# FINAL
# Development and Evaluation of CSO Control Alternatives

***Albany Pool***
***Part B Long-Term Control Plan***

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Capital District Regional Planning Commission (CDRPC)

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## Contents

## List of Tables



## Appendix A

# Development and Evaluation of CSO Control Alternatives

## 1.0 - Introduction

Many alternative strategies are available to control pollutants discharged from CSOs ranging from no action to complete separation of the combined sewer system into separate sanitary and stormwater systems. This assessment considers technologies presented in the EPA guidance manuals, selects appropriate technologies for further evaluation and identifies a recommended plan.

## 1.1 –CSO Control Objectives

NYSDEC regulations classify water bodies and their designated uses. They also identify impairments that may preclude the attainment of water quality standards. The NYSDEC Regulations Chapter X, Parts 858 Lower Hudson, Part 876 Mohawk River and Part 941 Upper Hudson indicate that the standards of quality and purity for these water bodies are the same as their current classifications. The headwaters of the Mohawk and Hudson Rivers are identified as Class A waters as the rivers enter the Albany Pool Communities. The Class A headwaters provides a source of drinking water, as well as fishing, bathing and primary contact recreation. The Class C waters of the Mohawk and Hudson begin at the upstream border of the Albany Pool Communities and continue downstream of the CSOs. Class C Waters are typically used for fishing. They may also be suitable for primary or secondary contact recreation, but there may be conditions that limit those uses. These classifications coincide with the current uses.

The primary objectives of the CSO LTCP are to maintain the current Class C river uses, support riverfront economic development and accommodate swimming and bathing at the potential future beach sites. The CSO LTCP is also required to meet current permit requirements, including the 15 best management practices (BMPs) included in each communities' permit.

## 1.2 – Regulatory Compliance Strategy

The results of the receiving water quality characterization and receiving water quality modeling efforts determined that bacteria and floatables should be the primary pollutants to be focused upon for achievement of water quality standards. As a result, the review of CSO abatement technologies will concentrate on technologies suitable for addressing bacteria and floatables.

As discussed in the Receiving Water Quality Development Report (August 2010), a one-dimensional receiving water quality model of the Hudson River was developed and used to evaluate compliance with bacteria standards for baseline (existing) conditions and five scenarios of future conditions. A summary of the bacteria modeling results follows in Table 1-1.

| Table 1-1: Bacteria Modeling Results | | | | | |
|---|---|---|---|---|---|
| **Scenario** | **WWTP Disinfection** | **Headwaters** | **Tributaries** | **CSO** | **Exceedances (months/30 months)** |
| Baseline | No | Baseline | Baseline | Baseline | 30 |
| 1 | Yes | Baseline | Baseline | Baseline | 2 |
| 2 | Yes | Improved | Improved | Baseline | 0 |
| 2A | Yes | Improved | Baseline; Patroon Creek improved to 2009 levels | Baseline | 0 |
| 3 | Yes | Baseline | Baseline | 85% Capture | 2 |
| 4 | No | Baseline | Baseline | 85% Capture | 30 |

Notes:

1) Disinfection was applied at the WWTPs only during the recreation season.
2) Improved headwaters and tributaries meet water quality standards for fecal coliform.
3) Exceedances are based upon the 5-yr simulation and refer to the number of months during the recreation season that the monthly geomean exceeds 200 cfu/ml at any transect within the Albany Pool. Monthly geometric means were calculated based on noon values.

The key conclusions of the Receiving Water Quality Model Development Report (August 2010) which shape the regulatory compliance strategy are as follows:

- A review of the historical river dissolved oxygen data indicates that CSOs are not a cause of violations of the dissolved oxygen standard. As a result, a dissolved oxygen river model is not required.
- Improvements to continuous sources of bacteria contributions to the Hudson River, such as WWTPs, tributaries and the headwaters, provide more effective bacteria based water quality improvements in comparison to improvements to intermittent wet weather based discharges.
- The water quality conditions of the headwaters of the Hudson River, as assumed under Scenario 2A are believed to be achievable since the WWTPs upstream of the Albany Pool have either completed or are in the midst of performing projects to disinfect their effluent discharges to the Hudson River. The documented improvements to water quality conditions of Patroon Creek are believed to be sustainable due to continuing efforts by the City of Albany and the Albany County Sewer District to identify and eliminate possible illicit sewer connections and are substantiated by sampling performed in 2009.

- The results of Scenario 2A (no exceedances during the recreation season over the 5-yr model simulation) indicate CSOs do not preclude the attainment of water quality standards upon implementation of seasonal disinfection of WWTPs and improvements to the headwaters and Patroon Creek associated with completed and ongoing projects.
- Use of the Demonstrative Approach should be considered for evaluating CSO controls. The focus of the CSO control alternatives analysis will be on best management practices, WWTP hydraulic and disinfection upgrades, floatables control and improvements to select watersheds where CSO controls provide cost-effective bacteria based water quality improvements in areas where primary contact recreation is envisioned.

In consideration of the receiving water quality model observations and conclusions, the regulatory compliance strategy for the Albany Pool Communities will utilize the Demonstrative Approach for development of a recommended plan for CSO compliance. The CSO control strategy will:

- Achieve regulatory compliance as measured by the water quality standard for bacteria;
- Optimize performance of existing infrastructure;
- Incorporate WWTP and system rehabilitation projects to address current needs and reduce risk of emergency repairs;
- Control floatables impacts to recreational areas;
- Preserve capital for future operation and maintenance.

The primary goal of the recommended plan is to minimize continuous contributions of bacteria to the Hudson River, optimize existing conveyance and WWTP capacity, reduce inflow sources and peak wet weather flows, and control floatables. To achieve compliance, CSO control technologies will focus on seasonal disinfection of WWTP effluent, WWTP process improvements, best management practices, system optimization, sewer separation, floatables control and tributaries enhancement.

## 1.3 - Identification and Screening of CSO Abatement Technologies

Specific factors that deem whether a technology is appropriate include: the water quality uses and goals, the current condition of the sewer system, the characteristics of the wet weather flow (peak flow rate, volume, frequency and duration), hydraulic and pollutant loading, climate, implementation requirements (land, neighborhood, noise, disruption), and maintenance requirements.

Each of the technologies evaluated in this report were divided into two general categories, Best Management Practices (BMPs) and CSO Control Technologies. BMPs include Quantity Source Control Measures and Quality Source Control Measures. These measures are generally low cost facilities or practices intended for reducing the volume of stormwater or the introduction of pollutants to the sewer system at the source. Many of the quantity and quality source control measures are already performed by the Albany Pool Communities and/or the upstream communities. An overview of these controls is presented herein as part of the Long Term Control Plan (LTCP) evaluation process. Some of the BMPs are watershed/drainage basin type controls that are complemented by general public housekeeping efforts (i.e., litter control, household hazardous waste collection, illegal dumping ordinances, etc.).

CSO Control Technologies consist of Collection System Controls, Storage Technologies; and Treatment Technologies which generally address pollutants after they have been introduced to the sewer system. Collection System Controls are utilized for the purposes of reducing inflow to the sewer system, maximizing capture of wastewater, and improving overall sewer system conveyance capacity. Storage Technologies are used to reduce peak wet weather flows and improve CSO capture by the collection system. Treatment technologies provide either in-system or WWTP enhancements focused on the pollutants which are causing non-compliance with the water quality standards.

Each technology is described below and evaluated in general terms of effectiveness and feasibility. Technologies that are infeasible for implementation or that offer no benefit to the CSO mitigation program were eliminated from further consideration. Technologies that should be considered as Long Term CSO abatement alternatives are further evaluated later in this report.

Table 1-2 lists each of the CSO abatement technologies considered in this report and identifies the results of the technology evaluation/screening. The technologies have been identified by the following categories:

- **Technology Not Feasible or Appropriate -** These technologies are not considered appropriate for CSO control because they will not work effectively or will not reduce water quality impacts to the extent required. They may also include technologies that exceed the requirements for meeting water quality standards, but have been eliminated from consideration in favor of other technologies which are less costly to build or operate, require a smaller footprint, or have other features that make them better suited for the application.

- **Continue Current Practice -** These technologies are typically best management practices that will help to optimize system operations and minimize CSO discharges and impacts to receiving water bodies.

- **LTCP Technology -** These technologies are feasible structural controls that will reduce and/or eliminate CSO discharges and impacts, and are being carried forward for further evaluation as a LTCP technology.

| Table 1-2: Screening of CSO Abatement Technologies | |
|---|---|
| **CSO Abatement Technologies** | **Recommendation** |
| **Quantity Source Control Measures** | |
| Porous Pavement | N |
| Flow Detention or Retention of Stormwater | N |
| Disconnection of Stormwater Inflow Sources | C |
| Utilization of Pervious Areas for Infiltration | N |
| Catch Basin Modifications to Reduce Peak Discharges | N |
| Construction of Urban Parks and Green Spaces | N |
| Installation of Green Roofs | N |
| Bioretention for Capture of Stormwater | N |
| Water Conservation to Reduce Wastewater Discharges | N |
| Infiltration Sumps for Stormwater Capture | N |
| **Quality Source Control Measures** | |
| Air Pollution Reduction | N |
| Solid Waste Management | C |
| Fat, Oil, and Grease Control Programs | C |
| Street Sweeping | C |
| Cleaning of Catch Basin Sumps | C |
| Catch Basin Modifications for Floatables Capture | C |
| Fertilizer/Pesticide Control | C |
| Snow Removal and Deicing Practices | C |
| Soil Erosion Control | C |
| Commercial/Industrial Runoff Control | C |
| Animal Waste Removal | C |
| Floating Curtains and Booms | N |
| **Collection System Controls** | |
| Existing Collection System Management | L |
| Regulator Modifications | L |
| Sewer Cleaning/Flushing | C |
| Sewer Separation | L |
| Infiltration/Inflow Control | L |
| Maximize Efficiency of Backwater Gates | L |
| Remote Monitoring and Control/Flow Diversion | N |
| Relocation of CSO Outfalls | L |

| Table 1-2: Screening of CSO Abatement Technologies | |
|---|---|
| **CSO Storage Technologies** | |
| In-Line CSO Storage and Real Time Control | N |
| Off-Line CSO Storage | L |
| Surface Storage of CSO | N |
| **CSO Treatment Technologies** | |
| Wastewater Treatment Plant Improvements | L |
| CSO Screening | L |
| Sedimentation | N |
| Enhanced High-Rate Clarification | N |
| Chemical Flocculation | N |
| Dissolved Air Flotation | N |
| Vortex Treatment Technologies | L |
| Biological Treatment | N |
| Filtration | N |
| Disinfection | L |

**Key**
**C - Continue Current Practice**
**L - Long Term Control Plan Technology**
**N - Not Feasible or Appropriate**

### 1.3.1 Quantity Source Control Measures

Source control measures can be employed to either decrease the quantity of water entering the system or reduce certain pollutants from the waste stream at their source (quality control). Generally, source control techniques do not require significant structural improvements and thus have minimal capital costs. However, these measures are typically labor intensive and, therefore, have high operation and maintenance costs. The intent of implementing a source control measure is to help reduce or eliminate more capital-intensive downstream (structural) CSO control facilities.

Quantity source control measures are intended to reduce and/or eliminate portions of the wet weather flow generated in the basin tributary to the CSO regulator. Quantity control measures include the use of porous pavements, flow detention or retention, area drain and roof leader disconnection programs, the use of pervious area for infiltration, and catch basin modifications using flow retardation devices.

#### 1.3.1.1 Porous Pavement

The quantity of runoff that enters a combined sewer system may be reduced or attenuated through the use of porous pavement. Porous pavement is potentially more cost effective in new developments than existing paved areas where the expense of pavement removal is required as well as disruption to traffic. Effectiveness of this technology, for the most part, is dependent on the soils characteristics in the areas where it is being considered for implementation. To maintain long-term effectiveness, periodic maintenance is required to remove sand, silt and other particulates that accumulate over time. While porous pavement should not be used in heavily traveled areas or areas which could generate contaminated runoff such as auto salvage yards, gas stations, and loading/unloading areas, they are suitable for parking areas, paths/ walkways and low volume traffic areas. Use of porous paving should consider impacts to adjacent building foundations or other structures that could be damaged by increasing the groundwater table.

While some local, site specific applications of this technology have been applied and were found to reduce stormwater runoff, the limitations on its applicability prevent its widespread use for CSO control. Recommendations for the consideration of porous pavement will be incorporated into the Green Infrastructure Technical Design Guidelines as part of the recommended plan. No additional consideration will be given to this technology for CSO control.

#### 1.3.1.2 Flow Detention or Retention of Stormwater

Detention or retention ponds located in upstream areas of the tributary basin can be used to temporarily store stormwater runoff, attenuate flow peaks and minimize potential downstream treatment capacities. After storms, collected storm water could be diverted to a storm sewer or adjacent stream or drained back into the system and be conveyed to the treatment facility for treatment.

On the west side of the river, some small stormwater storage projects are currently planned in Albany. These projects focus on small sewer catchments where flooding is a problem. On the east side of the river, there is limited opportunity to divert storm water runoff to detention or retention basins. Catch basins and other inflow sources in Troy and Rensselaer typically connect directly to the combined sewer and would require some level of separation to divert storm water to basins. In the City of Troy, there are four streams that connect directly to trunk sewers. The size of the streams, their reaction to wet weather, and the need to make better use of the RCSD interceptor system capacity make diversion of these streams to a storm sewer a more effective solution. Application of this technology is also limited by the topography and availability of land.

In consideration of the foregoing, flow detention or retention will not be considered further for widespread use as a CSO control technology.

#### 1.3.1.3 Disconnection of Stormwater Inflow Sources

In older urban and suburban areas, leaders from gutters and roofs and area drains are often connected to the combined sewer system. These direct connections to the system are often made by property owners trying to divert excessive surface runoff across their property to catch basins or street drainage collection system. However, these direct inflow connections increase the peak flow rates and volumes during storm events by decreasing the time of concentration within the drainage basin and preventing some of the runoff from infiltrating into pervious surfaces.

In order to successfully implement a disconnection plan, considerable effort must be put forth in developing a strategic area drain and roof leader disconnection program. Such a program would target houses and buildings where disconnection is considered feasible and beneficial. The identification of roof leader and area drain connections to the combined system is relatively inexpensive to perform (by smoke or dye testing and video inspection, as appropriate). Feasibility of disconnection could be developed through review of building layouts, and discussions with building owners and the local municipalities.

Consequently, such a program would involve cooperation with the public in coordinating disconnection efforts. Public mailings and incentives could be offered to promote participation in the roof leader disconnection program and raise awareness of the benefits of this mitigation measure. In some cities, such as New York City and Philadelphia, PA, rain barrel giveaway programs have been conducted to encourage residents to disconnect their roof leaders and collect runoff. Significant effort would also be required to address public concerns and manage liabilities associated with altering existing privately owned drainage systems to discharge to the ground surface.

Area drain and roof leader disconnection has been implemented as a BMP in many of the Albany Pool Communities and represents a viable and low cost CSO abatement alternative. Continuing this approach, as current practice, is recommended where deemed appropriate by collection system investigations.

The Village of Green Island has promulgated Sec. 133-19 of Local Law which prohibits these direct or indirect connections to a public sanitary or combined sewer. The City of Rensselaer and the other Albany Pool communities have similar local codes prohibiting such connections.

#### 1.3.1.4 Utilization of Pervious Areas for Infiltration

This technology combines some of the aspects of the previous two strategies by attempting to maximize the use of pervious areas for infiltration. Various types of facilities include grassed swales, infiltration trenches or basins and subsurface leaching facilities.

Generally, this type of control is more appropriate for new developments or redevelopment where some significant area of well-drained, pervious soils exist. Where possible, proposed flow detention ponds could be constructed with pervious soils on the bottom to take advantage of available infiltration rates.

Due to dense development and lack of large areas for detention, this technology may not be appropriate for CSO control in existing combined sewer areas. As such, this technology will be considered for new development through New York State's MS4 Program and included in the Green Infrastructure Technical Design Guidelines as part of the recommended plan.

#### 1.3.1.5 Catch Basin Modifications to Reduce Peak Discharges

Modifications to existing catch basins can be made to reduce peak stormwater inflows to the combined sewer system. Catch basins within a drainage area can be retrofitted with devices, such as a vortex valve, that will retard the surface water runoff entering the sewer system. The flow may back up in catch basins lacking capacity and divert overland to a downstream catch basin with available capacity. This is commonly referred to as flow slipping, and has been implemented in several cities across the country with varied success.

Catch basin inlet control devices can also be designed to provide some surface detention in flat areas, to reduce peak flows entering the combined system. Surface detention has been implemented in streets, parking lots, and parks using berms to trap storm water temporarily until capacity opens up in the combined sewer system. There are risks, however, linked to street and parking lot detention, particularly during the winter months when snow and ice raise public safety concerns. Accordingly, the selection of the appropriate size vortex valve and implementation at appropriate sites is important to effectively manage this risk. Typically, the selection of the appropriately sized vortex valve is made through a combination of system modeling and trial and error field testing.

In consideration of the local climate, traffic volumes and combined sewer system response to wet weather conditions, this technology does not provide sufficient CSO reduction benefits to outweigh the potential public safety issues and will not be given further consideration.

#### 1.3.1.6 Construction of Urban Parks and Green Spaces

Urban parks and green spaces reduce the impervious area draining to a combined sewer system, and thereby help mitigate CSOs. These features promote infiltration and groundwater recharge, while providing attractive recreational areas for the community. Planting of trees and other vegetation also adds to the effectiveness of these areas in decreasing inflow to the combined sewer system. Conceivably, these areas could also provide a level of surface detention with the proper landscape design and implementation of inlet control devices, as discussed above.

Because urban parks and green spaces help mitigate CSO impacts, it is recommended that the Albany Pool communities support efforts for their development. However, since there are few opportunities for increasing urban parks and green spaces in the urbanized combined sewer area that lead directly to quantifiable CSO benefits, this technology will not be considered further as a practical component of the Long Term Control Plan.

#### 1.3.1.7 Installation of Green Roofs

Green roofs are a low-impact development technique which controls the timing and volume of stormwater discharges from impervious surfaces such as roofs and parking lots. Green roofs can reduce the quantity of stormwater runoff from rooftops by absorbing the precipitation and delaying the peak discharge. The soil and vegetative layers typically include the following, from the bottom up:

- Waterproof membrane to protect the roof deck
- Root barrier to prevent roots from penetrating the membrane below
- Optional insulation
- Drainage layer to direct excess water from the roof
- Filter fabric so fine soils do not clog the layers below
- Engineered soil substrate

- Vegetation

Intensive green roofs are landscaped for aesthetic and recreational uses and are usually installed on flat roofs. Vegetation can include food producing, garden variety plants or trees and shrubs. A high level of management is required for intensive green roofs and the additional load on the roof can be as much as 80 to 150 pounds per square foot.

Extensive green roofs, or eco-roofs, are primarily used for environmental benefits rather than for aesthetic and recreational uses. Low maintenance vegetation which is tolerant of the local climate is typically planted. Little maintenance is required one or two years after installation. Irrigation systems are not usually required with extensive green roofs as they are needed for intensive green roofs, thereby decreasing the additional load on the roof to between 15 and 50 pounds per square foot. Extensive green roofs can be installed on roofs with a slope up to 25 percent.

Both extensive and intensive green roofs can absorb a large portion of the precipitation that falls on them during a typical rain event, decreasing the stormwater volume and peak flow from roofs. Disadvantages of green roofs include the capital cost, difficulty to repair possible leaks under the soil and vegetative layers and the potential additional structural support to hold the additional loads. Flat roofs need a drainage system to drain the excess water not absorbed by the vegetation and steep slopes may need erosion control measures. Maintenance costs will significantly exceed the costs of maintaining a conventional roof. In addition, it is very unlikely that many of the buildings within the Albany Communities were designed to structurally support the weight of the additional material on the roof (adding to the capital costs), in addition to the loads typically required by applicable codes and design standards. Implementation of green roofs also requires significant participation and cooperation of business and private property owners. Furthermore, rooftop greening may require an evaluation and possibly revisions to the Building Code.

While the implementation of green roofs should be considered for reducing runoff from new structures, particularly in the institutional or governmental areas, they will not be considered as a CSO abatement approach because of the limited impact and difficulty in implementation of this technology on existing structures. Green Roofs will be a technology addressed in the Green Infrastructure Technical Design Guidelines recommended as part of the LTCP.

