APPENDIX G

Black Water Consulting Engineers Technical Memorandum

Technical Memorandum

BLACKWATER CONSULTING ENGINEERS, INC.

To: Ken Irwin, City Manager; Michael H. Willett, Director of Public Works
From: Alison Furuya, P.E.; Jeff Black, P.E.

Subject: Potential Impacts to Patterson Wastewater Facilities from Crows Landing Industrial Business Park

Date: August 25, 2017

INTRODUCTION

Stanislaus County (County) is proposing to reuse the former Crows Landing Air Facility property and develop the Crows Landing Industrial Business Park (CLIBP). The CLIBP is a planned 1,528 acre business park consisting of public facilities, logistics, industrial, business park, and general aviation land uses. The County is seeking permission to convey the wastewater from the CLIBP to City of Patterson (City) facilities for conveyance, treatment and disposal. This technical memorandum (TM) evaluates the potential impacts of the CLIBP project to the City wastewater collection system and Water Quality Control Facility (WQCF). The evaluation included:

1. A review of the City's Wastewater Master Plan WWMP) [1] and other recently completed documents related to the City's wastewater facilities.

2. A review of the Wastewater Flow and Load assumptions for the future Crows Landing Industrial Business Park development phases memorandum (CLIBP Wastewater Memo) [2], as well as previous documents relating to wastewater infrastructure for the CLIBP.

BACKGROUND

Crows Landing Industrial Business Park Project

The following is a brief summary of the wastewater information provided in the CLIBP Wastewater Memo. Wastewater flow and loading projections for the CLIBP were developed using the assumptions presented in Table 1.

Table 1 – CLIBP Wastewater Flow and Loading Assumptions

Parameter	Value
Airport Users - Dry Weather Loading Factor	4 gpc/day
General Land Users - Dry Weather Loading Factor	1,000 gpd/acre
Wet Weather Loading Factor, Infiltration/Inflow (I/I)	100 gpd/acre
Dry Weather Peaking Factor	3
Raw Wastewater Constituents	
Biochemical Oxygen Demand (BOD_5)	300 mg/L
Total Suspended Solids (TSS)	300 mg/L
Total Kjeldahl Nitrogen (TKN)	50 mg/L

The CLIBP plan area infrastructure and land use development is anticipated to occur over three ten-year phases. Table 2 summarizes the projected flows and loads associated with each phase and buildout of the CLIBP.

Table 2 – CLIBP Wastewater Flow and Load Projections

Parameter	Units	Phase 1 2018-2028	Phase 2 2029-2039	Phase 3 2049-2050	Total (Buildout)
Flow					
Average Dry Weather Flow (ADWF)	mgd	0.394	0.223	0.274	0.891
Peak Dry Weather Flow (PDWF)	mgd	1.182	0.669	0.822	2.673
Peak Wet Weather Flow (PWWF)	mgd	1.259	0.691	0.849	2.799
Loads					
Average BOD_5 Load	lbs/day	986	558	686	2,229
Peak BOD_5 Load	lbs/day	1,282	725	891	2,898
Average TSS Load	lbs/day	986	558	686	2,229
Peak TSS Load	lbs/day	1,282	725	891	2,898
Average TKN Load	lbs/day	164	93	114	372
Peak TKN Load	lbs/day	214	121	149	484

City of Patterson Historical Wastewater Flows and Loads

Wastewater flow and influent data for the past five years were reviewed and are summarized in Tables 3 and 4. Several influent BOD and TSS results were unusually high in 2015 and 2016. These results are not included in the data summarized in Table 5.

Table 3 – WQCF Average Dry Weather Flow Summary

	WQCF Influent Flow (mgd)				
Month	**2012**	**2013**	**2014**	**2015**	**2016**
June	1.55	1.41	1.45	1.42	1.41
July	1.38	1.41	1.48	1.49	1.39
August	1.43	1.45	1.48	1.41	1.43
Average	**1.45**	**1.42**	**1.47**	**1.44**	**1.41**
5-yr Average = 1.44 mgd					

Table 4 – WQCF Influent BOD and TSS Summary

Parameter	Units	2012	2013	2014	2015	2016	Average
BOD_5							
Average	mg/L	280	259	287	366	245	**287**
Minimum	mg/L	180	140	120	160	120	**144**
Maximum	mg/L	660	520	710	900	970	**752**
BOD_5 Load							
Average	lbs/d	3,331	3,121	3,500	4,315	2,876	**3,429**
Minimum	lbs/d	2,106	1,708	1,477	1,829	1,380	**1,700**
Maximum	lbs/d	7,211	6,462	8,379	9,833	10,792	**8,535**
TSS							
Average	mg/L	225	235	295	319	208	**256**
Minimum	mg/L	20	44	110	44	72	**58**
Maximum	mg/L	810	610	1,000	820	720	**792**
TSS Load							
Average	lbs/d	2,662	2,834	3,577	3,781	2,436	**3,058**
Minimum	lbs/d	228	522	1,336	540	862	**698**
Maximum	lbs/d	8,850	7,336	11,819	9,708	8,010	**9,145**

City of Patterson Projected Growth

For this evaluation, wastewater flow was estimated to increase at the same rate as projected population growth rates. The City 2015-2023 Housing Element Updated, adopted February 2016 [3] presented population projections and average annual growth rates for the City and Stanislaus County. These population projections are summarized in Table 5.

Table 5 – Patterson and Stanislaus County Population Projections

Year	Patterson		Stanislaus County	
	Population	Average Annual Growth Rate	Population	Average Annual Growth Rate
2010	20,413		514,453	
2015	25,065	4.20%	551,668	1.40%
2020	30,375	3.90%	594,146	1.50%
2025	35,685	3.30%	636,625	1.40%
2030	40,995	2.80%	679,403	1.30%
2035	43,559	1.20%	721,582	1.20%
2040	46,124	1.20%	764,060	1.20%
Change/Average	25,711	2.8%	249,607	1.3%

Source: City of Patterson 2015-2023 Housing Element Updated, adopted February 2, 2016 [3]

Projected wastewater flows for the WQCF based on the growth rates presented in Table 5 for the City, with the addition of contributions from Diablo Grande and the CLIBP, are summarized in Table 6. A total ADWF of 1.47 mgd, the maximum ADWF measured for the past 5 years, was used as the starting condition. Average annual growth rates from year 2040-2050 were assumed to be consistent with the growth rate of 1.2% for 2036-2040. The projected buildout flow for the City is also included in the table, and is from the WWMP.

Table 6 – WQCF ADWF Flow Projections

Year/Condition	Average Annual Growth Rate [a]	Projected City ADWF (mgd)	Projected Diablo Grande ADWF (mgd)	Projected Total ADWF w/o CLIBP (mgd)	Projected CLIBP ADWF (mgd)	Projected Total ADWF with CLIBP (mgd)
Existing (2016)		1.40	0.04	1.44	-	1.44
2018	3.9%	1.51	0.05	1.56	0.39	1.96
2029	2.8 - 3.3%	2.15	0.11	2.25	0.62	2.87
2040	1.2 - 2.8%	2.49	0.16	2.65	0.89	3.54
2050	1.2%	2.80	0.22	3.02	0.89	3.91
Buildout	-	5.54	0.75	6.29	0.89	7.18

[a] Average annual growth rate assumptions are based on the average annual growth rates for Patterson presented in Table 6.
[b] Assumes an ADWF of 0.032 mgd for Diablo Grande in 2009-2010, with annual increases of 5,250 gpd per year.

The City receives wastewater from the Diablo Grande development, located west of the City limits. The WWMP reported an ADWF for Diablo Grande of 0.032 mgd, based on flow data from 2009-2010. This flow was used as a baseline and was increased by 5,250 gpd per year, based on the assumption that 30 housing units have been and will be added per year, with an average flow of 175 gallons per day (gpd) per unit. This growth assumption for Diablo Grande resulted in an estimated ADWF of 0.04 mgd for

Diablo Grande in 2016. The City is in the process of collecting flow data for Diablo Grande. The most recently collected data indicates that Diablo Grande is discharging average flows in the range of 350,000 to 420,000 gpd, which is significantly higher than the estimate shown in Table 6.

POTENTIAL IMPACTS TO COLLECTION SYSTEM

The CLIBP Wastewater Memo describes the installation of a temporary connection to the existing Western Hills Water District (WHWD) 18-inch sewer trunk line at the intersection of Ward Avenue and Marshall Road to convey CLIBP Phase 1 flows to the City collection system. This temporary connection will be replaced with a permanent connection to the proposed South Patterson Trunk Sewer (SPTS) at the intersection of Bartch Avenue and Ward Avenue, as part of CLIBP Phase 2.

The hydraulic model, developed as part of the WWMP, was evaluated for the existing trunk sewers on Ward Avenue, M Street and Ward Avenue (referred to as the Central Trunk Sewer (CTS) in this TM), and the proposed SPTS. The following two scenarios were executed to determine if the proposed CLIBP wastewater connections could be accommodated by the existing and proposed City collection system.

Scenario 1: CLIBP Phase 1 flows added to southern end of Ward Avenue Trunk Sewer. Diablo Grande ADWF of 0.10 mgd. Complete development of known potential developments in the City, as shown in Figure 1. The developments include: Villages of Patterson, Patterson Gardens, Keystone Business Park, West Ridge Business Park, Villa del Lago, Arambel Business Park, and other small developments.

Scenario 2: CLIBP Buildout flows added to the proposed SPTS. Diablo Grande buildout flows added to the proposed SPTS. Complete development of City General Plan areas.

The City wastewater loads assigned to the manholes were calculated using the method presented in the WWMP, which includes the use of a variable diurnal peaking factor (DPF) to calculate PDWF and an I/I factor based on area served to calculate PWWF. Consistent with the WWMP, Diablo Grande flows were assigned a constant peaking factor of 3.1 and an I/I factor of 300 gpd/ac over an area of 5,070 acres.

Detailed information regarding the hydraulic model, including a listing of the manhole IDs, wastewater loads, and capacity in the trunk sewers on Ward Avenue, Walnut Avenue, M Street, and the SPTS is provided in Appendix A. An overview of the hydraulic model results is provided below.

