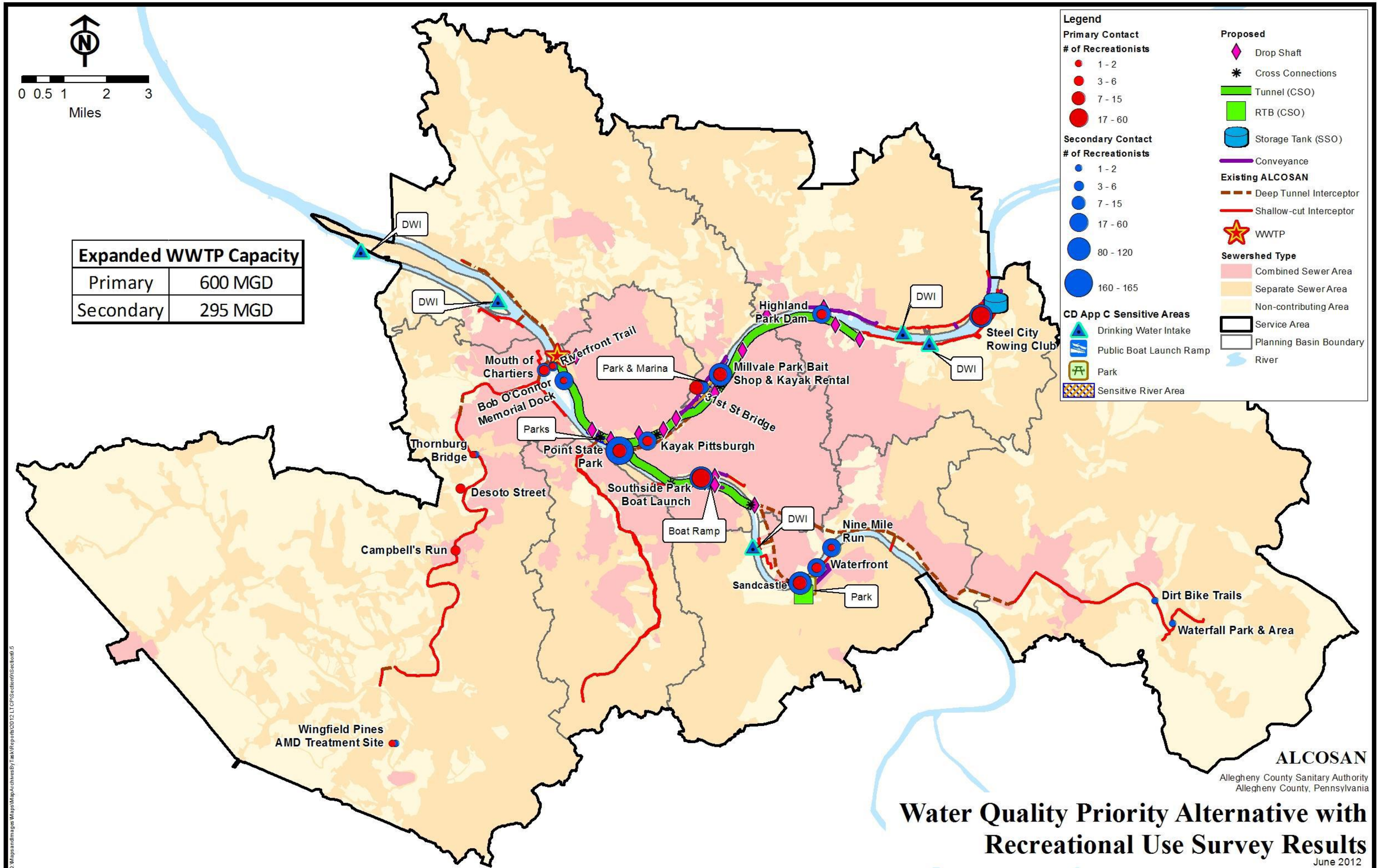

Table 9-88: Summary of Capital Improvements Associated with Water Quality Priority Plan

Capital Improvements	Size / Capacity	Estimated Capital Cost (millions)
Regional Storage/Conveyance Tunnel		
Ohio River segment	8-12 MG / 1.9 miles / 12 or 14 ft. diameter / 2 drop shafts	$ 84
Allegheny River segment	35-48 MG / 7.9 miles / 12 or 14 ft. diameter / 8 drop shafts	$ 305
Monongahela River segment	20-28 MG / 4.5 miles / 12 or14 ft. diameter / 4 drop shafts	$ 152
Tunnel dewatering pump station at Woods Run WWTP	120 MGD	$ 150
Tunnel Cross Connections		$ 85
Subtotal		**$ 776**
Planning Basin Improvements		
Lower Ohio / Girty's Run		
CSO consolidation sewer (LNA_CF10) to Allegheny tunnel		**$ 45**
Subtotal		**$ 45**
Main Rivers		
CSO consolidation sewer to Ohio tunnel (O-27, MR_CF11)		$ 13
CSO consolidation sewer to Allegheny tunnel (A-22, MR_CF04, MR_CF32, MR_CF34, MR_CF36, O-43)		$ 45
CSO consolidation sewer to Monongahela tunnel (MR_CF07, MR_CF17, MR_CF20, M-29)		$ 47
Subtotal		**$ 105**
Upper Allegheny		
CSO consolidation sewers to Allegheny tunnel (A-41, A-42, A-68, UA_CF04)		$ 54
SSO storage tank & relief sewer (A-45)		$ 14
SSO conveyance improvements (A-82)		$ 2
SSO conveyance improvements (A-85)		$ 3
Subtotal		**$ 73**
Upper Monongahela		
Sensitive Area Outfall Relocation (UM_CF01)		$ 27
CSO RTB (UM_CF02)		$ 79
Subtotal		**$ 106**
Subtotal of Planning Basin Improvements		**$ 330**
Woods Run WWTP Expansion		
Early action projects	Expand main pump station capacity to 480 MGD	$ 31
Secondary expansion / disinfection	Expand total secondary capacity to 295 MGD	$ 96
Wet weather headworks	400 MGD	$ 105
Major on site conveyance		$ 63
Wet weather disinfection	305 MGD	$ 31
Sludge thickening facilities		$ 9
Primary sedimentation tanks	Expand total primary capacity to 600 MGD	$ 44
Subtotal		**$ 378**
Preferred and Assumed Municipal Improvements		
CSO control improvements		$ 260
SSO control improvements		$ 270
Subtotal		$ 530
	TOTAL	**$ 2,014**

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9.7.3 Balanced Priorities

A third affordable alternative was developed as an attempt to balance the competing priorities of the first two alternatives. Combining elements of the SSO Control Priority and Water Quality Priority Alternatives, the Balanced Priorities Alternative attempts to balance the goal of improving water quality along the main rivers (in high recreational use areas) with the goal of eliminating SSOs. As shown in Figure 9-145, this alternative includes a regional storage/conveyance tunnel which controls the largest outfalls along the main rivers, but the extent of the tunnel along the Allegheny River is reduced as compared to the Water Quality Priority Alternative. It also focuses on eliminating all SSOs in the Chartiers Creek basin since it has the largest volume of future baseline SSOs of all the planning basins, and because of the 2007 Federal Consent Decree between ALCOSAN, eleven ALCOSAN consumer municipalities and the Pennsylvania Environmental Defense Fund. That consent decree requires SSO elimination into Chartiers Creek by the end of 2019.

The most prominent elements in the Balanced Priorities Alternative are:

- Expansion of the Woods Run WWTP to 480 MGD primary capacity and 295 MGD secondary capacity
- A regional CSO storage/conveyance tunnel along the Ohio, Allegheny and Monongahela Rivers with 11 drop shafts, five cross-connections to the existing tunnel, and up to three tunnel relief outfalls
- A 120 MGD regional tunnel dewatering pump station located at the Woods Run WWTP
- Consolidation and connector sewers to convey flow from some of the largest CSO outfalls in the Main Rivers and Lower Ohio/Girty's Run planning basins to the regional tunnel drop shafts.
- A relief interceptor and other associated conveyance in the Chartiers Creek planning basin
- An interim CSO retention treatment basin in the Chartiers Creek planning basin
- Controls to eliminate or relocate discharges from all fifteen of the CSO outfalls which directly impact sensitive areas. Outfall relocation of M-43 can be considered an interim control, as it will become part of a larger consolidation flow group once the tunnel is extended per the alignment of the Selected Plan.
- Implementation of all preferred and assumed municipal improvements as summarized in Section 9.3.3.

A summary of the potential improvements and associated capital costs of Balanced Priorities Alternative is contained within Table 9-89.

Section 9.7.4 compares the priorities, performance and benefits of the three affordable alternatives, and provides the basis for selection of the recommended plan.

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Figure 9-145: Balanced Priorities Alternative

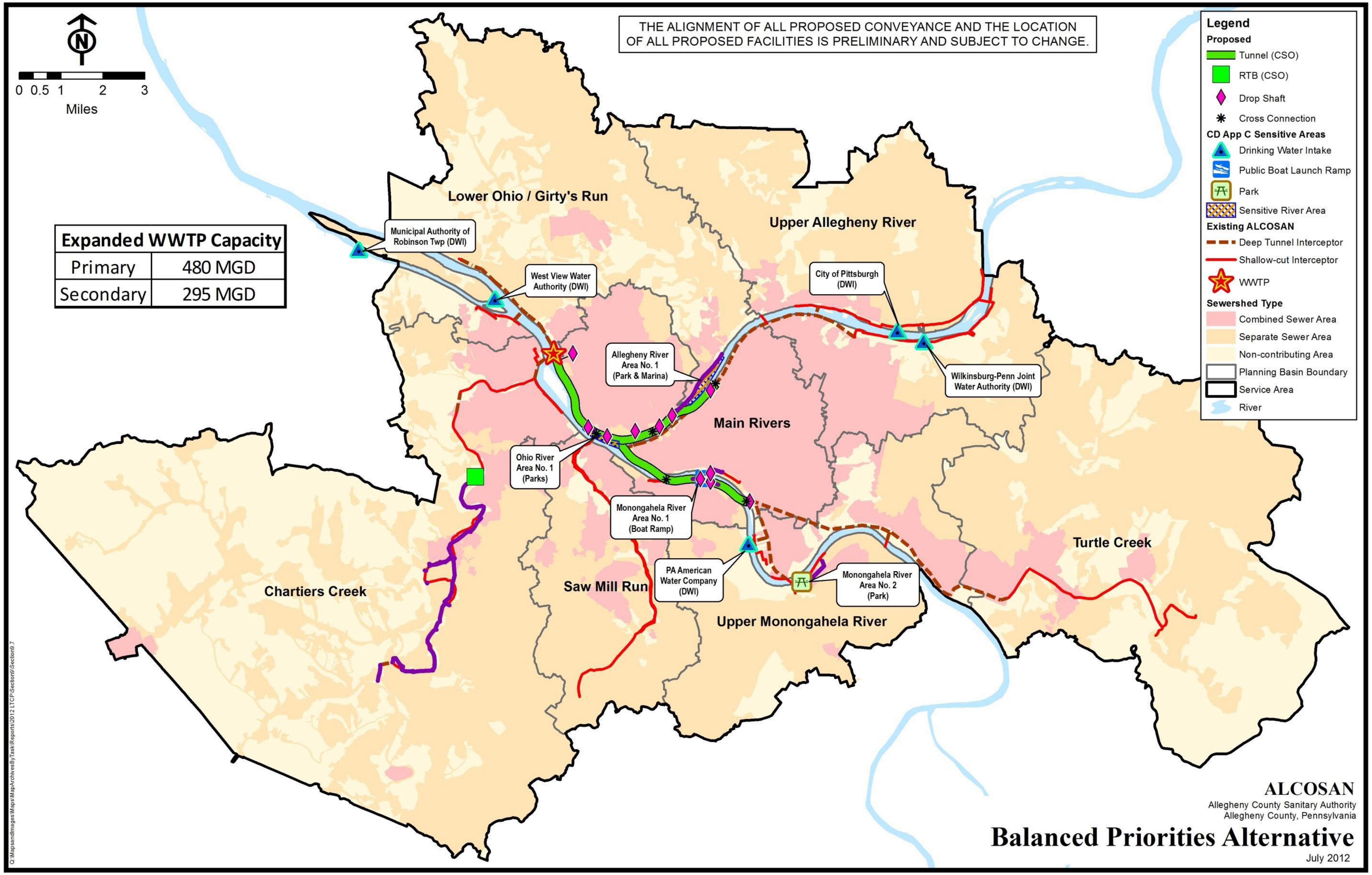


Table 9-89: Summary of Capital Improvements Associated with the Balanced Priorities Plan

