

Papillion Creek South Combined Sewer Backup and Major Street Flooding Recommended Approach TM

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Executive Summary

On October 1, 2007, the City of Omaha (City) submitted a Substantively Complete Long Term Control Plan (SCLTCP) to the Nebraska Department of Environmental Quality (NDEQ). The overall cost for this program is estimated at \$1.5 billion (2006 dollars). A portion of these funds is planned for the separation of combined sewers, which can reduce sewer backup (SB) and street flooding (SF) problems. In addition to the sewers identified to be separated as part of the SCLTCP, the City plans to continue the on-going sewer separation (RNC) program that is intended to specifically address SBs into basements.

An investigation was completed for the Papillion Creek South (PCS) Basin to evaluate approaches to addressing SB and SF problems known to date within the Basin. This Technical Memorandum (TM) provides a summary of the data to allow the City to clearly identify the separation plan for the PCS Basin as it relates to both the CSO and RNC programs and also to allow the City to establish a preliminary cost for these two programs. In addition to those costs, the information compiled provides the City with the following:

- Information on reported sewer related problems that will require additional investigation.
- Identification of known areas of major street flooding.
- A basin map that indicates the areas that will be separated upon completion of the proposed work.

Table ES-1 summarizes the costs for sewer separation included in the SCLTCP for the PCS Basin, the current work planned under the City's RNC Program in the PCS Basin, and additional costs that will be required to separate any more recently identified SB areas in the PCS Basin.

Table ES-1: Summary of SCLTCP, RNC Program, and Additional Sewer Separation Costs

Location	Estimated Costs (\$Mil)
SCLTCP Sewer Separation	\$8.32
Current RNC Program (less any overlap with the SCLTCP)	None Identified
Additional Sewer Separation Areas	None Identified
TOTAL	\$ 8.32

Special Conditions

There are no reported major street flooding issues in the PCS Basin.

There are no other special issues related to the PCS Basin.

Purpose

The purpose of this Technical Memorandum (TM) is to identify methods for addressing the sewer backup (SB) and major street flooding (SF) problems within the combined sewer basins. This TM addresses only those SB/SF problems that have been reported to date and are the result of storm events and related combined sewer overloading. This TM includes a description of areas identified for sewer separation as part of the combined sewer overflow (CSO) controls proposed in the Substantively Complete Long Term Control Plan (SCLTCP).

Potential solutions to address the SB/SF problems areas may include:

- Sewer Separation
 - City identified sewer separation study areas for the RNC program
 - Sewer separation as part of the CSO Control Program
 - Basin Consultant (BC) identified sewer separation study areas to be added to the existing RNC program
 - Additional sewer separation projects required for the CSO program that do not provide sewer backup relief
- Backflow prevention valves
- Green solutions (stormwater management projects)
- Hybrid projects (projects that include both sewer separation and other CSO technologies).

This TM discusses the relative impact, if any, that the proposed projects have on CSO volumes and rates.

Verification and validation of identified problems will be done as part of the preliminary design stage for sewer separation. If at any time prior to or during design of RNC projects further investigation of the identified SB/SF problems shows that inconsistent and/or significant problems cannot be validated, then the proposed separation project area may be modified or eliminated.

Project Background

The City of Omaha (City) includes over 1,950 miles of sewers. In the eastern portion of the City, most of the storm and sanitary sewers are combined. This combined sewer system (CSS) area encompasses approximately 51 square miles in two watersheds: the Missouri River and the Papillion Creek watersheds. The entire CSS area has been divided into ten basins for evaluation as part of the Omaha CSO Program. The PCS Basin is one of these basins that are being simultaneously evaluated by various engineering firms. The overall goal of the data analysis is to develop a Final Basin Plan, which will be incorporated into the Final Long Term Control Plan (LTCP) for the City's CSS.

PCS Basin Sewer Backup and Street Flooding Issues

In addition to implementation of the City's LTCP, the City intends to minimize the SB/SF problems in the combined sewer service area through the continuation of its Sewer Separation/Sewer Relief program, referred to as the RNC program, and additional sewer

separation projects that are not part of the CSO Program. As part of the previously prepared "Papillion Creek South Basin - Sewer Backup and Street Flooding - Existing Conditions TM" (dated September 21, 2007), the existing problem areas were identified by using available information, including the City's GIS database, previous sewer reports, the InfoWorks computer model, community outreach efforts, Basin Advisory Panel (BAP) meetings, and plans of projects completed to date. The SB/SF Existing Conditions TM summarized the available information from each of these sources.

