



King County

Department of Natural Resources and Parks

Wastewater Treatment Division

Contract P00208P16

**Professional Services for Evaluation of Inflow and Infiltration
Reduction Concepts**

Phase 1: Evaluation of Concepts

Task 430

**Approach to Achieve Common Sewer and Side Sewer/Lateral
Standards**

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Project 150258

**Brown and Caldwell
701 Pike Street, Suite 1200
Seattle, WA 98101**

Phone: 206.624.0100 | Fax: 206.749.2200

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1.0 Background and Purpose

This introductory section presents the background and purpose for this Task 430, Approach to Achieve Common Sewer and Side Sewer/Lateral Standards technical memorandum (TM).

Background

Inflow and infiltration (I/I) is rainwater, surface water, and groundwater that flows directly and indirectly into sanitary sewers. Although sewer design guidelines include a reasonable allowance for I/I, excessive rates of I/I in a sanitary sewer system can lead to basement backups, sanitary sewer overflows, and unnecessary conveyance and treatment costs. Excessive I/I flows in King County's (KC's) regional separate sanitary sewer system impact both capital and operational costs.

KC Wastewater Treatment Division's (WTD) Conveyance System Improvement (CSI) Program assesses the hydraulic capacity of the regional wastewater system with projected 20-year peak flows. This information is used to plan and size future capacity-related improvement projects.

Findings from CSI Program analysis show that about 70 percent of the peak flow in the separate sanitary sewer system is rain-derived inflow and infiltration. An estimated 27 percent of the annual wastewater system volume treated by KC's wastewater treatment plants can be attributed to I/I.

This I/I results in higher capital program costs by accelerating the need and scale of capacity improvement projects. Operational costs are increased because of the need to transport and treat higher rates of flow. The additional capital costs associated with increasing the capacity of the collection system, pump station, and wastewater treatment plant to handle excessive I/I flows are currently spread across all customers through WTD's sewer rates.

WTD implemented an I/I Control Program in 1999 as part of the Regional Wastewater Services Plan. Currently, the I/I Control Program efforts are focused on portions of the sanitary sewer system experiencing flow capacity shortages. Specifically, the I/I Control Program has developed data to assess where pursuing I/I reduction might be more cost-effective than increasing pipe and/or pump station capacity. Thus far, the I/I Control Program has been effective in reducing I/I experienced in some areas of the regional wastewater system; however, no comprehensive program is currently in place to address I/I throughout the regional wastewater system.

The Phase 1: Evaluation of Inflow and Infiltration (I/I) Reduction Concepts project has been developed to assist KC WTD and Metropolitan Water Pollution Abatement Advisory Committee (MWPAAC) member agencies in the exploration of new elements for the Regional I/I Control Program. This project will build on the work that WTD has done previously and explore more comprehensive and system-wide I/I reduction. WTD selected Brown and Caldwell (Consultant) per the P00208P16 Professional Services Contract to assist with this project. The Consultant has been tasked with the following:

- Collect and share existing I/I Control Program information with MWPAAC
- Review sewer and side sewer standards, assess existing local agency standards compared to best management practices (BMPs), and develop an approach to achieve common standards in the region
- Evaluate current city and utility district inspection programs for sewers and side sewers to identify BMPs and develop an outline for a regional inspection training program
- Identify the types of private side sewer programs in common use nationally, and evaluate private side sewer programs within the KC service areas for side sewer inspection and certification, grants or loans, and regional I/I support
- Develop a framework for implementing private side sewer programs within the KC service areas, specifically for side sewer inspection and certification, grants or loans, and regional I/I support

Purpose

As part of the Task 410 Verify 2004 King County Final Draft Regional I/I Control Standards, Procedures, and Policies TM, the 2004 KC standards, procedures, and policies for I/I were reviewed. For the Task 420 Assessment of Existing Local Agency Sewer and Side Sewer Standards TM, the current standards for the local agencies were compared with national BMPs. The findings of these assessments showed that many of the local agencies have evolved their I/I standards since the 2004 KC Standards were drafted, and have since adopted practices that are in alignment with national BMPs. Although most agencies are in alignment with national BMPs, the practices employed are not consistent or common within the regional service area and some agencies are going above and beyond national BMPs. There is interest in developing a mechanism for sharing information and move collaboratively toward every local agency employing a consistent minimum level of BMPs, through reducing the potential for I/I and/or mitigating I/I that enters WTD's regional separate sewer system.

The purpose of this TM is to develop a potential approach to share information on BMPs and achieve common sewer, side sewer, and lateral standards throughout the regional wastewater service area.

2.0 Status of Sewer and Side Sewer Standards

This section presents a summary of the current side sewer standards.