Capital Improvements	Size / Capacity	Estimated Capital Cost (millions)	
Regional Storage/Conveyance Tunnel			
Ohio River segment	8-12 MG / 1.9 miles / 12 or 14 ft. diameter / 2 drop shafts	$	84
Allegheny River segment	16-22 MG / 3.6 miles / 12 or 14 ft. diameter /5 drop shafts	$	136
Monongahela River segment	20-28 MG / 4.5 miles / 12 or 14 ft. diameter / 4 drop shafts	$	152
Tunnel dewatering pump station at Woods Run WWTP	120 MGD	$	150
Tunnel cross connections		$	75
Subtotal		**$**	**596**
Planning Basin Improvements			
Chartiers Creek			
Relief interceptor (CC_CF08)		$	5
Relief interceptor (CC_CF02)		$	44
Relief interceptor (CC_CF03)		$	87
Relief interceptor (CC_CF04)		$	80
Relief interceptor & interim RTB (CC_CF05)	118 mgd interim RTB / 300 MGD influent PS	$	136
Regulator modifications for C-21 only (CC_CF07)		$	2
Subtotal		**$**	**354**
Lower Ohio / Girty's Run			
CSO consolidation sewer (LNA_CF10) to Allegheny tunnel		$	45
Subtotal		**$**	**45**
Main Rivers			
CSO consolidation sewer to Ohio tunnel (O-27, MR_CF11)		$	13
CSO consolidation sewer to Allegheny tunnel (A-22, MR_CF32, MR_CF34, MR_CF36, O-43)		$	34
CSO consolidation sewer to Monongahela tunnel (MR_CF07, MR_CF17, MR_CF20, M-29)		$	47
Subtotal		**$**	**94**
Upper Monongahela			
Sensitive Area Outfall Relocation (CF01)		$	27
Subtotal		**$**	**27**
Subtotal of Planning Basin Improvements		**$**	**520**
Woods Run WWTP Expansion			
Early action projects	Expand main pump station capacity to 480 MGD	$	31
Secondary expansion / disinfection	Expand total secondary capacity to 295 MGD	$	96
Wet weather headworks	400 MGD	$	105
Major on site conveyance		$	63
Wet weather disinfection	305 MGD	$	31
Sludge thickening facilities		$	9
Subtotal		**$**	**334**
Preferred and Assumed Municipal Improvements			
CSO control improvements		$	260
SSO control improvements		$	270
Subtotal		**$**	**530**
	TOTAL	**$**	**1,981**

9.7.4 Comparison of Affordable Alternatives

ALCOSAN has developed and analyzed three 2026 alternatives as, each of which would set the foundation for cost effective implementation of the longer term Selected Plan. Each of the alternatives was designed to have a total capital cost estimate near the regional residential indicator high burden threshold of 2% of median household income, which equates to about $2 Billion (2010 dollars) in capital expenditures by 2026. Each alternative also includes the cost of implementing all preferred and assumed municipal overflow control improvements, as presented in Section 9.3.3, by 2026.

Each of the three affordable alternatives presents a case for addressing priority compliance requirements, while laying the foundation for meeting the longer term objectives of the Selected Plan. However, the alternatives vary significantly in how the initial $2 Billion investment is balanced between CSO and SSO control, between controls along tributaries and the main rivers, and between planning basins. As a result, the receiving water quality benefits and achievement of other performance goals is similarly varied. Nevertheless, one of these three affordable alternatives has been judged as providing the greatest benefit for the initial $2 Billion investment and has been identified as ALOCSAN's Recommended Plan. This section summarizes the performance and benefits of the three alternatives and Section 9.7.5 summarizes the considerations that led to the selection of the Recommended Plan.

In the results which follow, the three alternatives are compared to each other, to existing and future baseline conditions, and to the Selected Plan as reflected by Alternative 3f-modified-10Pct. This illustrates both what will be accomplished by 2026, and how far each affordable alternative goes in meeting each performance goal for the Selected Plan. To accompany the comparison, a summary of three affordable alternatives is included in Table 9-90. The total capital and present worth costs for the three alternatives are similar as shown in Table 9-91.

Figure 9-146 compares the annual untreated CSO volumes for the three alternatives. Of the three alternatives, the Water Quality Priority Alternative results in the smallest annual untreated CSO volume after implementation (about 2.5 BG/yr), and the SSO Control Priority Alternative results in the greatest (about 5 BG/yr). All three alternatives result in annual untreated CSO volumes that are at least 4 BG/yr less than future baseline conditions.

Figures 9-147 and 9-148 show the annual reduction in overflow volume in comparison to future baseline conditions for untreated CSOs and SSOs respectively. Each of the three alternatives provides a significant reduction in the annual untreated CSO volume, ranging from 48% to 72%, with the greatest reduction achieved by the Water Quality Priority Alternative. Each alternative also provides a significant reduction in the annual SSO volume ranging from 47% to 100%, with complete elimination of ALCOSAN SSOs to the 2-year level of control achieved by the SSO Control Priority Alternative.

Table 9-90: Affordable 2026 Alternatives

Alternative Description	WWTP Capacity	Regional Tunnel	ALCOSAN CSO Control	ALCOSAN SSO Control	Municipal Controls
SSO Control Priority (Alt. 3f-Mod SSO)	295 MGD Secondary 480 MGD Primary	None	75% capture Retention treatment basin at M-42 and M-59 Portions of all sensitive area controls that can be implemented without tunnel	All controlled to 2 yr storm	All municipal improvements implemented by 2026.
Water Quality Priority (Alt. 3f-Mod WQ)	295 MGD Secondary 600 MGD Primary	From WWTP to A-42 and M-29 120 MGD Dewatering PS 6 cross-connections to existing tunnel Up to 3 tunnel outfalls	87% capture Sensitive area controls, including M-43 controls without tunnel. Retention treatment basin at M-42 Controls for all major outfalls / flow groups in the Selected Plan for the given tunnel extent	Control all UA SSOs to 2 yr storm. All other SSOs left uncontrolled.	All municipal improvements implemented by 2026.
Balanced Priorities (Alt. 3f-Mod BAL)	295 MGD Secondary 480 MGD Primary	From WWTP to A-22 and M-29 120 MGD Dewatering PS 5 cross-connections to existing tunnel Up to 3 tunnel outfalls	79% capture Sensitive area controls, including M-43 controls without tunnel. Controls for all major outfalls / flow groups in the Selected Plan for the given tunnel extent	Controlled to 2-yr storm in CC basin. Left uncontrolled in LON, SMR, UA and portions of CC and TC basins.	All municipal improvements implemented by 2026.

Table 9-91: Cost Comparison of Affordable Alternatives

Alternative	CSO Control				SSO Control				Combined TPW Cost ($ million)
	Capital Cost ($ million)	TPW O&M Cost ($ million)	TPW R&R Cost ($ million)	TPW Cost CSO Control ($ million)	Capital Cost ($ million)	TPW O&M Cost ($ million)	TPW R&R Cost ($ million)	TPW Cost SSO Control ($ million)	
3f-Modified SSO	$1,134	$87	$35	$1,256	$891	$45	$54	$990	$2,246
3f-Modified WQ	$1,629	$86	$29	$1,744	$385	$32	$45	$462	$2,205
3f-Modified BAL	$1,453	$83	$29	$1,565	$528	$34	$46	$608	$2,172