In order to get a more complete picture of the historical SB/SF problems, reported SB and SF problems are illustrated in Figure 1. These SB and SF problems have been sorted into three categories. The categories are listed and defined below:

1. **Flood of 1999:** A problem labeled in this manner indicates that it was reported as a result of the August 6, 1999 flood. This was a large storm and exceeded the level of protection that that City can economically afford to resolve with sewer improvement projects. Therefore, these problems may well be legitimate SB and SF issues, however no sewer improvement projects will be recommended solely because of their existence.
2. **Reports not Addressed to Date:** A problem labeled in this manner indicates that it appears to be unresolved and not addressed by an already completed RNC project. Problems classified in this manner (and located in clusters) indicate areas in need of additional sewer improvement projects.
3. **Reports Addressed to Date:** A problem labeled in this manner indicates that it appears to have already been resolved by completed RNC project. Problems classified in this manner indicate that the surrounding area, most likely, does not need additional sewer improvement projects.

Categorization for Addressing SB/SF Issues

The categories for addressing the PCS Basin SB/SF issues are identified in the following sections. These categories represent the progression of analysis to minimize/eliminate the SB/SF issues.

Category 1 - Completed RNC/Sewer Improvement Projects. - This category includes all the SB/SF issues that have been addressed to date by work already completed or currently under construction in the PCS Basin. SB/SF issues in this category have been addressed through City RNC projects or various other sewer separation projects that were completed prior to the start of the RNC program in 1990. These older projects were classified as SOS, STS, or with other various identifiers. These completed projects can be further categorized into either "separation" or "conveyance relief" projects as defined below:

Separation - Projects that separated combined sewers within the right-of-way by either: (1) providing a dedicated sanitary sewer that conveys the sanitary flows downstream, or, (2) providing a dedicated storm sewer to convey the storm sewer flows downstream, leaving the existing sewer for sanitary flows only. Separation within the right-of-way does not include separation of any private sewer laterals or taps.

Conveyance Relief - Projects that provided relief for the existing combined system to address SB/SF issues. In most cases, these projects provided a new sewer that provided relief to the existing combined system. The new sewers were sized to provide only the additional required storm flow capacity.

Category 2 – Planned Sewer Separation in Existing City RNC Program. This category includes all the SB/SF issues that have been previously identified by the City to be addressed by planned sewer separation projects through the RNC program. Note that some of the planned RNC projects provide water quality benefits and are listed under the CSO Program. The summary data and costs for such projects are included under Category 4 or 5.

Category 3 – Additional Sewer Separation Projects, Identified by Basin Consultant, and Not Part of CSO Program. This category includes all the SB/SF issues that have been proposed to be addressed by additional sewer separation projects identified in this TM. The projects in this category are intended solely to address SB and do not provide water quality benefits for the receiving streams. *There are no additional RNC projects proposed for the PCS Basin.*

Category 4 – Sewer Separation included in the Substantively Complete LTCP. This category includes all the SB/SF issues that have been proposed to be addressed by sewer separation through the CSO program as part of the SCLTCP. These projects can be shown to produce water quality benefits for the receiving streams.

Category 5 – Additional Sewer Separation Projects, Added to the CSO Program. This category includes both the following:

- Additional combined sewer separation projects beyond the areas identified in the SCLTCP because they provide water quality benefits;
- Projects previously listed under Category 2 that, because they have been determined to provide water quality benefits, have been reclassified to be a part of the CSO LTCP.

No additional CSO sewer separation projects/study areas are proposed for the PCS Basin.

Costs

Costs for projects in the five categories are presented below, where applicable. The costs for Category 1 projects were based on completed construction costs. The costs for projects in Categories 2 through 5 are based on engineer's estimates. The project costs presented in this TM were taken from separation costs identified in the "PCS Basin Implementation Plan TM" (dated August 31, 2007). The pipe segments from each project area were taken out of the previously completed separation cost estimate and tabulated and include:

- a) construction cost,
- b) 67% soft cost markup per page 1 of the Cost Tool,
- c) 30% contingency and inflation factor, and
- d) the addition of MUD costs for the length of sanitary sewer reconstruction included in the study area.