#### 1.3.1.8 Bioretention for Capture of Stormwater

Bioretention is another low impact development technique that filters stormwater runoff from impervious areas. An area of soil, trees, and vegetation collect stormwater runoff from impervious areas and allow it to infiltrate. An example of bioretention system is a rain garden which is designed to hold up to six inches of water for a couple of days and has a mix of herbaceous and woody species planted in a soil mixture which optimizes percolation and pollutant removal. Tree pits along sidewalks where the pavement slopes to a depressed soiled area with a planted tree are another type of bioretention system.

Bioretention reduces the volume and peak flow rate of stormwater runoff. Disadvantages include potential clogging of the ponding area if regular maintenance is not conducted. Retrofitting an existing impervious area can be more costly due to the need to break up concrete and asphalt to install the bioretention system.

Bioretention will not be evaluated further due to the challenges of implementation in an older urban environment. Some local, site specific applications of this technology may be suitable for small storm water reductions but widespread implementation is not recommended for CSO control. Communities should consider applications for redevelopment projects or new commercial and institutional developments where appropriate to satisfy requirements of the MS4 storm water regulations. Bioretention will be a technology addressed in the Green Infrastructure Technical Design Guidelines recommended as part of the LTCP.

#### 1.3.1.9 Water Conservation to Reduce Wastewater Discharges

Efficiently using water to conserve energy and water supplies reduces wastewater flow rates and is another low impact development technique. Water conservation methods include utilization of water efficient fixtures (low-flush toilets, low-flow faucets), rain harvesting (rain barrels), waterless technologies, such as composting toilets and waterless urinals, and water recycling (reuse of greywater). While collection of rainwater in a barrel or tank is often applied for the purposes of reducing runoff, the captured rain water can be reused for gardening or lawn care in lieu of public water supplies.

Water recycling is the reuse of wastewater from sinks, tubs, clothes washers and dishwashers. This water can be reused for gardening, lawn care, and exterior washing. Typically wastewater is collected and discharged from the building via a building sewer without keeping greywater separate. It is anticipated that changes in plumbing and potential treatment to accommodate reuse of greywater will be required to apply this approach in the Albany Pool Communities.

Water conservation methods could be implemented via a public education and outreach campaign. However, the reduction in flow to the combined sewer system will only have an effect on base flows. Since wet weather flows in a combined sewer system overwhelm the base flows, water conservation measures are not likely to result in a significant reduction in CSO volume. Therefore, this technology will not be considered further as a LTCP technology.

#### 1.3.1.10 Infiltration Sumps for Stormwater Capture

The construction of infiltration sumps represents a technology highly dependent on the subsurface soil conditions. Infiltration sumps, which are essentially large, deep catch basins with no pipe outlet, collect storm water and allow it to infiltrate into the soil. Consequently, these relatively low-cost structures are only effective in areas where soils exhibit permeability. A review of the soils in the study area indicate that they primarily consist of clays and silts which have low permeability and are generally not favorable for implementation of infiltration sumps. In addition, the limited storage capacity within the sump could lead to the potential for street flooding during extreme wet weather conditions. This technology will only be considered where suitable soils exist and where “flow slipping” can be achieved without causing street flooding. The City of Albany has installed and plans to install more groundwater storage recharge basins and stormwater storage/infiltration basins in specific areas to reduce stormwater flow to the combined sewer system. Infiltration sumps will be a technology addressed in the Green Infrastructure Technical Design Guidelines recommended as part of the LTCP.

### 1.3.2 Quality Source Control Measures

Quality control measures help to reduce pollutant concentrations at sources in the tributary basins and improve stormwater runoff quality before it enters the combined sewer system. Most of these measures directly address source control before the pollutant is dissolved in the rainfall and/or conveyed to the catch basin. The final measure, catch basin cleaning, represents the last technology to retard the introduction of additional pollutants to the combined wastewater flow. The advantage of many of these technologies is that they can also have beneficial environmental effects in separated stormwater collection areas.

#### 1.3.2.1 Air Pollution Reduction

Particulate matter in the atmosphere ultimately settles and becomes a source of stormwater runoff contamination. The contamination is a result of both natural causes (fugitive dust from soils and pollen) and manmade processes (grinding and pulverizing processes, combustion, construction dust, etc.).

This source of pollution is not significant compared to other sources and therefore does not warrant further evaluation in the context of this study.

#### 1.3.2.2 Solid Waste Management

Improper disposal of litter, including leaves, grass clippings, waste paper, wrappings, cigarettes, metal, glass, and paper containers on city streets, in parks and along vacant properties often results in these items entering the collection system and potentially being discharged to the receiving water. The floatable nature of these items can cause visible pollution.

The Albany Pool communities have already implemented a number of ordinances to control litter and manage solid waste. The illegal dumping policies are enforced regularly by municipal agencies and enforcement should continue. Generally, in urban areas, it is not expected that further enhancements to existing solid waste management programs will completely control floatables. Accordingly, recommendations to improve current procedures and policies are not warranted.

The City of Rensselaer is implementing a catch basin stenciling program as it rehabilitates and/or replaces catch basins. New castings will be imprinted with alerts to the public to not dispose of trash in catch basins to avoid conveyance to a receiving waterway. This program is similar to the stenciling programs implemented by the other Albany Pool communities. It is recommended that each of the Albany Pool Communities continue their current practices for managing solid waste.

#### 1.3.2.3 Fats, Oil, and Grease Control Programs

Fats, oil, and grease are often improperly disposed of by pouring down the sink. Fats, oil and grease (FOG) build up in sewers over time and often cause blockages and reductions in pipe capacity. EPA's August 2004 "Report to Congress on Impacts and Control of CSOs and SSOs," reports that 47 percent of sewer blockages can be attributed to grease buildup. These blockages account for nearly half of all sanitary sewer overflows.

Education programs about proper disposal of FOG can reduce problems in the sewer system. At a minimum, restaurants and institutional food processing facilities must regularly maintain grease traps to remove the FOG floating on top. Grease traps slow the flow of wastewater and allow FOG to cool and float to the top where it can be removed, so it does not move downstream in the sewer system.

Homeowners are rarely aware that garbage disposals cause grease buildup in the house trap requiring the house trap to be treated on an annual basis. Education programs should be tailored to the audience, such as a “Do and Don’t” list for residents to discuss proper disposal, and a workshop or separate mailing for commercial establishments, such as restaurants. The effectiveness of pollution prevention programs, such as educating owners about FOG, is highly dependent on individual actions. The effect of the education and removal of FOG should not be underestimated.

The City of Cohoes has implemented a program where the inspection of grease traps at facilities that prepare or process foods is performed annually. All municipalities should consider annual inspections to be performed on all restaurants and institutional food processing facilities by the Health Department (during inspections), municipalities themselves or institute a self-monitoring program to prevent problems from developing. Where problems are discovered more frequent inspections may be necessary. In many cases mandatory grease trap pumping and reporting can reduce the need for the frequency of inspecting. Municipal codes should be evaluated to see if they need to be strengthened and communities should consider a small annual inspection fee to offset inspection program implementation.

When FOG is pumped out of grease traps it needs to be disposed of properly. The Sewer Districts should implement programs and facilities for acceptance of FOG for treatment since it is more cost effective than addressing the problems associated with FOG in the collection system. Additionally, more focus should be given to the development of businesses in the communities that accept FOG material since there is a market for this product. Over the past several years Albany County Sewer District has accepted FOG through its waste hauler program and has seen a noticeable increase in pumping by waste haulers. Presently, one company has begun accepting FOG for recycling with interest from others.

As a BMP, FOG control is prudent practice and the Albany Pool Communities should continue to monitor food production facilities and support education programs for the general public. While FOG control will not be considered for further evaluation as a CSO control measure, the Albany Pool Communities should continue to improve upon their current practices to reduce collection system maintenance problems and to reduce the risk of dry weather overflows.

#### 1.3.2.4 Street Sweeping

Street sweeping is a common practice in urban areas to improve the aesthetic environment by removing litter and debris from gutters. This practice can also improve the water quality of surface runoff by reducing the quantity of solids and floatables entering the combined sewer system. Street sweeping is performed using mechanical brooms or vacuum sweepers.

According to the City of Rensselaer and Troy Public Works Departments, street sweeping is performed (weather permitting) from April through the first snowfall. Streets are swept at least once per year, with more frequent street sweeping in densely developed areas, commercial and business zones and areas susceptible to sewer blockages. The other Albany Pool Communities perform street sweeping on similar schedules. The City of Watervliet performs street sweeping daily from April through December (weather permitting, main thorough fares are a priority). The City of Cohoes operates on similar seasonal schedule focusing on the sweeping of high trafficked roads at least once per week and secondary roads at least twice per year. The Village of Green Island performs seasonal street sweeping on an as needed basis.

While street sweeping does help to improve street aesthetics and reduce the amount of sediment and debris that make its way into the sewer system, it is unlikely that additional street sweeping will significantly improve the capture of floatables. As shown by floatables studies performed in New York City, catch basins with sumps and hoods combined with a consistent cleaning schedule provide a dependable approach to floatables capture. Accordingly, it is recommended that the current street sweeping practices be continued.

#### 1.3.2.5 Cleaning of Catch Basin Sumps

Catch basins collect and convey surface runoff to a combined sewer or drainage system. Basins are often designed with a sump below the outlet pipe to capture sand, grit, and solids. Catch basins require periodic cleaning to remove the solids and floatables captured in the sump. Structures can be cleaned using a bucket or vacuum. Properly maintained catch basins can help to reduce the quantity of solids that enter the combined sewer system.

Each of the Albany Pool communities conducts active catch basin cleaning programs. For example, the City of Cohoes aims to clean all catch basins at least once per year while the City of Watervliet and the Village of Green Island perform a comprehensive cleaning over a three year period. These programs are measures for reducing the volume of floatables entering the combined sewer system from surface runoff. Member towns are responsible for maintaining their storm and combined wastewater collection systems, including catch basins.

Because increasing the frequency of catch basin cleaning will not eliminate or significantly reduce bacterial contributions from CSOs, this BMP will not be considered further as a LTCP technology. The current practice, however, should be continued in conformance with the BMP for Control of Floatable and Settleable Solids to minimize the amount of road sediment and floatables introduced to the CSS.

#### 1.3.2.6 Catch Basin Modifications for Floatables Capture

Catch basins can be equipped with devices, such as hoods or baffles, to help capture floatables within the catch basin until the sump is cleaned. These devices, when properly maintained, effectively remove floatables and coarse solids that enter the combined sewer system and are discharged to the receiving water.

Design standards for each of the Albany Pool communities currently require catch basins with hoods and/or siphons, and a collection sump for heavy solids. All newly installed catch basins must follow these standards to provide for source control of floatables and settleable solids. As this technology is considered a suitable source control where floatables control facilities are required, sewersheds where existing catch basins are equipped with hoods and sumps will not require additional floatables control measures.

While extensive replacement of existing catch basins is not recommended, the Albany Pool communities should continue the practice of incorporating hoods and sumps when rehabilitating or replacing existing catch basins.

#### 1.3.2.7 Fertilizer/Pesticide Control

The use of fertilizers and pesticides can increase pollutant levels, primarily nutrients, in stormwater runoff. While controlling chemical use and storage can help reduce this pollutant loading, effective control of these pollutant sources is difficult.

Fertilizers and pesticides were not identified as a significant waste stream pollutant in Albany Pool CSO discharges, since the combined sewer service area is mostly urbanized and the outlying communities are primarily residential areas. Therefore, additional control of fertilizers and pesticides as an overall drainage basin program for CSO mitigation will not be considered in the development of the LTCP. However, each community has athletic fields, open space and parks which they maintain. It is advisable that maintenance staff continue their current practices to minimize fertilizer and pesticide use and the potential impacts on the watershed.

#### 1.3.2.8 Snow Removal and Deicing Practices

Salting roadways during the winter to reduce icing can increase surface runoff pollutant loads, particularly chloride concentrations. Improper storage of salt can also contribute to high chloride concentrations, especially if the salt is not covered or protected from weather. In some areas of the U.S., salt is mixed with sand to improve winter traction on roadways. The sand can accumulate in catch basins and eventually enter the combined sewer system contributing to the solids loading in CSO discharges.

The Albany Pool communities plow roadways and use salt for deicing roads. This practice is unavoidable considering the winter weather conditions in this region and the need to maintain safe roadways. Member communities properly store salt and other materials at their DPW storage yards in large sheds or cover the material with tarps to minimize wash-off into the sewer system. Modifications to current practices appear to be unnecessary and will not be considered for further study as part of this LTCP.

#### 1.3.2.9 Soil Erosion Control

Construction sites contribute to sediment in surface runoff. Albany Pool member communities currently enforce regulations that require storm water pollution prevention plans for development projects. In addition, construction sites which disturb more than one-acre are regulated by the Phase II SPDES stormwater regulations, which are regulated at the local level. Continued enforcement of these guidelines can maintain reduced suspended solids loadings to the receiving waters.

Although soil erosion is not a significant source of CSO-related pollution in the Albany Pool combined sewer service area, erosion and sediment control practices should continue to be enforced consistent with New York State Municipal Separate Storm Sewer Systems (MS4) law and at all construction sites where short term disturbances are expected. Additional controls for the LTCP will not be considered.

#### 1.3.2.10 Commercial/Industrial Runoff Control

CSO pollutant discharge quality can be improved through the control of runoff from commercial and industrial establishments in the drainage area. Of particular concern are gas stations and other petrochemical establishments. Oil traps or permanent oil collection systems can be used to reduce the quantity of pollutants entering the system.

Existing commercial and industrial runoff control measures should be continued in accordance with each business's stormwater pollution prevention plan and the MS4 stormwater regulations. No further controls will be considered as part of this LTCP.

#### 1.3.2.11 Animal Waste Removal

Animal waste is a source of stormwater pollution, especially nitrogen and pathogenic organisms (fecal coliform is an indicator). Proper disposal of animal waste could reduce bacteria and nutrient concentrations in CSO discharges. It is expected that current solid waste disposal, leash laws, littering ordinances, and street sweeping programs in communities served by the Albany Pool combined sewer systems are adequate to address this potential problem. Because the impact of this pollution source is limited and more stringent regulations would be difficult to enforce, this technology will not be considered further for CSO abatement.

#### 1.3.2.12 Floating Curtains and Booms

Floating curtains or booms can be installed in the water to serve as end-of-pipe containment controls to capture and contain floatables which discharge from the end of sewer outfalls. Boom trucks or skimmer vessels are then used to collect the floatables from these devices following wet weather events. Containment booms are sized based on peak flow rate, maximum flow velocity and the quantity of floatables expected. Booms cannot be used in winter months and can become dislodged with high river velocities and fluctuations in water level. In areas near waterfront redevelopment, these floatables containment systems can be unsightly.

Due to the ineffectiveness of end-of-pipe controls in capturing neutrally buoyant material and settleable solids, the operational issues during winter months and during high river levels, when large CSO events often occur, and the obstacles the booms cause to navigation, this technology will not be evaluated further. Floatables derived from stormwater runoff from roads and highways are more effectively addressed with other programs discussed herein.

### 1.3.3 Collection System Controls

Collection system controls and modifications are intended to reduce CSO flows within the interceptor system by removing inflow sources, increasing the use of existing interceptor capacity and pipeline storage, and/or optimizing performance of the collection system. These controls include existing system management, regulator modifications, sewer line cleaning and flushing, sewer separation, infiltration/inflow control, polymer injection (to increase pipe capacity), regulating and backflow gate modifications, real time (remote) system control, flow diversion, and relocation of outfalls to less sensitive areas.

#### 1.3.3.1 Existing Collection System Management

System management techniques can improve receiving water quality by reducing CSO discharge volumes and capturing first flush pollutant loads. Regular maintenance of CSO regulators, backwater gates and the interceptor piping system is essential to maintaining proper hydraulic conditions in the system and minimizing the quantity and frequency of CSO discharges. Sediment accumulations or blockages in the regulators or interceptor pipes can reduce the hydraulic capacity of the interceptor connections increasing the frequency of CSO discharges and, in severe cases, causing dry weather overflows. Backwater gates in need of maintenance could allow river water to enter the collection system, thereby reducing the capacity for sewer flows. Accordingly, adherence to a well-planned maintenance program can be important in controlling both dry and wet weather overflows.

The Albany Pool communities with the assistance of the Albany County and Rensselaer County Sewer Districts (RCSD) regularly inspect gates, siphons, and CSO regulator structures; and regularly clean sewers (combined and sanitary), interceptor systems, and catch basins. Dry weather overflows (DWOs) typically do not occur, unless due to a blockage, pump station failure or other unforeseeable event. The City of Cohoes has implemented a comprehensive plan of pump station improvements to increase the reliability of their pump stations to eliminate DWOs. Troy, Rensselaer and the RCSD are working together to address certain CSOs that are more susceptible to DWOs due to regulator blockages. Investigations are being performed to identify sources of debris and perform preventative maintenance on the sewer system.

#### 1.3.3.2 Regulator Modifications

Modifications to regulators can help to reduce CSO discharges by decreasing the frequency and/or volume discharged to the receiving waters. Regulators can be modified by raising weir elevations or increasing orifice openings to direct more flow to the interceptor, or to take advantage of upstream pipeline storage. Such measures maximize flow to the treatment facility, thereby minimizing untreated discharges to the receiving waters.

Downstream conveyance and in-line storage capacity should be fully utilized to the greatest extent possible in the combined sewer system. Accordingly, only when the storage is fully utilized will the effect of passing more flow through one regulator to reduce the number of CSO discharges result in increased CSO discharge volumes at the next downstream regulator. Dynamic or adjustable regulators may be installed for a higher level of system control to minimize the risk of flooding. While this type of regulator typically requires more maintenance due to the mechanical components, they can reduce the risk of flooding associated with the hydraulic influences of higher elevation sewersheds on those at lower elevations.

Regulator modifications are relatively low in cost and usually simple to implement. Other low cost system optimization measures include relieving small bottlenecks in regulators or the interceptor system. As confirmed using the collection system models, there are some areas in the Albany Pool sewer systems that bottleneck flow, which should be addressed. Following model calibration, evaluations were performed to maximize the capacity of the existing collection systems, fully utilize the available storage, and minimize CSO discharge volumes, frequencies and locations without any impact on the upstream collection systems. These evaluations considered regulator modifications, collection system upgrades to address hydraulic deficiencies, and other means of maximizing flow to the WWTPs. Regulator modifications will be included in the LTCP.

#### 1.3.3.3 Sewer Cleaning/Flushing

Deposition of solids is a common problem in many combined sewer systems. Combined systems were designed to handle peak wet weather flow; therefore, the hydraulic capacity greatly exceeds typical dry weather flow rates. Consequently, dry weather flow velocities are usually much lower than the design (full pipe) velocity and may cause solids to settle in the pipelines. Flow restrictions in wet weather also cause decreased velocities and settling of solids in upstream pipe sections. During large storms, these solids are re-suspended resulting in high pollutant concentrations during the initial period of a storm. Where sags or other system irregularities exist, storm flows may not re-suspend the deposited materials and the settled solids eventually accumulate, decreasing the hydraulic capacity of the pipe.

To avoid this “first flush" phenomenon (the re-suspension of settled solids due to storm flow) and maintain the hydraulic capacity of the pipes, sewers should be cleaned regularly by either mechanical means (rodding or draglines) or by flushing. Either technique will flush the solids through the system during dry weather, when system capacity is available to convey flow to the wastewater treatment plant. This will reduce solids discharged from CSOs to receiving waters during storm events and maximize the system conveyance capacity.

Many of the streets throughout the Albany Pool communities are tree lined. Sewer blockages can also be caused by tree roots entering the sewer in search of water through joints or imperfections in the pipe. The roots can form a ball or cause material back up and block the sewer. Root cutters or chemicals are typically used to remove and treat roots to eliminate the blockage. In severe cases, sections of pipe may have to be replaced to eliminate the root intrusion.

The Albany Pool communities and the sewer districts currently perform sewer cleaning on a regular schedule throughout the collection systems. The frequency of cleaning the sewer systems varies by community, depending upon the size of the sewer system and the availability of equipment and resources to perform the work. Sewers in historically problematic areas are cleaned more frequently – multiple times each year. However, past budget reductions have resulted in staff downsizing, leaving fewer crews to handle system operations and maintenance. It is recommended that current maintenance practices and cleaning schedules be reviewed to identify which areas and/or pipelines would benefit from more frequent cleaning, and determine the appropriate level of staffing required to perform these tasks.

Enhancement of the GIS mapping developed as part of this LTCP and development of asset management plans will be considered to facilitate recordkeeping and planning of system maintenance.