Figure 9-146: Affordable Alternative Annual Untreated CSO Volume Comparison

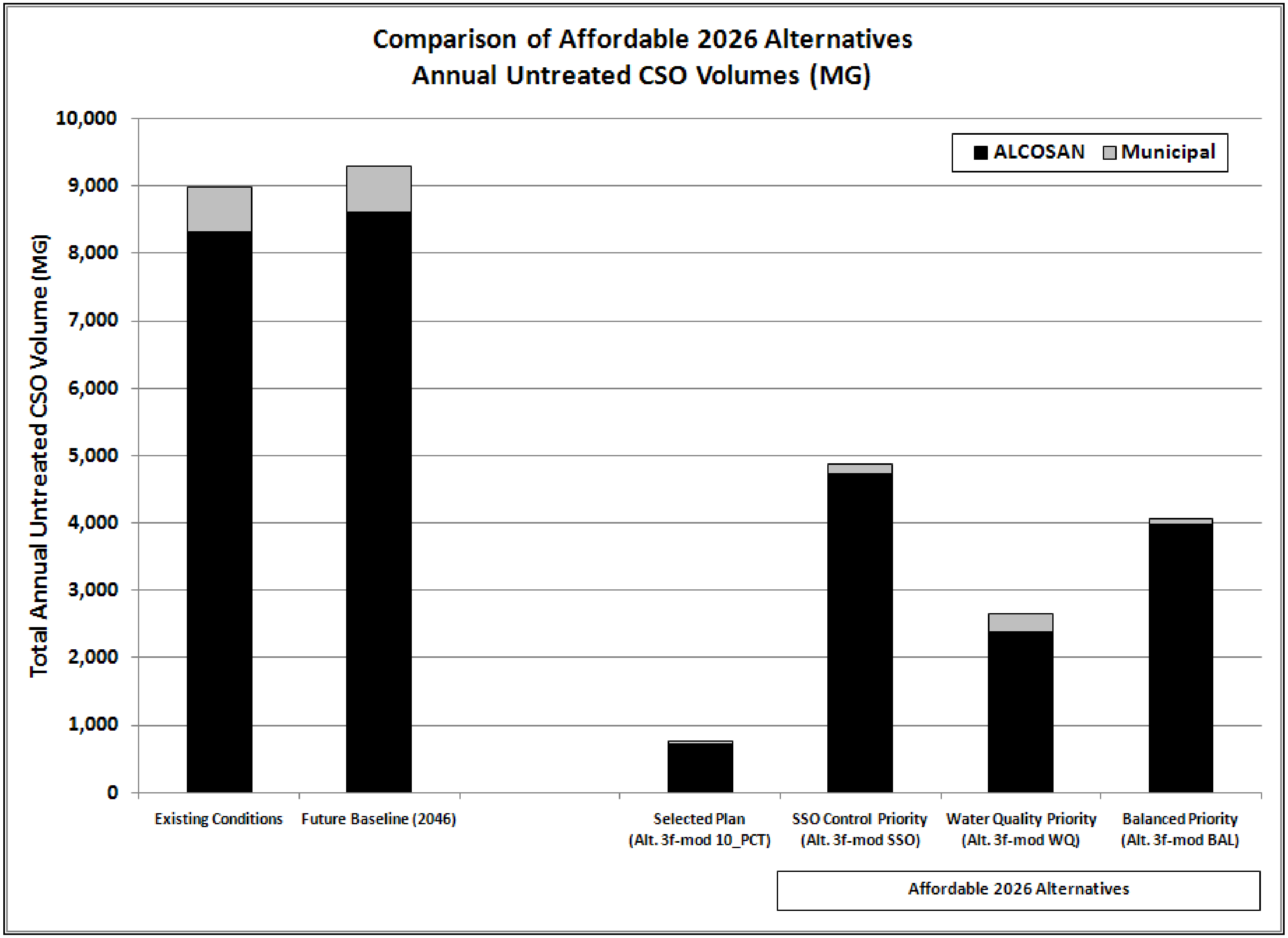


Figure 9-147: Affordable Alternative Reduction in CSO Volume Comparison

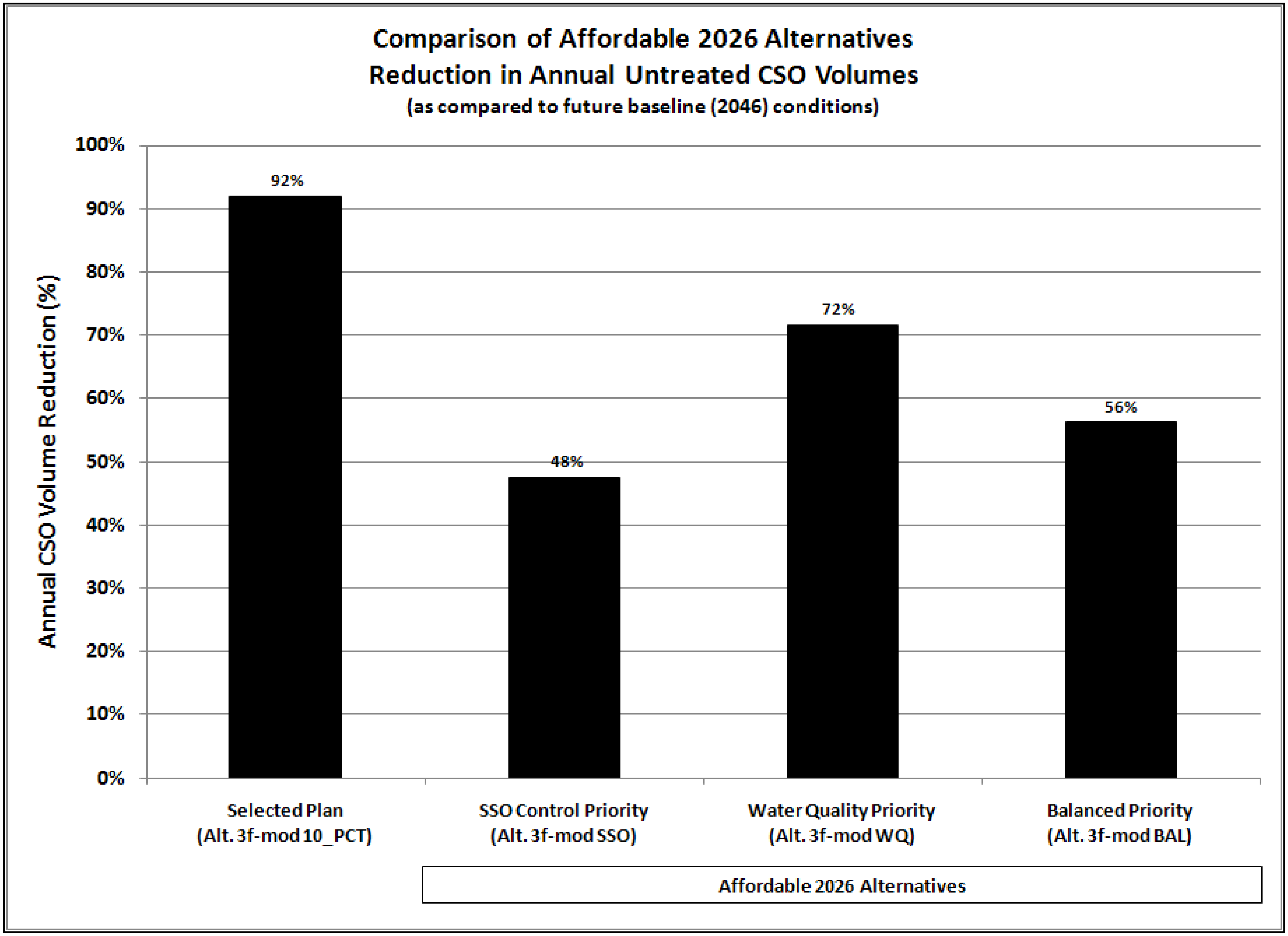


Figure 9-148: Affordable Alternative Annual Untreated SSO Volume Comparison

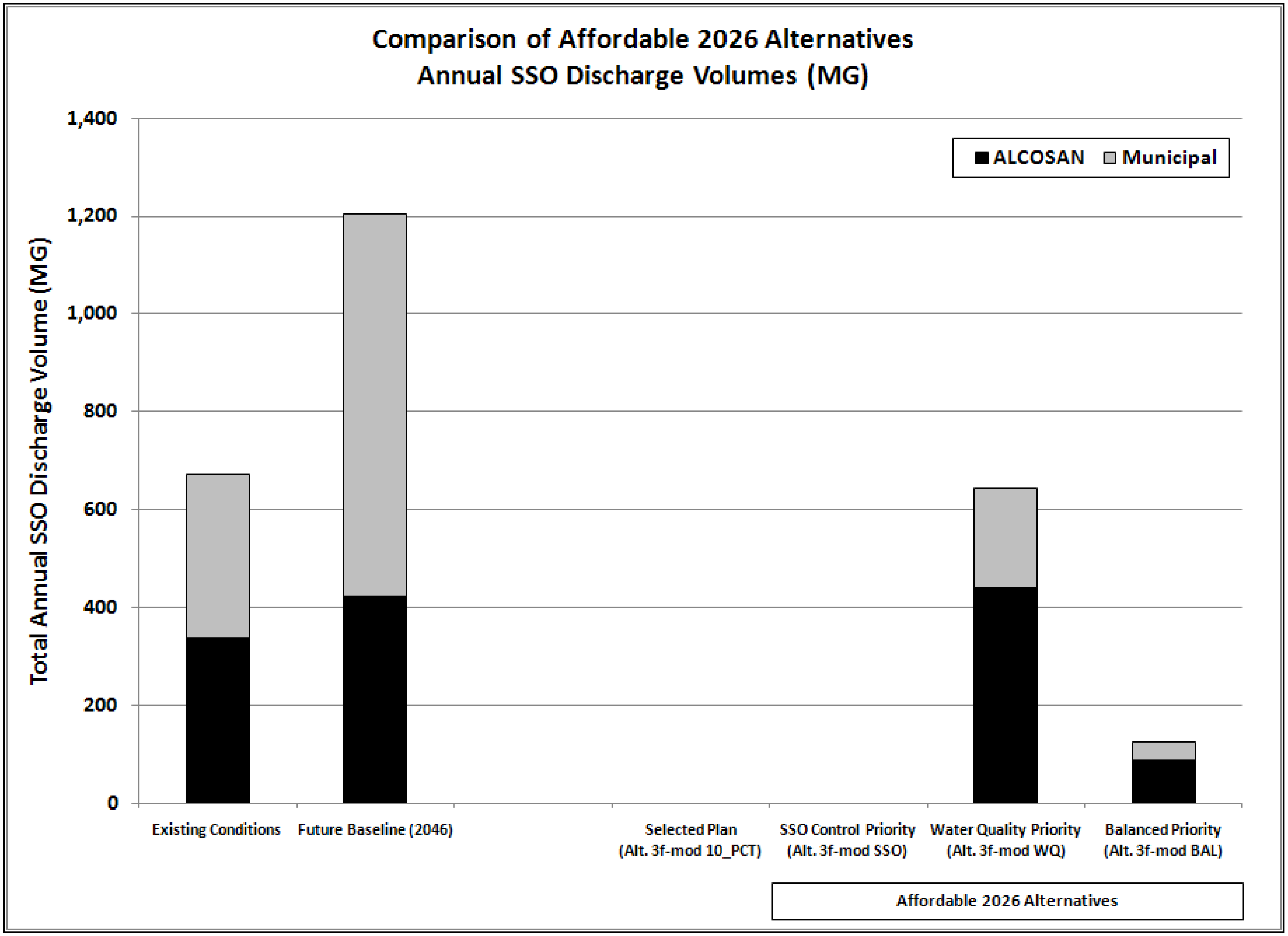


Figure 9-149 shows the percent capture by volume of the combined sewage collected in the combined sewer system during precipitation events on a system-wide basis for the typical year, in accordance with the CSO Policy definition. The percent capture for the three alternatives ranges from 75% to 87%. The Water Quality Priority Alternative will be able to achieve the presumptive criterion of 85% capture by volume, but the other two alternatives are unable to reach this benchmark.

Section 5.5.3 presents existing water quality conditions indicating that none of the ALCOSAN receiving waters currently achieve attainment with the fecal coliform criteria applicable to the recreation season of May through September (Figures 5-69 and 5-70). Section 9.5.6.5 discusses the fact that pollution sources other than SSO and CSO discharges preclude the attainment with water quality standards such that assessing the water quality benefits of alternatives requires the assumption that other pollution sources will also be addressed before significant improvements will be realized. Using this assumption, Figures 9-150 through 9-152 show the projected attainment with water quality standards for the three alternatives. All three alternatives show significant progress in meeting the geometric mean criterion. As expected, the SSO control focused alternative results in meeting water quality requirements near and downstream of controlled SSOs; primarily along Turtle Creek, the upper portions of Chartiers Creek, Saw Mill Run, the Allegheny River and Monongahela River. This alternative also provides substantial improvement throughout the service area, attributable to expansion of the Wood's Run treatment plant, CSO facilities on the Monongahela and other improvements associated with this alternative. The water quality priority alternative, which focuses improvements along the Main Rivers, results in attainment with water quality requirements along the Allegheny River and significant improvement along the Monongahela and Ohio Rivers, with less improvement along Chartiers Creek and Turtle Creek compared to the SSO focused alternative. The Balanced alternative shows significant improvement along the three main rivers and Chartiers Creek.