Summaries of the project costs for each category with projects are shown in Tables 1 through 3.

Category 1 – Completed Sewer Improvement/RNC Projects

The City has been implementing a sewer separation program since the 1980s for some portions of the combined sewer area of the City, including areas within the Papillion Creek South Basin. These projects have generally been implemented in order of importance as determined in previous reports. The sewer separation projects identified as StS, RNC, and OPW projects have been designed to relieve the existing combined system and not necessarily to achieve complete sewer separation.

In general, the City believes that in the areas of RNC projects, the sewer backup and street flooding problems have been addressed. Evidence of this can be found by comparing the dates of the reported problems in the area to the dates of the RNC projects. In general, there are few, if any, complaints in the RNC project areas after the completion of the RNC projects.

The sewer improvement projects completed to date in the PCS Basin that are not included as Baseline Projects in the LTCP are listed in Table 1 and illustrated on Figure 1. Some general statistics regarding the amount of sewer separation and areas where SBs were potentially addressed are provided.

Table 1: Category 1 (Completed Sewer Separation Improvement/RNC Projects)

Sewer Separation Project	Year	Type of Separation/Conveyance Relief	Street Length of Project	Street Length of Separation	Separated Watershed Area	Construction Cost (\$Mil)
RNC 5096	1993	Separation	635 LF	2,807 LF	11 Ac.	\$0.08
RNC 5588	1999	Separation	6,549 LF	11,709 LF	55 Ac.	\$0.83
RNC 5550	1999	Separation	2,587 LF	5,341 LF	25 Ac.	\$0.41
OPW 51171	2007	Separation	978 LF	978 LF	1 Ac.	\$0.20
Total						\$1.52

Based on analysis of the available information summarized in Figure 1, the following general conclusions are made:

- The completed sewer separation projects have already addressed nearly all of the historical SB/SF problem areas in the PCS combined sewer basin. Completed sewer separation areas are illustrated on Figure 1 along with historic sewer backup locations.
- The CSO control alternative to separate the remaining combined sewer portion of the PCS basin is in the general vicinity of a cluster of historic SB records. Any remaining locations subject to SB/SF issues should be solved by the CSO control alternative selected.

Category 2 – Planned Sewer Separation in Existing City RNC Program

There is currently one planned sewer separation improvement project identified by the City in the PCS Basin. This area at 42nd and X is illustrated on Figure 2 and was included as a Baseline Project in the SCLTCP (project OPW 50986).

The City has completed final sewer separation layouts for this project. This is a small localized sewer separation project to address areas not included or overlooked in past completed projects. The cost for separation of this area is presented later in this TM.

While no current records exist documenting SB issues along the 42nd and X project, it will remove a number of street curb inlets that are connected to this sewer main. This should reduce the potential for backups on the sewer main downstream from this project area. This should also eliminate all stormwater connections to the sewer system tributary to CSO 209.

Table 2: Planned Sewer Separation Projects

Sewer Separation Project	Type of Separation/Conveyance Relief	Street Length of Project	Street Length of Separation	Separated Watershed Area
OPW 50986, 42 nd and X	Separation	3,720 LF	5,418 LF	36 Ac.

Note: Costs for OPW 50986 are included in Category 4 since project is listed as a Baseline Project in the SCLTCP

Category 3 – Additional Sewer Separation Projects, Identified by Basin Consultant, and Not Part of CSO Program

SB/SF problem areas that are not addressed through completed RNC projects, planned RNC study areas, or CSO Control Program sewer separation projects fall into three separate subcategories:

- SB/SF issues located adjacent to completed RNC projects
- Clustered SB/SF issues not currently addressed by planned RNC study areas
- Outlier SB/SF issues that are not grouped and appear to be isolated issues.

There have not been any areas identified within the PCS Basin that would require additional sewer separation.

Category 4 – Sewer Separation Included in the Substantively Complete LTCP

The Substantively Complete LTCP identified separation as the CSO Control technology for the remainder of the PCS Basin combined sewer area. There remains an area of combined sewers in the 42nd and Q area east and south of Hitchcock Park. This area is tributary to CSOs 207 and 208. This area was identified for separation in order to close and eliminate these CSOs. Specifically, this improvement project will allow for stormwater to be

separated and removed from the combined sewer system for direct conveyance to Blood Creek.