- As detailed in the WWMP, the hydraulic limitations of pipe segment E5-6:E5:5 on M Street due to a reverse slope were confirmed, and this pipe segment is recommended for replacement.
- The Ward Avenue trunk sewer does not have sufficient capacity to accommodate the known areas in Patterson for potential growth, shown in Figure 1, and the addition of CLIBP Phase 1 flows. To accommodate the CLIBP flows, the existing 21-inch sections would need to be upsized to 24-inches.
- PWWF from Diablo Grande and potential developments in the City are critical to determining the remaining available capacity in the Ward Avenue Trunk Sewer for the CLIBP.
- The SPTS, as proposed in the WWMP, has sufficient capacity to accommodate the projected CLIBP buildout flows. Projected d/D values in the SPTS range from 0.42-0.60.

POTENTIAL IMPACTS TO WASTEWATER QUALITY CONTROL FACILITY

The existing reliable capacity and projected capacity following the completion of future expansion phases for the WQCF are summarized in Table 8. This information originated from the WWMP, with slight adjustments to provide more detail on capacity impacts associated with decommissioning existing facilities as they become antiquated. Additionally, the existing reliable capacity for the WQCF differs from the permitted capacity. The WQCF is currently regulated under Regional Water Quality Control Board (Regional Board) Waste Discharge Requirements Order R5-2007-0147 (WDRs). The WDRs include effluent nitrogen limits which have been challenging for the older treatment facilities at the WQCF to meet. Therefore, the City considers the reliable capacity of the WQCF to be less than the permitted capacity to ensure compliance with the WDRs. Based on the information presented in Table 7, the addition of the CLIBP flows would require and additional expansion project after Phase V.

Table 7 – WQCF Existing and Anticipated Capacity

Condition	Reliable Capacity (mgd)	Total Reliable Capacity (mgd)
Existing		1.85
North Activated Sludge Treatment System	0.6	
Advanced Integrated Pond System	0	
South Activated Sludge Treatment System		
Treatment Train 1	1.25	
Completion of Phase III Expansion		3.1
North Activated Sludge Treatment System	0.6	
Advanced Integrated Pond System	0	
South Activated Sludge Treatment System		
Treatment Train 1	1.25	
Treatment Train 2	1.25	
Phase IV Expansion		4.25
North Activated Sludge Treatment System	0	
Advanced Integrated Pond System	0	
South Activated Sludge Treatment System		
Treatment Train 1	1.25	
Treatment Train 2	1.25	
Treatment Train 3	1.75	
Phase V Expansion		6.5
North Activated Sludge Treatment System	0	
Advanced Integrated Pond System	0	
South Activated Sludge Treatment System		
Treatment Train 1	1.25	
Treatment Train 2	1.25	
Treatment Train 3	2	
Treatment Train 4	2	

Expansion phases are recommended to begin design and permitting seven years prior to reaching the reliable capacity of the facility and construction five years prior to reaching the reliable capacity of the facility. Table 8 presents estimates for the recommended construction completion time for Phase III and IV expansions. The flows to the WQCF are projected to exceed the existing reliable capacity of 1.85 mgd ADWF within the next five years and acceptance of wastewater from the CLIBP is not recommended until construction of Phase III has started. WQCF flows and development projections should be regularly updated to refine the timing for implementation of expansion projects.

Table 8 – Estimated Timing for WQCF Expansion Projects

Expansion Phase	Total Reliable Capacity after Expansion Phase Completed (mgd)	Recommended Year to Complete Construction	
		w/out CLIBP	w/ CLIBP
Existing	1.85	-	-
Phase III	3.1	2018	2017
Phase IV	4.25	2045	2028

Projected BOD, TSS, and TKN strength for the CLIBP are similar to historical WQCF influent concentrations and are not anticipated to be an issue.

DEVELOPER IMPACT FEES AND COST SHARING

Collection System

The WWMP provided cost estimates for construction of the SPTS. These costs are summarized in Table 9. Table 10 provides a summary of the wastewater loads which the SPTS is planned to accept.

Table 9 – Costs for South Patterson Trunk Sewer Components

Project Components	Base Cost
Junction Structure[a]	495,000
South Patterson Trunk Sewer	3,897,000
South Patterson Pump Station	640,000
South Patterson Force Main	635,000
Base Construction Cost	5,700,000
Probable Construction Cost [b]	8,379,000

[a] Base cost listed is half of the total cost because the junction structure will be for the North Patterson Trunk Sewer as well.

[b] Probable construction cost includes applying contingencies for planning and design (10%), construction management (10%), and construction (20%), to the Base Construction Cost to obtain a subtotal cost. An additional 5% contingency for program administration is applied to the subtotal cost to obtain the Probable Construction Cost.

Table 10 – South Patterson Trunk Sewer Design Wastewater Loads

Development Area	ADWF (gpd)
Diablo Grande	750,000
Crows Landing Industrial Business Park	891,000
Development in south Patterson	823,060
Projected ADWF Capacity Increase	2,464,060

Based on this information, incremental capacity is being provided at an approximate cost of $3.40/gpd ADWF. This unit cost can be used as an initial guide for developing impact fees for the collection system.

Wastewater Quality Control Facility

A conceptual list of components for the Phase IV expansion project is provided in Table 11. Budgetary costs are included with the list. The costs provided are based on cost estimates for the Phase III expansion project. The cost estimate indicates that expansion of treatment and disposal capacity is approximately $30/gpd ADWF.

Table 11 – Budgetary Phase IV Expansion Project Costs

Project Components	Probable Construction Cost (in $1,000,000)
Influent Pump Station	5.00
South Activated Sludge Treatment System, Unit 3	6.00
Solids Handling Facilities	5.50
Effluent Pumping Facilities	2.50
Plant Water System Improvements	0.50
Stormwater/Site Drainage Improvements	1.00
Electrical and Controls	4.00
Demolition of NASTS facilities	1.00
Site Piping	1.00
Site Grading and Surfacing Improvements	1.00
Tertiary Filters	3.00
Disinfection Facilities	2.00
Odor Control	1.00
Percolation Pond Expansion	2.00
Base Construction Cost	35.50
10% Planning and design contingency	*3.55*
10% Construction management contingency	*3.55*
20% Construction contingency	*7.10*
Subtotal	49.70
5% Program Administration contingency	2.49
Total Project Cost	52.19
WQCF Capacity Increase	1.75 mgd
Cost per gallon capacity	$30

[a] Percolation Pond Expansion cost includes land acquisition.

CLIBP Wastewater Cost Share Estimate

Table 12 presents an estimated cost share for the CLIBP for expanding the wastewater collection and WQCF facilities to accommodate the projected flows from the project. The total estimated CLIBP cost

share is $29.8 million. The cost share does not include improvements to the existing City wastewater facilities that may be needed to accommodate CLIBP flows on a temporary basis.

Table 12 – Estimated CLIBP Cost Share for Expanding City Wastewater Facilities

Description	Value
Collection System Expansion Unit Cost	$3.40/gpd ADWF
WQCF Phase IV Expansion Project Unit Cost	$30/gpd ADWF
CLIBP Buildout ADWF	0.891 mgd
CLIBP Buildout Cost Share	$29.8M

SUMMARY

The findings from this evaluation are summarized below.

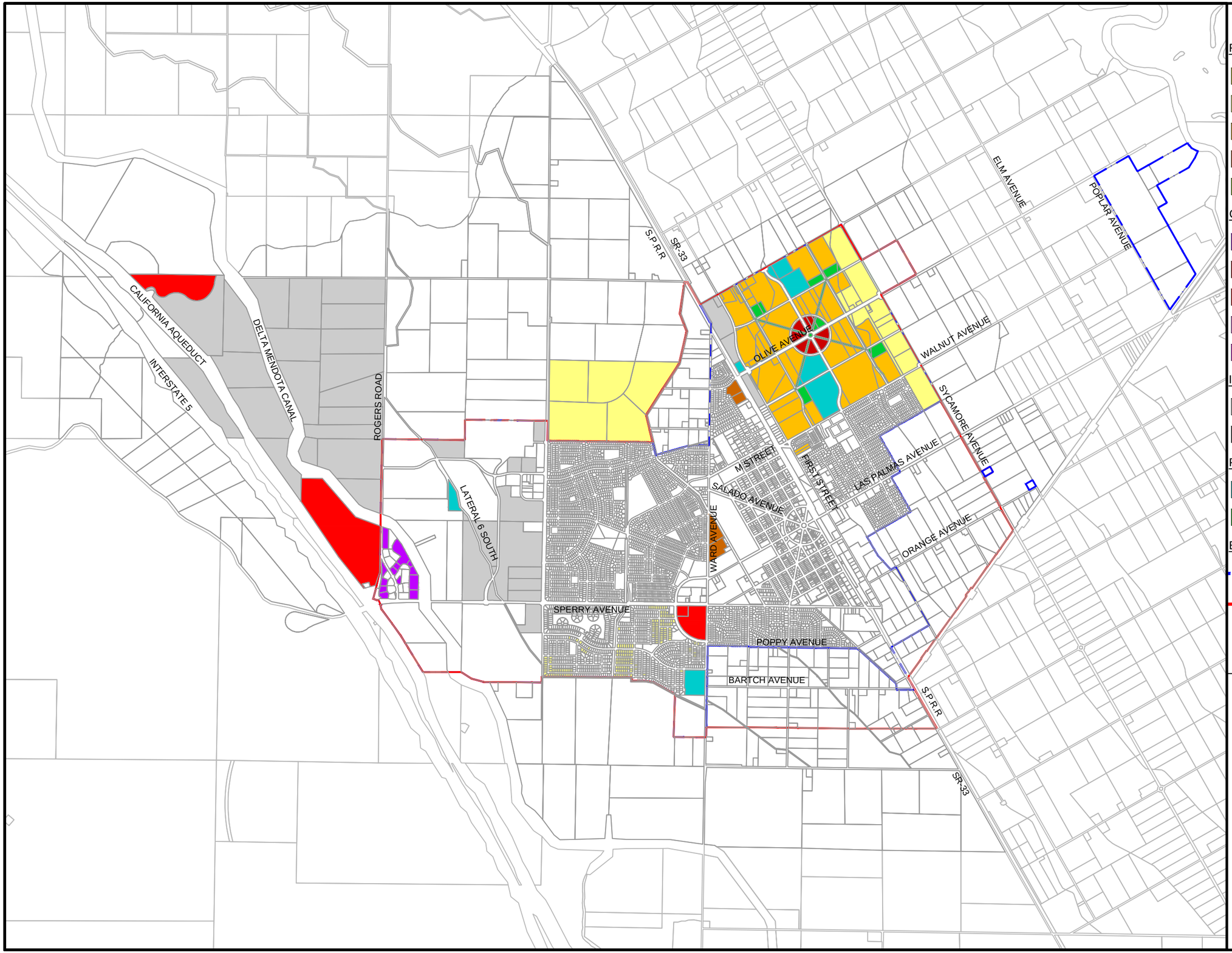
1. The existing collection system does not have sufficient capacity to accept the CLIBP Phase 1 flows and known potential developments in the City.
2. Recommended improvements to the collection system can be implemented to increase capacity in the existing system to accept CLIBP Phase 1 flows. These improvements include:
    a. Replacement of pipe segment E5-6:E5:5 on M Street, as previously identified in the WWMP.
    b. Upsizing of approximately 1,300 feet of 21-inch pipe in Ward Avenue.
3. The WQCF Phase III Expansion Project should be completed prior to accepting flow from the CLIBP. Accepting the CLIBP flows would be dependent on priority developments within the City.
4. The WQCF Phase IV Expansion Project should be planned for completion in the year 2028, if CLIBP wastewater is treated by the City.
5. The estimated CLIBP cost share for expanding the City wastewater facilities is $29.8 million.
6. The estimates presented in this TM are based on growth and flow assumptions. These assumptions should be reviewed regularly.