Figures 9-153 and 9-154 compare the water quality benefits of the three alternatives in terms of percent of total river-mile-days less than the 200 and 400 cfu/100 ml thresholds for all ALCOSAN receiving waters and the main rivers, respectively. When considering all ALCOSAN receiving waters, including the main rivers and tributaries, the system-wide water quality benefit is nearly equal for the three alternatives. When considering only improvements to the main rivers (Allegheny, Monongahela and Ohio Rivers), where recreational use is most prevalent, the water quality focused alternative performs better than the SSO and balanced alternatives.

The next three figures show the results of an analysis used to quantify discharges to sensitive areas. The discharges under existing conditions and future baseline conditions are compared to the reduced discharges to sensitive areas provided by the selected plan and each of the three alternative affordable 2026 plans. Figure 9-155 compares the frequency of discharges to sensitive areas. Figure 9-156 compares discharge volumes and Figure 9-157 compares discharge durations.

Figure 9-149: Affordable Alternative Percentage Capture Comparison

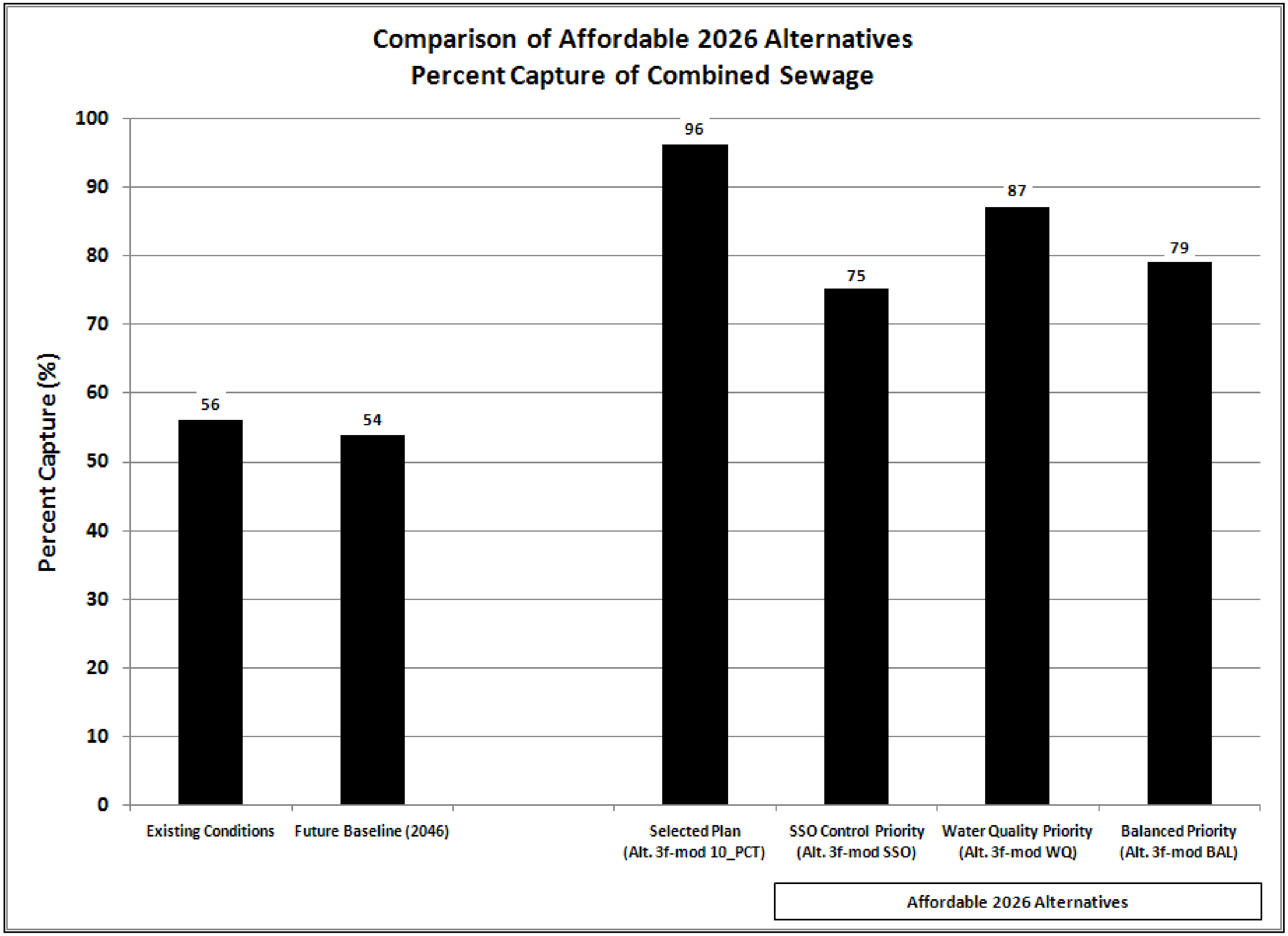
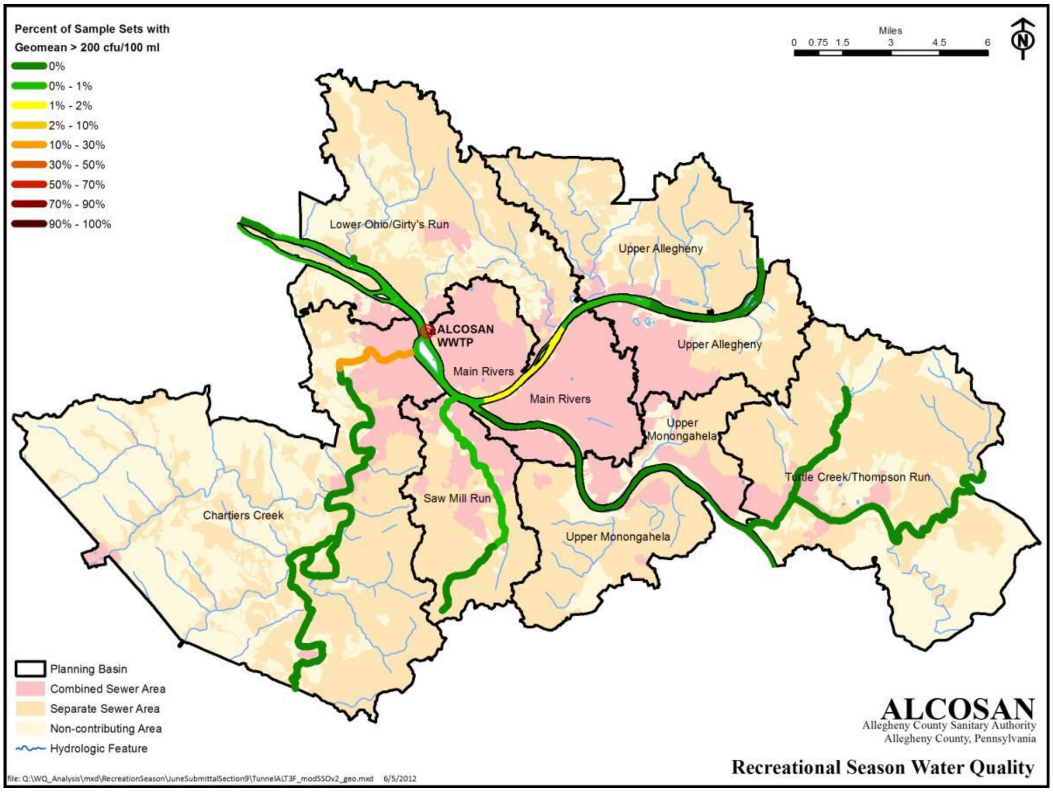


Figure 9-150 – SSO Priority Fecal Coliform Water Quality Standard Attainment Assessment for the Geometric Mean and 10% Criteria



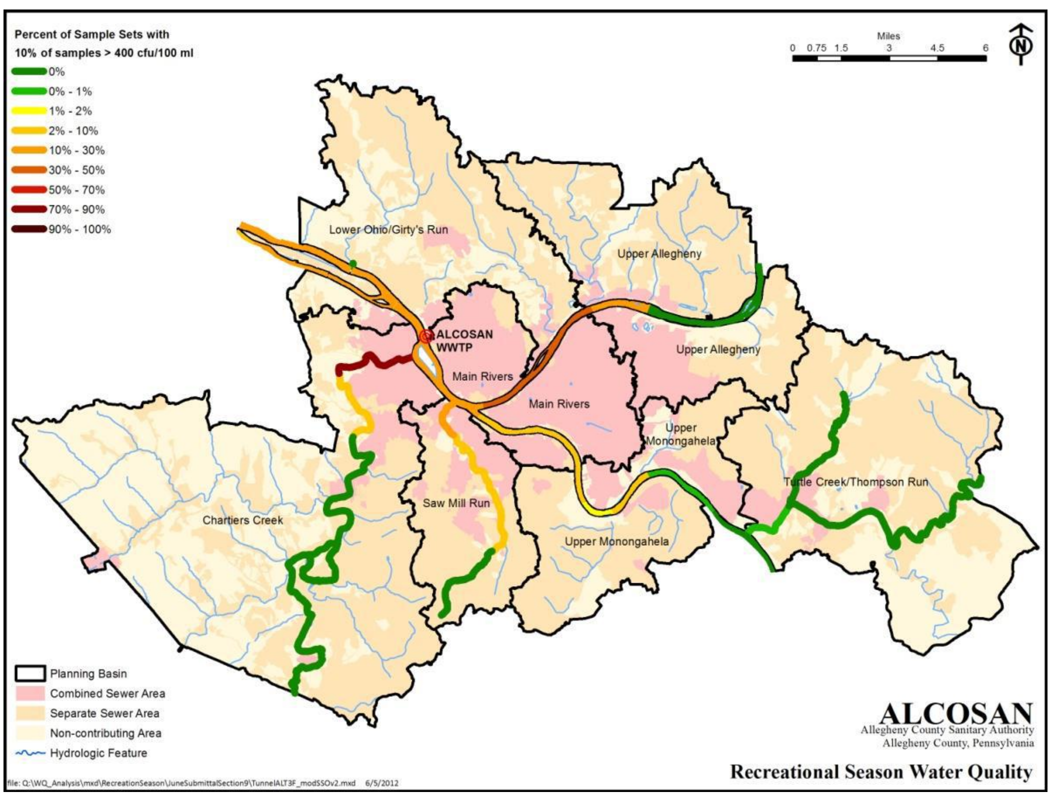
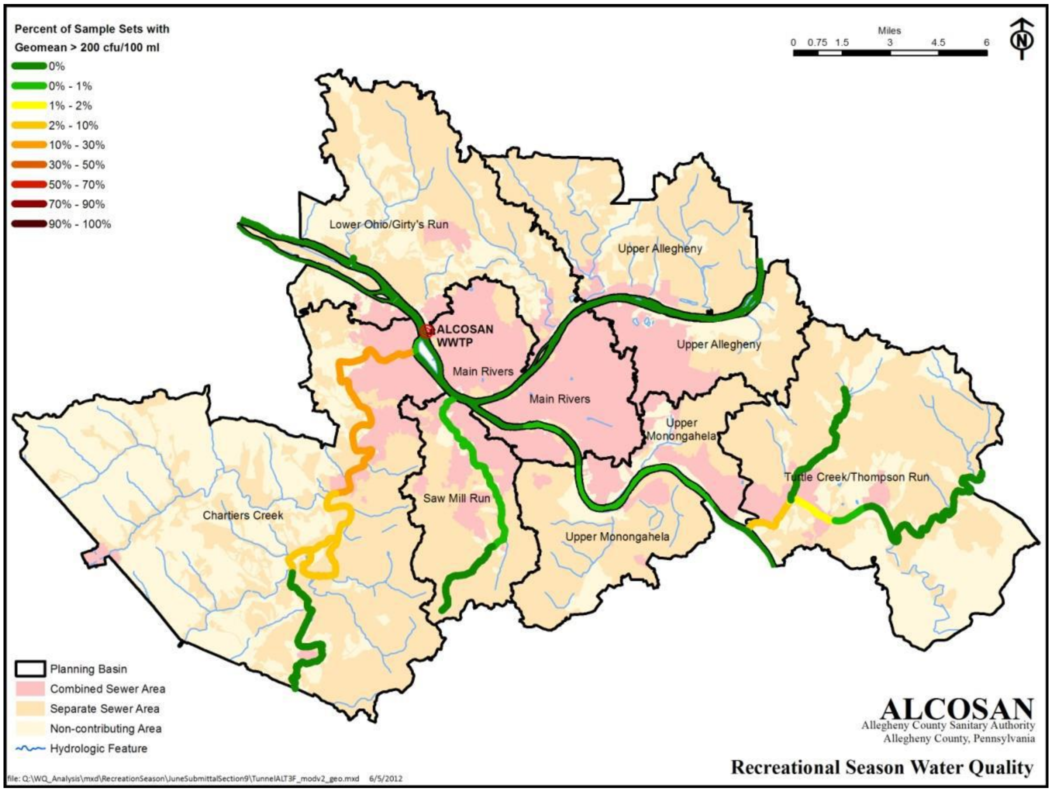