The CSO Control Improvement Project designations and descriptions indicated in Figure 2 are as follows:

- SA-207/208-1 – CSO Control Improvement Project will convey separated stormwater flows to Blood Creek. Sanitary flows will remain in the Blood Creek sewer main converting it from a combined sewer to a sanitary only sewer. This project will result in the closing and elimination of CSOs 207 and 208. This project will separate the only remaining area of combined sewers in the PCS Basin.

The CSO controls presented in the LTCP should address any potential SB/SF issues remaining in the PCS Basin.

Table 3: Sewer Separation Projects Included in SCLTCP

ID	Location	Length of New Storm Sewer	Length of New San. Sewer	Street Length of Separation	Project Cost (\$Mil)
OPW 50986	42 nd and X	3,720	0	5,418	\$1.11
SA-207/208-1	42 nd and Q	6,465	710	23,332 LF	\$7.21
Total					\$8.32

Category 5 – Additional Sewer Separation Projects, Added to the CSO Program

There have not been any additional CSO sewer separation projects identified in the PCS Basin.

Remaining SB/SF and Other Problem Areas

Isolated problem areas (outliers) are any problems reported in the City’s GIS database that fall outside the sewer separation areas previously described in this TM. These outliers can be a single complaint or a few scattered complaints.

No outliers occur in the combined sewer portion of the PCS Basin.

There are outliers that occur in the extended basin area that are not evaluated in this TM. The extended basin area was constructed with separate sanitary and storm sewers and is not part of the CSS.

There are no reported major street flooding problems in the PCS Basin.

Green Solutions

This section discusses which sewer backup areas, if any, could benefit from Green Solutions in the PCS Basin. In general it appears that the sewer backup issues can be resolved through

sewer separation projects. Although green solutions may have an added benefit in problem areas, no green solutions are recommended at this time to specifically address any problem areas. Green solutions will be investigated further as part of another 2008/2009 refinement task.

Hybrid Projects

Hybrid projects are not being considered for the PCS Basin. Sewer separation has been chosen as the CSO control alternative for this Basin.

Impacts to CSO Flow Rates

This section estimates the impacts that the projects recommended in this TM might have on CSO rates, in addition to the CSO controls already identified in the SCLTCP. Estimates for reduction in flow rates for the CSO Projects included in the SCLTCP were included in the SCLTCP document. Refined estimates of the reductions in volume and flow rate will be calculated in late 2008 using the updated InfoWorks Model. *Since there were no additional RNC projects proposed for the PCS Basin, no additional volume or rate reductions are identified.*