Legal Authorities Currently in Place

As described in the December 2005 KC I/I Control Program Recommendations report, federal and state regulations, King County Code, and agreements between KC and local agencies recognize the importance of controlling I/I in wastewater systems.¹ KC's wastewater disposal agreements address I/I control through references to Section 28.84.050 of the King County Code. These references effectively establish an I/I threshold for sewers constructed after January 1, 1961, of 1,100 gallons per acre per day and a corresponding surcharge penalty for exceedance of the threshold. They also require local sewers to be constructed and maintained in accordance with the rules and regulations of Metro (King County).

The 2005 KC report references a legal review illustrating that I/I reduction-related improvements such as private property repairs could be cost-effective (i.e., advantages to the public outweigh the cost) and that the public benefit is demonstrated to outweigh the cost of other I/I management approaches. The expenditure of public funds for this purpose would be legally defensible and would not be a violation of the Washington State Constitution provisions. This could be relevant if practices such as installing T-liners in laterals when installing cured-in-place pipe (CIPP) liners in sewer mains are adopted. In this instance, it is often cost-effective to use a long lateral liner that would go past the right-of-way (ROW)/easement limit and into the side sewer. If the local agency did not have authority to spend money on private property, the liner could not go past the ROW.

Not reviewed as part of this contract were the current legal authorities for rights-of-entry onto private property, as well as the ability of local agencies to inspect side sewers and require property owners to repair defects. Consequently, it is not known whether each individual agency has the proper authority to undertake all the I/I-related BMPs discussed in subsequent sections of this TM. It is understood that some local agencies are not responsible for plumbing inspections conducted on upper laterals, and are not necessarily notified when modifications (remodels and demolitions) are made to existing structures. Therefore, it is important to recognize that it is not feasible for all local agencies to adopt all regional sewer and side sewer standards and that, in some instances, not all standards will be applicable or appropriate. If a decision is made to adopt this approach to achieve

¹ For more information, see Sections 2.2.2–2.2.5 of the *Executive's Recommended Regional Infiltration/Inflow Control* report dated December 2005.

common sewer and side sewer standards, further review of the legal authorities required will be provided.

Current Standards Status

The draft set of design and construction standards to reduce and control I/I presented to local agencies in 2004 were based on sound judgments of BMPs at the time, and addressed the following:

- Established proper construction practices and materials for I/I repair and rehabilitation projects
- Encouraged appropriate inspection and testing prior to acceptance of new or rehabilitated sections of sewer
- Developed inspection and repair standards for new and existing structures on private property
- Encouraged appropriate system maintenance
- Provided appropriate predesign, investigation of I/I conditions, inspection of construction, and enforcement of standards

Recognizing that MWPAAC consists of cities and sewer districts that range in size and demographics, a scalable approach to achieving common side sewer standards is presented.

3.0 Approach to Achieving Common Sewer and Side Sewer Standards

This section provides a potential approach for achieving common sewer and side sewer standards.

Approach

Recognizing that not all BMPs are suitable to each local agency to the same degree, a scalable, continual-improvement approach is suggested. This approach will ensure that each local agency can commit to implementing BMPs for sewer and side sewer standards that are right for that agency but are also in alignment with the goals of the regional wastewater service area. The following steps are suggested to develop common sewer and side standards:

1. Define Minimum Regional Side Sewer I/I BMPs
2. Define Regional BMP Performance Levels
3. Consolidate Regional BMPs and Performance Levels and Develop BMP Scoring Tool
4. Identify Individual Agency Side Sewer I/I Minimum BMP Gaps and Develop Action Plans
5. Review and Revise Individual Agency BMPs and Action Plans

There are options to implement each step of this approach. Each step is defined and then followed by options for regional implementation for consideration.

Step 1: Define Minimum Regional Side Sewer I/I BMPs

A list of BMPs would be developed to which each local agency could compare its current practices, determining which of these are applicable. BMP performance-level guidelines would then be developed that would provide for a range of implementation opportunities for the individual agencies. The BMPs would be developed using existing information from the 2004 KC Standards,

current national BMPs, and local BMPs identified during the recent review of each agency standards. The following lists potential BMPs to be developed:

- I/I program definition:
 - Goals and objectives established (policy)
 - Responsibilities established
 - Funding established
 - Program established
 - Prioritization of activities
 - Mapping/inventory of public and private sewer assets
 - Legal authorities determined for private asset inspection and corrections
- I/I prevention:
 - Sewer system design guidelines that address flood-prone areas
 - Watertight manhole specifications
 - Watertight mainline specifications, standard drawings, and proper construction methods
 - Side sewer specifications, standard drawings, and proper construction methods
 - New construction, repair/rehabilitation, and replacement inspection and product-specific inspections
 - Contractor prequalification
 - Private property owner/occupant educational materials
 - Sewer system component maintenance BMPs
- Identifying and quantifying I/I flows/locating I/I sources:
 - Flow monitoring
 - Manhole inspections
 - Closed-circuit television (CCTV) inspections of mains, side sewers, and lateral sewers
 - Smoke testing
 - Rainfall simulation
 - Illicit storm drain/cross-connection dye tracing
 - Illicit private property I/I source connections
 - Satellite altimetry/thermography, radar rainfall, aerial photography, and other remote sensing resources
 - Assessment of stormwater conveyance system performance and condition
- Addressing I/I sources:
 - Illicit source disconnection requirements and standard drawings
 - Best available technologies for mainline sewer, side sewer, and lateral repair and replacement
 - Appropriate inspection requirements for mainline, side sewer, and lateral repairs
- Private property owner occupant resources:
 - Side sewer maintenance BMPs (including backflow valves and low-pressure system components)
 - I/I source disconnection guidelines
 - Plumber/utility contractor prequalification

Options for Implementation

The following are options for implementation of Step 1:

1. Contract with a consultant to develop the initial list of BMPs. Send the list of BMPs to agencies for review, comment, and approval.
2. Collaboratively develop the list of BMPs using a facilitated workshop consisting of engineering, maintenance, and inspection personnel from a cross-section of agencies. As with option 1, this BMP list would then be sent to agencies for review, comment, and approval.
3.<***additional options to be developed based on input from MWPAAC***>
4.

Step 2: Define Regional BMP Performance Levels

The approach for evaluating practices comes from asset management principles. Instead of a continuous rating system (such as 0 to 10), specific performance levels are defined that describe an increasing sophistication employed by the agency. For application to I/I practices, five performance levels would be defined for each BMP. The levels are defined below, starting with the highest level, “optimized,” and ending with the lowest level, “unaware”:

- **Optimized:** A level that reflects industry BMP status. Organization and staff see value in continual improvement and regularly pursue new methods, ideas, products, or other innovation.
- **Advanced:** Going beyond a defined practice. Quantitative performance measures are defined, tracked, and used to adjust practice and documentation. Practice is continually performed.
- **Defined:** Activities are defined, documented, and repeatable. Purpose and practice are communicated to staff. Practice has been performed within the last 6 years. The defined level would be considered the ideal minimum level for demonstrating that an agency was meeting a national standard BMP.
- **Initial:** Aware of need for this BMP, but no systematic, documented approach. Activities are reactive and unrepeatable. Practice has not been performed in more than 3 years. This level could be acceptable for an agency if a certain BMP was not as applicable to that agency.
- **Unaware:** Lacking awareness regarding the need for this specific I/I BMP.

Examples of performance-level definitions are provided in Table 1 for BMPs around flow monitoring and watertight system design specifications.

Table 1. Example Performance Levels for BMPs

Status	Flow Monitoring	Watertight System Design Specification
Optimized	Dedicated to improving monitoring processes, equipment, and data management procedures	Refines watertight specifications by identifying possible inflow sources and including preventive measures in specifications (e.g., requiring manholes located in potential flooded areas to be equipped with locking gasketed ring and cover, lateral abandonment, lake line provisions, etc.)
Advanced	Regular system monitoring, including long-term flow monitors, in support of I/I program	Addresses sewer main and side sewer water testing, integrates lateral liners with main liners, and requires watertight system components (e.g., prefabricated manhole base with glass fiber supported plastic liner and gasketed connections, watertight seals on liners, etc.)
Defined	Performed for focused I/I studies	Requires sewer main testing and some watertight system components (e.g., rubber gasket or solvent welded joints, manholes not located in gutters, etc.)
Initial	Infrequent, sporadic, and not strategic	Requires minimal I/I prevention measures (e.g., sewer main testing)
Aware	Does no flow monitoring	Does not address watertightness issues in specifications

Options for Implementation

The following are options for implementation of Step 2:

1. Contract with a consultant to develop the performance levels for the list of regional BMPs agreed upon in Step 1. Send the performance levels to MWPAAC agencies for review, comment, and approval.
2. Collaboratively develop the performance levels using facilitated workshops consisting of engineering, maintenance, and inspection personnel from a cross-section of the agencies. As with option 1, the performance levels would then be sent to agencies for review, comment, and approval.
3.<***additional options to be developed based on input from MWPAAC***>
4.

Step 3: Document Regional BMPs and Performance Levels and Develop BMP Scoring Tool

The list of BMPs and performance levels developed in the workshops would be documented and housed on a Regional I/I Program website. A scoring tool similar to Figure 1 below and sample action plan presented in Table 2 would be developed and be available to the local agencies through the website.

