CITY OF ALEXANDRIA

Combined Sewer System Long Term Control Plan Update

The City's Combined Sewer System

Under most of the City's streets there are two sewers; one for carrying stormwater to streams and rivers and one for carrying sanitary sewage from homes and businesses to the wastewater treatment plant (Figure 1). In a small area of the City in and around Old Town the City maintains and operates a Combined Sewer System (CSS). A CSS is a sewer system in which there is one pipe that conveys both sanitary sewage and stormwater to a local wastewater treatment plant (Figure 2). Under dry conditions all flow is conveyed to the treatment plant where it is treated, but during rain events the amount of stormwater entering the sewers can overwhelm the system and the combined sewage overflows into the local receiving waters (e.g., Hunting Creek) out of permitted Combined Sewer Overflows (CSOs). Along with stormwater discharges, these overflows impact local water quality. CSS systems are common in older cities throughout the US.

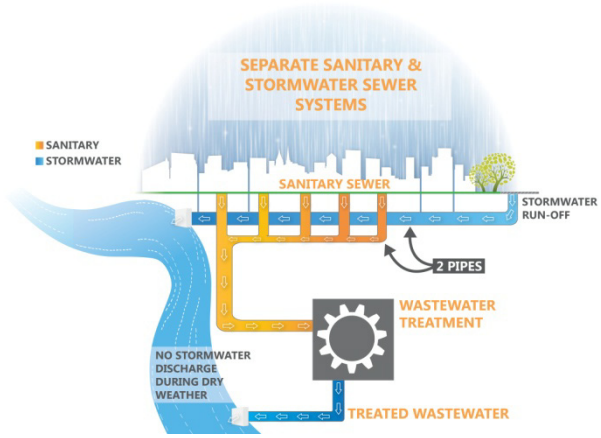

Figure 1: Separate Sewer System

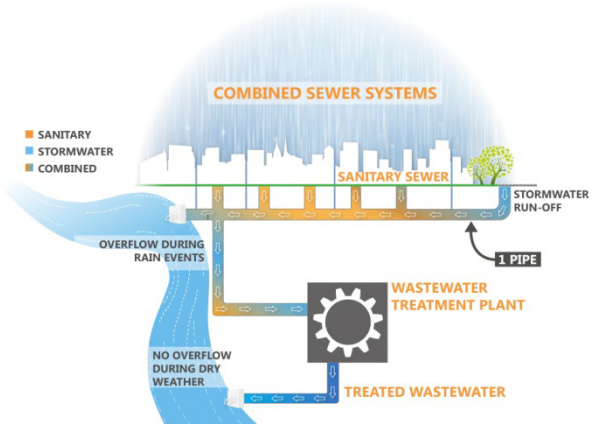

Figure 2: Combined Sewer System

What is a Long Term Control Plan?

The City of Alexandria's Long Term Control Plan is a plan to control and reduce pollution from combined sewage overflows within the City through proper operation and maintenance. The City's initial Long Term Control Plan was approved by the Virginia Department of Environmental Quality in 1999 and incorporated into the City's discharge permit. Consistent with other combined sewer communities, the City's current Long Term Control is built around best management practices set forth by the Environmental Protection Agency.

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Water Quality and New Regulations

The water quality in and around Alexandria has been monitored by the City for many years. The Virginia Department of Environmental Quality determined that Hunting Creek exceeded water quality standards for *E. coli* bacteria and established a Total Maximum Daily Load (TMDL) for *E. coli* bacteria. The TMDL is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and calls for reductions in the *E. coli* bacteria discharged from combined sewers. The City was issued a new combined sewer system discharge permit in 2013 that requires the City to update its Long Term Control Plan by August 2016. The Long Term Control Plan Update will be a strategic plan that will provide a path for the City to meet the Hunting Creek TMDL for *E. coli* bacteria. This plan update will focus on decreasing the amount of bacteria discharged into the receiving waters and gradually reducing impacts from the combined sewer system.