CSO Area Priorities

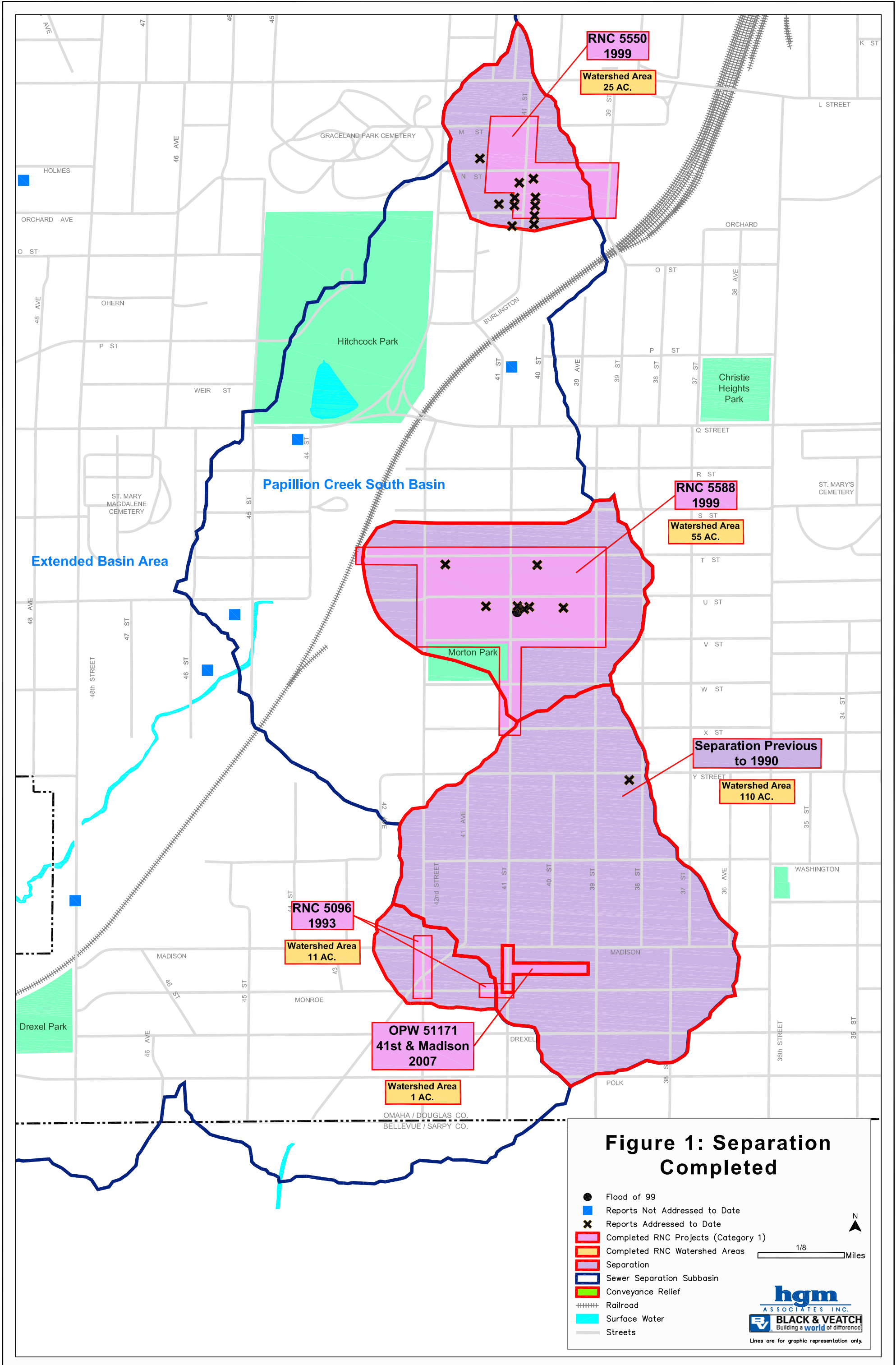
Each of the CSO sewer separation areas will be subdivided into individual projects. These projects will be scheduled as part of the Final LTCP. The priority of these individual projects will be based on the funding levels for the sewer separation portion of the CSO Program and will generally be completed from downstream to upstream in the sub-basins. The project sequence will be evaluated and established by the City of Omaha and the PMT.