REFERENCES

[1] City of Patterson Wastewater Master Plan, prepared by Black Water Consulting Engineers, Inc. and NV5, April 2016

[2] Wastewater Flow and Load assumptions for the future Crows Landing Industrial Business Park development phases memorandum, prepared by AECOM, July 6, 2017

[3] City of Patterson 2015-2023 Housing Element Update, adopted February 2, 2016



LEGEND

RESIDENTIAL

- ER ESTATE RESIDENTIAL
- LDR LOW-DENSITY RESIDENTIAL
- MDR MEDIUM-DENSITY RESIDENTIAL
- HDR HIGH-DENSITY RESIDENTIAL
- DR DOWNTOWN RESIDENTIAL

COMMERCIAL

- HSC HIGHWAY SERVICE COMMERCIAL
- DC DOWNTOWN CORE
- GC GENERAL COMMERCIAL
- MU MIXED-USE
- MP MEDICAL PROFESSIONAL

INDUSTRIAL

- LI LIGHT INDUSTRIAL
- HI HEAVY INDUSTRIAL

PUBLIC

- P/QP PUBLIC / QUASI-PUBLIC
- P/OS PARKS / OPEN SPACE

BOUNDARY

- CL CITY LIMITS
- SOI SPHERE OF INFLUENCE

FIGURE 1

CITY OF PATTERSON
CLIBP SCENARIO
ADDITIONAL DEVELOPED PARCELS

N

0 3000' 6000'

SCALE: 1"=3000'

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APPENDIX A
HYDRAULIC MODEL RESULTS

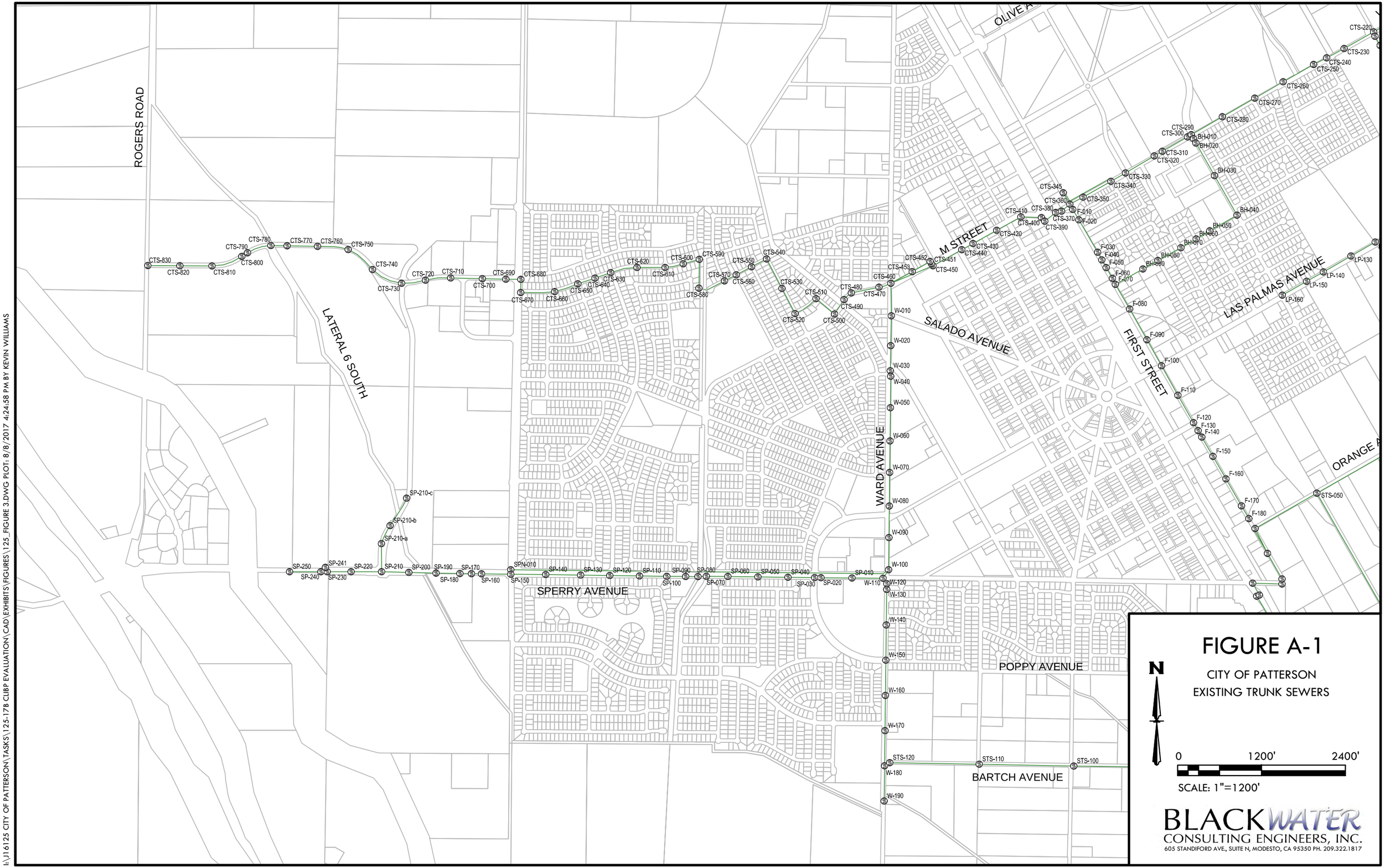

FIGURE A-1

CITY OF PATTERSON
EXISTING TRUNK SEWERS

N

0 1200' 2400'

SCALE: 1"=1200'

BLACKWATER
CONSULTING ENGINEERS, INC.
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E:\J16125 CITY OF PATTERSON\TASKS\125-178 CLIBP EVALUATION\CAD\EXHIBITS\FIGURES\125_FIGURE 3.DWG PLOT: 8/8/2017 4:25:28 PM BY KEVIN WILLIAMS

FIGURE A-2

CITY OF PATTERSON
EXISTING TRUNK SEWERS

N

0 1200' 2400'

SCALE: 1"=1200'

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Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Manhole Loading Calculations

ID	Additional ADWF @ MH (gpd)	Additional I/I @ MH (gpd)	Total ADWF @ MH (gpd)	Diurnal Peaking Factor	Total PWWF @ MH (gpd)	Total I/I @ MH (gpd)	Total PWWF @ MH (gpd)	Model MH Load (gpd)
BH-010	0	0	55,074	3.33	183,278	88,973	272,251	0
BH-020	0	0	55,074	3.33	183,278	88,973	272,251	0
BH-030	0	0	55,074	3.33	183,278	88,973	272,251	0
BH-040	698	4,398	55,074	3.33	183,278	88,973	272,251	6,670
BH-050	13,128	19,888	54,376	3.33	181,006	84,575	265,582	62,878
BH-060	2,915	3,774	41,249	3.35	138,017	64,687	202,704	13,382
BH-070	15,525	20,100	38,333	3.35	128,409	60,913	189,321	71,643
BH-080	22,808	40,813	22,808	3.37	76,866	40,813	117,678	117,678
BH-090	0	0	0	3.40	0	0	0	0
CTS-010	0	0	2,546,651	1.58	3,553,569	5,627,556	9,181,125	0
CTS-020	72,176	255,258	2,546,651	1.58	3,553,569	5,627,556	9,181,125	369,296
CTS-030	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-040	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-050	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-060	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-070	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-080	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-090	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-100	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-110	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-120	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-130	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-140	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-150	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-160	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-170	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-180	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-190	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-200	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-210	0	0	2,474,475	1.58	3,439,531	5,372,298	8,811,829	0
CTS-220	268,839	405,388	2,474,475	1.58	3,439,531	5,372,298	8,811,829	1,052,774
CTS-230	0	0	2,120,677	1.58	2,880,530	4,878,524	7,759,054	0
CTS-240	15,334	22,693	2,120,677	1.58	2,880,530	4,878,524	7,759,054	46,921
CTS-250	0	0	2,105,343	1.58	2,856,302	4,855,831	7,712,133	0
CTS-260	0	0	2,105,343	1.58	2,856,302	4,855,831	7,712,133	0
CTS-270	33,022	42,752	2,105,343	1.58	2,856,302	4,855,831	7,712,133	94,928
CTS-280	0	0	2,072,321	1.58	2,804,127	4,813,079	7,617,206	0
CTS-290	0	0	2,072,321	1.58	2,804,127	4,813,079	7,617,206	175,990
CTS-300	7,581	9,903	2,017,247	1.58	2,717,110	4,724,105	7,441,215	21,882
CTS-310	0	0	2,009,666	1.58	2,705,132	4,714,202	7,419,334	0
CTS-320	9,080	11,861	2,009,666	1.58	2,705,132	4,714,202	7,419,334	26,207
CTS-330	3,811	5,364	2,000,586	1.58	2,690,786	4,702,341	7,393,127	11,384
CTS-340	5,539	17,119	1,996,775	1.58	2,684,765	4,696,978	7,381,743	25,871
CTS-350	0	0	1,991,236	1.58	2,676,013	4,679,858	7,355,872	0
CTS-360	13	106	1,991,236	1.58	2,676,013	4,679,858	7,355,872	1,115,324
CTS-370	0	0	1,660,602	1.58	2,153,612	4,086,936	6,240,548	0
CTS-380	0	0	1,660,602	1.58	2,153,612	4,086,936	6,240,548	0
CTS-390	0	0	1,660,602	1.58	2,153,612	4,086,936	6,240,548	0
CTS-400	0	0	1,660,602	1.58	2,153,612	4,086,936	6,240,548	0
CTS-410	17,054	27,290	1,660,602	1.58	2,153,612	4,086,936	6,240,548	54,236
CTS-420	8,107	11,090	1,643,548	1.58	2,126,666	4,059,646	6,186,312	23,899
CTS-430	110,773	128,317	1,635,441	1.58	2,113,857	4,048,556	6,162,413	303,338
CTS-440	0	0	1,524,668	1.58	1,938,835	3,920,239	5,859,074	0
CTS-450	6,952	23,748	1,524,668	1.58	1,938,835	3,920,239	5,859,074	34,733