#### 1.3.3.4 Sewer Separation

Sewer separation is defined as the reconstruction of an existing combined sewer system into non-interconnected sanitary and storm sewer systems. The sanitary sewer system is tributary to the wastewater treatment facility, and the storm sewer system discharges directly to local receiving waters or detention ponds.

Typically, to separate an existing combined sewer area, either a new drainage system is constructed or new sewer pipelines are installed and the existing combined sewer is used as the sanitary or separate storm drain, respectively. In many cases, construction of new sanitary sewers is preferable due to the added benefit of reducing infiltration associated with deficiencies in the existing sewers. If portions of the combined sewer system were found to be susceptible to structural failure, they would likely require complete replacement and two new pipes would likely be constructed for the separate sewer and drain systems.

Unlike storage and treatment alternatives, which reduce the frequency of CSO discharges, full sewer separation of a combined sewer system eliminates CSOs by diverting all sanitary flow to the wastewater treatment facility and discharging stormwater to receiving waters. The EPA CSO abatement policies require that combined sewer system separation be evaluated as a step in CSO facilities planning. Although full separation eliminates CSOs, it may not, in all cases, be the most appropriate alternative in terms of addressing site-specific water quality objectives. Full separation eliminates pollutant loadings to receiving waters caused by the sanitary flow in CSOs; however, impacts caused by stormwater pollutants remain and often increase. Such pollutants may include animal wastes, bottles, cans, cups, wrappers, cigarette butts, leaves, sediment, and other items that enter the storm drains.

Under the EPA Phase II stormwater program, communities will be required to assess their stormwater quality. The EPA "Report to Congress, Impacts and Control of CSOs and SSOs" dated August 2004 states that implementation of stormwater controls may be necessary following separation to obtain pollutant load reductions necessary for attainment of water quality standards.

Furthermore, full sewer separation may not be economically or physically feasible in highly congested urban downtown areas. In some cases, older buildings with flat roofs often have roof drainage integrated with their plumbing systems. System wide sewer separation, although costly, is considered as a long-term plan technology and will be discussed further in this report. Also discussed as a viable alternative, is the concept of partial separation. Partial separation may be targeted to divert enough storm flow out of a particular regulator in the combined system tributary, so that local CSOs may be eliminated or greatly reduced. Areas where flooding is a known problem are good candidates for separation or partial separation. Partial separation projects, such as the ones already completed, and the planned elimination of CSO 013 in Cohoes target specific areas where CSO reduction benefits may outweigh the construction costs and other impacts.

Each of the Albany Pool Communities has performed full and/or partial sewer separation projects to reduce infiltration and inflow to their collection systems. Projects have historically focused on areas subject to sewer backups and flooding. The City of Troy is focusing on sewersheds where streams are known to enter the collection system. Diversion of the streams from the combined sewer system is expected to improve system capacity for conveyance of wastewater to the WWTP. Planned projects for each community will be discussed further in this report.

#### 1.3.3.5 Infiltration/Inflow Control

To maximize the collection system's ability to convey wastewater, it is necessary to remove extraneous flows caused by infiltration and inflow. Infiltration is groundwater that enters the system through broken or cracked pipes, defective joints, depressed manholes, and broken manhole walls. Replacing or lining defective pipes, pipe joints and manholes can reduce infiltration. Infiltration problems are generally difficult to isolate, which impacts the cost-effectiveness of this measure. Often, significant lengths of sewer must be rehabilitated before gaining significant infiltration reductions.

By design, surface runoff is the primary source of inflow into a combined sewer system with direct connections to the system from catch basins, roof leaders, sump pumps, cellar and yard drains. Inflow also results from commercial and industrial drains, and malfunctioning flap gates. In order to maximize wastewater capacity of the combined sewer systems, the Albany Pool communities will have to work with the surrounding communities to reduce inflow sources.

It is difficult to eliminate all inflow from a combined system. However, the measures discussed in previous sections of this report may be taken to reduce and attenuate peak flows. In addition, controlling inflow sources in the separated portions of upstream tributary communities would likely help reduce CSOs and minimize control structures by removing flow from the system before entering the combined system. Inflow sources could be diverted to separate storm drains in these separated areas at a lower cost than in combined areas, since the storm drains are often already in place. In some instances, the separated systems with apparent infiltration and inflow sources belong to a non-CSO community that contributes additional flow volume to the interceptor.

In light of the above discussion, the benefits associated with achievable levels of infiltration and inflow reduction in the both the combined and especially the separated portions of member communities will be evaluated further as a LTCP technology.

#### 1.3.3.6 Maximize Efficiency of Backwater Gates

This technology utilizes control valves and devices to optimize system operations through control of flow into and through the interceptor system. Regulating devices include vortex valves, inflatable dams, and motorized or hydraulically operated sluices or control valves. These devices are used to restrict downstream flow conveyance, thereby maximizing existing pipeline storage. These devices will be considered during evaluations to maximize flow to the WWTPs.

Backwater gates, such as tide gates, flap gates, or elastomeric gates, are used to prevent the receiving water from entering the interceptor system. The volume of inflow through backwater gates can be significant, particularly during high tide or following wet weather conditions. Debris from the overflow or the river enters the outfall pipe and occasionally causes gates to be propped open for extended periods of time. Although existing flap gates are regularly inspected, access to safely remove obstructions and minimize the amount of river water entering the combined system is particularly troublesome for those outfalls that are submerged. Accordingly, some problem backwater gates have been identified and recommendations will be developed for modifications to improve performance and access for maintenance. These improvements will help to reduce inflow sources and maximize system conveyance and treatment capacity that can be allocated for wet weather flow.

#### 1.3.3.7 Remote Monitoring and Control/Flow Diversion

Diverting flow from one drainage basin of limited hydraulic capacity to a drainage basin having excess capacity can reduce the volume and frequency of CSO discharge. Available and existing pipeline capacity may be used to convey flow, or as in-line storage. Components include: a data gathering system to monitor rainfall, pumping rates, treatment rates and regulator positions; a central computer processing center to provide real time control; and an instrumentation and control system to remotely regulate pumps, gates, valves and regulators.

Real-time control programs are available for providing either system-wide or localized control. System-wide, real-time control is capable of providing integrated control of regulators, gates, and pump station operations based on anticipated flows from rainfall events and actual flow conditions within the system. System response to control commands may be evaluated prior to execution, through the use of computer models linked to the real-time control system. Such global real-time control provides a means for optimization of the entire collection system (i.e. maximized flow to the treatment plant and minimized untreated discharges to receiving waters) for a variety of conditions. Local real-time control impacts specific dynamic regulators, based on feedback control from flow monitoring points located upstream or downstream of the point of interest.

While real-time control is a promising CSO control technology, the steep topography and the size and slope of the trunk sewers particularly in the Cities of Albany, Cohoes, Troy and Rensselaer present little opportunity for effective use of system storage. This technology will not be considered further for optimizing system performance.

#### 1.3.3.8 Relocation of CSO Outfalls

Relocation of CSO outfalls from sensitive to less sensitive discharge locations is similar to previous technologies in that regulator modification and flow diversion may be involved. This solution may also involve routing overflows through new pipe to a new discharge point, or just raising regulator weirs to force more flow downstream. It also may involve consolidation of CSO discharges to minimize the number of CSO control facilities and aid in their siting.

Relocation of CSO outfalls from sensitive areas to less sensitive areas or for the purposes of combining regulators to reduce the overall number of CSO outfalls will be considered further as a viable CSO control technology.

### 1.3.4 CSO Storage Technologies

Storage of CSO flows can be performed either at a local site adjacent to a regulator (or other control device), or downstream at a central site that consolidates the need for several facilities. Storage facilities are typically used to hold CSO discharge until after a storm event has subsided, at which time the flow can be conveyed to the treatment facility. However, storage facilities can also be designed to provide some sedimentation and disinfection treatment capacity for storms larger than the design storm used to size the storage facility.

Storage technologies generally represent larger, more costly structural modifications to a combined sewer system. These modifications are rarely undertaken without a complete assessment of the CSO discharges and interceptor system and the preparation of a system-wide facilities plan. These technologies are presented briefly below and include inline storage, off-line storage, and surface storage.

#### 1.3.4.1 Inline CSO Storage and Real Time Control

The use of inline storage can be considered a cost-effective method of reducing combined sewer overflows by utilizing available pipeline storage volume, in-line storage tanks where the dry weather flow passes directly through the tank, or parallel relief sewers. The storage volume helps to both dampen peak flows and detain combined wastewater for later treatment at the WWTPs. Inflatable dams, control gates or other devices, such as weirs, can be used to create or optimize inline storage in existing pipes during a rainfall event. Some of these devices and control measures are described above but, due to the steep topography, are not considered appropriate for the Albany Pool systems. Also, new oversized pipes may be constructed in the interceptor or collection system for improved inline storage capacity.

Inline storage can be a viable CSO abatement technology if the existing sewer system pipelines are large enough and deep enough to provide significant storage volume. Pipes with steep slopes require numerous flow control devices at regular grade changes to maximize use of available storage. With numerous flow control devices, inline storage is more difficult to control and less cost-effective than downstream controls.

Considering the limited storage volume available in the existing sewer system conveyance piping, these facilities will not be evaluated further as a LTCP measure.

#### 1.3.4.2 Off-Line CSO Storage

Off-line storage and pumpback to the interceptor system is one of the most widely used and effective methods for CSO mitigation. Similar to inline storage, off-line storage facilities temporarily store wet weather overflow volumes until the flow can eventually be conveyed and treated at the WWTP. Types of storage facilities include above ground tanks, underground tanks, shafts or conduits, abandoned pipelines, or deep tunnels. Off-line storage is usually located at individual overflow points for storage of localized CSOs. The storage facilities may also be located near dry weather or wet weather treatment facilities, or pump stations in lower reaches of the system, where the off-line storage would consolidate overflows conveyed in the collection system from upstream locations. These facilities can be relatively simple in design and operation, and can effectively reduce the frequency of overflows.

The location, sizing and design of off-line storage facilities must consider neighboring uses. Excessively long detention times can result in the settled solids causing offensive odors. Prompt dewatering and solids removal must be considered. Odor control equipment should be considered, as applicable. Additionally, off-line storage facilities can be used for providing contact time for disinfecting the effluent during larger events. Off-line storage facilities will be further evaluated as a CSO Long-Term control technology, as discussed later in this report.

#### 1.3.4.3 Surface Storage of CSO

There are several ways in which stormwater runoff can be captured and stored, prior to entering the collection system. Some means for storage include: roof storage, playground storage, natural ponds, or man-made basins or lagoons.

Roof storage can be effective in locations with buildings having flat roofs. However, stored water can seep into the buildings and/or damage the structural integrity of the building. Roof storage is most attractive for new construction in warm climates where snow and ice will not collect on flat roofs. Therefore, it is not usually an effective means for storage in cold weather climates like upstate New York.

Playground and recreational areas can be used to detain rainfall for a limited time to reduce peak flow in the system. Space availability, public acceptance and potential hazardous conditions are drawbacks associated with this method. In addition, use of these facilities to store runoff may interfere with their intended use and increase maintenance requirements.

Depending on existing land use and existing natural topography, temporary stormwater detention may be implemented for runoff attenuation. Storm flow retention in areas having porous soils will allow some or all of the detained flow to infiltrate into the soil instead of entering the combined sewer system.

Open space in densely developed urban areas is generally limited to parking lots and park /recreational areas. Typically, use of these areas for storage of runoff interferes with their intended use; thus, this technology is not desirable and will not be considered further.

### 1.3.5 CSO Treatment Technologies

Treatment technologies target reduction of pollutant loads in combined sewer overflows to receiving waters. In consideration of the findings of the receiving water and collection system characterization programs and the CSS and receiving water quality modeling, the evaluation of treatment technologies will focus on those specific technologies suitable for addressing floatables and bacteria. Treatment residuals must be addressed as part of the implementation plan. Technologies used for treating CSOs prior to discharge are presented below.

#### 1.3.5.1 Wastewater Treatment Plant Improvements

Increasing the capacity of the Albany County Sewer District (ACSD) and Rensselaer County Sewer District (RCSD) Wastewater Treatment Plants to handle higher peak wet weather flows is one way to reduce the frequency and volume of untreated CSO discharges upstream in the collection system.

An option that is typically available to communities which serve combined sewer systems is to allow more flow to pass through the WWTP during wet weather events. This can be accomplished by increasing primary treatment and disinfection capabilities, and bypassing the secondary treatment process. The RCSD, ACSD North and ACSD South WWTPs currently send all flows (wet and dry weather) through primary treatment but bypass a portion of the flows in excess of secondary treatment capacity. While operating in this mode, each of the WWTPs provides screening, grit removal, primary sedimentation, and partial secondary treatment before discharging to the Hudson River. This operation consistently achieves their treatment requirements, while preventing beneficial organisms from washing out of the secondary treatment tanks during high flows. While the ACSD North and South WWTPs receive and treat the peak flows identified in their permit, the RCSD WWTP does not have the capacity to receive and treat the permitted peak wet weather flows. As a result, this option represents an attractive means for reducing CSOs and maximizing flow through the RCSD treatment plant, and will be further discussed herein.

The sewer districts are currently in negotiations with the NYS DEC to clarify their peak wet weather treatment capacity and disinfection requirements. In order to maximize flow to the treatment facility, improvements to the collection system infrastructure will also be required. Maximization of collection system capacity will also be evaluated in this report.

#### 1.3.5.2 CSO Screening

Screens for wastewater treatment are available in various types and sizes, ranging from bar racks to coarse/fine screens or microstrainers. Screens can be installed at either inline or off-line facilities. Inline facilities must be closely monitored and cleaned to prevent loss of hydraulic capacity, which could cause flooding. Screens are effective in removing large solids and floatables from the CSO flow - the effectiveness being dependent on the clear opening of the screen. The size of the screen openings determines the level of treatment achieved.

Microstrainers can achieve primary treatment levels by removing 60 percent of the suspended solids. However, high headlosses, O&M requirements related to clogging, and reportedly reduced disinfection effectiveness of microstrained flows (attributed to a shredding effect of solids resulting in increased surface area for bacteria growth) detract from the attractiveness of microstrainers in some applications.

Mechanical bar screens are typically installed at the entrance to storage and treatment facilities to remove large objects, trash, and debris, and to protect treatment and pumping equipment. Often, two sets of screens in series are used. The first set usually consists of coarse screens with 1-½ to 3-inch bar spacing. Finer screens with ¼-inch to 1-inch spacings are located just downstream. A double screen set-up also has less of a tendency to become blocked than a single fine screen.

In lieu of stationary fine bar screens, traveling woven wire mesh screens are sometimes used. These types of screens provide more efficient removal of floatables, but operation and maintenance requirements are extremely high. Since the media are cleaned using a high velocity water jet spray, handling and disposal of this sidestream would greatly increase operation complexity, as well as the required building size, operational requirements, and, consequently costs. In addition, head loss through this unit is two to three times that of a stationary unit. Accordingly, this method of fine screening is not considered applicable for use at CSO storage or treatment facilities.

Mechanical stormwater screens have become popular for remote capture of floatables within the interceptor system. These screens are designed to maintain solids and floatables within the collection system for removal by mechanical bar screens at regional locations such as pump stations or WWTPs. The bar screen openings are 6 millimeters and are cleaned with plastic combs whose teeth ride within the opening, pushing material off of the face of the screen and back into the flow to the interceptor sewer. The cleaning mechanisms are hydraulically operated and powered by a 3 to 5 horsepower motor. The screened flow is conveyed to the outfall pipe.

Operation and maintenance primarily consists of periodic inspections and changing fluids on the hydraulic power pack. These screens are designed to maintain the floatables and solids within the existing interceptor sewer and prevent them from discharging through the outfall pipe. The interceptor sewer transports the material in the wastewater flow to a pump station or the WWTP headworks where the floatables and solids are removed by existing mechanical bar screens The screens discharge the material to dumpsters where it is stored until it can be transported for disposal. .The compact design of the stormwater screens allows them to be constructed in below grade chambers with the hydraulic power pack in a traffic control box at grade for easy access for maintenance. Stormwater screens have also been successfully used as pretreatment prior to disinfection of CSOs.

Netting systems provide another option for screening and capturing solids and floatables from CSO discharges, but do not provide sufficient solids removal to be used as pretreatment for disinfection of CSOs. Netting systems can be provided as end-of-pipe or in-line systems. End-of-pipe systems include in-water systems and headwall systems. In-line systems are constructed within underground chambers with access hatches provided for replacement of full nets. In-water systems consist of netting supported within framework floating on pontoons. Booms are used to direct floatables to the mouth of the net sack. Headwall systems consist of netting installed within a framework system fastened to the outfall headwall.

The openings in the netting are typically ½", but alternate sizing can be provided. The size (length, width and height) of the netting sacks varies based on the particular application, the estimated volume of solids and frequency of replacing the nets. Netting systems can be costly due to the manually intensive labor. A crane is typically used to hoist the nets and transfer them to a dumpster or truck for transport. The nets and captured floatables are typically transported to a landfill for disposal.

Screening is a viable treatment alternative to meet CSO floatable control strategies. Specific screening technologies to be advanced in the LTCP will be determined on a case-by case-basis and will consider known operational performance and community preferences.

#### 1.3.5.3 Sedimentation

Gravity sedimentation using high surface overflow rates (to conserve space) can achieve 20 to 40-percent BOD removal and 50 to 70-percent TSS removal in CSOs. Land requirements and residual solids handling are important considerations in determining the feasibility of sedimentation.

Sedimentation reduces solids loadings from CSOs by gravitational settling and removal of suspended solids. As a result, metals and BOD loadings are also reduced. In addition, the process is used in many wastewater treatment applications providing an extensive base of full scale operating data.

The major disadvantage of sedimentation is that land requirements are relatively high. Because land availability is usually limited in urban areas, siting of CSO abatement facilities with sedimentation basins can be a challenging issue. Considering the size requirements and potential for odors, sedimentation will not be considered for CSO treatment. The use of this technology will be limited to supplementing wet weather capacity at the existing WWTPs.

#### 1.3.5.4 Enhanced High-Rate Clarification

A relatively new concept for treating storm flows is enhanced high-rate clarification. This technology, which can be operated intermittently during storm events, is a physical-chemical process in which coagulant and polymer are added to wastewater. The coagulant aggregates the suspended solids in the flow into a floc. The resulting floc particles adsorb onto either very fine sand added to the wastewater, or recirculated solids with the aid of a polymer. The fine sand (or recirculated solids) acts as ballast and increases the settling rate of the adsorbed floc. Hence, the process is also known as “ballasted flocculation.”

A typical ballasted flocculation system consists of the addition of ferric chloride, polymer, and “microsand” (sand approximately 100 microns in diameter) to wastewater. The wastewater and additives are rapidly mixed (flash mixing), then slowly stirred in a maturation tank before settling in a clarifier. In the systems, which utilize microsand, the sludge from settling is passed though a hydrocyclone, where the microsand is removed from the sludge and recycled.

At least three suppliers provide enhanced high-rate clarification systems. Suppliers include: Kruger’s Actiflo process, which uses microsand as ballast, Siemens Microsep process, which also uses microsand as ballast, and Infilco Degremont’s DensaDeg process, which uses recirculated solids as ballast.

Whichever process is selected, BOD and TSS removal rates associated with high-rate clarification have been shown to be roughly double those of traditional clarification. BOD removal is between 65 and 80 percent and TSS removal is between 70 and 95 percent according to the EPA’s August 2004 “Report to Congress on the Impacts and Control of CSOs and SSOs”. Other benefits of this process are:

- Area requirements are only one-tenth of traditional clarification area requirements (5 to 15 percent of the space required for conventional primary treatment)

- Can handle high hydraulic loading rates and treat rapidly varying flows, and
- Able to achieve secondary treatment concentration standards for BOD and TSS

The storage of chemicals and response/start-up time may be of concern if this technology is implemented at a satellite location, away from the WWTP. Other disadvantages of this technology include the increased operational cost relative to biological treatment and conventional clarification due to the cost of chemicals, ballasted media, and sludge disposal and the limited ability to remove soluble pollutants. Also, many of the technologies reviewed have limited ability in removing soluble pollutants. Given the relative infrequent operation of the high rate clarification system, the increased operational costs may not be as substantial as initially expected. The August 2004 "Report to Congress on the Impacts and Control of CSOs and SSOs" illustrates the operating cost of a chemical or physical treatment process, like ballasted flocculation versus the operating cost of a biological process. Since the biological process has to operate continuously, albeit at small flows most of the time, the annual operating costs are higher than for the intermittent operation of a process such as ballasted flocculation.