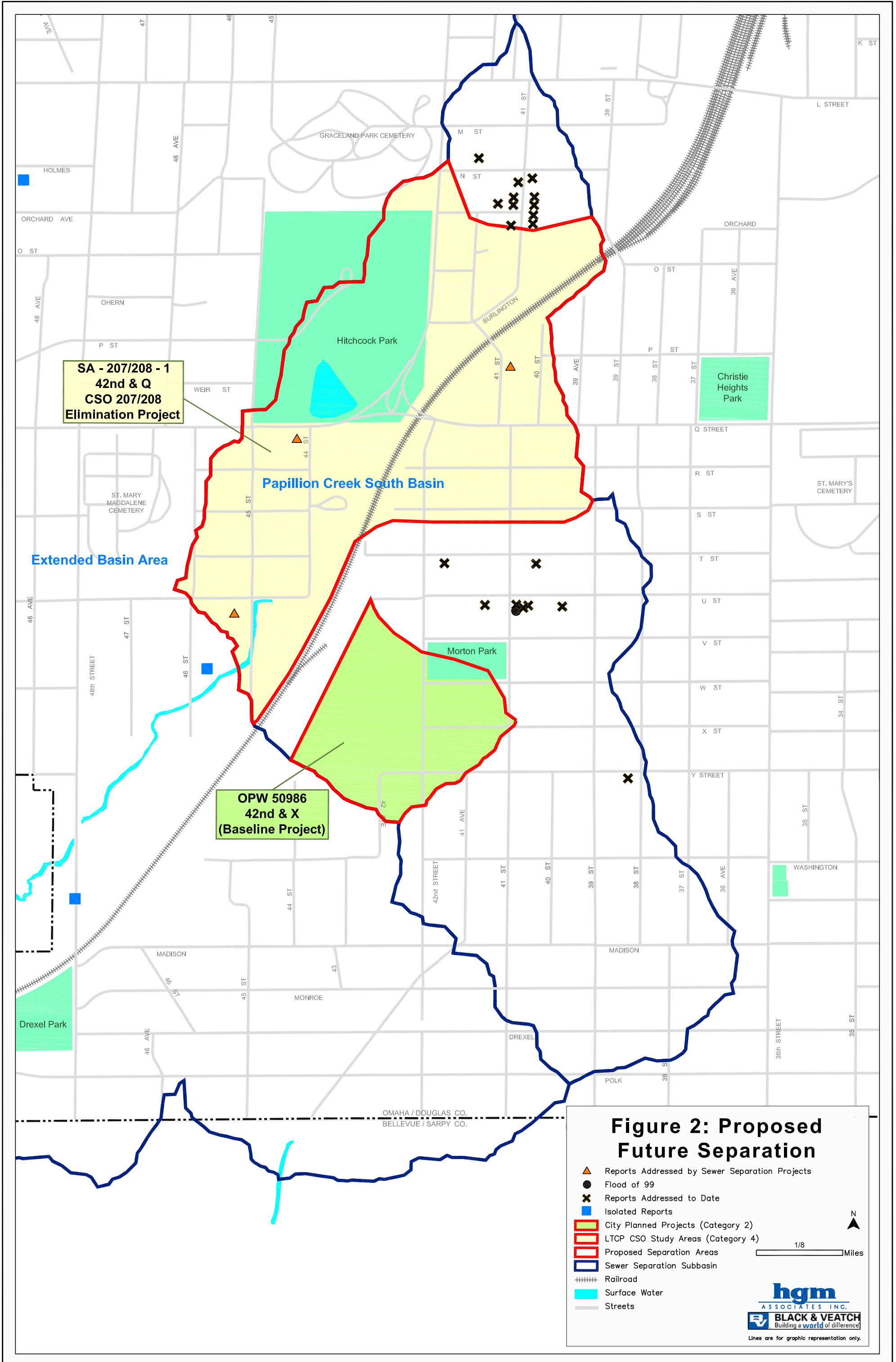
Acronym/Term	Definition
AC	Acres
BAP	Basin Advisory Panel
BC	Basin Consultant
City	City of Omaha
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
GIS	Geographic Information System
LF	Linear Feet
LTCP	Long Term Control Plan