Options for Implementation

1. Contract with a consultant to consolidate the regional BMPs and performance levels and develop the scoring tools and action plan templates.
2.<***additional options to be developed based on input from MWPAAC***>
3.

Step 4: Identify Individual Agency Side Sewer I/I Minimum BMP Gaps and Develop Action Plans

With the performance levels defined for each BMP, a gap analysis would be performed to determine where each agency currently is with regard to each BMP. The assessment performed for Task 420 could be used to inform the baseline gap analysis.

For each BMP, the agency would assess where it is currently performing and determine where it wants to be in the future. As part of this analysis, the agency would also prioritize which BMPs are important for that agency.

Tools such as the example in Figure 1 could be used to score and track each practice for the individual agencies. Below are the basic steps of the gap analysis:

1. Assess local agency current status relative to an applicable BMP standard
2. Determine goals for improvement relative to each BMP standard
3. Determine the priorities for each BMP
4. Define the level of effort of implementation
5. Develop and implement an action plan

This process is further described by example.

		Flow Monitoring	Watertight System Spec
Optimized	5		
Advanced	4		
Defined	3		
Initial	2		
Unaware	1		
Current Score (1)		3	2
6-Year Goal (2)		5	4
Gap		2	2
Priority(3)		2	3
Priority x Gap		4	6
Rank of Priority x Gap		2	1
Level of Effort (4)		1	3

Figure 1. Example of side sewer I/I BMP scoring

Gold represents the current score and blue represents the 6-year goal.

In the example pictured in Figure 1, the agency's first step is to review its current practice with the BMP performance levels described in Table 1. For this example, the agency determined that it was currently at a defined level for flow monitoring, meaning that it has performed focused studies and that it was at an initial level for watertight specifications, meaning it currently has only minimal I/I prevention measures.

Second, the agency would determine where it wants to be in 6 years with regard to managing the BMP. In this example, the agency would like to have an optimized practice with regard to flow monitoring dedicated to improving processes and an advanced practice with regard to watertight specifications where it would address sewer main and side sewer water testing, integrate lateral liners with main liners, and require watertight system components.

The gap between where the agency is currently and where it wants to be is a 2 for flow monitoring and a 2 for watertight specifications.

The agency would then prioritize each BMP—basically, define how important it is to achieve these goals. In this example on a scale of 1 to 3, with 3 being the higher priority, flow monitoring was given a 2 and watertight specifications was given a 3. The gaps are then weighted by the priorities and the BMPs are ranked. In this example, developing the advance practice for watertight specifications was a higher-ranked BMP to implement. This tool also allows a score for level of effort for implementation. In this example, on a scale of 1 to 3 with 3 being the higher level of effort to implement, watertight specifications would involve a higher level of effort than implementing flow monitoring.

With the gaps and priorities identified, action plans would be developed that would outline the level of effort and schedule for implementing the BMPs. An example action plan is shown in Table 2.

Table 2. Example Action Plan for BMPs

Action Plan Steps	Flow Monitoring	Watertight System Design Specification
Goal	Develop a dedicated process to improving monitoring processes, equipment, and data management procedures	Have a specification that addresses sewer main and side sewer water testing, integrates lateral liners with main liners, and requires watertight system components (e.g., prefabricated manhole base with glass fiber supported plastic liner and gasketed connections, watertight seals on liners, etc.)
Description	Description of actions to be taken to achieve goal	Description of actions to be taken to achieve goal
Outcome	Process and procedures in place	Updated specification that is regularly implemented at the agency
Staff/resources	List of staffing and/or resources needed to meet goal	List of staffing and/or resources needed to meet goal
Schedule	Provide schedule for completing goal	Provide schedule for completing goal
Cost	List cost for implementation	List cost for implementation

Options for Implementation

The following are options for implementation of Step 4:

1. Contract with a consultant to develop a manual or protocol to perform the gap analysis and develop action plans. Individual agencies would perform the gap analysis and develop action plans on their own. This could be done as part of general sewer plan updates.
2. Contract with a consultant to assist agencies in developing their gap analyses and action plans. The level of assistance could range from answering questions about the method and materials to actively leading the assessment and gap analysis process.
3.<***additional options to be developed based on input from MWPAAC***>
4.

Step 5: Review and Revise Individual Agency BMPs and Action Plans

Review the BMPs should occur at a minimum of every 6 years along with to ensure that the BMPs and performance levels are still relevant or determine if revision is necessary because of new regulations, practices, and/or technologies. Revisions would be incorporated into the templates and tools and disseminated to the local agencies.

Options for Implementation

The following are options for implementation of Step 5:

1. Assess BMPs and implementation status on a 6-year cycle.
2. Contract a consultant to assist KC and local agencies in assessing BMPs and implementation status.