Figure 9-151: Water Quality Priority Fecal Coliform Water Quality Standard Attainment Assessment for the Geometric Mean and 10% Criteria



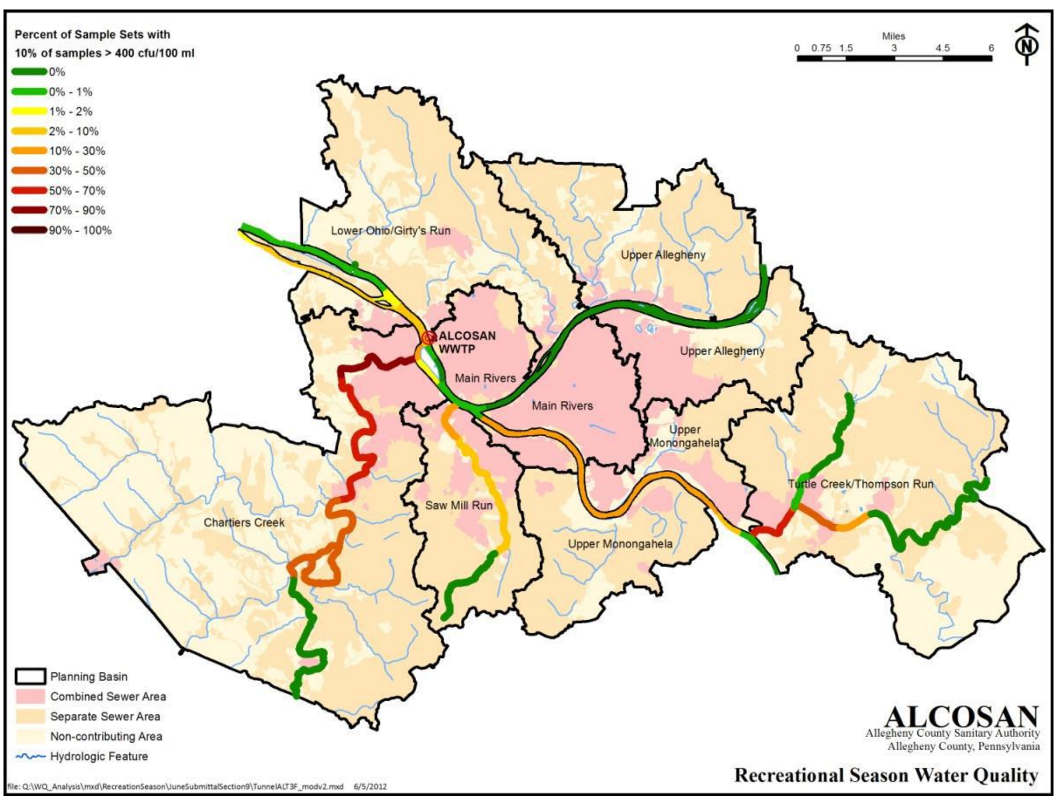
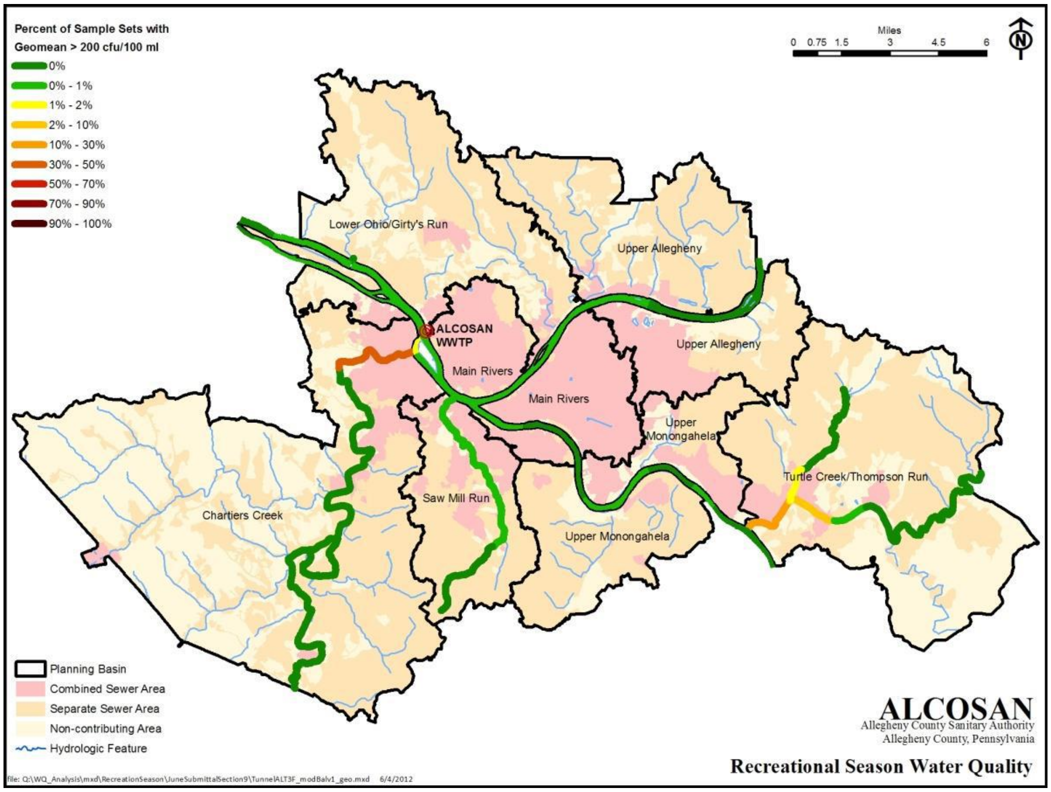


Figure 9-152: Balanced Plan Fecal Coliform Water Quality Standard Attainment Assessment for the Geometric Mean and 10% Criteria



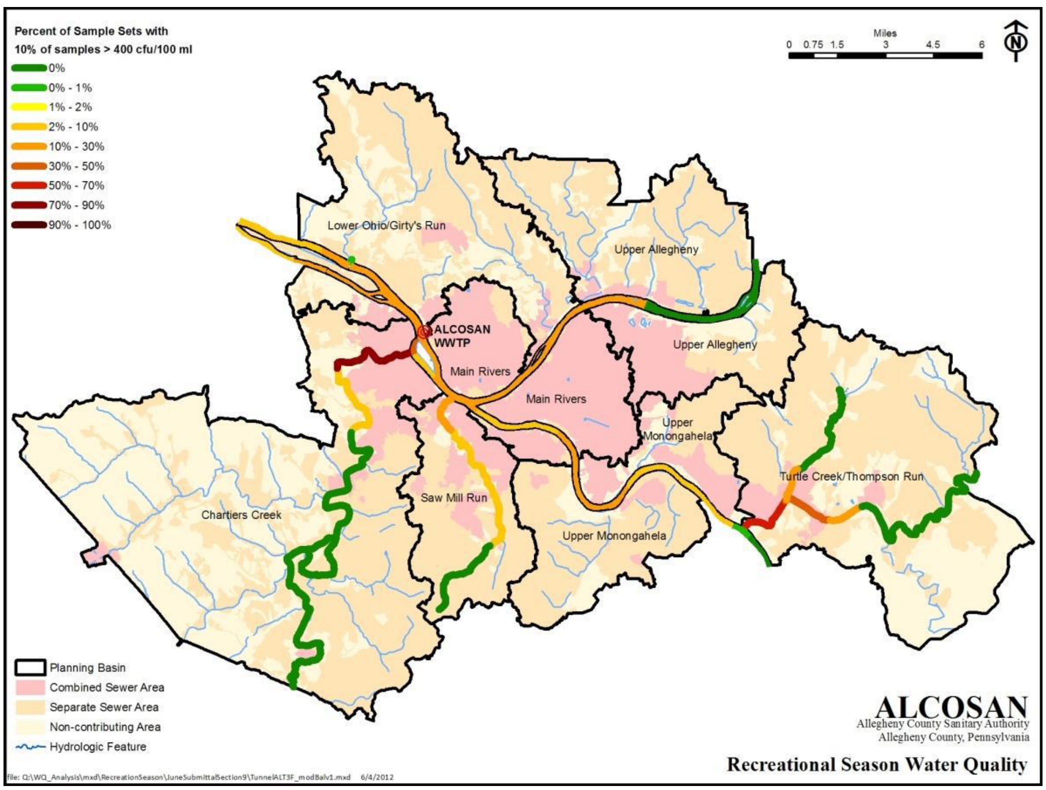


Figure 9-153: ALCOSAN Receiving Waters (Allegheny River, Monongahela River, Ohio River, Chartiers Creek, Saw Mill Run and Turtle Creek) Water Quality Benefit Comparison