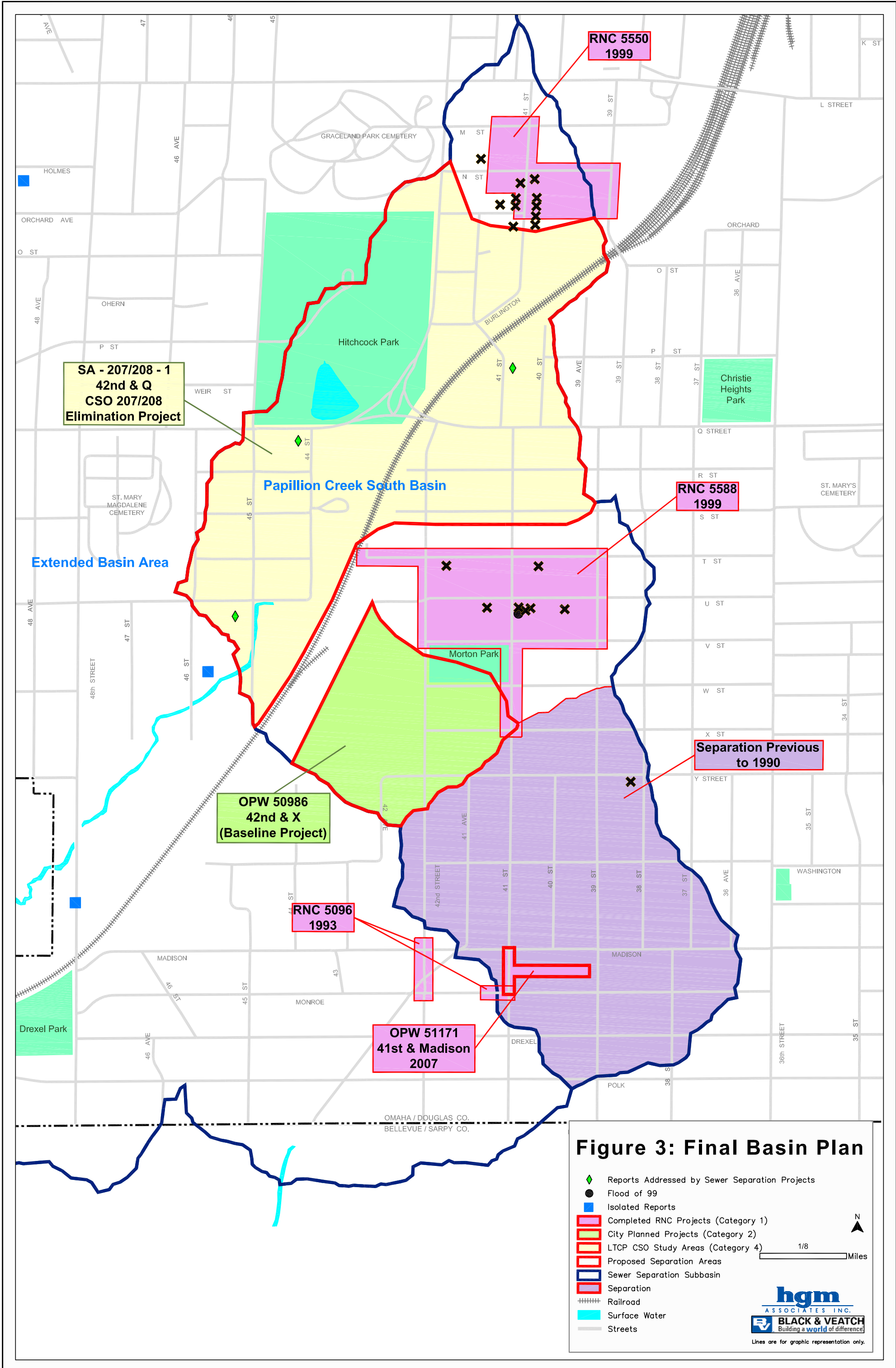
MUD	Metropolitan Utilities District
OPW	Combined Sewer Renovation/Separation (Project)
PCS	Papillion Creek South
PMT	Program Management Team
RNC/RNCL	Combined Sewer Renovation/Separation (Project)
TM	Technical Memorandum
SB	Sewer Backup
SCLTCP	Substantively Complete Long Term Control Plan
SF	Street Flooding

Attachment 1 – Figures

- Figure 1 Separation Completed
- Figure 2 Proposed Future Separation
- Figure 3 Final Basin Plan







Appendix A – Cost Estimates

City of Omaha

CSO CONTROL PROGRAM
Project Cost Summary Sheet

Project ID: 2 2 9 4 207 08 A

Description: Sewer separation project from 42nd St to 39th St and from S St to Orchard Avenue in the Papillion Creek South Basin. This is to complete separation in the CSO 207/208 basin. Private sewer separation of CSO 209 watershed.

Estimate Date: 4/15/2007

Prepared By: Evan Wickham P.E. HGM Associates Inc

Printed Date: 4/11/2008

Cost Estimate Description		Totals
Estimated Open Cut Sewer Construction Cost		\$ 1,279,000
Estimated Tunneling Construction Cost		\$ 285,000
Estimated Off-line Storage Facilities Construction Cost		\$ -
Estimated I/I Removal Cost		\$ -
Estimated Pump Station Cost		\$ -
Estimated Flow Control Structure		\$ -
Estimated Bioretention Cost		\$ -
Estimated Force Main Cost		\$ -
Estimated High Rate Treatment Cost		\$ -
Estimated Screening Cost		\$ -
Misc. Extra Cost	Description: Private sector removal + rehab costs	\$ 2,603,480
Total Estimated Construction Cost =		\$ 4,167,480
Construction Performance Incentive	Check if in Business District	\$ 42,000
Cost for MUD utility relocation		\$ 204,000

Real Estate Costs Description		Totals
Easement Cost	# of Properties = 0	\$ -
Property Acquisition		\$ -
Misc. Extra Cost	Description:	\$ -
Total Additional Costs =		\$ -

Multipliers Description	Multiplier	
Administration Costs-Design, R/W, Legal Fees, & Construction	5%	
Contingencies	25%	
Interest	5%	
Miscellaneous - PTI, test bore, ECI Inspector	4%	
Field Engineering & Inspection	5%	
Design & Eng. Services	15%	
Program Management	2%	
Planning & Preliminary Design	5%	
Performance Bond	1%	
Total Multipliers =		67%