In summary, enhanced high-rate clarification provides significantly higher treatment capacities than conventional primary treatment, with significantly higher BOD and TSS removals. Therefore, enhanced high-rate clarification is generally considered a viable alternative for providing higher wet weather treatment flow capacity and reducing CSOs. However, the cost of this proprietary technology will have to be weighed against the benefits to determine its true viability in the project area. Furthermore, potentially higher O&M requirements associated with this technology may limit its applicability to areas that can support these requirements. For example, enhanced high-rate clarification may be viable for implementation at the regularly staffed WWTP, but may be more difficult to support at unmanned satellite treatment facilities. Screening is required prior to the ballasted flocculation treatment component and disinfection is required after. UV disinfection can be utilized with ballasted flocculation treatment because of the high level of suspended solids removal.

As there are more cost-effective options for addressing the primary pollutants of concern (bacteria and floatables), enhanced HRC will not be considered for in-system treatment of CSOs or supplementing the existing wet weather capacity of the WWTPs.

#### 1.3.5.5 Chemical Flocculation

Chemical flocculation is a high-rate treatment process utilizing metal salts and polymers to aggregate particles in CSO flow. Depending on their density, the aggregate of particles, or floc, will either sink to the bottom or float to the top where it can be removed. A concentrated sludge is produced, requiring no additional thickening. Chemical flocculation is reported to remove 40 to 80 percent BOD and 60 to 90 percent TSS. Similar to ballasted flocculation, chemical flocculation can handle high hydraulic loading rates and treat rapidly varied flow. Chemical flocculation is also limited in its ability to remove soluble pollutants. There is a potential increase in sludge production due to the addition of treatment chemicals and an increased operational cost due to the cost of chemicals. Since ballasted flocculation achieves similar results to chemical flocculation but at a higher hydraulic capacity (20,000 gpd/sq. ft for chemical versus 90,000 gpd/sq. ft. for ballasted flocculation) and similar high costs; chemical flocculation will not be further considered for in-system treatment of CSOs.

In consideration of the findings of the Wet Weather WWTP Capacity Evaluations, further consideration of chemical flocculation under this LTCP will be limited to enhancement of existing WWTP processes at the RCSD WWTP.

#### 1.3.5.6 Dissolved Air Flotation

Dissolved air flotation (DAF) relies on small air bubbles to suspend particulate matter to float to the surface for removal. Oil, grease, and other floatables can also be removed. This technology has been used to treat CSOs and has proved to be relatively effective in removing up to 20 to 50 percent of the suspended solids and floatables.

Small and light suspended matter can be removed more efficiently and quickly by this process than by sedimentation. Chemical addition (generally polymer) is usually used to improve removal efficiency. Operating costs are relatively high due to pumping costs to pressurize the water and compressed air, and chemical requirements. The process is also sensitive to operational control.

DAF has been used primarily for processing sludges in municipal, industrial water, and wastewater treatment applications and most recently for water treatment. Due to the relatively high operating costs and sensitivity to operational control associated with DAF, other less costly and complex technologies have been developed that have replaced DAF in many applications.

DAF is not recommended for CSO abatement because of operational demands that are further complicated by the characteristics of CSOs, such as the need for start-up on short notice and ability to handle highly variable flow rates. Consequently, DAF is not considered feasible for CSOs and will not be considered further.

#### 1.3.5.7 Vortex Treatment Technologies

Vortex treatment technologies separate suspended solids and floatables from liquid flow through rotationally induced forces. These technologies have been reported to remove up to 50 percent of the suspended solids from the combined sewer flow, but historical data on treatment effectiveness tends to be highly variable among facilities currently in operation.

There are several types of vortex treatment technologies including swirl concentrators, continuous deflective separation, which use a screen to capture and retain solids, and vortex separators, which use tank geometry and hydraulics to provide settling. Some vortex technologies operate in-line, and others are designed to operate off-line. They are available in various sizes, depending on peak flow rate. In general, these units can be less expensive than other traditional CSO treatment technologies.

Vortex separators are commonly used for stormwater treatment, since many have proven to be effective for debris removal, such as plastic products, wrappers, styrofoam cups, sticks, rocks, etc. Some vortex technologies also remove petroleum products and grease, which are other common pollutants found in stormwater runoff.

The vortex removal concept has several advantages over other treatment/storage options, because these types of units:

- Regulate flow to the interceptor systems and treat CSO discharge;
- Require less land area than conventional sedimentation or off-line storage;
- Contain virtually no mechanical equipment and, because solids remain in suspension, do not require removal facilities; and
- Have low operation and maintenance costs.

Vortex treatment technologies represent a potentially low cost and efficient technique to provide effective satellite floatables control. These units, however, have some limitations and potential drawbacks, including:

- Underflow diversion rate is subject to design limitations, relative to incoming combined flow;
- Loss of floatables to overflow during extremely high flows,
- Tank configuration results in a large hydraulic headloss requirement between the influent combined sewer and the underflow pipe;
- Limited long-term data available concerning performance and reliability;
- Fair to poor removal of oil and grease, nutrients, and colloidal material; and
- Negligible removal of soluble solids and pollutants.

In order to operate effectively, vortex treatment technologies need to be cleaned regularly. A maintenance schedule should be established based on solids loading and accumulation rates. Some types of vortex treatment must be dewatered and cleaned with a vacuum truck, which will increase work demands of the collection system maintenance crews. Other types of systems are designed to pump out the debris that is screened out of the flow, which can potentially create sedimentation and grit accumulation in pipelines.

The City of Cohoes has successfully operated a continuous deflective separation unit at their Mohawk street outfall (CSO #7) since 2005. Because of the effectiveness of this unit as a floatables control device, they are considering utilizing a similar satellite system elsewhere. The Village of Green Island is also considering implementation of this technology at their Hamilton Street outfall.

Because of the uncertainty concerning solids removal efficiencies, the lack of bacteria removal andspace requirements, vortex removal technologies will only be considered for floatables control.

#### 1.3.5.8 Biological Treatment

Biological treatment processes, including contact stabilization, trickling filters, rotating biological contactors, treatment lagoons, and land application, have been most successfully used in the treatment of sanitary sewage and industrial wastewater. Their exclusive use for the treatment of combined sewer overflows has several drawbacks including:

- Difficulty maintaining biomass (used to assimilate nutrients in combined sewage) during dry weather (continuous operation is required);
- Difficulty in handling erratic loading conditions inherent to combined sewer overflows;
- Potential odors and snail population problems;
- High clogging potential;
- Costly operation and maintenance;
- Highly skilled operators are required; and
- Extensive level of treatment provided by biological treatment is not required for combined sewage.

Potentially, CSO discharge into wetlands could provide some level of biological treatment; however, this is not considered appropriate for the combined sewer area. Consequently, biological treatment off site of the WWTPs will not be considered further in this study.

#### 1.3.5.9 Filtration

Filtration is a physical treatment process that removes solids by straining wastewater through a filter medium, such as sand, charcoal (carbon adsorption), or membranes. Deep bed filtration has the ability to treat high and rapidly varying flows. Filtration can consistently achieve secondary treatment concentration standards for BOD and TSS. Its major disadvantage is the tendency to clog rapidly during use, thus limiting its hydraulic capacity and ability to remove solids; or the need for frequent backwashing to prevent clogging. It can be used after sedimentation to reduce clogging, but this level of treatment is typically not required for CSO applications. Consequently, filtration will not be considered.

#### 1.3.5.10 Disinfection

Disinfection is used to destroy pathogenic microorganisms. Many disinfection technologies are available including chlorination, ozonation, and ultraviolet radiation. The most common method is chlorine addition, although its apparent toxicity to aquatic life is a concern. For this reason, dechlorination is often required.

Both chemical disinfection and UV disinfection have been widely used with WWTPs following conventional primary and secondary treatment. Disinfection agents used for wastewater and stormwater treatment include: gaseous chlorine, hypochlorite (calcium and sodium), chlorine dioxide, and ozone. All of these disinfection agents are oxidizing agents, corrosive to equipment, and are highly toxic to microorganisms and other life. Ultraviolet light has been used as a disinfection agent, but has proven to be ineffective for most satellite CSO treatment systems because of their turbid mixed flows. There has been limited success in using UV disinfection after technologies such as screening and swirl concentrators. However, new ultraviolet technologies are becoming available and may prove to be effective for CSO disinfection. Also, UV disinfection has the potential to be used after other treatment processes, such as ballasted flocculation due to that process's better removal of finer particles.

Selecting a disinfection system is based on the following considerations:

- Existing infrastructure.
- Capability to meet highly variable fluctuations, in terms of both quantity and quality.
- Availability of trained operators to carefully handle dangerous gases, typically chlorine, chlorine dioxide, or ozone. Although there are fewer hazards associated with hypochlorite, it requires bulk storage.

When selecting a disinfection system, the capacity and location of the treatment facility must be considered. Use of toxic gases is undesirable in densely populated areas and small-scale facilities that are only monitored periodically. For this reason, use of gaseous chlorine is not considered.

Case studies regarding the use of bromine chloride, ozone, peracetic acid and ultraviolet light for CSO disinfection are limited at this time. Ozone has been proven to be effective, although it is considered expensive. Ultraviolet light is typically only effective for flow with lower turbidities;large particles block much of the light, rendering this technique ineffective.

Generally, chlorination (hypochlorite) is accepted as the most cost-effective and technically reliable disinfection treatment to reduce coliform levels. Chlorination with liquid sodium hypochlorite will be considered further. High-rate chlorination with hypochlorite represents a variation of traditional chlorination methods that may also be pursued. High-rate chlorination enables effective disinfection with reduced contact times. This is accomplished through a combination of higher disinfectant dosing and intensive mixing. This technology is usually implemented in cases where existing facilities will not provide adequate contact times to achieve the desired bacteria kill rates. Thus, construction costs for new facilities are avoided. Also, it may be effective in minimizing space requirements for new chlorine contact basins. Acceptable bacteria kill rates have been reported for high-rate chlorination with contact times as low as 5 to 7-minutes.

To eliminate the potential toxic effect of residual chlorine on biota, chlorinated effluent may need to be dechlorinated prior to discharge. General dechlorination practice indicates that sodium bisulfite is a reliable and cost-effective chemical to remove chlorine residuals from the wastewater effluent.   This may not be required in some locations if a TMDL approach to residual chlorine is approved.

### 1.3.6 Summary

This assessment has eliminated many technologies from further consideration for the Albany Pool CSO LTCP. Those technologies which remain have been identified as the best options for directly addressing the primary pollutants of concern (bacteria and floatables) as identified in the receiving water quality characterization and modeling efforts. Other technologies on this list have been identified for addressing BMPs. These technologies will incorporate good maintenance practices to ensure that system operation is maximized to the extent possible before more expensive structural controls are implemented. The remaining controls technologies will be further evaluated later in this report. Table 1-3 provides a summary of these technologies.

**Table 1-3: Long Term Control Plan Technologies**

| CSO Abatement Technology | Application |
|---|---|
| Disinfection at the Treatment Plants | Sewer Districts |
| WWTP Improvements | Sewer Districts |
| Existing Collection System Management | Communities & Sewer Districts |
| Regulator Modifications to Enhance CSO Capture | Sewer Districts |
| Maximize Efficiency of Backwater Gates | Communities |
| Infiltration/Inflow Control | Communities & Sewer Districts (also upstream communities with separate systems) |
| Relocation of CSO Outfalls | Communities |
| Sewer Separation | Communities |
| Off-line CSO Storage Tanks | Communities |
| Screening (Including Vortex Treatment) | Communities & Sewer Districts |

## 1.4 Evaluation of CSO Control Facility Requirements

The SPDES Permits for each of the communities and sewer districts identify the basic requirements for combined sewer systems. Each permit includes 15 best management practices (BMPs) for CSOs which focus on improving collection system performance and reducing water quality impacts of CSO discharges. The SPDES permits for each of the sewer districts also include requirements for seasonal disinfection of WWTP effluent, as well as a residual chlorine limit.

While the SPDES Permit requirements provide the minimum basic requirements for CSO control, the USEPA CSO Control Policy provides the regulatory framework for evaluating CSO control alternatives. The Policy allows for two approaches to CSO control evaluations, the Presumption Approach and the Demonstrative Approach.

In accordance with the regulatory compliance strategy for the Albany Pool Communities discussed above, the Demonstrative Approach will be used for development of the CSO Long Term Control Plan (LTCP). CSO controls will primarily focus on achieving regulatory compliance as measured by the water quality standard for fecal coliform. Consistent with the demonstrative approach, the Albany Pool communities plan to take a build and measure approach to allow them to cost–efficiently address CSO related water quality compliance issues. The CSO LTCP will initially focus on the main contributors of the primary pollutant of concern (bacteria), and then address other measures for improving system performance, reducing CSO discharges and controlling floatables in the remaining overflows.

As indicated by the receiving water modeling, reduction of continuous sources of fecal coliform provide the greatest bacteria-based water quality benefits to the Hudson River. Seasonal disinfection of all WWTP effluent and enhancement of tributaries provide opportunities for significantly reducing continuous bacteria contributions to the river. Additional CSO control measures include WWTP capacity improvements, best management practices (BMPs), system optimization, and sewer separation. These control measures provide improvements in wet weather capture and reduction of CSO discharges. Floatables control facilities provide the means for minimizing the discharge of floatables associated with those CSOs remaining after the implementation of the LTCP. Additional tools for improving CSO control and educating the public have also been considered.

In accordance with the foregoing discussion, CSO controls have been evaluated and categorized into the recommended projects as follows:

- Disinfection Projects – These consist of seasonal disinfection of the effluent at each sewer district WWTP.

- Tributary Enhancements – The water quality improvements observed along Patroon Creek during the water quality sampling program highlight the benefits of investigating sources of bacteria contributions to tributaries of the Hudson River. Initial projects will consist of field investigations to identify potential illicit sewer connections, failed septic systems, exfiltration from sewers running parallel or crossing stream, or other sources of bacteria.

- BMPs/System Optimization – These projects focus on SPDES Permit BMPs and maximizing the performance of the existing infrastructure through system characterization and mapping, regulator modifications, reduction of system inflow, capacity upgrades, and improved operations.

- Sewer Separation/Storm Water Storage – These projects consist of separating sewers in select sewersheds (including diverting streams from existing combined sewers and storm water from existing outfalls), installation of storm water storage structures, diversion of stormwater to groundwater recharge basins.

- Floatables Control Facilities – These facilities provide screening of CSO discharges to remove floatable material. Projects were identified based upon the volume of overflow contributed by a particular outfall or its location in relation to recreational areas. Projects also include consolidation of outfalls where appropriate.

- Additional Pool-Wide Projects – These projects were developed for the purpose of improving management and operations of the existing wastewater infrastructure, modifying land use ordinances for the purposes of controlling stormwater runoff and developing programs for educating the public on the water quality impacts of CSOs on the Hudson River.

### 1.4.1 Disinfection Projects

The SPDES permits for each sewer district include requirements for seasonal disinfection of effluent from May 1 through October 31 of each year. The permits for the Albany County and Rensselaer County Sewer Districts differ slightly but both include fecal coliform limits for 30 day and 7 day geometric means (200 and 400 CFU/100 ml respectively) and a daily maximum for total residual chlorine limit, and an implementation timeline.

Each of the sewer districts is currently moving forward with designs for disinfection facilities to achieve compliance with their permits. The Rensselaer County permit requires they complete construction of the disinfection facilities and achieve compliance with the effluent disinfection requirements by September 1, 2012. A separate study performed by others recommended a low pressure, high output ultraviolet light disinfection system with a chlorination/dechlorination based disinfection system for peak wet weather flow. The Albany County permit requires they commence construction 30 months following the approval of the LTCP. To support the basis of design for their disinfection projects, the ACSD completed a New York State Energy Research and Development Authority (NYSERDA) study that evaluated the disinfection alternatives at their North and South plants. Based on the findings of that study, the ACSD has elected to pursue the design and construction of a chemical disinfection system at the North Plant using sodium hypochlorite and a low pressure, high output ultraviolet light disinfection system at the South Plant.

As shown by Scenario 1 of the water quality modeling, as summarized in Table 1-1 earlier in this report, the implementation of disinfection facilities at the WWTPs will result in reducing the frequency of bacterial exceedances from 30 to 2 months over a 5 year simulation period. Similar improvements to the quality of the headwaters of the Hudson and Mohawk Rivers are anticipated as disinfection facilities are constructed and placed into service for WWTPs upstream of the Albany Pool. A summary of the proposed disinfection projects identified in this LTCP follows in Table 1-4.

| Table 1-4: Disinfection Projects | |
|---|---|
| **Community/Sewer District** | **Project Name** |
| ACSD | North Plant Disinfection Project |
| ACSD | South Plant Disinfection Project |
| RCSD | Disinfection Facilities at WWTP |

### 1.4.2 Tributary Enhancements

Scenarios 2 and 2A of the receiving water quality modeling showed that improvements to tributaries can result in compliance with the bacteria standard for the Hudson River. Water quality sampling performed in 2008 and 2009 along Patroon Creek showed measureable reductions in the bacteria levels during dry and wet weather conditions following the performance of field investigations and corrective actions by the City of Albany and the Albany County Sewer District (ACSD). Additional trunk sewer repairs are proposed along Patroon Creek to expand upon the improvements observed from the previous sewer rehabilitation work.

In consideration of the water quality improvements observed on the west side of the river, as a result of investigation and repairs, a number of projects have been identified for the purposes of evaluating Hudson River tributaries which pass through the Cities of Troy and Rensselaer. The projects initially consist of investigations along each of the tributaries. Additional projects will follow based upon the findings of the field investigations.

Table 1-5 provides a summary of the Recommended Tributary Enhancement Projects.

| Table 1-5: Tributary Enhancement Projects | |
|---|---|
| **Community/Sewer District** | **Project Name** |
| ACSD | Patroon Creek Trunk Sewer Repairs |
| Rensselaer/East Greenbush | Investigate Non-CSO Bacteria Sources Along Mill Creek |
| Troy | Cross Street Trunk Sewer (CSO 045) Evaluation (Along Wynants Kill) |
| Troy | Cross Street Trunk Sewer Repair Along Wynants Kill (CS0 045) |
| Troy/Brunswick | Investigate Non-CSO Bacteria Sources Along Poesten Kill |
| Troy/North Greenbush | Investigate Non-CSO Bacteria Sources Along Wynants kill |

### 1.4.3 WWTP Process Improvements

BMP #5, as listed in the SPDES Permit establishes the capacity requirements for receiving and treating peak wet weather at each WWTP. The wet weather capacity of each of the sewer district WWTPs was evaluated in the June 2011 Wastewater Treatment Plant Wet Weather Capacity Report for compliance with their SPDES Permits. Alternatives for enhancing the wet weather capacity of each WWTP were evaluated as part of the control evaluations.

The evaluation discussion in the WWTP Wet Weather Capacity Report concluded that ACSD North WWTP is limited by its process capacity. The plant has an existing average primary treatment capacity of 35 mgd and an existing average secondary treatment capacity of 29 mgd. Plant effluent passes through the existing disinfection contact tanks but no disinfection capability currently exists. The plant has an existing peak wet weather primary treatment capacity of 88 mgd and an existing peak secondary treatment capacity of 55 mgd. During peak wet weather flow events, the primary effluent in excess of 55 mgd is sent through the secondary bypass and blended with the secondary effluent before discharge. The ACSD North Plant evaluation concluded that the plant operations support the best management practice of maximizing flow to the WWTP. Peak wet weather capacities determined by this evaluation are consistent with current operations. The existing operations and plant performance support the treatment of peak wet weather flows up to the original design flow of 88 mgd for primary treatment and 55 mgd for secondary treatment at current influent characteristics. Though short term preliminary and partial primary treatment in excess of 88 mgd can be provided, accepting more flow to increase the wet weather peak influent above current levels is not recommended in order to avoid performance degradation; particularly since the loss of one unit will significantly increase the load on the remaining units in service.

The evaluation for the ACSD South WWTP concluded that the South Plant is limited by both its hydraulic and process capacities depending on the flow condition and Hudson River elevation. Because of the hydraulic limitation, the capacity can be influenced by Hudson River elevation. The ACSD South WWTP has an existing average primary and secondary treatment capacity of 29 mgd. Plant effluent passes through the existing disinfection contact tanks but no disinfection capability exists. Similarly, the plant has an existing peak wet weather primary treatment capacity of 29 mgd and an existing peak secondary treatment capacity of 32 mgd. The peak wet weather capacities for both primary and secondary treatment limits are controlled by the plant hydraulic capacity. Because the peak process capacities exceed hydraulic capacities, the plant is operated outside normal hydraulic limitations in order to maximize wet weather flow and reach the process capacity limits. Under these circumstances, the plant secondary and primary clarifier weirs are allowed to submerge, resulting in a peak wet weather primary treatment capacity of 45 mgd and an existing peak secondary treatment capacity of 40 mgd. During peak wet weather flow events, the primary effluent in excess of 40 mgd is sent through the secondary bypass and blended with the secondary effluent before discharge.