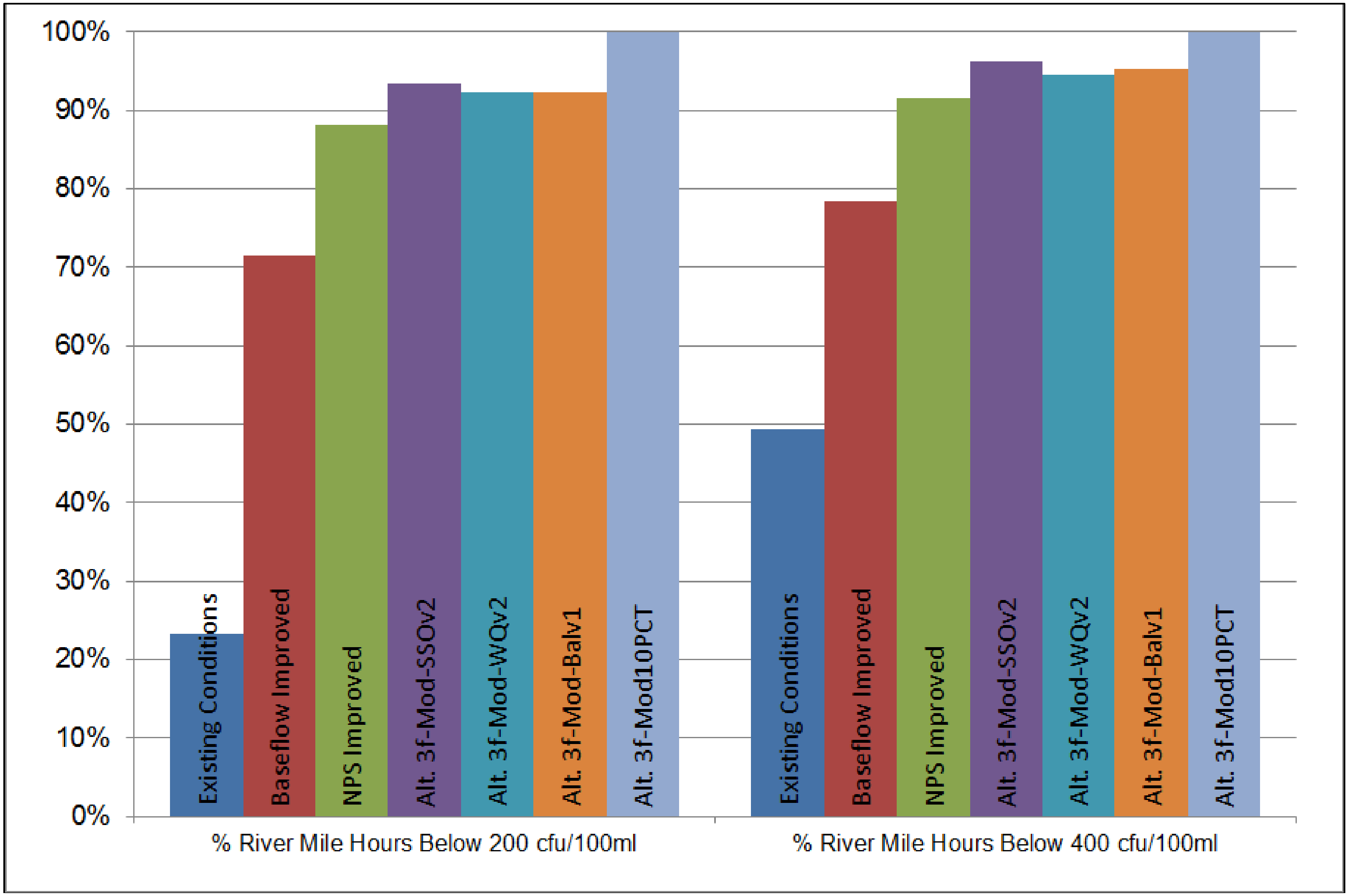


Figure 9-154: Main Rivers (Allegheny River, Monongahela River, and Ohio River) Water Quality Benefit Comparison

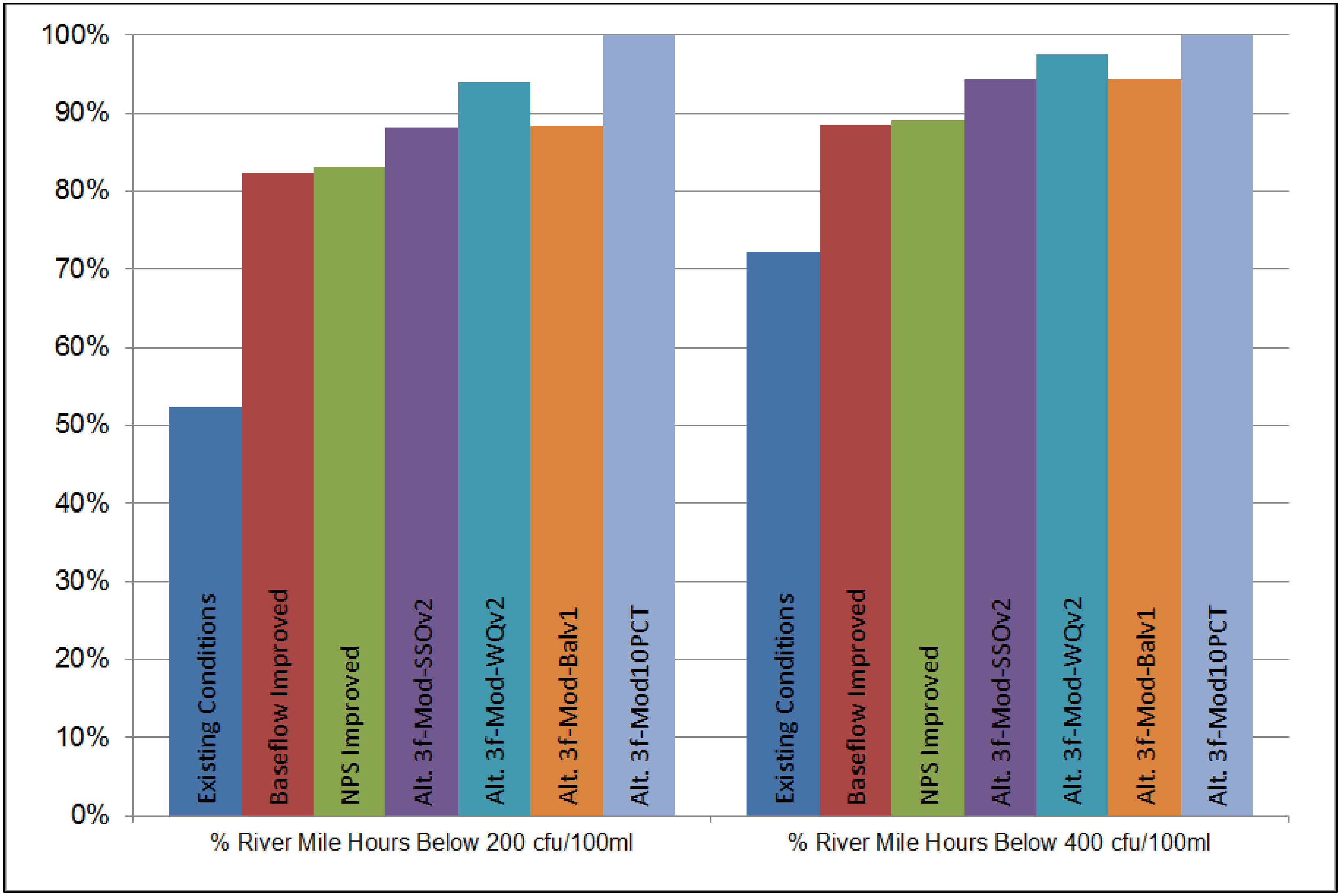


Figure 9-155: Comparison of CSO Frequency for Outfalls Discharging to Sensitive Areas

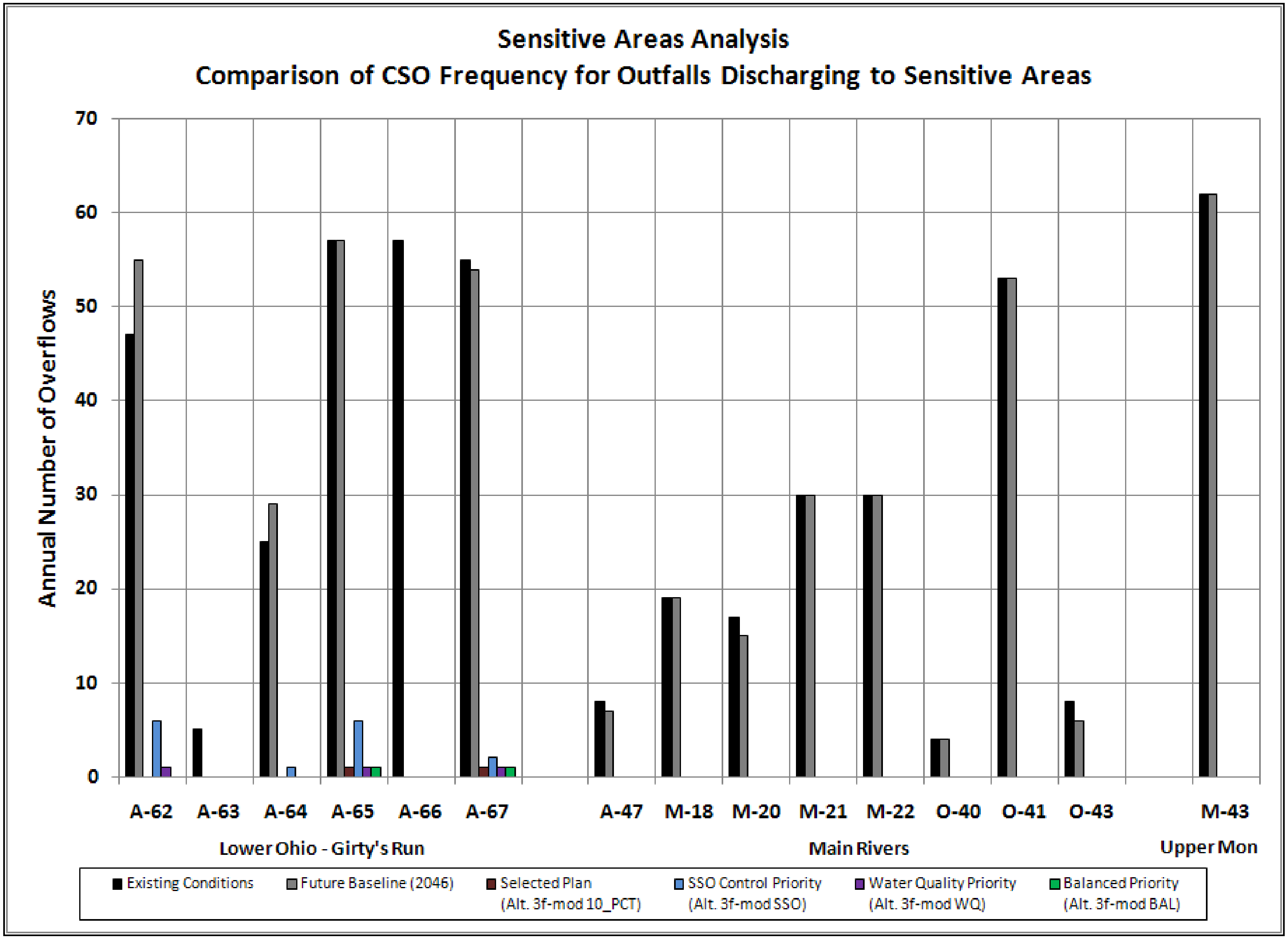


Figure 9-156: Comparison of CSO Volumes for Outfalls Discharging to Sensitive Areas