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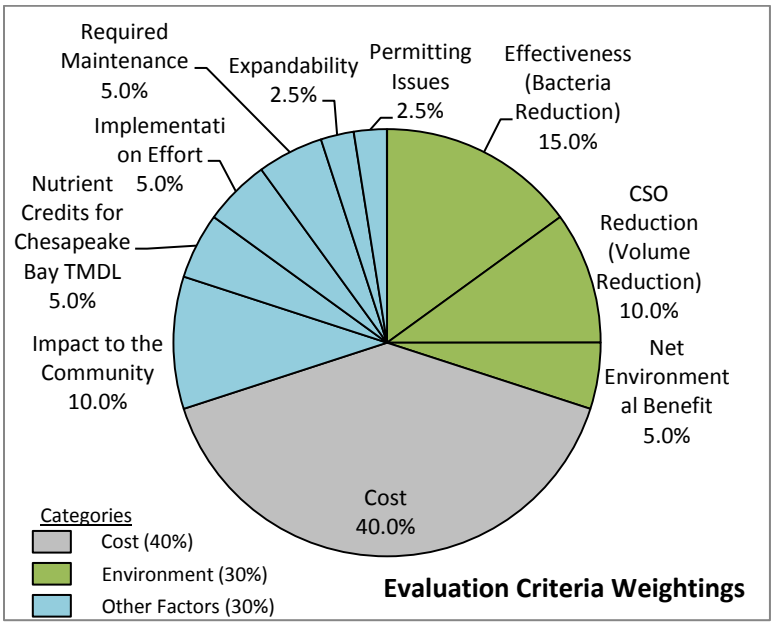
Combined Sewer Control Strategies Evaluated

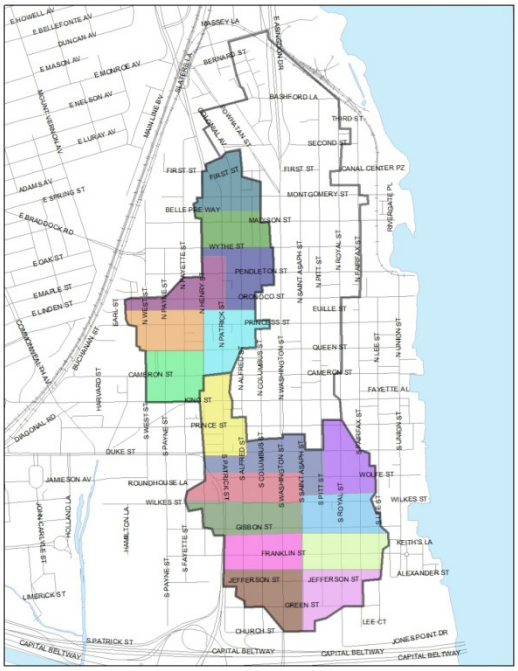
Rank	CSO Control Strategy	Score
9	Complete Sewer Separation	2.10
8	Green Infrastructure	3.13
7	Separate Disinfection Facilities	3.34
6	One Storage Tunnel (relocate outfalls to the Potomac)	3.68
5	Storage Tunnel for Hooffs Run and Disinfection at Royal Street	3.69
4	Separate Storage Tanks	3.76
3	One Storage Tunnel	3.86
2	Storage Tunnel for Hooffs Run and Storage Tank at Royal Street	3.97
1	Separate Storage Tunnels	3.98



A total of nine combined sewer control strategies were considered and ranked based on applying a series of evaluation criteria. Combined sewer control strategies ranked 1, 2, and 3 are being considered for further evaluation. Green Infrastructure and Sewer Separation will continue to be evaluated as integral complementary strategies. The remaining control strategies are being eliminated from further consideration.

9. Complete Sewer Separation ($300 - $450 M)

Separation would create two separate systems: a stormwater system utilizing the current combined sewer pipes and a new sanitary system. Full separation would require digging up the infrastructure in Old Town and would lead to years of disruption. The City already has a separation plan, which is known as the Area Reduction Plan. The Area Reduction Plan is tied to redevelopment projects within the combined sewer area. Over the last 10 years the City has separated more than 37 acres from the combined sewer system. In order to meet the regulatory timeline, separation would be independent of redevelopment.