The RCSD SPDES permit reads as follows: “The treatment plant shall be capable of receiving and treating: the peak design hydraulic loading rates for all process units;

i.e., a minimum of 63.5 mgd through the plant headworks; a minimum of 51 mgd through the primary treatment works and disinfection works if applicable; and a minimum of 51 mgd through the secondary treatment works during wet weather. The interceptors shall be capable of delivering those maximum daily flows during wet weather."

The capacity evaluations for the RCSD WWTP identified that the plant will easily meet current permit limits at the future average day condition, but will have difficulty treating 51 mgd through secondary treatment per the current SPDES permit. Even though the plant appears to be able to handle 70 mgd hydraulically, it will likely not be able to treat this flow even if only 35 mgd is directed through the secondary system.

The plant performance is predicated on influent strength, primary settling tank (PST) total suspended solids (TSS) removal, sludge settling properties in the final settling tanks (FSTs) and duration of storm event. Upgrades to the final settling tanks are needed to achieve treatment of 51 mgd through the secondary system. Other options could include converting the existing four FSTs from peripheral feed to center feed to reduce severe short circuiting, ballasted flocculation of the aeration tank mixed liquor to enhance settling in the final settling tanks or install a separate high rate physical/chemical treatment process downstream of the primary settling tanks. The effluent from the high rate process would be tied into the secondary bypass and combined with the final settling tank effluent.

In summary, certain processes would also likely require upgrades to allow permitted flows to be treated at the RCSD plant including:

- Influent screens
- Grit removal system (primary sludge degritting)
- Final settling tank upgrades

**Influent Screens**
The influent screens (total of 3) are rated for 21 mgd each. Currently only one screen operates and another can be used as a manual bar rack during peak flow events. The County is currently replacing two of the three screens under a separate project, with construction scheduled to start in 2011.

**Primary Sludge Degritting**
The increased amount of primary sludge and associated grit projected may be an issue with the grit screw collectors and capacity of the aging grit classifiers. RCSD has indicated that the primary clarifier screw collectors can become overloaded with grit and debris now. When this happens, a tank has to be drained and the grit manually removed in order to put the tank back into service. This is a current bottleneck and will need to be addressed in the future.

**Final Settling Tank Upgrades**
In order to treat 51 mgd per the current SPDES permit, the existing four peripheral feed clarifiers would need to be demolished and new center feed mechanisms installed.

This would require significant construction sequencing to maintain plant operations and tie-in to existing yard piping.

A summary of the recommended WWTP Process Improvements Projects is provided below in Table 1-6.

| Table 1-6: WWTP Process Improvements Projects | |
|---|---|
| **Community/Sewer District** | **Project Name** |
| RCSD | Replacement of Mechanical Bar Screens |
| RCSD | Primary Sludge Degritting |
| RCSD | Final Clarifier Upgrades |

### 1.4.4 BMPs/System Optimization

The combined sewer system modeling discussed in the CSO Model Development and Baseline Conditions Report (October 2009) evaluated the capacity of the collection systems to convey the peak wet weather flows to each of the WWTPs. The baseline modeling performed as part of the development of this LTCP identified a number of locations where capacity limitations exist.

Best management practices #1, 4, 5, 6 and 14 included in each community's SPDES permit primarily focus on improving system performance, maximizing flow to the WWTP and minimizing the risk of dry weather overflows. The following is a description of these BMPS:

- BMP# 1 requires the community to regularly inspect and maintain their collection system components.
- BMP #4 requires the communities and sewer districts to maximize the flow to the WWTPs.
- BMP #5 provides specific peak wet weather flows to be received at each of the WWTPs.
- BMP #6 prohibits dry weather overflows from combined sewer systems.
- BMP#14 addresses characterization and monitoring of the collection system and provides additional information to the sewer system operator to providing for a better understanding of how the collection system reacts to wet weather conditions.

The BMP #6 permit requirement relates to the regulator structures owned by the sewer districts. These structures divert wastewater to the interceptor system and are intended to divert dry weather flow to the WWTP, while limiting overflows to wet weather conditions. As the communities own the CSO outfalls, this permit requirement is also contained in their SPDES Permits. Therefore, responsibility for inspection and maintenance to prevent dry weather overflows is shared between each community and the sewer district. Troy, Rensselaer and RCSD are currently negotiating a consent order with NYSDEC in relation to alleged dry weather overflows. The CSO control evaluations herein will focus on the areas of concern and improving system performance to maximize flow to the WWTP and minimize the risk of dry weather overflows.

While each of the communities and sewer districts have procedures they follow for maintaining their respective collection systems in accordance with BMP #1, the City of Rensselaer has identified a specific project required to address a perpetual capacity issue. DPW crews have been unable to inspect and clean a section of trunk sewer on Partition Street due to railroad access limitations. This section of sewer is suspected of restricting flow and causing backups during wet weather conditions. The City is moving ahead with right-of-way access negotiations with the railroad necessary for performing the cleaning and inspection of the sewer. Upon review of the sewer inspection, a report will be developed with recommendations for rehabilitation or replacement projects to be performed to address the capacity issues.

The City of Albany also undertakes routine cleaning and inspection of the combined sewer pipes. The upgrading of comminutors at two pump stations will improve the function of the collection system as a whole. Additionally, ongoing sewer rehabilitation on pipes throughout the city is being completed in accordance with BMP#1.

Several projects are recommended for addressing BMPs #4 and #5. On the east side of the River, the Rensselaer County Sewer District plans to perform upgrades to the 106th Street and Monroe Street Pump Stations in Troy and the Aiken Street and Forbes Avenue Pump Stations in Rensselaer. The upgrades will include replacement of the manually cleaned bar screens with mechanical screens and upgrades to the pumping equipment and controls to convey a minimum wet weather peak of 63.5 mgd in accordance with the district's SPDES Permit.

The City of Albany has proposed a number of projects for the LTCP in order to maximize the wastewater flow to the WWTP. The installation of a tide gate at Bouck will minimize river water entering the combined sewer system that is currently occupying capacity in the system for wastewater flow. The elimination of three overflows including the Schyler, Liberty and Hudson CSOs will force more wet weather flows to the treatment plant, maximizing the volume of wastewater that is treated at the plant. In addition, the modification of the Bouck regulator configuration (the most downstream regulator structure) will allow more flow to enter the interceptor system and be conveyed to the treatment plant, while minimizing surcharging upstream in the interceptor.

On the west side of the River, regulator and weir modification projects are recommended for Cohoes, Watervliet and Green Island to address BMP #4.

In response to BMP#6, several projects have been identified that will help to reduce the risk of dry weather overflows (DWOs). The Cities of Troy and Rensselaer, in cooperation with RCSD, have moved ahead with plans to modify certain regulators alleged to have overflowed during dry weather conditions. In addition, monitoring efforts have been increased at these outfalls and others suspected of being a high risk for DWO. Monitoring efforts may lead to additional recommendations for regulator modifications to maximize flow to the WWTP and minimize the risk of DWOs. In addition, pump station improvement projects in Cohoes are recommended.

The City of Rensselaer is moving ahead with a project to eliminate a dry weather overflow that was recently found on Broadway. This project will include improvements to increase sewer capacity as well as separation of storm sewer connections. Eliminating the inflow sources will also help to address the capacity problems along this sewer. Similar work has been ongoing in the City of Albany where the search for, and elimination of illicit discharges to the Patroon Creek is continuing.

In response to BMP#14, the City of Troy and the RCSD plan to install meters on connections from separate sewers conveying sanitary sewage from the neighborhood of Pleasantdale in the town ofSchaghticoke, Brunswick and North Greenbush. These meters will be used for tracking wet weather impacts from these communities and monitoring sewer allocations with each of the communities. Should infiltration and inflow from these communities be found to impact peak wet weather flows, there may be a need to perform sewer improvements in these communities to supplement the efforts of the Albany Pool Communities and sewer districts to optimize collection system performance and maximize the capture and treatment of wet weather flow.

Each of the communities is performing catch basin survey and mapping. The surveys will identify the condition of existing catch basins and determine the number of catch basins which meet current standards for source control of floatables with hoods and sumps. The catch basin data will be incorporated into the city's GIS mapping. Commercial and industrial areas, which are likely to generate the greatest volume of street litter and floatables, are of highest priority. Residential areas will follow.

A summary of the BMP/System Optimization Projects follows in Table 1-7.

| Table 1-7: BMPs/System Optimization Projects | |
|---|---|
| **Community/Sewer District** | **Project Name** |
| Albany | Bouck Tide Gate Installation |
| Albany | Pumping Station Upgrades |
| Albany | Sewer Rehabilitation Projects Throughout the City of Albany |
| Albany | Remove Schyler (CSO 015) Overflow |
| Albany | Remove Liberty (CSO 022) Overflow |
| Albany | Modify Bouck Regulator |
| Albany | Remove Hudson Street Overflow |
| Cohoes | Upgrade Pump Stations (new pumps and controls) |
| Cohoes | Pump Station Bypass Evaluation |
| Cohoes | Pump Station Bypass Design and Construction |
| Cohoes | Improvements at Ten Regulators |
| Green Island | Swan St. and Hamilton St. Improvements |
| Rensselaer | Broadway Dry Weather Overflow Elimination Project |
| Rensselaer | Partition Street Trunk Sewer Inspection and Cleaning (CSO006) |
| RCSD | Upgrade Pump Stations |
| RCSD | Regulator |
| RCSD/Troy | Outside Community Metering |
| Rensselaer/Troy | Regulator Monitoring for DWOs |
| Troy | Catch Basin Survey and Mapping |
| Watervliet | Improvements at Five Regulators |
| Watervliet | $18^{th}$ Street and Avenue A Weir Improvements |

### 1.4.5 Sewer Separation /Storm Water Storage

CSOs occur when wet weather conditions generate peak wastewater flows in excess of the sewer system capacity. Wet weather peaks can be reduced by diverting inflow sources to storm sewers, storage tanks or recharge basins. These improvements can also help to reduce the risk of dry weather overflows.

Three sewer separation projects are proposed in the City of Rensselaer for the purposes of reducing wet weather contributions in sewersheds tributary to CSOs 006 (Partition Street) and 012 (Farley Drive). The Farley Drive project is intended to eliminate an existing CSO to an unnamed tributary. Upon completion of the sewer improvements, the outfall will be monitored to make sure that closure of the outfall will not result in sewer backups.

In the City of Troy, several projects are proposed for the purposes of diverting streams from the sewer system. The stream flow takes up valuable capacity in the sewer system, increases pumping and treatment costs, and can potentially lead to dry weather overflows. The projects will also divert storm sewers from the combined sewer system where feasible. As all of the inflow sources will not be removed, the outfalls will remain. The projects will be performed at 113th Street (CSOs 013 and 013A), 123rd Street (CSO 002), Van Buren Street (CSO 041), and Polk Street (CSO 044). The storm sewer on Hoosick Street will be extended to divert a large storm water connection from this sewershed. The project will reduce wet weather inflow, improving capacity and minimize the risk of dry weather overflows.

In response to local flooding during wet weather events, the City of Albany has taken on a number of separation projects that will make sewer capacity available for wastewater flows. These include groundwater recharge basins, stormwater storage structures and partial separation of local roadway drainage. These measures will reduce inflow and reduce peak flows to the combined sewer system, ultimately reducing the CSO overflow volume.

Numerous target sewer rehabilitation and separation projects are proposed for Cohoes. The most significant project addresses the systems along Vliet Steet and Manor Avenue through proposed rehabilitation, replacement and separation which will have direct impact on the frequency of discharge at CSO 007. Additional projects proposed on George Street, Columbia Street and Middle Vliet Street will influence CSOs 008 and 015.

Table 1-8 provides a summary of the recommended sewer separation and stormwater storage projects.

| Table 1-8: Sewer Separation/Stormwater Storage Projects | |
|---|---|
| **Community/Sewer District** | **Project Name** |
| Albany | Elberon Place Area Storm Water Storage |
| Albany | Lawnridge/Grove/Glendale/Forrest Ave. Separation (CSO 016) |
| Albany | Marietta Place Area Storage Structures |
| Albany | Marion/Myrtle Area Storm Water Storage Structures |
| Albany | Mereline Combined Sewage Storage |
| Albany | Upper Washington Avenue Groundwater Recharge |
| Albany | Melrose/Winthrop Groundwater Recharge Basins |
| Cohoes | Vliet St. and Manor Ave. Sewer Rehab, Replacement and Separation. Phase I (CSO 007) |
| Cohoes | Vliet St. and Manor Ave. Sewer Rehab, Replacement and Separation. Phase II (CSO 007) |
| Cohoes | Vliet St. and Manor Ave. Sewer Rehab, Replacement and Separation. Phase III (CSO 007) |
| Cohoes | Columbia St. Phase II Separation (CSO 008/015) |
| Cohoes | George St. Sewer Separation (CSO 008/015) |
| Cohoes | Middle Vliet St. Sewer Separation (CSO 007) |
| Cohoes | 2011 Storm Sewer Improvements |
| Rensselaer | Broadway Sewer and Drain Improvements (CSO 006) |
| Rensselaer | Washington Ave. Sewer Improvements and Elimination of Farley Drive CSO (CSO 012) |
| Troy | 123rd Street Stream Separation (CSO 002) |
| Troy | Van Buren Street Stream Separation (CSO 041) |
| Troy | Polk Street Stream Separation (CSO 044) |
| Troy | 113th Street Stream Separation (CSO 013 and 013A) |
| Troy | Hoosik St. Storm Sewer Extension (CSO 024) |

### 1.4.6 Floatables Control Facilities

Each community's SPDES permit includes requirements for control of floatable and settleable solids in accordance with BMP#7. Compliance with this BMP can be achieved through the implementation of source or end-of-pipe controls. The feasible alternatives identified during the screening process were evaluated for compliance with BMP#7 and recommendations have been developed for each community based upon the volume of overflow contributed by a particular outfall or its location in relation to recreational areas.

On the east side of the River, Troy and Rensselaer have incorporated sumps and hoods into their catch basins to provide source control of floatable and settleable solids. Both communities are performing catch basin inventories as part of their MS4 stormwater programs to better plan cleaning and maintenance efforts.

The City of Albany has relatively few outfall pipes, making end of pipe floatables control an attractive option. Outfall CSO 016 (Big C) provides drainage for over 75% of the City, and as part of the LTCP the City will propose including a floatables control facility (FCF) to address floatables at this outfall. Outfall CSO 019 conveys overflow from three regulator structures to the River, and will also be incorporated into the FCF because of its close proximity to the CSO 016 outfall.

The Corning Preserve is the centerpiece for riverfront recreation in Albany, and as such, floatables control is a priority. As part of the LTCP the City proposed floatables control facilities be constructed on outfalls that discharge within the Corning Preserve. The floatables control facilities will be sized based on a cost-benefit analysis, but initial sizing requires a 90 MGD facility at Big C and 20 MGD facilities at both outfalls within the Corning Preserve (CSO 026 and CSO030).

Smaller satellite floatables control projects are planned for the largest and most frequent CSOs in Cohoes and Green Island. In Cohoes, a floatables control facility for "Little C" is proposed along with the consolidation of CSO's 008 and 015. In Green Island, a floatables control facility is proposed for Hamilton Street at CSO 003.

A summary of the recommended Floatables Control Facilities is provided below in Table 1-9.

**Table 1-9: Floatables Control Facilities**

| Community/Sewer District | Project Name |
|---|---|
| Albany | Floatables Control Facility for CSO 016 and CSO 019 |
| Albany | Floatables Control Facility for CSO 026 Outfall |
| Albany | Floatables Control Facility for CSO 030 Outfall |
| Cohoes | Little C Floatables Control Facility (CSO 008/015) |
| Green Island | Hamilton St. Floatables Control Facility (CSO 003) |

### 1.4.7 Additional Pool-Wide Projects

During development of the CSO LTCP, some projects were discussed that provide benefits to each of the Albany Pool communities and ultimately the water quality of the Mohawk and Hudson Rivers. Each of these projects is recommended for pool-wide development to minimize costs and provide a consistent approach and benefits to each of the communities.

The RCSD and the cities of Rensselaer and Troy are in the midst of negotiating terms of a pending consent order with NYSDEC associated with reports of dry weather overflows (DWOs). One of the proposed requirements of the draft consent order is for each of the parties to develop sewer system operation, maintenance and inspection plans intended to improve performance of the collection system and reduce the risk of DWOs. The draft terms of the consent order also include provisions for each party to develop an asset management plan to proactively address collection and treatment system rehabilitation and replacement projects. While the other Albany Pool communities are not currently required to develop these documents, the communities recognize the benefits of having these plans in place. Funding agencies are reportedly modifying their scoring systems for prioritizing funding eligibility for those communities who have asset management or capital improvement plans in place. In addition to improving the chances for funding LTCP projects, the communities recognize the benefits these planning tools provide for better planning of capital improvement projects, reducing the frequency of unplanned emergency repairs and controlling the impacts to user rates.

Through the development of the CSO LTCP and application of the new MS4 stormwater regulations, the communities recognize the benefits of low impact design and the need to incorporate measures to better control stormwater runoff into their land development ordinances. To address this need, a Green Infrastructure Technical Design Guidance will be developed for each of the communities to use in planning future economic growth and urban renewal. By developing this manual as a group, the communities will not only benefit from cost savings, they will have a document that provides consistent design guidance and standard details for application of Green Technologies throughout the region. Considering the limited historical data available locally on the durability and long term performance of green infrastructure measures, it allows the communities to pilot various technologies used in other regions of the United States and share the lessons learned as these new technologies are applied throughout the Capital Region. By taking a pool-wide approach, the communities can more effectively apply low impact design or green technologies to address wet weather based regional water quality issues.

A fourth pool-wide project arose from discussions with the Riverkeeper and concerned citizens at the January 13, 2011 public meetings to present the findings of the receiving water quality monitoring and modeling tasks. Although the recommended CSO LTCP will achieve compliance with the water quality standards for fecal coliform, there is potential for bacteria concentrations to rise in the Hudson River for short term periods in response to contributions from various wet weather pollutant sources. These impacts are seen in the headwaters and throughout the Albany Pool. To address concerns related to short term wet weather impacts, the combined sewer system and receiving water models could be utilized to develop a predictive tool for assessing the risk associated with using the River following a storm event. Rainfall data from Albany International Airport could be used to provide real-time predictions of bacteria levels in the Hudson River. Risk factors for recreational uses would be applied based upon the predicted bacteria counts. A webpage would be developed to translate the results of the real-time modeling to provide the public with a better understanding of the predicted water quality conditions and the risks associated with primary or secondary recreational use of the River. The predictive modeling would also be incorporated into the post construction monitoring of the CSO LTCP to confirm compliance with the water quality standards for bacteria.

A summary of the recommended Additional Pool-Wide Projects is provided below in Table 1-10.

| Table 1-10: Additional Pool-Wide Projects | |
|---|---|
| **Community/Sewer District** | **Project Name** |
| All Communities | Sewer System Operations, Maintenance and Inspection Plans |
| All Communities | Asset Management Plans |
| All Communities | Green Infrastructure Technical Design Guidance |

## 1.5 CSO Control Alternatives Cost Estimating Guidelines

Project cost estimates were developed for each of the recommended projects identified above in accordance with CSO Control Alternatives Cost Estimating Guidelines (See Appendix A) developed for the Albany Pool CSO LTCP. These guidelines were developed from cost curves and other data sources, as follows:

- 1993 EPA curves, "Manual – Combined Sewer Overflow Control";
- Historical CDM and MPI cost estimates for construction and planning projects and contractor bids;
- The Metropolitan Sewer District of Greater Cincinnati's "Capacity Assurance Program Project Cost Estimating Reference Documents";
- Indianapolis's "Cost Estimating Procedures for Raw Sewage Overflow Control Alternatives Evaluation";
- Kansas City's "Overflow Control Program Basis of Cost Manual";
- Omaha CSO Control Program's "Cost Estimate Approach and Criteria for Screening and Selection"; and
- Allegheny County Sanitary Authority's Alternatives Costing Tool (ACT).