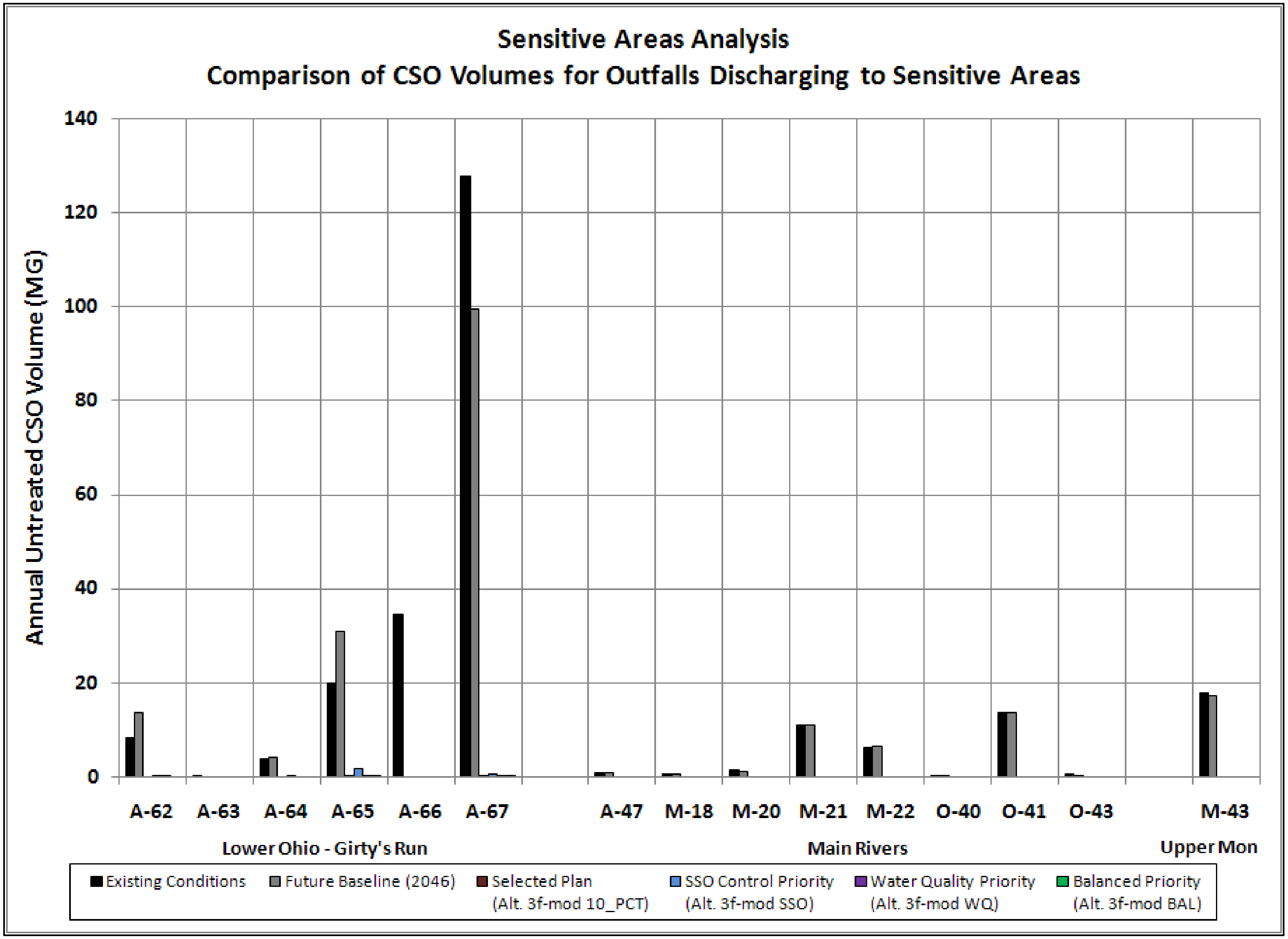
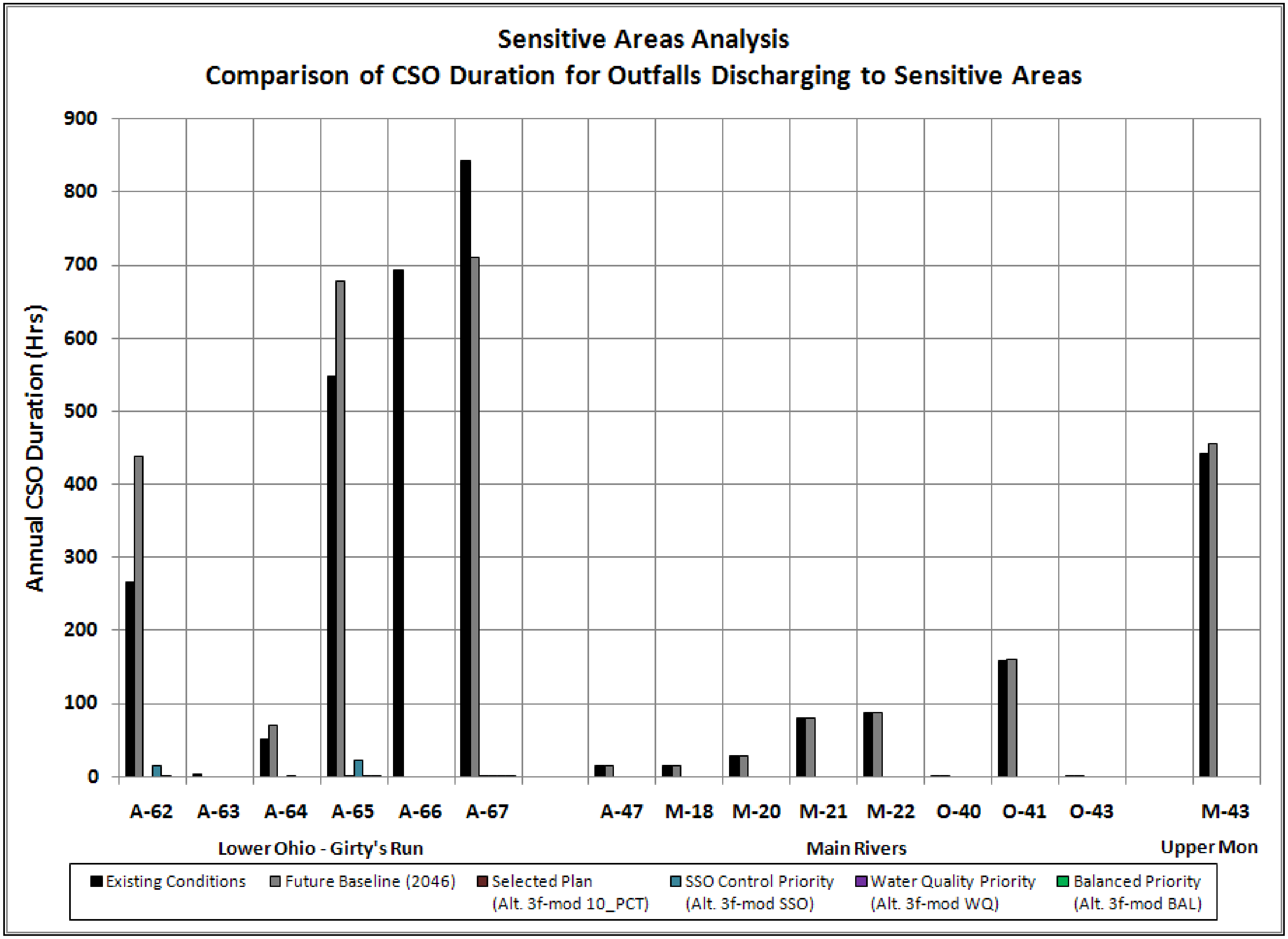


Figure 9-157: Comparison of CSO Durations for Outfalls Discharging to Sensitive Areas



9.7.5 Selection of the Recommended Plan

Implementation of the Selected Plan identified in Section 9.6.1 by 2026 would, as documented in Section 9.6.2, pose severe implementation challenges and, as documented in Section 9.6.3, also result in unsustainable household cost burdens and financing demands. This section described the evaluation of three alternatives that mitigate these concerns by limiting the capital investment through 2026 to $2 billion. Each of the three alternatives represents a potential first phase of improvements that can cost effectively support progress towards ultimate implementation of the full Selected Plan, but with emphasis on different overflow control priorities. The wet weather planning process made evident the many infrastructure improvement needs necessary to meet key objectives, including water quality improvements and capacity for regional growth. The analysis of improvements that can be completed with a $2 billion budget reinforced the importance of these many competing needs and the reality that a compromise must be reached.

Selection of a recommended 2026 plan required considerations of the compliance requirements met and the performance benefits provided by each alternative. Full SSO control to the 2-year level of control limits the ability to control CSOs in areas of high recreational use, and focusing solely on recreational use areas along the main rivers does not address important SSO control objectives. These fundamental competing interests led to the development of the Balanced Priority Alternative which aims to address a combination of CSO and SSO objectives. Each of the three alternatives compromises some important near-term improvements, but this cannot be avoided without overburdening the ratepayers, the financial markets and the specialized construction industry required for such large-scale wastewater infrastructure programs.

ALCOSAN will continue to analyze these important and competing infrastructure improvement needs and take input from the regulatory agencies, stakeholders, and the general public during the August through mid-October 2012 public comment period for the draft WWP. Furthermore, ALCOSAN will continue to refine these alternatives and the Selected Plan during the public comment period to incorporate any significant changes due to revised municipal control strategies, or other updated information.