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Manhole Loading Calculations

ID	Additional ADWF @ MH (gpd)	Additional I/I @ MH (gpd)	Total ADWF @ MH (gpd)	Diurnal Peaking Factor	Total PWWF @ MH (gpd)	Total I/I @ MH (gpd)	Total PWWF @ MH (gpd)	Model MH Load (gpd)
CTS-451	0	0	1,517,715	1.58	1,927,850	3,896,491	5,824,341	0
CTS-452	0	0	1,517,715	1.58	1,927,850	3,896,491	5,824,341	0
CTS-453	7,580	11,388	1,517,715	1.58	1,927,850	3,896,491	5,824,341	23,364
CTS-460	247,797	363,619	1,510,136	1.58	1,915,874	3,885,103	5,800,977	4,366,322
CTS-470	0	0	247,406	3.08	760,995	673,660	1,434,655	0
CTS-480	0	0	247,406	3.08	760,995	673,660	1,434,655	0
CTS-490	0	0	247,406	3.08	760,995	673,660	1,434,655	0
CTS-500	162	210	247,406	3.08	760,995	673,660	1,434,655	657
CTS-510	4,108	7,710	247,244	3.08	760,548	673,449	1,433,998	19,037
CTS-520	1,805	2,337	243,136	3.08	749,221	665,739	1,414,960	7,328
CTS-530	2,116	2,740	241,331	3.08	744,230	663,402	1,407,632	8,602
CTS-540	12,489	16,804	239,215	3.09	738,367	660,663	1,399,030	51,643
CTS-550	4,838	6,264	226,726	3.10	703,528	643,859	1,347,387	19,870
CTS-560	12,121	35,406	221,888	3.11	689,921	637,595	1,327,516	69,762
CTS-570	5,442	7,045	209,767	3.13	655,564	602,190	1,257,754	22,594
CTS-580	26,546	41,483	204,325	3.13	640,015	595,145	1,235,160	118,451
CTS-590	427	677	177,779	3.17	563,047	553,662	1,116,709	1,930
CTS-600	1,134	1,468	177,353	3.17	561,795	552,984	1,114,779	4,797
CTS-610	18,010	27,690	176,219	3.17	558,465	551,517	1,109,982	81,033
CTS-620	2,066	2,674	158,209	3.19	505,123	523,827	1,028,949	8,846
CTS-630	44,436	65,087	156,144	3.20	498,950	521,153	1,020,103	200,577
CTS-640	0	0	111,708	3.25	363,461	456,065	819,526	0
CTS-650	48,084	64,927	111,708	3.25	363,461	456,065	819,526	217,368
CTS-660	1,784	2,310	63,624	3.32	211,020	391,138	602,158	8,082
CTS-670	3,756	14,737	61,841	3.32	205,248	388,829	594,077	26,916
CTS-680	4,378	16,008	58,085	3.32	193,068	374,092	567,160	30,253
CTS-690	775	4,568	53,707	3.33	178,824	358,084	536,908	7,095
CTS-700	1,808	10,704	52,932	3.33	176,297	353,516	529,813	16,603
CTS-710	1,640	9,567	51,124	3.33	170,397	342,812	513,209	14,926
CTS-720	1,982	7,009	49,484	3.34	165,039	333,245	498,284	13,496
CTS-730	16,305	111,614	47,502	3.34	158,552	326,236	484,787	165,370
CTS-740	439	3,535	31,197	3.36	104,795	214,622	319,417	4,991
CTS-750	11,904	84,068	30,758	3.36	103,339	211,087	314,426	123,768
CTS-760	2,619	10,623	18,854	3.38	63,639	127,019	190,658	19,409
CTS-770	0	0	16,235	3.38	54,853	116,396	171,250	0
CTS-780	0	0	16,235	3.38	54,853	116,396	171,250	0
CTS-790	0	0	16,235	3.38	54,853	116,396	171,250	0
CTS-800	10,890	73,344	16,235	3.38	54,853	116,396	171,250	110,063
CTS-810	0	0	5,344	3.39	18,134	43,053	61,186	0
CTS-820	5,344	43,053	5,344	3.39	18,134	43,053	61,186	61,186
CTS-830	0	0	0	3.40	0	0	0	0
F-010	0	0	330,621	2.97	980,914	592,816	1,573,731	0
F-020	1,562	8,713	330,621	2.97	980,914	592,816	1,573,731	12,674
F-030	5,580	8,866	329,058	2.97	976,953	584,104	1,561,056	23,069
F-040	0	0	323,478	2.98	962,749	575,237	1,537,987	0
F-050	1,410	1,825	323,478	2.98	962,749	575,237	1,537,987	5,427
F-060	232,069	328,155	322,068	2.98	959,148	573,412	1,532,560	991,919
F-070	2,706	3,503	89,999	3.28	295,385	245,257	540,642	12,074
F-080	973	3,648	87,293	3.29	286,814	241,754	528,568	6,736
F-090	3,300	18,402	86,320	3.29	283,726	238,106	521,832	28,889
F-100	0	0	83,020	3.29	273,239	219,704	492,943	0
F-110	0	0	83,020	3.29	273,239	219,704	492,943	0
F-120	0	0	83,020	3.29	273,239	219,704	492,943	0
F-130	0	0	83,020	3.29	273,239	219,704	492,943	0

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Manhole Loading Calculations

ID	Additional ADWF @ MH (gpd)	Additional I/I @ MH (gpd)	Total ADWF @ MH (gpd)	Diurnal Peaking Factor	Total PWWF @ MH (gpd)	Total I/I @ MH (gpd)	Total PWWF @ MH (gpd)	Model MH Load (gpd)
F-140	0	0	83,020	3.29	273,239	219,704	492,943	0
F-150	0	0	83,020	3.29	273,239	219,704	492,943	0
F-160	0	0	83,020	3.29	273,239	219,704	492,943	0
F-170	14,154	78,936	83,020	3.29	273,239	219,704	492,943	124,243
F-180	68,866	140,768	68,866	3.31	227,931	140,768	368,700	368,700
LP-010	0	0	84,958	3.29	279,403	88,387	367,790	0
LP-020	0	0	84,958	3.29	279,403	88,387	367,790	0
LP-030	0	0	84,958	3.29	279,403	88,387	367,790	0
LP-040	13,115	13,677	84,958	3.29	279,403	88,387	367,790	55,574
LP-050	0	0	71,843	3.31	237,506	74,710	312,216	0
LP-060	0	0	71,843	3.31	237,506	74,710	312,216	0
LP-070	0	0	71,843	3.31	237,506	74,710	312,216	0
LP-080	1,130	3,996	71,843	3.31	237,506	74,710	312,216	7,626
LP-090	0	0	70,714	3.31	233,876	70,714	304,589	0
LP-100	0	0	70,714	3.31	233,876	70,714	304,589	0
LP-110	0	0	70,714	3.31	233,876	70,714	304,589	0
LP-120	0	0	70,714	3.31	233,876	70,714	304,589	0
LP-130	0	0	70,714	3.31	233,876	70,714	304,589	0
LP-140	0	0	70,714	3.31	233,876	70,714	304,589	0
LP-150	0	0	70,714	3.31	233,876	70,714	304,589	0
LP-160	54,461	70,714	70,714	3.31	233,876	70,714	304,589	304,589
SP-010	4,031	14,988	492,065	2.76	1,355,833	1,302,841	2,658,674	23,519
SP-020	0	0	488,034	2.76	1,347,303	1,287,853	2,635,156	0
SP-030	124,749	225,240	488,034	2.76	1,347,303	1,287,853	2,635,156	510,264
SP-040	0	0	363,285	2.92	1,062,279	1,062,612	2,124,892	0
SP-050	0	0	363,285	2.92	1,062,279	1,062,612	2,124,892	0
SP-060	0	0	363,285	2.92	1,062,279	1,062,612	2,124,892	0
SP-070	8,805	13,423	363,285	2.92	1,062,279	1,062,612	2,124,892	35,081
SP-080	0	0	354,479	2.94	1,040,621	1,049,190	2,089,811	0
SP-090	0	0	354,479	2.94	1,040,621	1,049,190	2,089,811	0
SP-100	91,804	143,909	354,479	2.94	1,040,621	1,049,190	2,089,811	381,822
SP-110	0	0	262,675	3.06	802,708	905,281	1,707,989	0
SP-120	0	0	262,675	3.06	802,708	905,281	1,707,989	0
SP-130	0	0	262,675	3.06	802,708	905,281	1,707,989	0
SP-140	0	0	262,675	3.06	802,708	905,281	1,707,989	0
SP-150	4,709	17,819	262,675	3.06	802,708	905,281	1,707,989	30,617
SP-160	0	0	257,966	3.06	789,910	887,462	1,677,372	0
SP-170	0	0	257,966	3.06	789,910	887,462	1,677,372	0
SP-180	0	0	257,966	3.06	789,910	887,462	1,677,372	0
SP-190	3,140	11,347	257,966	3.06	789,910	887,462	1,677,372	19,914
SP-200	0	0	254,826	3.07	781,343	876,114	1,657,458	0
SP-210	579	2,349	254,826	3.07	781,343	876,114	1,657,458	3,932
SP-210-a	0	0	254,247	3.07	779,760	873,765	1,653,525	0
SP-210-b	0	0	254,247	3.07	779,760	873,765	1,653,525	0
SP-210-c	24,768	100,447	254,247	3.07	779,760	873,765	1,653,525	168,963
SP-220	0	0	229,479	3.10	711,244	773,318	1,484,562	0
SP-230	195,536	677,861	229,479	3.10	711,244	773,318	1,484,562	1,275,206
SP-240	0	0	33,944	3.36	113,899	95,457	209,356	0
SP-241	33,944	95,457	33,944	3.36	113,899	95,457	209,356	209,356
SP-250	0	0	0	3.40	0	0	0	0
W-010	17,123	60,555	1,014,932	2.20	2,324,692	2,847,824	5,172,516	78,122
W-020	0	0	997,810	2.22	2,307,125	2,787,269	5,094,394	0
W-030	0	0	997,810	2.22	2,307,125	2,787,269	5,094,394	0
W-040	0	0	997,810	2.22	2,307,125	2,787,269	5,094,394	0