The guidelines provide a set methodology for developing planning level construction costs for various control alternatives, as well as a process for including contingencies, non-direct costs, overhead and profit and soft costs for legal, administrative and engineering services.

For smaller projects (less than $100,000) or those with unique design features, such as: regulator modifications; tide gate repairs; installation of sewer meters; outfall closure; etc., estimates were developed using: manufacturer quotes; Means Cost Estimating

Guides; or other available cost estimating data. Budget estimates were provided for projects that did not have a clearly defined scope or may change based upon the needs of the individual communities. Examples of these projects include sewer system and mapping projects, investigations of non-CSO bacterial sources in tributaries and the additional pool-wide projects. Engineering or bids received for projects currently in design or construction stages were used where appropriate.

## 1.6 Summary of Recommended CSO LTCP

In accordance with the CSO control strategy, the Recommended CSO LTCP focuses on the main contributors of the primary pollutant of concern (bacteria), and then addresses measures for improving system performance, reducing CSO discharges and controlling floatables in the remaining overflows. Table 1-11 provides a summary of the Recommended CSO LTCP and the estimated project costs.

| **Table 1-11: Recommended CSO LTCP** | | **Estimated Project Cost (millions)** |
|---|---|---|
| **Community** | **Project** | |
| | **Disinfection Projects** | |
| ACSD | North Plant Disinfection Project | $5.70 |
| ACSD | South Plant Disinfection Project | $3.10 |
| RCSD | Disinfection Facilities at WWTP | $7.22 |
| **Subtotal** | | **$16.02** |
| | **WWTP Process Improvements** | |
| RCSD | Replacement of Mechanical Bar Screens | $1.18 |
| RCSD | Primary Sludge Degritting | $3.12 |
| RCSD | Enhanced Final Settling | $11.47 |
| **Subtotal** | | **$15.77** |
| | **BMPs/System Optimization** | |
| Albany | Bouck Tide Gate Installation | $0.12 |
| Albany | Pumping Station Upgrades | $0.37 |
| Albany | Sewer Rehabilitation Projects Throughout the City of Albany | $0.63 |
| Albany | Eliminate Schyler (CSO 015) Overflow | $0.27 |
| Albany | Eliminate Liberty (CSO 022) Overflow | $1.10 |
| Albany | Modify Bouck Regulator | $0.25 |
| Albany | Eliminate Hudson Street Overflow | $0.01 |
| Cohoes | Upgrade Pump Stations (new pumps and controls) | $0.06 |
| Cohoes | Pump Station Bypass Evaluation | $0.03 |
| Cohoes | Pump Station Bypass Design and Construction | $0.11 |
| Cohoes | Improvements at Ten Regulators | $0.10 |
| Green Island | Swan St and Hamilton St. Improvements | $0.02 |
| Rensselaer | Partition Street Trunk Sewer Inspection and Cleaning (CSO 006) | $0.05 |
| RCSD | Upgrade Pump Stations | $10.00 |
| RCSD | Regulator Improvements to Address DWOs | $0.38 |

| Table 1-11: Recommended CSO LTCP | | Estimated Project Cost (millions) |
|---|---|---|
| RCSD/Troy | Outside Community Metering | $2.07 |
| Troy | Regulator Monitoring for DWOs | $0.04 |
| Troy | Catch Basin Survey and Mapping | $0.02 |
| Watervliet | Improvements at Five Regulators | $0.05 |
| Watervliet | 18th Street & Avenue A Weir Improvements | $0.04 |
| **Subtotal** | | **$15.72** |
| **Sewer Separation/Storm Water Storage** | | |
| Albany | Elberon Place Area Storm Water Storage | $0.30 |
| Albany | Lawnridge/Grove/Glendale/ Forrest Avenue Partial Separation (CSO 016) | $0.37 |
| Albany | Marietta Place Area Storage Structures | $0.22 |
| Albany | Marrion/Myrtle Area Storm Water Storage Structures | $0.34 |
| Albany | Mereline Combined Sewage Storage | $0.50 |
| Albany | Upper Washington Avenue Groundwater Recharge | $0.50 |
| Albany | Melrose/Winthrop Groundwater Recharge Basins | $0.65 |
| Cohoes | Vliet St and Manor Ave. Sewer Rehab, Replacement and Separation. Phase I (CSO 007) | $1.43 |
| Cohoes | Vliet St and Manor Ave. Sewer Rehab, Replacement and Separation. Phase II (CSO 007) | $1.43 |
| Cohoes | Vliet St and Manor Ave. Sewer Rehab, Replacement and Separation. Phase III (CSO 007) | $1.43 |
| Cohoes | Columbia St. Phase II Separation (CSO 008/015) | $1.00 |
| Cohoes | George St. Sewer Separation (CSO 008/015) | $0.42 |
| Cohoes | Middle Vliet St. Sewer Separation (CSO 007) | $0.50 |
| Cohoes | 2011 Storm Sewer Improvements | $1.50 |
| Rensselaer | Broadway Sewer and Drain Improvements (CSO 006) | $2.80 |
| Rensselaer | Broadway Dry Weather Overflow Elimination Project | $1.79 |
| Rensselaer | Washington Avenue Sewer Improvements and Elimination of Farley Drive CSO (CSO 012) | $3.00 |
| Troy | 123rd Street Stream Separation (CSO 002) | $4.54 |
| Troy | Van Buren Street Stream Separation (CSO 041) | $4.74 |
| Troy | Polk Street Stream Separation (CSO 044) | $2.17 |
| Troy | 113th Street Stream Separation (CSO 013 and 013A) | $1.43 |
| Troy | Hoosick St. Storm Sewer Extension (CSO 024) | $1.05 |
| **Subtotal** | | **$32.11** |
| **Floatables Control Facilities (FCFs)** | | |
| Albany | FCF for CSO 016 and CSO 019 Outfalls (Regulators Big C, 4 and 4a, Arch, Ferry and Madison) | $14.52 |
| Albany | FCF for CSO 026 Outfall (Regulators Maiden, Stuben and Orange) | $4.00 |

| Table 1-11: Recommended CSO LTCP | | Estimated Project Cost (millions) |
|---|---|---|
| Albany | FCF for CSO 030 Outfall (Regulators Quackenbush, Jackson and Livingston) | $4.00 |
| Cohoes | Little C FCF (CSO 008/015) | $2.87 |
| Green Island | Hamilton St FCF (CSO 003) | $0.36 |
| **Subtotal** | | **$25.75** |
| **Tributary Enhancements** | | |
| ACSD | Patroon Creek Trunk Sewer Repairs | $0.68 |
| Rensselaer/East Greenbush | Investigate Non-CSO Bacteria Sources Along Mill Creek | $0.03 |
| Troy | Cross Street Trunk Sewer Repair Along Wynants Kill (CSO 045) | $1.92 |
| Troy | Cross Street Trunk Sewer Evaluation (along Wynants Kill) (CSO 045) | $0.05 |
| Troy/Brunswick | Investigate Non-CSO Bacteria Sources Along Poesten Kill | $0.04 |
| Troy/North Greenbush | Investigate Non-CSO Bacteria Sources Along Wynants Kill | $0.03 |
| **Subtotal** | | **$2.75** |
| **Additional Pool-Wide Projects** | | |
| All Communities | Hudson River Water Quality Public Advisory Webpage | $0.50 |
| All Communities | Green Infrastructure Technical Design Guidance | $0.10 |
| All Communities | Sewer System Operations, Maintenance and Inspection Plans | $0.30 |
| All Communities | Asset Management Plans | $0.60 |
| **Subtotal** | | **$1.50** |
| **Total Recommended Plan** | | **$109.62** |

## 1.7 Summary of Completed CSO Projects

Upon reviewing the Recommended CSO LTCP, it is important to recognize the efforts of each of the communities and sewer districts prior to engaging in this CSO control planning effort. Each of the communities has performed a number of projects intended for improving collection and treatment systems performance. The performance of these projects highlights the commitment of the Albany Pool Communities to improving the water quality of the Mohawk and Hudson Rivers.

A summary of each of the completed projects and the associated project costs is provided as Table 1-12.

| Table 1-12: Completed CSO Projects | | Estimated Project Cost (millions) |
|---|---|---|
| **Community** | **Project** | |
| | **Disinfection Projects** | |
| | No Projects Completed | |
| | **WWTP Process Improvements** | |
| ACSD | North Plant Screen Replacement Project Phase 2 | $0.55 |
| ACSD | South Plant Screen Replacement Project Phase 2 | $0.55 |
| ASCD | North Plant Primary Clarifier Upgrades | $0.25 |
| ASCD | North Plant Screen Replacement Project Phase 1 | $0.75 |
| ASCD | South Plant Screen Replacement Project Phase 1 | $0.75 |
| ACSD | South Plant Emergency Generator | $0.50 |
| ACSD | Influent Pumps North and South Plants | $1.60 |
| ASCD | Aeration System Upgrades North and South | $2.80 |
| RCSD | Secondary Clarifier | $2.25 |
| RCSD | Replace Mechanicals on One Primary Settling Tank | $0.28 |
| **Subtotal** | | **$10.28** |
| | **BMPs/System Optimization** | |
| Albany | Backflow Prevention Valve Program | $0.34 |
| Cohoes | PS Telemetry Project | $0.06 |
| Cohoes | Comprehensive Pump Station Evaluation | $0.02 |
| Cohoes | Bridge Ave. PS Upgrade (PS #4) | $0.28 |
| Cohoes | Ontario St. PS Upgrade (PS #5) | $0.28 |
| Cohoes | Continental Ave. PS Upgrade (PS #6) | $0.28 |
| Cohoes | Linden St. PS Upgrade (PS #10) | $0.28 |
| Cohoes | McDonald Drive PS Upgrade (PS #1) | $0.03 |
| Cohoes | DPW Garage PS Upgrade (PS #9) | $0.02 |
| Cohoes | Linen Place PS Upgrade (PS #2) | $0.02 |
| Cohoes | North Mohawk St. PS Upgrade (PS #7) | $0.03 |
| Cohoes | Niver Street PS Upgrade (PS #13) | $0.02 |
| **Subtotal** | | **$1.64** |
| | **Sewer Separation/Storm Water Storage** | |
| Albany | Berkshire Blvd Sewer Separation | $1.77 |
| Albany | Beaver Creek Sewer Separation, Phase 1-5 | $3.95 |
| Albany | Hansen Avenue Combined Sewer Storage Facility | $0.31 |
| Albany | North and South Pearl Street | $2.56 |
| Albany | Whitehall Road Improvements | $0.50 |
| Albany | Academy Road Sewer Separation | $0.13 |
| Albany | Erie Blvd Service Area Extension | $0.15 |
| Albany | Rose Court Detention System | $0.36 |
| Albany | Melrose Avenue Recharge System | $0.39 |
| Albany | Hansen Alley Detention System | $0.22 |
| Albany | Ridgefield Alley Detention System | $0.15 |
| Albany | Academy Road Retention System | $0.21 |
| Albany | North Pine Sewer Separation | $0.15 |
| Albany | Central Avenue Storm Improvements | $1.63 |

| Table 1-12: Completed CSO Projects | | Estimated Project Cost (millions) |
|---|---|---|
| Albany | Delaware Avenue Sewer Separation | $2.11 |
| Cohoes | McDonald Dr. Sewer Separation | $0.10 |
| Cohoes | Lancaster St. Sewer Separation | $0.30 |
| Cohoes | Vliet St. Sewer Separation | $0.30 |
| Cohoes | Bridge Ave. Sewer Separation | $0.12 |
| Cohoes | White and Main St. Parking Improvements and Drainage | $0.20 |
| Troy | 101st and 102nd Street Separation and CSO Elimination Project | $3.00 |
| Watervliet | 10th Ave sewer separation | $0.02 |
| Watervliet | Wiswall Ave. Sewer Separation | $0.38 |
| Watervliet | 12th Ave CSO Elimination | $0.23 |
| **Subtotal** | | **$19.24** |
| **Floatables Control Facilities** | | |
| Cohoes | Vliet Street FCF (CSO 007) | $1.00 |
| Watervliet | 19th Street Reconstruction | $0.72 |
| **Subtotal** | | **$1.72** |
| **Tributary Enhancements** | | |
| | No Projects Completed | |
| **Total Street To Date By Albany Pool Communities** | | **$32.88** |

## 1.8 Assessment of CSO Control Effectiveness

Each of the projects recommended for implementation under the Albany Pool CSO LTCP were assessed based on their ability to address six basic components as follows:

- SPDES Permit Compliance – consists of projects that primarily focus on addressing Best Management Practices for CSOs;
- Pending Consent Order Requirements – include those projects which address concerns relating to dry weather overflows or sanitary sewer overflows;
- CSO Capture – comprises projects that reduce CSO discharge frequency and volume, as well as maximize flow to the WWTP;
- Receiving Water Quality Improvements – include those projects which will reduce pollutants entering the Hudson River and its tributaries through direct discharges or other sources;
- Green Infrastructure – applies to those projects which reduce energy consumption by using premium efficiency equipment in pumping and treatment and/or reduce the volume of stormwater conveyed to the WWTP;
- Floatables Control – includes those projects primarily focused on the capture of floatables in CSO discharges.

A summary of the benefits associated with each of the Recommended LTCP projects is provided as Table 1-13.

**Table 1-13: Benefits of Recommended LTCP Projects**

| Community | Project | SPDES Permit | Pending Consent Order | CSO Volume | Water Quality | Green Infrastructure | Floatables Control |
|---|---|---|---|---|---|---|---|
| **Disinfection Projects** | | | | | | | |
| ACSD | North Plant Disinfection Project | X | | | X | | |
| ACSD | South Plant Disinfection Project | X | | | X | | |
| RCSD | Disinfection Facilities at WWTP | X | | | X | | |
| **WWTP Process Improvements** | | | | | | | |
| RCSD | Replacement of Mechanical Bar Screens | X | | X | X | X | X |
| RCSD | Primary Sludge Degritting | X | | X | X | X | |
| RCSD | Enhanced Final Settling | X | | X | X | X | |
| **BMPs/System Optimization** | | | | | | | |
| Albany | Bouck Tide Gate Installation | | | X | | X | |
| Albany | Pumping Station Upgrades | | | X | X | X | X |
| Albany | Sewer Rehabilitation Projects Throughout the City of Albany | | | X | X | X | X |
| Albany | Remove Schyler (CSO 015) Overflow | | | X | X | | X |
| Albany | Remove Liberty (CSO 022) Overflow | | | X | X | | X |
| Albany | Modify Bouck Regulator | | | X | X | X | X |
| Albany | Remove Hudson Street Overflow | | | X | | | X |
| Cohoes | Upgrade Pump Stations (new pumps and controls) | | | X | X | X | |
| Cohoes | Pump Station Bypass Evaluation | | X | X | X | | |
| Cohoes | Pump Station Bypass Design and Construction | X | X | X | X | | X |
| Cohoes | Improvements at Ten Regulators | | | X | X | | X |
| Green Island | Swan St and Hamilton St. Improvements | | | X | X | | X |
| Rensselaer | Partition Street Trunk Sewer Inspection and Cleaning (CSO 006) | X | X | | X | | |
| RCSD | Upgrade Pump Stations | X | X | X | X | X | X |
| RCSD | Regulator Improvements to Address DWOs | X | X | X | X | | X |
| RCSD/Troy | Outside Community Metering | X | X | | | | |
| Troy | Regulator Monitoring for DWOs | X | X | X | X | | |

| Table 1-13: Benefits of Recommended LTCP Projects | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Community** | **Project** | **SPDES Permit** | **Pending Consent Order** | **CSO Volume** | **Water Quality** | **Green Infrastructure** | **Floatables Control** |
| Troy | Catch Basin Survey and Mapping | X | X | X | X | | X |
| Watervliet | Improvements at Five Regulators | | | X | X | | X |
| Watervliet | 18th Street & Avenue A Weir Improvements | | | X | X | | |
| **Sewer Separation/Storm Water Storage** | | | | | | | |
| Albany | Elberon Place Area Storm Water Storage | | | X | X | X | |
| Albany | Lawnridge/Grove/Glendale/ Forrest Avenue Separation (CSO 016) | | | X | X | X | X |
| Albany | Marietta Place Area Storage Structures | | | X | X | X | X |
| Albany | Marrion/Myrtle Area Storm Water Storage Structures | | | X | X | X | |
| Albany | Mereline Combined Sewage Storage | | | X | X | X | X |
| Albany | Upper Washington Avenue Groundwater Recharge | | | X | X | X | |
| Albany | Melrose/Winthrop Groundwater Recharge Basins | | | X | X | X | |
| Cohoes | Vliet St and Manor Ave. Sewer Rehab, Replacement and Separation. Phase I (CSO 007) | | | X | X | X | X |
| Cohoes | Vliet St and Manor Ave. Sewer Rehab, Replacement and Separation. Phase II (CSO 007) | | | X | X | X | X |
| Cohoes | Vliet St and Manor Ave. Sewer Rehab, Replacement and Separation. Phase III (CSO 007) | | | X | X | X | X |
| Cohoes | Columbia St. Phase II Separation (CSO 008/015) | | | X | X | X | X |
| Cohoes | George St. Sewer Separation (CSO 008/015) | | | X | X | X | X |
| Cohoes | Middle Vliet St. Sewer Separation (CSO 007) | | | X | X | X | X |
| Cohoes | 2011 Storm Sewer Improvements | | | X | X | X | X |
| Rensselaer | Broadway Sewer and Drain Improvements (CSO 006) | X | X | X | X | X | X |
| Rensselaer | Broadway Dry Weather Overflow Elimination Project | X | X | X | X | X | X |
| Rensselaer | Washington Avenue Sewer Improvements and Elimination of Farley Drive CSO (CSO 012) | X | | X | X | X | X |
| Troy | 123rd Street Stream Separation (CSO 002) | | | X | X | X | X |
| Troy | Van Buren Street Stream Separation (CSO 041) | | | X | X | X | X |
| Troy | Polk Street Stream Separation (CSO 044) | | | X | X | X | X |

| Table 1-13: Benefits of Recommended LTCP Projects | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Community** | **Project** | **SPDES Permit** | **Pending Consent Order** | **CSO Volume** | **Water Quality** | **Green Infrastructure** | **Floatables Control** |
| Troy | 113th Street Stream Separation (CSO 013 and 013A) | X | X | X | X | X | X |
| Troy | Hoosick St. Storm Sewer Extension (CSO 024) | X | X | X | X | X | X |
| **Floatables Control Facilities (FCFs)** | | | | | | | |
| Albany | FCF for CSO 016 and CSO 019 Outfalls (Regulators Big C, 4 and 4a, Arch, Ferry and Madison) | | | | X | | X |
| City of Albany | FCF for CSO 026 Outfall (Regulators Maiden, Stuben and Orange) | | | | X | | X |
| City of Albany | FCF for CSO 030 Outfall (Regulators Quackenbush, Jackson and Livingston) | | | | X | | X |
| Cohoes | Little C FCF (CSO 008/015) | | | | X | | X |
| Green Island | Hamilton St FCF (CSO 003) | | | | X | | X |
| **Tributary Enhancements** | | | | | | | |
| ACSD | Patroon Creek Trunk Sewer Repairs | | | X | X | | |
| Rensselaer/East Greenbush | Investigate Non-CSO Bacteria Sources Along Mill Creek | | | | X | | |
| Troy | Cross Street Trunk Sewer Repair Along Wynants Kill (CSO 045) | | | X | X | | X |
| Troy | Cross Street Trunk Sewer Evaluation (along Wynants Kill) (CSO 045) | | | X | X | | |
| Troy/Brunswick | Investigate Non-CSO Bacteria Sources Along Poesten Kill | | | | X | | |
| Troy/North Greenbush | Investigate Non-CSO Bacteria Sources Along Wynants Kill | | | | X | | |
| **Additional Pool-Wide Projects** | | | | | | | |
| All Communities | Hudson River Water Quality Public Advisory Webpage | | | | X | | |
| All Communities | Green Infrastructure Technical Design Guidance | | | | | X | |
| All Communities | Sewer System Operations, Maintenance and Inspection Plans | X | X | | X | | |
| All Communities | Asset Management Plans | | X | | X | | |

Combined sewer system and receiving water quality model runs were performed to determine the benefits associated with implementation of the recommended plan. The receiving water quality model run was performed for a five year simulation to cover a wide range of seasonal variations in groundwater and precipitation. Results of the post construction model run were compared with the baseline conditions to quantify the improvements to collection system and treatment system performance. In addition, the frequency of bacteria violations based on the receiving water quality standards were evaluated to reaffirm the receiving water modeling results performed during development of the Albany Pool CSO Control Strategy.