Data File Base ENRCCI	7312	PROJECT CAPITAL COST ESTIMATE =	\$ 7,002,000
Data File ENRCCI in use	7888	Project 50 Year Present Worth Estimate =	\$ 7,046,000

ENRCCI overwrite by Estimator 7888

PROJECT CAPITAL COST ESTIMATE =	\$ 7,002,000
Project 50 Year Present Worth Estimate =	\$ 7,046,000
Construction Cost Estimate =	\$ 4,167,480

City of Omaha

CSO CONTROL PROGRAM

Project Values Summary Sheet

Value Description	Totals
Length of Open Cut Sewer Conveyance (Feet)	6,115
Length of Tunnel Sewer Conveyance (Feet)	350
Off-line Storage Annual Volume Stored (Million Gallons)	0
Off-line Storage Estimated # of Annual Occurrence	0
Flow Control Structure Annual Volume Stored (Million Gallons)	0
Flow Control Structure Estimated # of Annual Occurrence	0
Bioretention Structure Annual Volume Stored (Million Gallons)	0
Bioretention Structure Estimated # of Annual Occurrence	0
Length of I/I Removal Lining (Feet)	0
Annual Volume of Pumping (Million Gallons)	0
Estimated Total Dynamic Head of Pumping (Feet)	0
Length of Force Main Conveyance (Feet)	0
Annual Volume of High Rate Treatment (Million Gallons)	0
High Rate Treatment Estimated # of Annual Occurrences	0
Screening Estimated # of Annual Occurrences	0
Screening Annual Volume Disinfected	0
Length of Sanitary Sewer Open Cut Requiring cost for MUD (Feet)	710

Papillion Creek South Basin: SA-207/208-1

Activity	Percentage	Cost	Task 1	%	Task 2	%	Task 3	%	Task 4	%	Task 5	%	Task 6	%	Total \$	Total %
Construction Cost (Cost Tool)		\$4,167,480									\$3,959,106	95%	\$208,374	5%	\$4,167,480	100%
Eng. Legal, Admin	5%	\$208,374	\$10,419	5%	\$20,837	10%	\$62,512	30%	\$41,675	20%	\$62,512	30%	\$10,419	5%	\$208,374	100%
Contingencies	25%	\$1,041,870					\$52,094	5%			\$989,777	95%			\$1,041,870	100%
Interest	5%	\$208,374									\$208,374	100%			\$208,374	100%
PTI, Test Bore, ECI	4%	\$166,699	\$33,340	20%	\$133,359	80%									\$166,699	100%
Field Eng/Inspection	5%	\$208,374									\$187,537	90%	\$20,837	10%	\$208,374	100%
Design & Eng. Services	15%	\$625,122					\$562,610	90%	\$62,512	10%					\$625,122	100%
Program Management	2%	\$83,350	\$4,167	5%	\$8,335	10%	\$25,005	30%	\$16,670	20%	\$25,005	30%	\$4,167	5%	\$83,350	100%
Planning & Prelim Design	5%	\$208,374	\$62,512	30%	\$145,862	70%									\$208,374	100%
Performance Bond	1%	\$41,675									\$41,675	100%			\$41,675	100%
Capital Cost		\$6,959,692	\$110,438	1.6%	\$308,394	4.4%	\$702,220	10.1%	\$120,857	1.7%	\$5,473,985	78.7%	\$243,798	3.5%	\$6,959,692	100.0%
MUD Utility Relocation		\$204,000							\$204,000						\$204,000	
Construction Performance Incentive		\$42,000									\$42,000				\$42,000	
TOTAL Capital Cost		\$7,206,000	\$110,438	1.5%	\$308,394	4.3%	\$702,220	9.7%	\$324,857	4.5%	\$5,515,985	76.5%	\$243,798	3.4%	\$7,205,692	100.0%

Task 1 - Additional Study	\$110,000	1.5%
Task 2 - Prelim Design	\$308,000	4.3%
Task 3 - Final Design	\$702,000	9.7%
Task 4 - Utility Relocations	\$325,000	4.5%
Task 5 - Construction	\$5,516,000	76.5%
Task 6 - Start-up and Close-out	\$244,000	3.4%
Total Capital Cost	\$7,206,000	100.0%

Direct Entry Cells from Cost Tool