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Manhole Loading Calculations

ID	Additional ADWF @ MH (gpd)	Additional I/I @ MH (gpd)	Total ADWF @ MH (gpd)	Diurnal Peaking Factor	Total PWWF @ MH (gpd)	Total I/I @ MH (gpd)	Total PWWF @ MH (gpd)	Model MH Load (gpd)
W-050	5,468	4,485	997,810	2.22	2,307,125	2,787,269	5,094,394	10,257
W-060	0	0	992,342	2.23	2,301,353	2,782,784	5,084,137	0
W-070	6,027	4,943	992,342	2.23	2,301,353	2,782,784	5,084,137	11,395
W-080	0	0	986,315	2.24	2,294,900	2,777,841	5,072,741	0
W-090	0	0	986,315	2.24	2,294,900	2,777,841	5,072,741	0
W-100	0	0	986,315	2.24	2,294,900	2,777,841	5,072,741	0
W-110	0	0	986,315	2.24	2,294,900	2,777,841	5,072,741	2,150,725
W-120	0	0	494,250	2.88	1,447,016	1,475,000	2,922,016	0
W-130	0	0	494,250	2.88	1,447,016	1,475,000	2,922,016	0
W-140	0	0	494,250	2.88	1,447,016	1,475,000	2,922,016	0
W-150	0	0	494,250	2.88	1,447,016	1,475,000	2,922,016	0
W-160	0	0	494,250	2.88	1,447,016	1,475,000	2,922,016	0
W-170	0	0	494,250	2.88	1,447,016	1,475,000	2,922,016	0
W-180	0	0	494,250	2.88	1,447,016	1,475,000	2,922,016	0
W-190	494,250	1,475,000	494,250	2.88	1,447,016	1,475,000	2,922,016	2,922,016

2,036,148	City ADWF MH Load total
86,788	NPTS and SPTS flows from developed land (not included in this scenario)
2,122,937	Total City ADWF
100,250	Diablo Grande ADWF, assumed for Year 2028
394,000	Plus CLIBP Phase 1 flow
2,617,187	TOTAL ADWF

Other Assumptions

3.1	Diablo Grande separate Diurnal Peaking Factor (constant)
310,775	Diablo Grande Peak Dry Weather Flow (assumed constant throughout the system)
1,398,000	Diablo Grande I/I flow assumed
77,000	Plus CLIBP Phase 1 I/I flow

For sewers with flow from Diablo Grande (W trunk sewers and sewers downstream of CTS-460):
Diurnal Peaking Factor (DPF) = 3.4 - 1.31*(Total ADWF [mgd] - Diablo Grande ADWF [mgd]), with a minimum value of 1.58
Total PDWF = (Total ADWF- Diablo Grande Buildout ADWF)*DPF + Diablo Grande Buildout ADWF*Diablo Grande separate Diurnal Peaking Factor
Total PWWF = Total PDWF + Total I/I
Model MH Load = Total PWWF @ MH - Total PWWF @ upstream manhole

For sewers with no flow from Diablo Grande:
Diurnal Peaking Factor (DPF) = 3.4 - 1.31*Total ADWF [mgd], with a minimum value of 1.58
Total PDWF = Total ADWF*DPF
Total PWWF = Total PDWF + Total I/I
Model MH Load = Total PWWF @ MH - Total PWWF @ upstream manhole

Appendix A
Scenario 2: Buildout
Manhole Loading Calculations
South Patterson Trunk Sewer

ID	Additional ADWF @ MH (gpd)	Additional I/I @ MH (gpd)	Total ADWF @ MH (gpd)	Diurnal Peaking Factor	Total PDWF @ MH (gpd)	Total I/I @ MH (gpd)	Total PWWF @ MH (gpd)	Model MH Load (gpd)
STS-030	101,862	116,873	2,464,060	1.58	5,033,214	2,788,936	7,822,150	277,814
STS-040	54,010	56,324	2,362,198	1.58	4,872,273	2,672,063	7,544,336	141,660
STS-050	115,529	182,544	2,308,188	1.58	4,786,937	2,615,739	7,402,676	365,080
STS-060	19,195	56,070	2,192,659	1.58	4,604,402	2,433,195	7,037,597	86,398
STS-080	136,858	233,103	2,173,465	1.58	4,574,074	2,377,125	6,951,199	276,232
STS-090	35,242	43,440	2,036,607	1.71	4,530,945	2,144,021	6,674,967	46,092
STS-100	105,148	148,250	2,001,365	1.76	4,528,293	2,100,582	6,628,875	175,501
STS-110	92,471	143,225	1,896,217	1.90	4,501,042	1,952,332	6,453,374	191,130
STS-120	1,803,746	1,809,106	1,803,746	2.02	4,453,138	1,809,106	6,262,244	6,262,244

Assumptions

750,000	Diablo Grande Buildout ADWF
891,000	CLIBP Buildout flow
3.1	Diablo Grande separate Diurnal Peaking Factor (constant)
2,325,000	Diablo Grande Peak Dry Weather Flow (assumed constant throughout the system)
1,398,000	Diablo Grande I/I flow assumed
126,000	CLIBP Buildout I/I flow

Diurnal Peaking Factor (DPF) = 3.4 - 1.31*(Total ADWF [mgd] - Diablo Grande ADWF [mgd]), with a minimum value of 1.58
Total PDWF = (Total ADWF- Diablo Grande Buildout ADWF)*DPF + Diablo Grande Buildout ADWF*Diablo Grande separate Diurnal Peaking Factor
Total PWWF = Total PDWF + Total I/I
Model MH Load = Total PWWF @ MH - Total PWWF @ upstream manhole

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Ward Avenue Trunk Sewer
Manhole Results

ID	Rim Elevation (ft)	Total Flow (gpd)	Grade (ft)	Status	Hydraulic Jump	Surcharge Depth (ft)	Unfilled Depth (ft)
W-010	103	78,121.59	93.84	Not Full	No	0.14	9.16
W-020	104.6	0	94.88	Not Full	No	0.38	9.72
W-030	106.9	0	95.92	Not Full	No	0.71	10.98
W-040	106.9	0	95.96	Not Full	No	0.59	10.94
W-050	108.8	10,256.95	96.75	Not Full	No	-0.58	12.05
W-060	110.7	0	98.68	Not Full	No	-0.61	12.02
W-070	112.6	11,394.94	100.49	Not Full	No	-0.56	12.11
W-080	113.9	0	102.32	Not Full	No	-0.59	11.58
W-090	115.7	0	104.18	Not Full	No	-0.59	11.52
W-100	117.8	0	106.04	Not Full	No	-0.59	11.76
W-110	119.6	2,150,713.82	106.92	Not Full	Yes	-0.50	12.68
W-120	119.05	0	108.29	Not Full	No	-0.93	10.76
W-130	119.8	0	112.18	Not Full	No	-0.83	7.62
W-140	122.6	0	117.12	Not Full	No	-0.81	5.48
W-150	125.59	0	120.24	Not Full	No	-0.69	5.35
W-160	128.6	0	123.20	Not Full	No	-0.69	5.40
W-170	131.99	0	124.67	Not Full	No	-0.32	7.32
W-180	135.66	0	125.77	Not Full	Yes	-0.32	9.89
W-190	139.02	2,922,000.81	133.56	Not Full	No	-0.79	5.46

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Ward Avenue Trunk Sewer
Pipe Results