Table 1-14 provides a summary of the cumulative CSO control and receiving water improvements associated with implementation of the Recommended CSO LTCP.

**Table 1-14: CSO Control and Receiving Water Improvements**

| Statistic | Baseline Conditions | Post Construction of Recommended Projects |
|---|---|---|
| CSO Volume (MGal) | 1236 | 925 |
| Number of Pool-Wide Events | 65 | 65 |
| Wet Weather Flow Treated at WWTPs (MGal) | 2827 | 3031 |
| Pool-Wide Percent Capture | 69.5% | 77.2% |
| CSO Flow Receiving Floatables Control (MGal) | 27 | 454 |
| Pool-Wide Treatment & Floatables Capture | 70.1% | 88.8% |
| Disinfection at WWTPs | No | Seasonal |
| Fecal Coliform WQ Standard Violations (during the recreation season for 5 yr model run) | 30 | 0 |

Under post construction conditions, the model predicts that the volume of CSO discharged annually will be reduced by 311 million gallons or 25%. Pool wide percent capture improves from 69.5 % to 77.2 % with an additional 204 million gallons of wet weather flow being conveyed to and treated by the WWTPs. Upon implementation of the seasonal disinfection facilities at each of the WWTPs, violations of the Fecal Coliform Water Standard during the recreation season (May-October) will be eliminated.

The results of the receiving water quality modeling for the post construction conditions support the achievement of water quality standards for fecal coliform. In accordance with the Demonstration Approach of the USEPA CSO Policy, the Recommended Long

Term Control Plan for the Albany Pool Communities will achieve compliance with the receiving water quality standards as follows:

i. The control program meets water quality standards and preserves designated uses.

ii. The remaining CSO discharges will not preclude the attainment of the water quality standards for bacteria or the designated uses of the receiving waters.

iii. The proposed controls provide the maximum bacterial reduction benefits reasonably attainable, and

iv. The Recommended LTCP provides for cost effective expansion, retrofit or upgrade if required in the future to meet the receiving water quality standards or preserve designated uses.

A post construction monitoring program will be developed to demonstrate compliance. Details of the plan will be provided in the CSO Long Term Control Plan.

# Appendix A

# Alternative Cost Estimating Guide

# Section 1
# Alternative Cost Estimating Guide

## 1.1 Intro

Costs developed in accordance with this guide are for planning level estimates to assist in comparing CSO abatement alternatives. Once the alternatives have been narrowed down to two or three recommended alternatives, more detailed cost estimating will be performed prior to finalizing the long term control plan. The purpose of developing these planning level costs is to identify whether "Alternative A" is more or less expensive than "Alternative B" and to aid in narrowing the numerous available alternatives down to a manageable number for finalizing recommendations for abatement of CSOs. It is anticipated that these cost estimates will be used solely for a comparative purpose and not be used for budgeting construction costs. Once alternatives are chosen and a plan is selected, preliminary designs and more detailed budgeting costs should be developed.

Construction cost estimates for alternative CSO treatment/storage options were developed based on review and use of the following data sources:

- 1993 EPA curves, "Manual – Combined Sewer Overflow Control"
- Historical CDM cost estimates for construction and planning projects and contractor bids
- The Metropolitan Sewer District of Greater Cincinnati's "Capacity Assurance Program Project Cost Estimating Reference Documents"
- Indianapolis' "Cost Estimating Procedures for Raw Sewage Overflow Control Alternatives Evaluation"
- Kansas City's "Overflow Control Program Basis of Cost Manual"
- Omaha CSO Control Program's "Cost Estimate Approach and Criteria for Screening and Selection"
- ALCOSAN's Alternatives Costing Tool (ACT)
- Malcolm Pirnie project cost curves

## 1.2 Conveyance Pipe – Open Cut

Conveyance piping may be required to enhance existing system capacity, consolidate or regionalize outfalls and to divert CSOs to storage or treatment facilities. Conveyance piping may also be used to divert storm water to source controls upstream in the system. To simplify the effort of estimating costs for these sewers, unit costs have been developed for ranges in sewer size and depth. Costs for manholes and diversion chambers are also provided based upon ranges of pipe size and depth. The unit costs include: excavation, excavation support, dewatering, furnishing and placement of bedding and select backfill, pipe or structure installation and site restoration. Tables are provided below for use in developing conveyance piping estimates.

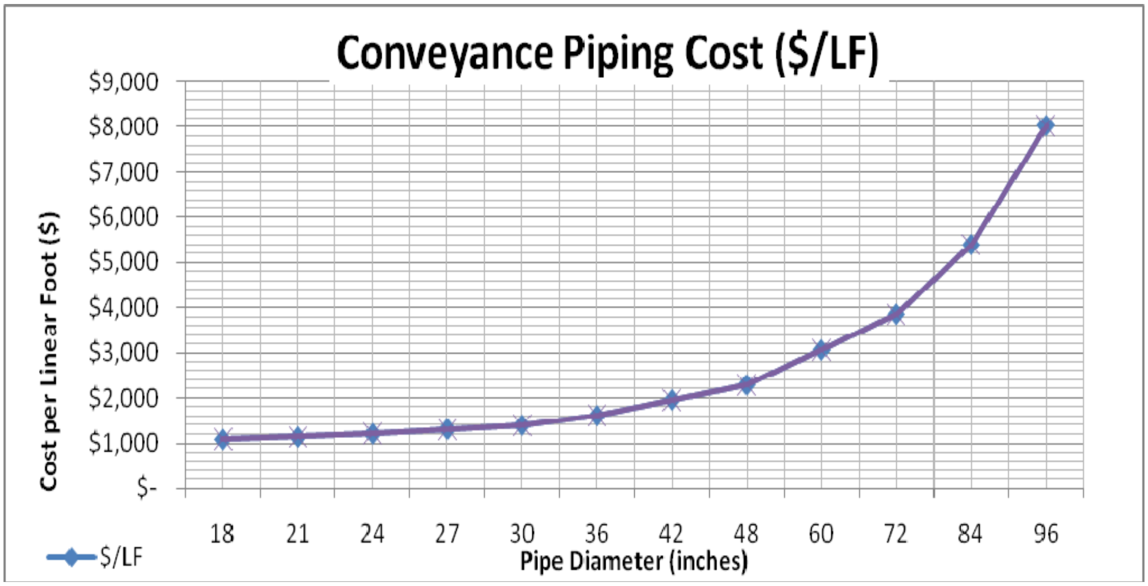
***Design Criteria***

- Pipe length
- Pipe diameter
- Depth of pipe – base cost assumes 12′ of cover

***Construction Costs***

Cost curves were developed using R.S. Means costs for sewer construction. Costs include: excavation, sheeting, transport and disposal of spoil, bedding, pipe installation, manholes (4 every 1000 feet), select backfill, compaction, and pavement restoration. Piping from 12″ to 24″ was assumed to be PVC, while piping larger than 24″ was assumed to be RCP.

- Use cost curve for conveyance pipe construction costs
- Add 30% to the unit cost for every 5′ of additional cover.



## 1.3 Sewer Separation

The costs for sewer separation are based upon either the construction of a new sanitary sewer with conversion of the combined sewer to a storm sewer or construction of a new storm sewer to convert the combined sewer to a sanitary sewer. Where a new sanitary sewer is installed, service laterals are diverted to convey sanitary waste from the existing combined sewer to the new sanitary sewer. The new sanitary sewer is connected to the existing interceptor sewer and the combined sewer is then converted to a storm sewer and the regulator connection to the interceptor is abandoned. Where buildings have internal plumbing that combine roof runoff with sanitary waste, separation of private plumbing will need to be performed. This method of separating combined sewers has been found to be the most effective as it provides a new sanitary sewer, thereby eliminating infiltration issues associated with using the existing combined sewer as the separate sanitary sewer.

Where infiltration is not a major problem, installation of a storm sewer may be considered. Catch basins and other inflow sources are diverted from the existing combined sewer to the new storm sewer. The existing combined sewer is rehabilitated through the use of trenchless pipe lining systems or grouting equipment to reduce the potential for infiltration. The outfall pipe exiting the regulator chamber is plugged and abandoned to prevent future overflow.

Costs from several Onondaga County sewer separation projects completed in recent years were used to develop the unit cost for sewer separation using sanitary sewers for the Albany Pool communities. Construction costs average about $210,000 per acre of developed sewershed to be separated. Parks and large unsewered areas should not be included in the area calculations. Additional costs for residential and commercial building interior plumbing modifications must also be considered. Costs for interior plumbing modifications were found to be approximately $15,000 per home or commercial building and included costs for a licensed plumber, permits, and inspection. Costs for exterior plumbing modifications such as connecting roof leaders to a new storm lateral that connects to the combined sewer are generally included in the unit cost. In some cases, the roof leaders can be allowed to drain to the ground and flow overland.

Construction costs for separation using sanitary sewers include: trenching, excavation support, dewatering, pipe installation, replacement of service connections within the right-of-way, abandonment of the regulator, utility relocation, select bedding, backfill and compaction, trench, sidewalk, curb and pavement restoration. The costs also included full road-width pavement restoration in roadways (top course only), which was required due to the extensive disturbance to existing pavement associated with replacement of service laterals.

Costs from sewer separation projects utilizing primarily new storm sewers in Boston, Massachusetts and Buffalo, New York were used to develop the unit cost for the

Albany Pool communities. Construction costs average about $140,000 per acre of developed sewershed to be separated. Additional costs for residential and commercial building interior plumbing modifications must also be considered. Costs for interior plumbing modifications such as sump pump installation and discharge on a "splash block" for overland flow to the new storm sewers of $5,000 per home or commercial building should be used. Under this type of separation, in most cases, roof leaders are allowed to drain to the ground and flow overland.

Construction costs for separation using storm sewers include: trenching, excavation support, dewatering, pipe installation, rehabilitation of the existing combined sewer, utility relocation, select bedding, backfill and compaction, abandonment of the outfall, sidewalk, curb and pavement restoration. The costs also included full road-width pavement restoration in roadways (top course only), which was required due to the extensive disturbance to existing pavement associated with replacement of service laterals.

***Design Criteria***

- Area of sewershed to be separated, in acres
- Pipe diameter of new sanitary sewer is assumed to be between 8" and 18", with depths between 10' and 15'
- Pipe diameter of new storm sewer is assumed to be between 18" and 48" with depths of pipe assumed to be between 5' and 10'
- Number of buildings requiring internal plumbing modifications

***Costs***

- A unit cost of $210,000 per acre will be used for sewer separation by construction of a new sanitary sewer
- A unit cost of $140,000 per acre will be used for separation of sewers by construction of a new storm sewer
- Plumbing modifications inside residential or commercial buildings is $15,000 ($5,000)/building

## 1.4 Pump Stations and Force Mains

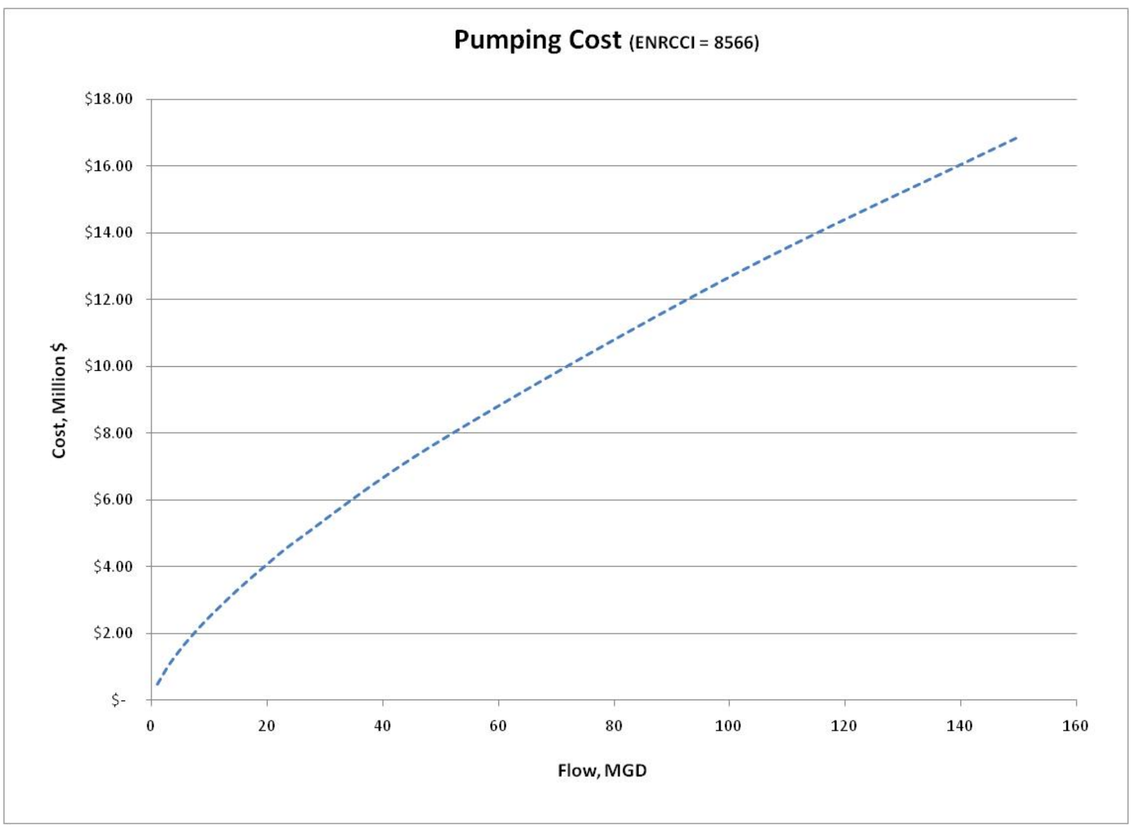
Pump station costs include: a dry well and wet well, piping and valves within the station, a mechanical bar screen, submersible pumps, a cast-in-place concrete foundation, block structure and associated electrical and HVAC. Costs for conveyance piping to the pump station should be estimated as outlined in Section 1.1 above. Costs for force main piping from the pump station need to be added to the cost of the pump station. Costs for ranges in pipe size are provided below. These costs assume five feet of cover and include all costs for installation and restoration along the alignment of the pipe. Odor control should be considered for pump stations in residential areas.

***Design Criteria***

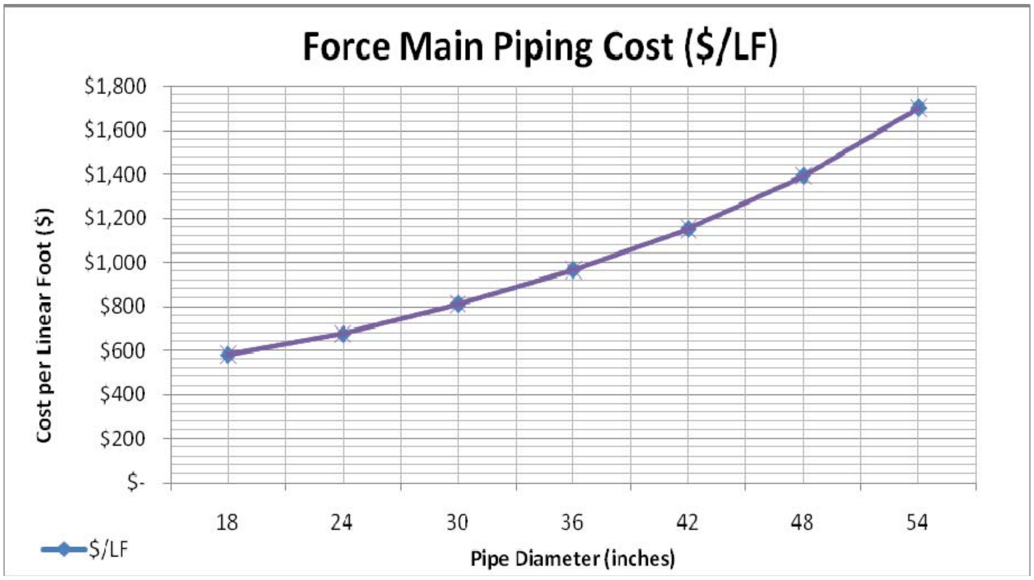
- Peak flow rate - determined by the CSS model
- Depth of pump station assumed to be 20′ to 30′
- Size of force main
- Odor control for residential areas (add 2% of construction cost)

***Construction Costs***

An average of data collected from the EPA cost guidance documents, Hartford, Indianapolis, CDM and MPI data was used to develop the cost curve and table below.



Force main costs are as follows:




## 1.5 Low Impact Development and Redevelopment

The costs for low impact development and redevelopment (LID/R) were developed for five stormwater control technologies: bioretention systems, subsurface infiltration, green roofs, porous pavements and street trees. The sizing and costs for each of these controls, with the exception of street trees, are based upon capture of the first inch of rainfall. The application of street trees is limited by either the layout of the current road system or the planned development. As a result, street trees are typically applied in conjunction with other alternatives. Costs are provided in the table below, but it should be recognized that stormwater runoff reduction associated with planting street trees is about 20% of the effectiveness of the other technologies listed and costs and sizing should be accounted for accordingly.

***Design Criteria***

- Acreage of the impervious area being diverted to the control

***Construction Costs***

- Cost data was developed for Philadelphia by CDM using data from controls installed in Chicago, Illinois and Eugene, Oregon. Costs were averaged to develop the cost summary table. Cost data was supplemented using R.S. Means.

| Control | Type | Minimum Cost ($ / impervious acre) | Median Cost ($ / impervious acre) | Mean Cost ($ / impervious acre) | Max Cost ($ / impervious acre) |
|---|---|---|---|---|---|
| Bioretention | Retrofit | $65,000 | $120,000 | $160,000 | $410,000 |
| | Redevelopment | $44,000 | $90,000 | $110,000 | $200,000 |
| Subsurface Infiltration | Retrofit | $65,000 | $120,000 | $160,000 | $410,000 |
| | Redevelopment | $44,000 | $90,000 | $110,000 | $200,000 |
| Green Roof | Retrofit | $430,000 | $500,000 | $500,000 | $570,000 |
| | Redevelopment | $200,000 | $250,000 | $250,000 | $290,000 |
| Porous Pavement | Retrofit | $65,000 | $120,000 | $160,000 | $410,000 |
| | Redevelopment | $44,000 | $90,000 | $110,000 | $200,000 |
| Street Trees | Retrofit | $18,000 | $18,000 | $18,000 | $18,000 |
| | Redevelopment | $15,000 | $15,000 | $15,000 | $15,000 |

## 1.6 Storage

Storage facility costs include: site preparation, excavation and excavation support, dewatering, transport and disposal of spoil material, select bedding and backfill, storage tank construction, automatic flushing systems, a pump station to pump captured CSO back to the interceptor when the storm event is over, instrumentation, SCADA, and odor control.