Notes:

- Approximately 19 acres under construction continuously for 17 years
- No reduction in number of overflows until full separation is completed
- Additional area added to the stormwater permit
- Potential impact of historical character
- Most disruptive

8. Green Infrastructure ($140 - $210 M)

Green infrastructure can be used as a method to reduce stormwater runoff and the volume of combined sewer overflows in the City of Alexandria. The combined sewer system is in a densely populated area, with a large portion of the land covered with impervious surfaces (pavement, sidewalks, and buildings). These impervious surfaces prevent much of the rainfall from being absorbed into the ground and divert the rainfall into the combined sewer system, where it may eventually overflow. Green infrastructure can capture rainfall, remove pollutants, and lengthen the amount of time it takes for the rainfall to make it into the sewers. By lengthening the amount of time it takes to reach the sewer it may be possible to reduce the amount of overflow volume and frequency. Green infrastructure technology examples include rain gardens, bioswales, and permeable pavement. Other communities have begun to incorporate green infrastructure into their combine sewer mitigation efforts, including Washington D.C., New York City, and Philadelphia.

Notes

- Reduces stormwater volume but does not address bacterial load directly
- If implemented on ALL City-owned parcels and City right-of-way
  - 20-30% reduction in combined sewer overflow volume
  - Will not achieve regulatory compliance
  - Full implementation of green infrastructure may be unrealistic by 2035
- More applicable as an integrated complementary strategy

7. Separate Disinfection Facilities ($65 - $100 M)

During a rain event the combined sewer overflow would be diverted to a new disinfection facility. The disinfectant is added or applied to kill (inactivate) the bacteria before it discharges into Hooffs Run and/or Hunting Creek. Disinfection technologies include sodium hypochlorite (chlorine) and ultra-violet (UV) radiation disinfection. The disinfection facilities would be in the vicinity of the existing outfalls. Other communities have installed disinfection facilities to address their combined sewer systems, including Indianapolis and Detroit.

Notes

- Safety concerns related to transportation and storage of chemicals in residential and urban settings
- No reduction in combined sewer volume
- Only kills bacteria, other pollutants remain

6. One Storage Tunnel and Outfall to Potomac ($130 - $195 M)

Combined sewer overflow would be diverted into a large CSO storage tunnel. The tunnel would capture and store most wet weather events throughout the year. After the rain event, the stored volume would be sent to the wastewater treatment plant for a high level of treatment. Very large wet weather events would fill up the tunnel and the remaining CSO volume would overflow to a newly constructed outfall on the Potomac River. The current CSO-004 outfall would be eliminated.

Notes

- Stores and treats CSO to substantially reduce overflows
- Remaining overflows outfall to Potomac River
  - Additional regulatory and permitting challenges
- Most costly store and treat option
- Most complex hydraulics

5. Storage Tunnel for Hooffs Run and Disinfection at Royal Street ($85 - $130 M)

This strategy consists of a CSO storage tunnel that would capture flows from CSO-003 and CSO-004 at Hooffs Run. The tunnel would capture and store most wet weather events throughout the year. After the rain event, the stored volume would be sent to the wastewater treatment plant for a high level of treatment. Very large wet weather events would fill up the tunnel and the remaining CSO volume would overflow to a relocated CSO-004 outfall on Hooffs Run near AlexRenew.

Additionally a disinfection facility is constructed in the vicinity of CSO-002. During a rain event the combined sewer overflow would be diverted to a new disinfection facility. The disinfectant is added or applied to kill the bacteria before it discharges into Hunting Creek.