ID	Diameter (in)	Length (ft)	Slope	Total Flow (gpd)	Flow Type	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (gpd)	Coverage Count	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
W-010:CTS-460	21	421	0.002	5,172,488.11	Pressurized	3.33	1.00	1.07	1.75	1.02	0.44	4,851,952.10	0	No	1.75	3.33
W-020:W-010	21	421	0.002	5,094,366.52	Pressurized	3.28	1.00	1.14	1.75	0.97	0.44	4,476,077.23	0	Yes	1.75	3.28
W-030:W-020	21	421	0.002	5,094,366.52	Pressurized	3.28	1.00	1.21	1.75	0.94	0.44	4,216,787.86	0	Yes	1.75	3.28
W-040:W-030	21	14	0.004	5,094,366.52	Pressurized	4.76	0.65	0.76	1.14	1.04	0.84	6,722,104.09	0	Yes	1.75	3.28
W-050:W-040	21	465	0.004	5,094,366.52	Free Surface	4.63	0.67	0.78	1.17	1.04	0.80	6,494,169.53	0	Yes	1.70	3.30
W-060:W-050	21	465	0.004	5,084,109.57	Free Surface	4.72	0.65	0.76	1.14	1.04	0.83	6,666,458.58	0	Yes	1.16	4.67
W-070:W-060	21	465	0.004	5,084,109.57	Free Surface	4.52	0.68	0.81	1.19	1.04	0.77	6,317,183.37	0	No	1.19	4.52
W-080:W-070	21	465	0.004	5,072,714.63	Free Surface	4.62	0.67	0.78	1.16	1.04	0.80	6,494,169.53	0	Yes	1.18	4.56
W-090:W-080	21	465	0.004	5,072,714.63	Free Surface	4.62	0.67	0.78	1.16	1.04	0.80	6,494,169.53	0	No	1.16	4.62
W-100:W-090	21	465	0.004	5,072,714.63	Free Surface	4.62	0.67	0.78	1.16	1.04	0.80	6,494,169.53	0	No	1.16	4.62
W-110:W-100	21	172	0.003	5,072,714.63	Free Surface	4.28	0.71	0.86	1.25	1.04	0.70	5,911,079.91	0	No	1.25	4.28
W-120:W-110	18	95	0.02	2,922,000.81	Free Surface	7.38	0.38	0.30	0.57	0.82	2.00	9,601,425.61	0	Yes	0.83	4.52
W-130:W-120	18	85	0.011	2,922,000.81	Free Surface	5.93	0.45	0.41	0.67	0.82	1.46	7,120,305.60	0	No	0.67	5.93
W-140:W-130	18	500	0.01	2,922,000.81	Free Surface	5.66	0.46	0.44	0.69	0.82	1.36	6,683,518.26	0	No	0.69	5.66
W-150:W-140	18	500	0.006	2,922,000.81	Free Surface	4.68	0.54	0.56	0.81	0.82	1.03	5,184,186.52	0	No	0.81	4.68
W-160:W-150	18	500	0.006	2,922,000.81	Free Surface	4.65	0.54	0.57	0.81	0.82	1.02	5,148,309.37	0	No	0.81	4.65
W-170:W-160	18	500	0.002	2,922,000.81	Free Surface	3.04	0.79	0.96	1.18	0.82	0.49	3,044,259.15	0	No	1.18	3.04
W-180:W-170	18	500	0.002	2,922,000.81	Free Surface	3.04	0.79	0.96	1.18	0.82	0.49	3,044,259.15	0	No	1.18	3.04
W-190:W-180	18	500	0.009	2,922,000.81	Free Surface	5.46	0.48	0.46	0.71	0.82	1.29	6,371,162.40	0	No	0.71	5.46

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Central Trunk Sewer
Manhole Results

ID	Rim Elevation (ft)	Total Flow (gpd)	Grade (ft)	Status	Hydraulic Jump	Surcharge Depth (ft)	Unfilled Depth (ft)
CTS-010	55	0	46.26	Not Full	No	0.01	8.74
CTS-020	55	369,294.08	46.29	Not Full	No	0.04	8.71
CTS-030	55	0	46.45	Not Full	No	-0.11	8.56
CTS-040	54.5	0	46.55	Not Full	No	-0.20	7.95
CTS-050	55	0	46.81	Not Full	No	-0.45	8.19
CTS-060	56	0	47.05	Not Full	Yes	-0.68	8.96
CTS-070	56	0	51.92	Not Full	No	-0.98	4.08
CTS-080	56.56	0	53.39	Not Full	No	-1.51	3.17
CTS-090	57.97	0	54.60	Not Full	No	-1.21	3.38
CTS-100	59.36	0	55.48	Not Full	No	-1.21	3.88
CTS-110	60.81	0	56.42	Not Full	No	-1.21	4.39
CTS-120	62.15	0	57.29	Not Full	No	-1.21	4.86
CTS-130	63.59	0	58.22	Not Full	No	-1.21	5.38
CTS-140	65.02	0	59.13	Not Full	No	-1.21	5.89
CTS-150	66.41	0	60.03	Not Full	No	-1.21	6.38
CTS-160	67.8	0	60.92	Not Full	No	-1.21	6.88
CTS-170	70	0	61.80	Not Full	No	-1.21	8.20
CTS-180	70.51	0	62.66	Not Full	No	-1.21	7.85
CTS-190	71.99	0	63.61	Not Full	No	-1.21	8.38
CTS-200	73.39	0	64.52	Not Full	No	-1.21	8.88
CTS-210	74.84	0	65.44	Not Full	No	-1.21	9.40
CTS-220	76	1,052,768.53	66.19	Not Full	No	-1.21	9.81
CTS-230	77.3	0	67.28	Not Full	No	-1.16	10.02
CTS-240	78.11	46,920.76	68.07	Not Full	No	-1.13	10.04
CTS-250	78.63	0	68.57	Not Full	No	-1.18	10.06
CTS-260	79.95	0	69.85	Not Full	No	-1.13	10.10
CTS-270	81.23	94,927.51	70.97	Not Full	No	-1.08	10.26
CTS-280	82.64	0	72.21	Not Full	No	-1.14	10.43
CTS-290	84	175,989.09	73.53	Not Full	Yes	-1.17	10.47
CTS-300	84	21,881.89	73.57	Not Full	No	-1.36	10.43
CTS-310	86	0	74.77	Not Full	No	-1.10	11.23
CTS-320	86	26,206.86	75.04	Not Full	No	-1.33	10.96
CTS-330	88	11,383.94	76.19	Not Full	Yes	-1.00	11.81
CTS-340	89	25,870.87	77.10	Not Full	No	-1.13	11.90
CTS-350	90	0	78.65	Not Full	Yes	-1.04	11.35
CTS-360	90	1,115,318.20	80.31	Not Full	No	-1.09	9.69
CTS-370	90	0	80.92	Not Full	No	-1.17	9.08
CTS-380	90	0	81.13	Not Full	No	-1.17	8.87

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Central Trunk Sewer
Manhole Results

ID	Rim Elevation (ft)	Total Flow (gpd)	Grade (ft)	Status	Hydraulic Jump	Surcharge Depth (ft)	Unfilled Depth (ft)
CTS-390	91	0	82.19	Not Full	Yes	-1.17	8.81
CTS-400	91.5	0	82.79	Not Full	No	-1.37	8.71
CTS-410	92.5	54,235.72	84.11	Not Full	Yes	-1.16	8.39
CTS-420	94	23,898.88	86.26	Not Full	No	-1.25	7.74
CTS-430	96	303,336.42	88.15	Not Full	No	-1.18	7.85
CTS-440	97	0	88.92	Not Full	Yes	-1.12	8.08
CTS-450	99	34,732.82	90.96	Not Full	No	-1.24	8.04
CTS-451	99	0	91.60	Not Full	No	-0.63	7.41
CTS-452	99	0	92.23	Not Full	No	0.03	6.78
CTS-453	100.5	23,363.88	92.51	Not Full	No	0.03	7.99
CTS-460	102.3	4,366,299.30	92.74	Not Full	No	0.06	9.56
CTS-470	103.2	0	92.80	Not Full	No	-0.12	10.40
CTS-480	103.9	0	92.85	Not Full	No	-0.13	11.05
CTS-490	104.3	0	92.88	Not Full	No	-0.14	11.42
CTS-500	103.9	656.997	92.93	Not Full	No	-0.58	10.97
CTS-510	105	19,036.90	93.01	Not Full	No	-0.84	11.99
CTS-520	106.3	7,327.96	93.36	Not Full	No	-0.86	12.95
CTS-530	105.4	8,601.96	93.76	Not Full	No	-0.86	11.64
CTS-540	104.5	51,642.73	94.07	Not Full	No	-0.86	10.43
CTS-550	105.2	19,869.90	94.32	Not Full	No	-0.88	10.88
CTS-560	105.8	69,761.64	94.49	Not Full	No	-0.89	11.31
CTS-570	105.9	22,593.88	94.60	Not Full	No	-0.91	11.30
CTS-580	110	118,450.38	94.90	Not Full	No	-0.92	15.10
CTS-590	108.65	1,929.99	95.31	Not Full	No	-1.02	13.34
CTS-600	109.07	4,796.98	96.48	Not Full	No	-1.02	12.59
CTS-610	108.7	81,032.58	96.71	Not Full	No	-1.03	11.99
CTS-620	109.94	8,845.95	98.61	Not Full	No	-0.71	11.33
CTS-630	112.4	200,575.96	100.17	Not Full	No	-0.71	12.23
CTS-640	114.09	0	100.93	Not Full	No	-0.73	13.16
CTS-650	116.51	217,365.87	101.98	Not Full	Yes	-0.79	14.53
CTS-660	118.42	8,081.96	104.71	Not Full	No	-0.61	13.71
CTS-670	121.22	26,915.86	107.26	Not Full	No	-0.60	13.96
CTS-680	121.6	30,252.84	109.11	Not Full	No	-0.61	12.49
CTS-690	122.6	7,094.96	109.95	Not Full	No	-0.61	12.66
CTS-700	124.05	16,602.91	111.60	Not Full	Yes	-0.61	12.45
CTS-710	126.5	14,925.92	113.83	Not Full	No	-0.64	12.68
CTS-720	128.5	13,495.93	115.64	Not Full	No	-0.62	12.86
CTS-730	130.5	165,369.14	117.42	Not Full	No	-0.63	13.08

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Central Trunk Sewer
Manhole Results

ID	Rim Elevation (ft)	Total Flow (gpd)	Grade (ft)	Status	Hydraulic Jump	Surcharge Depth (ft)	Unfilled Depth (ft)
CTS-740	132.9	4,990.97	119.60	Not Full	No	-0.70	13.30
CTS-750	135.4	123,767.36	121.85	Not Full	No	-0.70	13.55
CTS-760	139	19,408.90	124.03	Not Full	No	-0.77	14.97
CTS-770	142.7	0	126.27	Not Full	No	-0.78	16.43
CTS-780	145.1	0	127.61	Not Full	Yes	-0.79	17.49
CTS-790	147.8	0	133.41	Not Full	No	-0.83	14.40
CTS-800	148.7	110,062.43	134.18	Not Full	No	-0.81	14.53
CTS-810	153	0	137.69	Not Full	No	-0.88	15.31
CTS-820	155.8	61,185.68	141.34	Not Full	No	-0.88	14.46
CTS-830	160	0	144.87	Not Full	No	-1.00	15.13