*Design Criteria*

- Conveyance piping to divert CSO to the facility
- Volume of tank or overflow to be captured as determined by the CSS model
- Pump back rate to interceptor to empty the tank – assume 48 hours
- Size of force main to interceptor

*Construction Costs*

- Cost data from ALCOSAN, EPA, Indianapolis, Hartford, CDM and Malcolm Pirnie were averaged to develop the cost curve. Data from Kansas City and Cincinnati were not used because they were much lower than the other cost sources.
- Use construction cost curve for tank costs
- Add costs for conveyance piping to the storage facility per Section 1.1
- Add cost for force main to the existing interceptor per Section 1.4 (pump back costs are included in the cost curve)


## 1.7 Primary Sedimentation

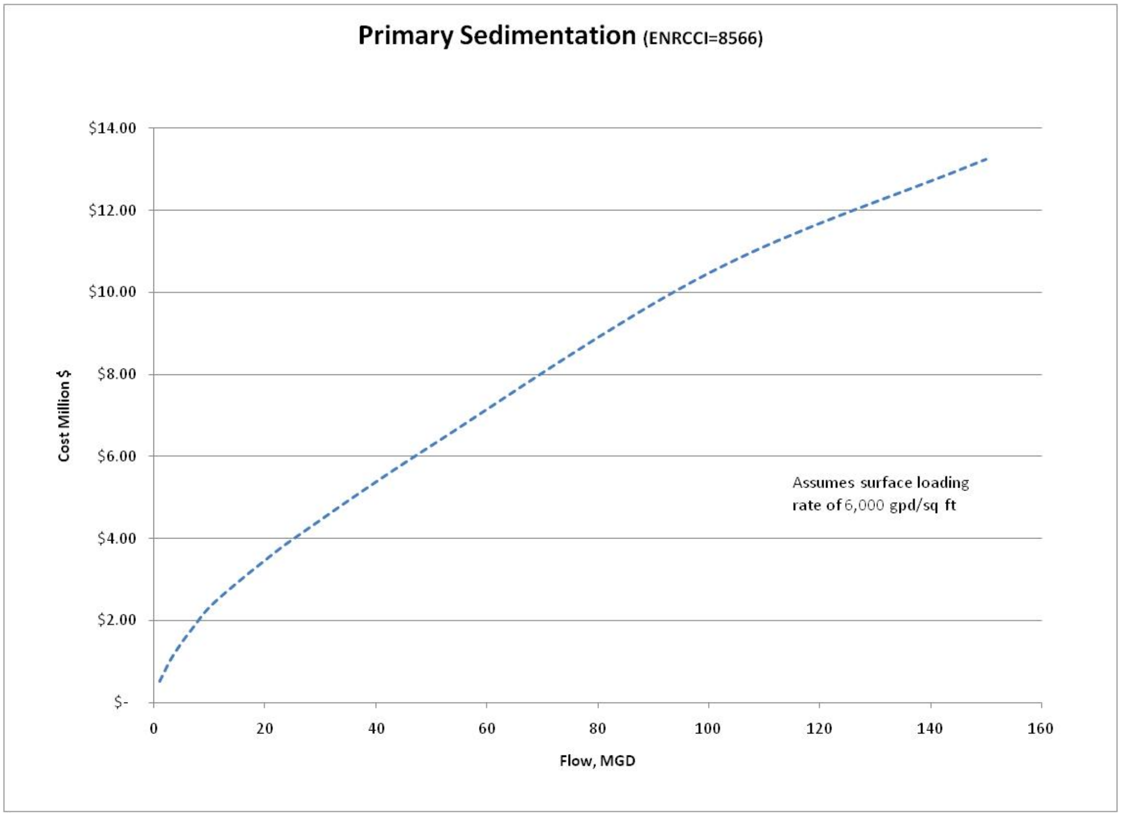
Primary sedimentation basin costs include: the settling tank, site preparation, excavation and excavation support, dewatering, spoil transport and disposal, select bedding and backfill, regulator, screening, outfall, automatic flushing, instrumentation, SCADA, pumping station and odor control. Conveyance piping to the facility and the force main piping back to the interceptor must be added to the costs of the facility. Disinfection costs should be added as applicable.

*Design Criteria*

- Peak overflow rate of 6,000 gpd/sq ft
- Influent flow rate as determined by CSS model
- Check size of basin for detention time for disinfection– see disinfection section

*Construction Costs*

- Cost data from EPA, CDM, Malcolm Pirnie, Hartford, Kansas City, Omaha and Cincinnati were used to develop the cost curve.
- Refer to cost curve attached for estimating facility costs
- Add costs for conveyance piping to the sedimentation facility per Section 1.1




# 1.8 Screening

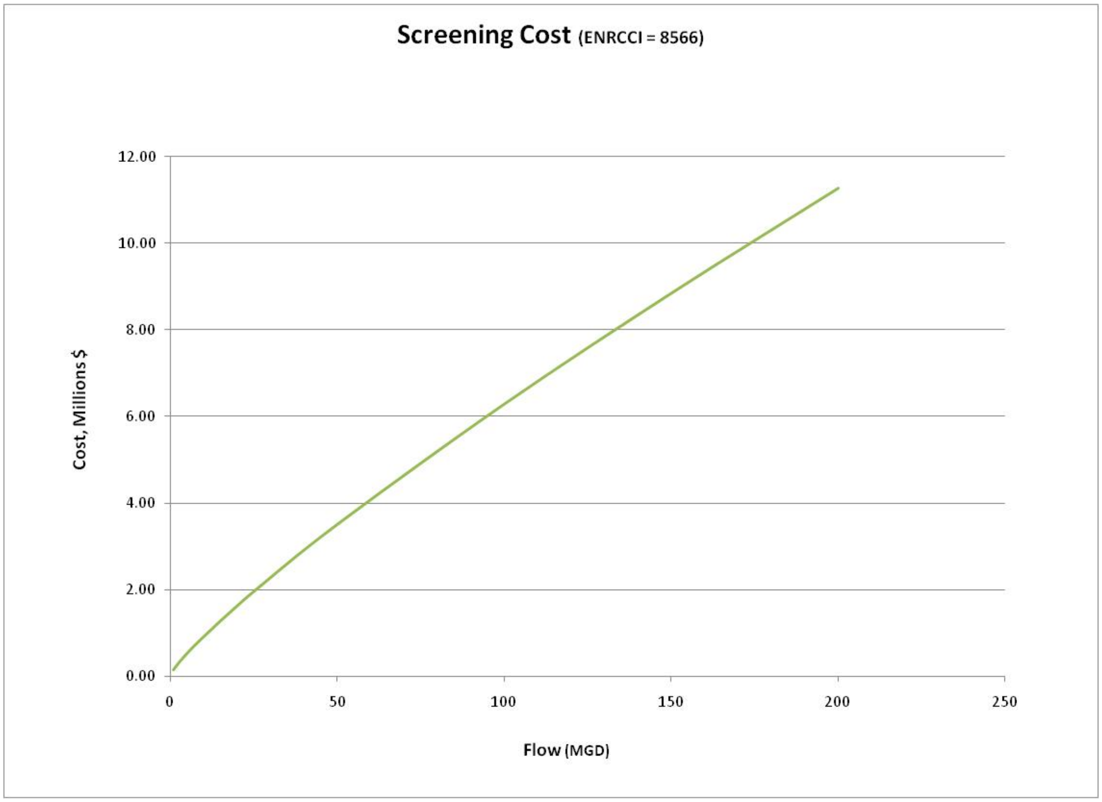
Screens are typically installed to provide floatables control. EPA's Combined Sewer Overflow Control Manual – September 1993, recommends the use of automatically activated mechanically cleaned screens for CSO facilities with 0.25 to 1 inch spacing between bars. Costs include mechanically cleaned screens and controls.

***Design Criteria***

- Peak flow rate as determined by the CSS model

***Construction Costs***

- Costs used from ALCOSAN, EPA, Hartford, Indianapolis, Kansas City, CDM and Malcolm Pirnie were all relatively close and were averaged to develop the cost curve for screening
- Refer to construction cost curve for estimating facility costs
- Add costs for conveyance piping to the storage facility per Section 1.1
- Add disinfection costs, as applicable, per Section 1.8.




## 1.9 High Rate Treatment

High rate treatment includes: screens, pumping, ballasted flocculation process equipment and tankage, chemical and ballast storage building and associated facilities. Additional costs for disinfection should be generated if effluent is required to be disinfected prior to discharge from the facility.

***Design Criteria***

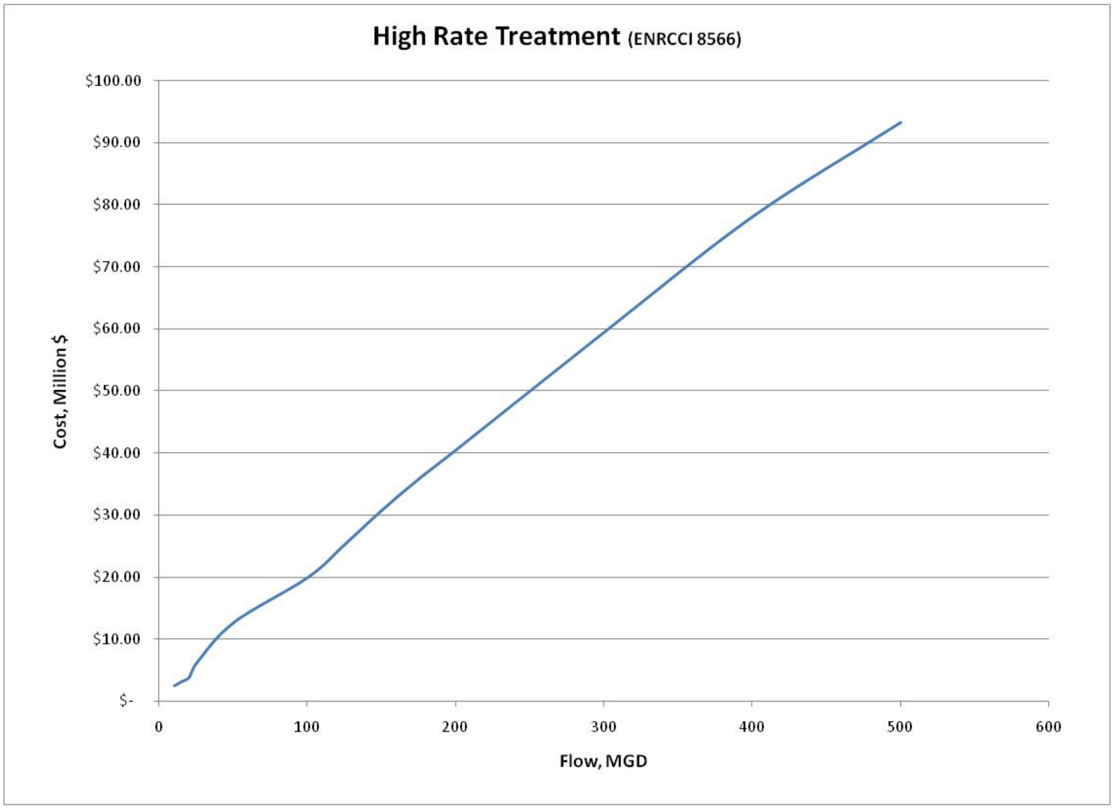
- Peak flow rate as determined by the CSS model

***Construction Costs***

- Cost data from ALCOSAN, EPA, Hartford, Kansas City, CDM and Malcolm Pirnie was reviewed and data from ALCOSAN and Malcolm Pirnie were averaged to develop the cost curve for high rate treatment. As the costs included different combinations of features (such as pumping, screens and disinfection) the cost data was modified using the cost curves developed for other alternatives to put each of the data sources on the same plane. The modified cost curves account for the costs of screening, pumping and high rate treatment. Disinfection costs must be added separately, if required.

- Refer to the attached cost curve for estimating facility costs

- Add costs for conveyance piping per Section 1.1
- Add disinfection costs per Section 1.8, if required.




# 1.10 Tunnels

Tunneling costs assume the tunnel construction will require significant structural support associated with tunneling in soft materials. Other features included in the costs are: regulators to divert and control storm flows, consolidation conduits to convey combined sewage to the tunnel, coarse screening, vertical drop shafts, air separation chambers, access shafts, vent shafts, tunnel construction, transport and disposal of spoils, a dewatering system to pump combined sewage stored in the tunnel to the conveyance system, and odor control systems.

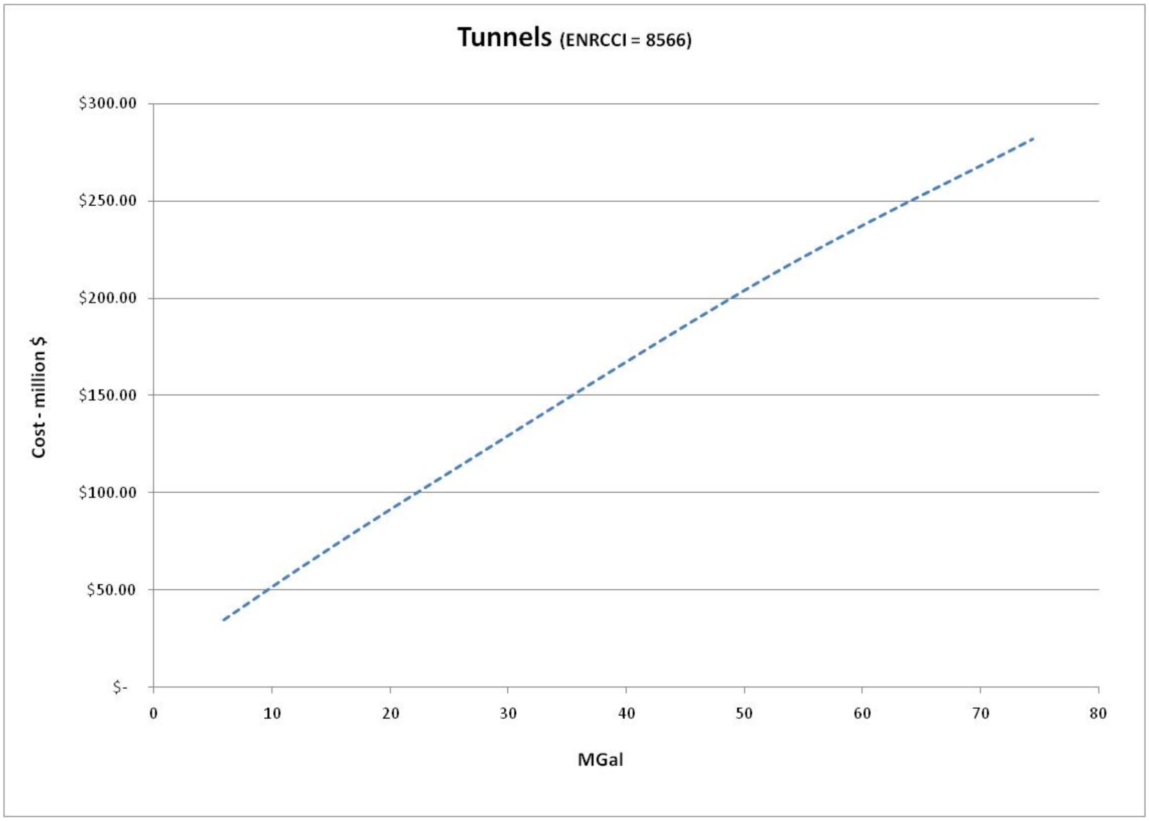
*Design Criteria*

- Volume of combined sewage to be stored as determined from the CSS model
- Maximum pump back rate after the storm –50% of the average daily flow during dry weather

- Maximum dewatering time – 48 hours
- Extensive geotechnical investigations compared to other treatment alternatives

***Construction Costs***

- Cost data from EPA cost curves, Hartford, Indianapolis, Kansas City, CDM and Malcolm Pirnie were averaged to develop the cost curve for Albany Pool communities.
- Refer to the attached cost curve to estimate the cost of the facilities.




*Cost curve assumptions:*
*6, 13, and 24 MG assumes 10,000 LF and 10, 15, and 20 ft diameter respectively*
*52 and 74 MG assumes 22,000 lf and 20 and 24 ft diameter*
*Assumes soft rock/materials tunnels where significant structural support, dewatering and other types of boring and excavation equipment (other than open face rock tunnel boring machine) is required*

## 1.11 Disinfection – Chlorination/Dechlorination

Chlorination and dechlorination is assumed to occur in conjunction with another treatment technology for the purposes of killing bacteria prior to discharge of the treated effluent. If chlorination/dechlorination is a stand-alone process, costs for an enclosure need to be added. Facilities include a contact basin, chemical storage, metering pumps and other accessories that will be housed in the building or enclosure provided with the other treatment facility. The contact basin typically consists of an open serpentine tank located outside the equipment building. Sodium hypochlorite and sodium bisulfite are typically used for chlorination and dechlorination. Components included in the cost curves include: chemical storage tanks, metering pumps, dilution water supply, piping and valves, diffusers to disperse the chemical into the wastewater flow and chlorine residual analyzers.

***Design Criteria***

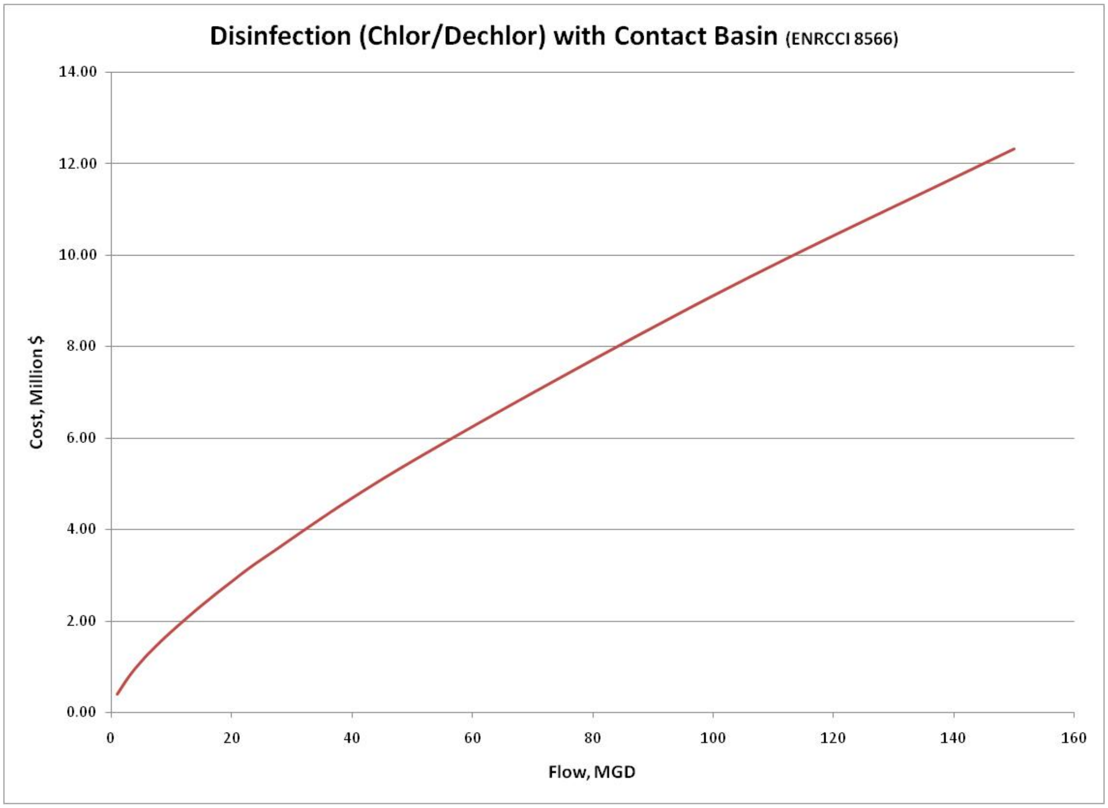
- Peak flow rate as determined by the CSS model

- Detention/contact time – a minimum of 15 minutes will be used to size facilities per EPA's Combined Sewer Overflow Control Manual – September 1993. While EPA's September 1999 CSO Technology Fact Sheet on Chlorine Disinfection, discusses shorter contact times (between 1 and 10 minutes), shorter times will not be considered until design. As design of a facility progresses, pilot studies and review of design data will be required to determine the required contact time.

***Construction Costs***

- Cost data from ALCOSAN, EPA, Hartford, Indianapolis, Kansas City, CDM and Malcolm Pirnie were averaged to develop the cost curve for disinfection by chlorination and dechlorination. Costs for a contact basin were added assuming a 15 minute contact time. All but the Hartford cost data was relatively close. The higher Hartford cost data was averaged with the other data to provide a more conservative value. Hartford and ALCOSAN cost curves were adjusted based on recent construction projects, therefore that data provides value and was included in the average.

- Refer to the attached cost curve for estimating facility costs.




## 1.12 Non Construction Costs

In developing the opinion of probable project cost, a number of non-construction costs must be taken into consideration and added to the construction cost estimate. These non-construction costs include indirect costs (such as permits, tax, insurance and bonds), overhead and profit, construction contingencies, project contingencies, escalation to the midpoint of construction, land or easement acquisitions, and soft costs such as (administration, engineering and legal fees). These costs are to be computed and incorporated in the total opinion of probable construction cost using the steps outlined as follows:

1) Subtotal of facility construction cost developed using the above cost curves
2) Add 10% for indirect costs (not applicable to sewer separation)
3) Calculate subtotal
4) Add 15% for overhead and profit (not applicable to sewer separation)
5) Calculate subtotal
6) Add 25% for the construction contingency

7) Calculate subtotal

8) Add 20% for the project contingency

9) Add land acquisition costs (assume assessed property value multiplied by 150%)

10) Calculate subtotal

11) Add 30% for engineering, administrative and legal fees

12) Calculate total for the Opinion of Probable Project Cost.

For the purposes of evaluating alternatives, all costs will be based upon the July 2009 ENRCCI of 8566. Upon identifying the recommended alternative and developing an implementation schedule, the opinion of probable construction cost will be escalated to the projected midpoint of construction.

## 1.13 Life Cycle Costs

The life cycle costs include the construction and non-construction costs presented above plus the costs to operate and maintain the facilities. These costs will be further analyzed after the alternatives are narrowed down to a manageable number.