Notes

- Safety concerns related to transportation and storage of chemicals near the Royal Street outfall
- No reduction in combined sewer volume at Royal Street
- Only kills bacteria, other pollutants remain from Royal Street outfall

4. Separate Storage Tanks ($90 - $135 M)

During a rain event, the combined sewer overflow would be diverted to storage tanks. The storage tanks can either be constructed above ground or below ground. The storage tank(s) would be in the vicinity of the existing outfalls. After the rain event, the stored volume would be sent to the wastewater treatment plant for a high level of treatment. Storage tanks are a common and accepted technology for storage of combined sewage overflows. Although not specific to combined sewers, underground storage tanks have been installed in the City at the Four Mile Run Pump Station located at the north end of Commonwealth Avenue. Arlington County utilized above ground storage tanks at their wastewater treatment plant (intersection of Route 1 and S. Glebe Road).

Notes

- Does not address additional wet weather issues
- Siting challenges
- Future challenges related to access and maintenance
- Tank located adjacent to Duke Street
- Constructability challenges and road closures

3. One Storage Tunnel ($120 - $180 M)

Combined sewer overflows from CSO-002, CSO-003, and CSO-004 would be diverted into a large CSO storage tunnel. The tunnel would capture and store most wet weather events throughout the year. After the rain event, the stored volume would be sent to the wastewater treatment plant for a high level of treatment. Very large wet weather events would fill up the tunnel and the remaining CSO volume would overflow to a relocated CSO-004 outfall on Hooffs Run near AlexRenew and to the existing CSO-002 outfall on Hunting Creek.

Notes

- 8-foot diameter tunnel
- 7,400 linear feet
- 3 million gallons of storage
- Reduction from 40 – 60 overflows to 4 overflows per year
- Overflows to Hunting Creek and/or Hooffs Run

2. Storage Tunnel for Hooffs Run and Storage Tank at Royal Street ($100 - $150 M)

This strategy consists of a CSO storage tunnel that would capture flows from CSO-003 and CSO-004. The tunnel would capture and store most wet weather events throughout the year. After the rain event, the stored volume would be sent to the wastewater treatment plant for a high level of treatment. Very large wet weather events would fill up the tunnel and the remaining CSO volume would overflow to a newly constructed outfall on Hooffs Run near AlexRenew. The existing CSO-004 would be eliminated.

Additionally a storage tank would be constructed in the vicinity of CSO-002. During a rain event the combined sewer overflow would be diverted a new storage tank that would store the flow and send it back to the wastewater plant for a high level of treatment following the event.

Notes

CSO-003/004 (Hooffs Run) Tunnel

- 8-foot diameter tunnel
- 2,600 linear feet
- 1 million gallons storage tunnel
- Reduction from 40 – 60 overflows to 4 overflows per year
- Overflows to Hooffs Run

CSO-002 (Royal St.) Tank

- 2 million gallon storage tank
- Reduction from 40 – 60 overflows to 4 overflows per year
- Overflows to Hunting Creek

1. Separate Storage Tunnels ($105 - $160 M)

This strategy consists of a CSO storage tunnel that would capture flows from CSO-003 and CSO-004. The tunnel would capture and store most wet weather events throughout the year. After the rain event, the stored volume would be sent to the wastewater treatment plant for a high level of treatment. Very large wet weather events would fill up the tunnel and the remaining CSO volume would overflow to a newly constructed outfall on Hooffs Run near AlexRenew. The existing CSO-004 would be eliminated.

Additionally a second tunnel would be constructed in the vicinity of CSO-002. During a rain event the combined sewer overflow would be diverted to this new tunnel. Following the event, the flows stored in the tunnel would be pumped back into the sewer system where it would flow to the treatment plant for a high level of treatment.

Notes

CSO-003/004 (Hooffs Run) Tunnel

- 8-foot diameter tunnel
- 2,600 linear feet
- 1 million gallons of storage
- Reduction from 40 – 60 overflows to 4 overflows per year
- Overflows to Hooffs Run

CSO-002 (Royal St.) Tunnel

- 15-foot diameter tunnel
- 1,700 linear feet
- 2 million gallons of storage
- Reduction from 40 – 60 overflows to 4 overflows per year
- Overflows to Hunting Creek