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Central Trunk Sewer
Pipe Results

ID	Diameter (in)	Length (ft)	Slope	Total Flow (gpd)	Flow Type	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (gpd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
CTS-020:CTS-010	33	38	0.001	9,181,073.27	Pressurized	3.54	0.64	0.74	1.76	1.23	0.51	12,432,136.22	Yes	2.75	2.39
CTS-030:CTS-020	33	230	0.001	8,811,779.19	Free Surface	3.50	0.62	0.71	1.72	1.21	0.51	12,377,965.43	Yes	2.72	2.30
CTS-040:CTS-030	33	154	0.001	8,811,779.19	Free Surface	3.50	0.62	0.71	1.72	1.21	0.51	12,351,144.24	Yes	2.60	2.35
CTS-050:CTS-040	33	392	0.001	8,811,779.19	Free Surface	3.50	0.62	0.71	1.72	1.21	0.51	12,362,167.13	Yes	2.42	2.46
CTS-060:CTS-050	33	354	0.001	8,811,779.19	Free Surface	3.50	0.62	0.71	1.72	1.21	0.51	12,354,632.77	Yes	2.19	2.69
CTS-070:CTS-060	18	25	0.257	8,811,779.19	Free Surface	25.27	0.35	0.26	0.52	1.37	7.24	34,522,489.34	Yes	1.30	8.40
CTS-080:CTS-070	33	200	0.004	8,811,779.19	Free Surface	5.23	0.45	0.42	1.24	1.21	0.94	20,987,861.52	No	1.24	5.23
CTS-090:CTS-080	33	500	0.002	8,811,779.19	Free Surface	3.97	0.56	0.61	1.55	1.21	0.62	14,540,817.00	No	1.55	3.97
CTS-100:CTS-090	33	494	0.002	8,811,779.19	Free Surface	3.97	0.56	0.61	1.54	1.21	0.62	14,547,356.61	Yes	1.55	3.97
CTS-110:CTS-100	33	517	0.002	8,811,779.19	Free Surface	3.98	0.56	0.60	1.54	1.21	0.63	14,614,070.95	Yes	1.54	3.98
CTS-120:CTS-110	33	478	0.002	8,811,779.19	Free Surface	3.99	0.56	0.60	1.54	1.21	0.63	14,621,712.29	Yes	1.54	3.98
CTS-130:CTS-120	33	511	0.002	8,811,779.19	Free Surface	3.97	0.56	0.61	1.55	1.21	0.62	14,542,397.78	No	1.55	3.97
CTS-140:CTS-130	33	507	0.002	8,811,779.19	Free Surface	3.98	0.56	0.60	1.54	1.21	0.63	14,599,651.54	Yes	1.54	3.98
CTS-150:CTS-140	33	496	0.002	8,811,779.19	Free Surface	3.98	0.56	0.60	1.54	1.21	0.63	14,599,331.59	No	1.54	3.98
CTS-160:CTS-150	33	494	0.002	8,811,779.19	Free Surface	3.97	0.56	0.61	1.54	1.21	0.62	14,547,356.61	No	1.54	3.97
CTS-170:CTS-160	33	488	0.002	8,811,779.19	Free Surface	3.97	0.56	0.61	1.54	1.21	0.62	14,554,053.98	Yes	1.54	3.97
CTS-180:CTS-170	33	477	0.002	8,811,779.19	Free Surface	3.97	0.56	0.61	1.54	1.21	0.62	14,552,667.02	No	1.54	3.97
CTS-190:CTS-180	33	525	0.002	8,811,779.19	Free Surface	3.98	0.56	0.60	1.54	1.21	0.63	14,579,234.02	Yes	1.54	3.97
CTS-200:CTS-190	33	500	0.002	8,811,779.19	Free Surface	3.97	0.56	0.61	1.55	1.21	0.62	14,540,817.00	No	1.55	3.97
CTS-210:CTS-200	33	513	0.002	8,811,779.19	Free Surface	3.98	0.56	0.60	1.54	1.21	0.63	14,592,689.71	Yes	1.54	3.97
CTS-220:CTS-210	33	414	0.002	8,811,779.19	Free Surface	3.98	0.56	0.60	1.54	1.21	0.63	14,587,572.16	No	1.54	3.98
CTS-230:CTS-220	30	481	0.003	7,759,010.66	Free Surface	4.47	0.54	0.56	1.34	1.16	0.76	13,765,531.98	Yes	1.44	4.09
CTS-240:CTS-230	30	304	0.003	7,759,010.66	Free Surface	4.35	0.55	0.58	1.37	1.16	0.73	13,290,480.64	No	1.37	4.35
CTS-250:CTS-240	30	195	0.003	7,712,089.91	Free Surface	4.55	0.53	0.55	1.32	1.16	0.78	14,116,749.94	Yes	1.35	4.43
CTS-260:CTS-250	30	493	0.002	7,712,089.91	Free Surface	4.34	0.55	0.58	1.37	1.16	0.73	13,276,994.60	No	1.37	4.34
CTS-270:CTS-260	30	480	0.002	7,712,089.91	Free Surface	4.16	0.57	0.62	1.42	1.16	0.68	12,549,948.77	No	1.42	4.16
CTS-280:CTS-270	30	527	0.002	7,617,162.40	Free Surface	4.31	0.55	0.58	1.36	1.15	0.73	13,201,918.62	Yes	1.39	4.21
CTS-290:CTS-280	30	510	0.003	7,617,162.40	Free Surface	4.43	0.53	0.56	1.33	1.15	0.76	13,675,791.75	Yes	1.35	4.37
CTS-300:CTS-290	30	42	0.005	7,441,173.32	Free Surface	5.77	0.43	0.38	1.07	1.14	1.13	19,670,253.44	Yes	1.24	4.76
CTS-310:CTS-300	30	442	0.002	7,419,291.43	Free Surface	4.05	0.56	0.61	1.40	1.14	0.67	12,258,108.89	No	1.40	4.05
CTS-320:CTS-310	30	127	0.004	7,419,291.43	Free Surface	5.10	0.47	0.45	1.17	1.14	0.95	16,678,378.46	Yes	1.29	4.51
CTS-330:CTS-320	30	475	0.002	7,393,084.57	Free Surface	3.73	0.60	0.67	1.50	1.13	0.59	11,044,112.05	No	1.50	3.73
CTS-340:CTS-330	27	233	0.006	7,381,700.63	Free Surface	5.79	0.50	0.49	1.12	1.17	1.09	14,933,653.74	Yes	1.31	4.77
CTS-350:CTS-340	27	349	0.004	7,355,829.76	Free Surface	5.21	0.54	0.57	1.21	1.17	0.93	12,981,141.89	No	1.21	5.21
CTS-360:CTS-350	27	351	0.005	7,355,829.76	Free Surface	5.52	0.52	0.53	1.16	1.17	1.02	14,008,565.97	Yes	1.19	5.36
CTS-370:CTS-360	27	154	0.004	6,240,511.56	Free Surface	5.13	0.48	0.47	1.08	1.07	0.99	13,434,248.20	Yes	1.12	4.90
CTS-380:CTS-370	27	47	0.004	6,240,511.56	Free Surface	5.13	0.48	0.47	1.08	1.07	0.99	13,415,593.83	No	1.08	5.13
CTS-390:CTS-380	27	235	0.005	6,240,511.56	Free Surface	5.15	0.48	0.46	1.08	1.07	0.99	13,479,326.22	Yes	1.08	5.14
CTS-400:CTS-390	27	64	0.009	6,240,511.56	Free Surface	6.73	0.39	0.32	0.88	1.07	1.47	19,432,774.93	No	0.88	6.73
CTS-410:CTS-400	27	233	0.004	6,240,511.56	Free Surface	5.07	0.48	0.47	1.09	1.07	0.97	13,213,927.18	No	1.09	5.07

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Central Trunk Sewer
Pipe Results