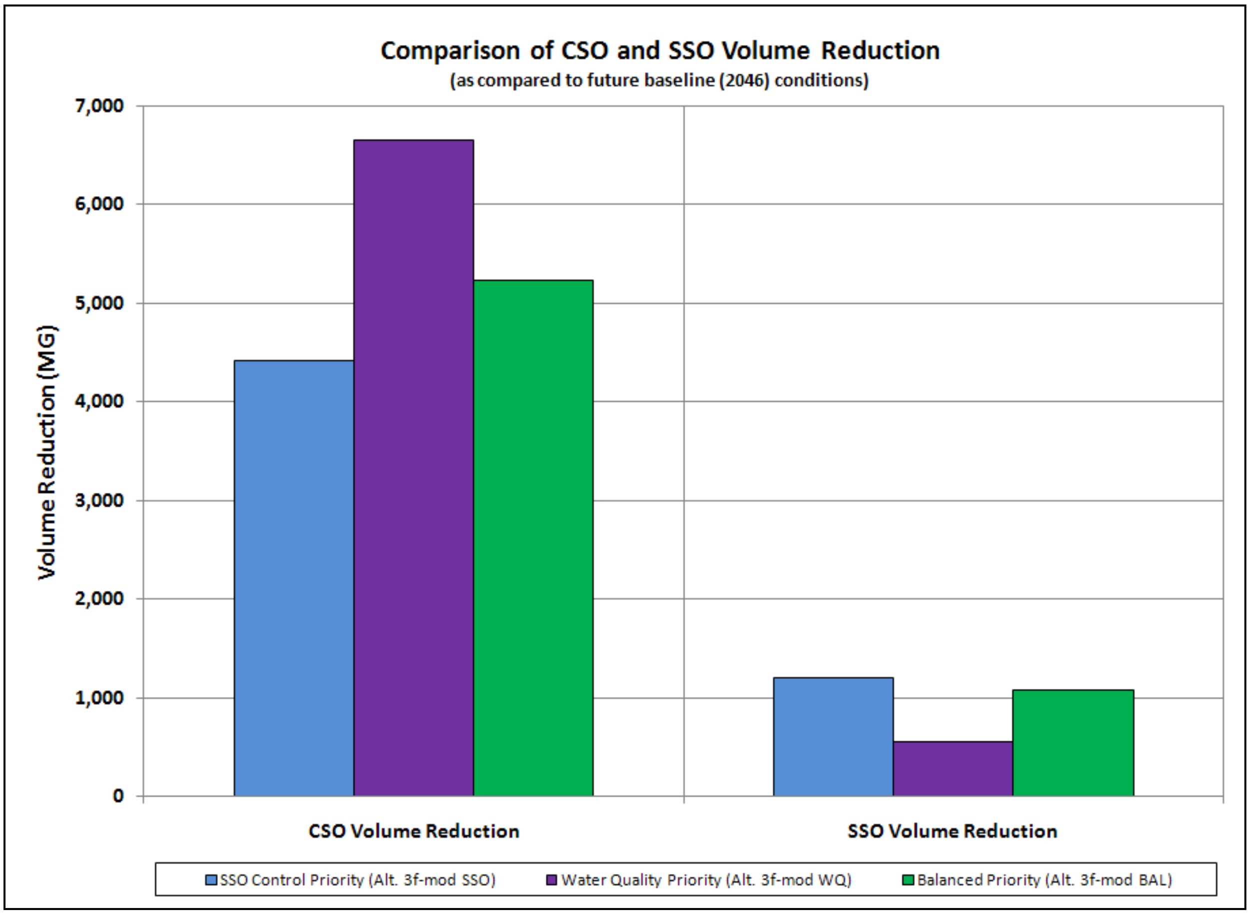
Basis for Selection

Figure 9-158 presents the CSO and SSO volume reductions associated with each of the three $2 billion alternatives and serves as a basis for selection of the Recommended 2026 Plan. The Water Quality Priority Alternative clearly provides the largest CSO volume reduction, whereas the SSO Control Priority provides the largest SSO volume reduction. The Balanced Priority Alternative falls in between for both performance measures with the principal trade off being priority to the sanitary sewer overflows that occur in the upper reaches of the Chartiers Creek planning basin. This aspect of the plan is dictated by ALCOSAN's existing obligation under a November 30,2004 consent decree (the "Chartiers CD") between the Pennsylvania Environmental Defense Fund, ALCOSAN and eleven[9-18] of the ALCOSAN municipalities, to eliminate SSOs into Chartiers Creek by 2019. It also is important to understand that

9-18 Scott Township, Municipality of Mt. Lebanon, Collier Township, Green Tree Borough, Heidelberg Borough, Ingram Borough, Kennedy Township, Rosslyn Farms Borough, Thornburg Borough, Upper St. Clair Township and the Borough of Bridgeville

ALCOSAN's SSO controls within Chartiers Creek are necessary to enable the eleven municipalities to comply with their obligations under this federal consent decree.
As important as the legal deadline is the geographic size and hydraulic magnitude of the wet weather flows generated within the sanitary sewered municipalities within the Chartiers Creek watershed. As detailed in Section 4 of this document, approximately 27% of the current SSO volume is attributable to the Chartiers Creek planning basin. By coupling Chartiers Creek SSO control with the SSO control measures to be implemented by ALCOSAN's customer municipalities and the hydraulic benefits realized by the treatment plant expansion and regional tunnel, the Balanced Priority Alternative will eliminate approximately 90% of the system-wide sanitary sewer overflow volume.

Figure 9-158: Affordable Alternatives CSO and SSO Volume Reduction Comparison

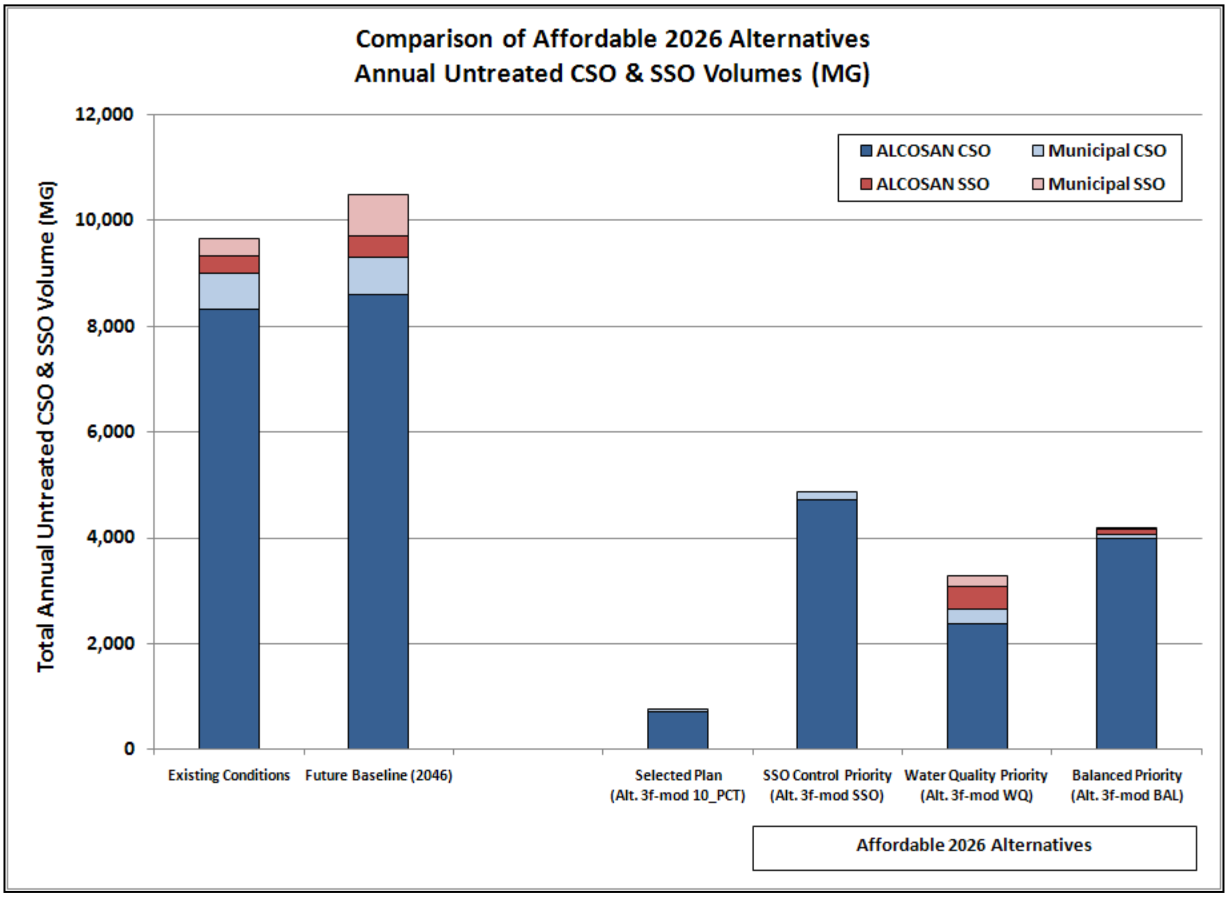


Rather than focusing on the elimination of the last 10% of the SSO discharge volume realized by the SSO Alternative, the Balanced Alternative invests more in CSO controls that can achieve a larger total discharge volume reduction system-wide. ALCOSAN submits that there is a compelling environmental benefit to the Balanced Alternative over the SSO Alternative, and ALCOSAN has noted that EPA previously has approved other initial phases of Wet Weather Plans with less than full control of SSOs. Implementing the Balanced Alternative would mean that approximately 100 million gallons per year of sanitary sewer overflow that would have been eliminated with the SSO Alternative would continue after 2026. In exchange, the Balanced

Alternative would enable the capture and treatment of an additional 800 million gallons of combined sewer overflows, leading to a net decrease in total overflow volume of 700 million gallons per typical year.

Similar logic applies when considering how the Water Quality Priority Alternative compares to the SSO and Balanced Alternatives in that it provides the lowest total discharge volume of the three affordable alternatives as shown in Figure 9-159. The Water Quality Priority Alternative delivers a net decrease in total CSO and SSO discharge volume of 900 million gallons per typical year compared to the Balanced Alternative. However, the Water Quality Alternative achieves only 47% SSO volume reduction as compared to future baseline conditions, while the Balanced Alternative achieves 90%. ALCOSAN recognizes the competing need to make progress towards the two separate CD requirements that call for the elimination of SSOs in Chartiers Creek by 2019 and system-wide by 2026.

Figure 9-159: Affordable Alternatives CSO and SSO Discharge Volume Comparison



The collective consideration of these competing goals, compliance requirements, and performance benefits of the three alternatives has led ALCOSAN to propose the Balanced Priority Alternative as the Recommended Plan. ALCOSAN is proposing a phased implementation strategy that will include the implementation of the Balanced Alternative by September 30th, 2026 and phased subsequent improvements leading to full implementation of the Selected Alternative. ALCOSAN documented in Section 9.6.1 that the Selected Alternative will result in the elimination of SSOs and the discharge of CSOs in conformance with the CSO Control Policy. Implementing the Balanced Alternative as a first phase of wet weather overflow control improvements will lead to tangible water quality benefits and establish a strong foundation for continued implementation of the Selected Alternative that meets the full objectives of the wet weather program and the requirements of the Chartiers CD.

CSO Control Policy Conformance

As documented in Section 9.6, ALCOSAN's Selected Alternative will discharge from the Conveyance and Treatment System only to the extent that such Discharges, as demonstrated by Post-Construction compliance monitoring, will meet the requirements of the Clean Water Act, consistent with EPA's Combined Sewer Overflow Policy. The Recommended 2026 Plan complies with the USEPA's CSO Control Policy[10-19] based on the following provisions.

- The Recommended 2026 Plan provides for a phased implementation of CSO controls based on the relative importance of and adverse impacts upon WQS and designated uses, as well as ALCOSAN's financial capability and previous efforts to control overflows; [10-20]
- The Recommended 2026 Plan will provide the maximum pollution reduction benefits reasonably attainable due to the affordability, financial capability and scheduling limitations imposed by the September 2026 deadline. [10-21]
- The Recommended 2026 Plan is designed to allow cost effective expansion;[10-22]

After the subsequent phases of the Selected Plan have been completed, the Plan will fully satisfy all water quality improvement objectives.

[9-19] 59 FR 18688
[9-20] Reference: 59 FR 18695 Para IV-B(3)
[9-21] Reference: 59 FR 18695 Para II-C(4)(b)(iii)
[9-22] Reference: 59 FR 18693 Para II-C(4)(b)(iv)