ID	Diameter (in)	Length (ft)	Slope	Total Flow (gpd)	Flow Type	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (gpd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
CTS-420:CTS-410	27	396	0.006	6,186,275.84	Free Surface	5.58	0.45	0.41	1.00	1.07	1.12	15,094,738.68	Yes	1.05	5.29
CTS-430:CTS-420	27	404	0.005	6,162,376.96	Free Surface	5.13	0.48	0.46	1.07	1.06	0.99	13,470,824.99	No	1.07	5.13
CTS-440:CTS-430	27	211	0.003	5,859,040.54	Free Surface	4.54	0.50	0.50	1.13	1.04	0.85	11,642,255.59	No	1.13	4.54
CTS-450:CTS-440	27	431	0.005	5,859,040.54	Free Surface	5.26	0.45	0.41	1.01	1.04	1.06	14,208,146.39	Yes	1.07	4.87
CTS-451:CTS-450	27	23	0.001	5,155,703.30	Free Surface	2.60	0.72	0.87	1.63	0.97	0.37	5,918,344.79	No	1.63	2.60
CTS-452:CTS-451	27	7	-0.003	5,155,703.30	Pressurized	2.01	1.00		2.25	0.00	0.24		No	2.25	2.01
CTS-453:CTS-452	27	318	0.001	5,155,703.30	Pressurized	2.01	1.00	1.08	2.25	0.93	0.24	4,774,983.50	No	2.25	2.01
CTS-460:CTS-450	12	655	0.001	668,604.42	Pressurized	1.32	1.00	1.07	1.00	0.41	0.23	625,005.78	Yes	1.00	1.32
CTS-460:CTS-453	27	350	0.001	5,132,339.42	Pressurized	2.00	1.00	1.07	2.25	0.93	0.24	4,797,667.63	Yes	2.25	2.00
CTS-470:CTS-460	21	279	0.002	1,434,644.54	Free Surface	2.53	0.39	0.33	0.69	0.54	0.62	4,390,122.23	Yes	1.75	0.92
CTS-480:CTS-470	21	272	0	1,434,644.54	Free Surface	1.12	0.77	0.94	1.35	0.54	0.17	1,525,052.52	Yes	1.62	0.95
CTS-490:CTS-480	21	161	0	1,434,644.54	Free Surface	1.18	0.73	0.89	1.28	0.54	0.19	1,618,492.47	Yes	1.62	0.96
CTS-500:CTS-490	21	247	0.001	1,434,644.54	Free Surface	1.76	0.52	0.53	0.91	0.54	0.37	2,693,826.43	Yes	1.23	1.23
CTS-510:CTS-500	21	348	0.001	1,433,987.55	Free Surface	1.76	0.52	0.53	0.91	0.54	0.37	2,696,557.12	Yes	0.99	1.58
CTS-520:CTS-510	21	370	0.001	1,414,950.64	Free Surface	1.77	0.51	0.52	0.90	0.53	0.37	2,721,945.58	No	0.90	1.77
CTS-530:CTS-520	21	438	0.001	1,407,622.68	Free Surface	1.77	0.51	0.52	0.89	0.53	0.37	2,731,727.77	No	0.89	1.77
CTS-540:CTS-530	21	441	0.001	1,399,020.73	Free Surface	1.76	0.51	0.51	0.89	0.53	0.37	2,722,420.32	Yes	0.89	1.76
CTS-550:CTS-540	21	245	0.001	1,347,378.00	Free Surface	1.74	0.50	0.50	0.87	0.52	0.37	2,704,799.29	No	0.87	1.74
CTS-560:CTS-550	21	250	0.001	1,327,508.10	Free Surface	1.76	0.49	0.48	0.86	0.52	0.38	2,755,242.79	Yes	0.87	1.73
CTS-570:CTS-560	21	185	0.001	1,257,746.46	Free Surface	1.72	0.48	0.46	0.84	0.50	0.38	2,721,945.58	Yes	0.85	1.69
CTS-580:CTS-570	21	442	0.001	1,235,152.58	Free Surface	1.71	0.47	0.45	0.83	0.50	0.38	2,719,338.92	Yes	0.83	1.70
CTS-590:CTS-580	21	450	0.001	1,116,702.20	Free Surface	1.83	0.42	0.36	0.73	0.47	0.44	3,099,411.91	Yes	0.73	1.83
CTS-600:CTS-590	21	247	0.001	1,114,772.21	Free Surface	1.82	0.42	0.36	0.73	0.47	0.43	3,064,477.87	No	0.73	1.82
CTS-610:CTS-600	21	264	0.001	1,109,975.23	Free Surface	1.83	0.41	0.36	0.72	0.47	0.44	3,095,973.85	Yes	0.73	1.82
CTS-620:CTS-610	15	396	0.004	1,028,942.65	Free Surface	3.13	0.43	0.39	0.54	0.50	0.86	2,644,203.91	No	0.54	3.13
CTS-630:CTS-620	15	389	0.004	1,020,096.70	Free Surface	3.12	0.43	0.39	0.54	0.50	0.86	2,650,949.73	Yes	0.54	3.11
CTS-640:CTS-630	15	259	0.003	819,520.74	Free Surface	2.65	0.41	0.36	0.52	0.44	0.75	2,297,266.68	Yes	0.53	2.58
CTS-650:CTS-640	15	246	0.005	819,520.74	Free Surface	3.08	0.37	0.29	0.46	0.44	0.93	2,811,952.17	Yes	0.49	2.85
CTS-660:CTS-650	12	355	0.007	602,154.87	Free Surface	3.30	0.39	0.32	0.39	0.41	1.08	1,882,460.56	No	0.39	3.30
CTS-670:CTS-660	12	428	0.006	594,072.91	Free Surface	3.15	0.40	0.33	0.40	0.40	1.02	1,778,603.06	No	0.40	3.15
CTS-680:CTS-670	12	310	0.006	567,157.05	Free Surface	3.13	0.39	0.32	0.39	0.39	1.03	1,788,379.52	Yes	0.39	3.07
CTS-690:CTS-680	12	166	0.005	536,904.21	Free Surface	2.88	0.40	0.33	0.40	0.38	0.94	1,632,559.67	No	0.40	2.88
CTS-700:CTS-690	12	334	0.005	529,809.25	Free Surface	2.87	0.39	0.33	0.39	0.38	0.93	1,627,664.43	Yes	0.39	2.86
CTS-710:CTS-700	12	367	0.006	513,206.33	Free Surface	3.07	0.37	0.28	0.37	0.37	1.04	1,807,766.31	Yes	0.38	2.91
CTS-720:CTS-710	12	360	0.005	498,280.41	Free Surface	2.83	0.38	0.31	0.38	0.37	0.94	1,632,559.67	No	0.38	2.83
CTS-730:CTS-720	12	359	0.005	484,784.48	Free Surface	2.80	0.37	0.30	0.37	0.36	0.94	1,630,284.32	Yes	0.38	2.77
CTS-740:CTS-730	12	450	0.005	319,415.34	Free Surface	2.50	0.30	0.20	0.30	0.29	0.95	1,632,559.67	Yes	0.34	2.13
CTS-750:CTS-740	12	450	0.005	314,424.37	Free Surface	2.48	0.30	0.19	0.30	0.29	0.95	1,632,559.67	Yes	0.30	2.47
CTS-760:CTS-750	12	450	0.005	190,657.01	Free Surface	2.15	0.23	0.12	0.23	0.22	0.94	1,632,559.67	Yes	0.26	1.78
CTS-770:CTS-760	12	450	0.005	171,248.11	Free Surface	2.09	0.22	0.11	0.22	0.21	0.94	1,632,559.67	Yes	0.23	2.01

Appendix A
Scenario 1: CLIBP Phase 1 (Year 2018-2028)
Central Trunk Sewer
Pipe Results

ID	Diameter (in)	Length (ft)	Slope	Total Flow (gpd)	Flow Type	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (gpd)	Backwater Adjustment	Adjusted Depth (ft)	Adjusted Velocity (ft/s)
CTS-780:CTS-770	12	244	0.006	171,248.11	Free Surface	2.16	0.21	0.10	0.21	0.21	0.99	1,717,339.00	Yes	0.22	2.12
CTS-790:CTS-780	12	354	0.012	171,248.11	Free Surface	2.87	0.18	0.07	0.18	0.21	1.45	2,565,211.33	No	0.18	2.87
CTS-800:CTS-790	12	95	0.008	171,248.11	Free Surface	2.45	0.20	0.08	0.20	0.21	1.17	2,051,412.00	No	0.20	2.45
CTS-810:CTS-800	12	449	0.008	61,185.68	Free Surface	1.81	0.12	0.03	0.12	0.13	1.12	2,064,467.81	Yes	0.16	1.20
CTS-820:CTS-810	12	456	0.008	61,185.68	Free Surface	1.81	0.12	0.03	0.12	0.13	1.12	2,065,608.79	Yes	0.12	1.81
CTS-830:CTS-820	12	456	0.008	0	Free Surface	0.00	0.00		0.00	0.00	0.00	2,065,608.79	Yes	0.06	0.00

Appendix A
Scenario 2: Buildout
South Patterson Trunk Sewer
Manhole Results

ID	Rim Elevation (ft)	Total Flow (gpd)	Grade (ft)	Status	Hydraulic Jump	Surcharge Depth (ft)	Unfilled Depth (ft)
STS-010	55	0	47.331	Not Full	No	-1.569	7.669
STS-020	67	0	58.938	Not Full	No	-1.562	8.062
STS-030	75	277,812.56	63.039	Not Full	No	-1.561	11.961
STS-040	76	141,659.26	67	Not Full	No	-1.6	9
STS-050	93	365,078.10	79.853	Not Full	No	-1.747	13.147
STS-060	96	86,397.55	83.245	Not Full	No	-1.555	12.755
STS-070	108	0	98.402	Not Full	No	-1.398	9.598
STS-080	109	276,230.56	99.677	Not Full	No	-1.123	9.323
STS-090	122	46,091.76	106.888	Not Full	No	-1.112	15.112
STS-100	127	175,500.09	111.9	Not Full	No	-1.1	15.1
STS-110	133	191,129.01	118.094	Not Full	No	-0.806	14.906
STS-120	136	6,262,211.45	125.198	Not Full	No	-0.802	10.802

Appendix A
Scenario 2: Buildout
South Patterson Trunk Sewer
Pipe Results

Pipe ID	Diameter (in)	Length (ft)	Slope	Total Flow (gpd)	Velocity (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Froude Number	Full Flow (gpd)
STS-010:CTS-010	36	2,730.00	0.002	7,822,110.34	3.64	0.48	0.46	1.43	1.10	0.61	16,953,783.51
STS-020:STS-010	36	5,684.00	0.002	7,822,110.34	3.61	0.48	0.47	1.44	1.10	0.60	16,813,011.21
STS-030:STS-020	36	2,715.00	0.002	7,822,110.34	3.61	0.48	0.47	1.44	1.10	0.60	16,796,945.88
STS-040:STS-030	36	2,586.00	0.002	7,544,297.78	3.61	0.47	0.44	1.40	1.08	0.61	16,999,613.48
STS-050:STS-040	36	3,947.00	0.002	7,402,638.52	4.09	0.42	0.37	1.25	1.07	0.74	20,293,145.75
STS-060:STS-050	36	2,653.00	0.001	7,037,560.41	3.23	0.48	0.47	1.45	1.05	0.54	15,011,693.05
STS-070:STS-060	30	1,627.00	0.004	6,951,162.86	5.16	0.44	0.40	1.10	1.10	0.99	17,310,174.73
STS-080:STS-070	30	353	0.002	6,951,162.86	3.88	0.55	0.59	1.38	1.10	0.65	11,836,746.59
STS-090:STS-080	30	2,076.00	0.002	6,674,932.30	3.69	0.56	0.60	1.39	1.07	0.61	11,221,679.74
STS-100:STS-090	30	1,927.00	0.002	6,628,840.54	3.63	0.56	0.60	1.40	1.07	0.60	10,999,850.82
STS-110:STS-100	24	1,353.00	0.004	6,453,340.45	5.11	0.60	0.67	1.19	1.13	0.90	9,680,947.36
STS-120:STS-110	24	1,280.00	0.004	6,262,211.45	4.93	0.60	0.67	1.20	1.11	0.87	9,344,099.15