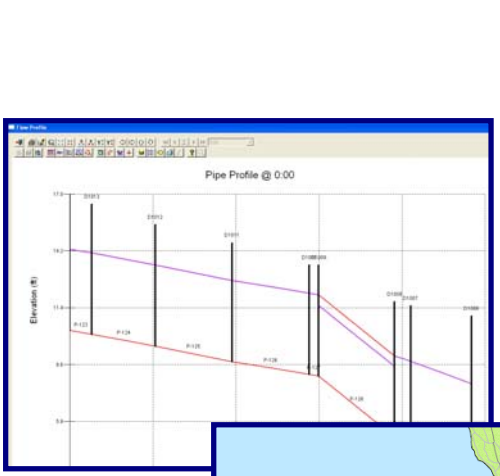
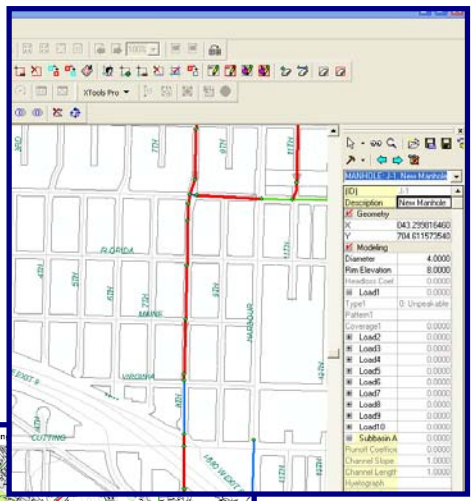
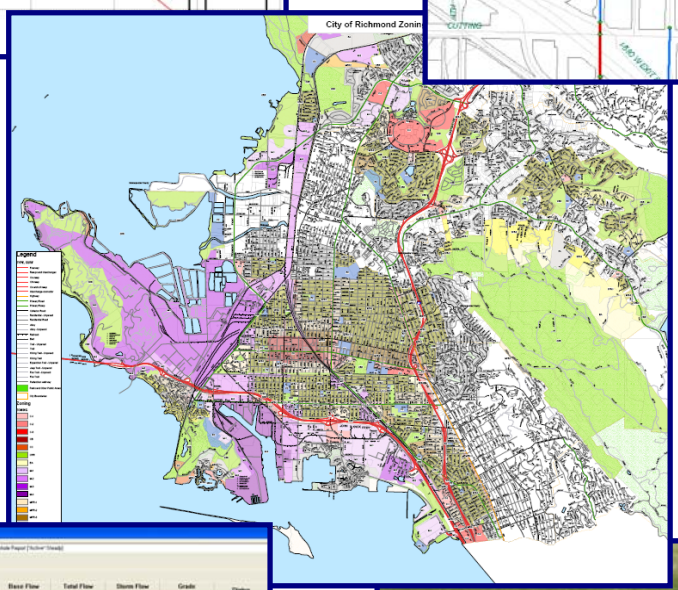
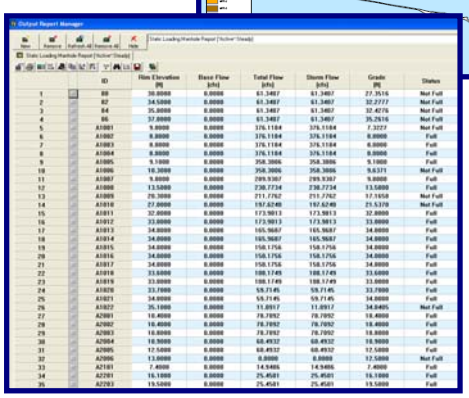
City of Richmond
Storm Drain Master Plan









November 2006

City of Richmond
Storm Drain Master Plan

City of Richmond

Client Representative Veolia Water

Boyle Engineering Corporation

Project Manager David Ogden, PE

Project Engineers Henry Liang, PE
Noé Martinez, PE
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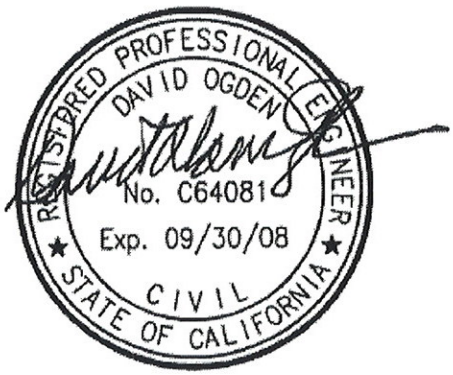
Richard Relyea



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November 2006

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Executive Summary

In recognition of the need to continue to provide adequate drainage service to the City of Richmond's (City) residents and to plan for the expansion of the drainage system to address anticipated growth, Veolia Water, with City approval, authorized Boyle Engineering Corporation (Boyle) to prepare this Storm Drainage Master Plan Report. Not only will an effective storm drain system minimize flooding problems, but maximizing storm drainage resources also provides enhanced water resource management. This report considers drainage system improvements and development that has occurred since previous storm drainage plans and incorporates the latest growth plans envisioned by the City. Using the hydraulic computer model prepared for this effort, the primary purposes of this Master Plan Report are to assess the existing storm drain system, determine system deficiencies, recommend cost-effective improvements to correct identified deficiencies, and identify facilities and costs for planned orderly expansion of the system to provide for planned future growth within the study area.

The current drainage system collects surface runoff in pipelines that discharge into creeks/canals or the bay. Stormwater discharges into creeks/canals and the bay are regulated by the Regional Water Quality Control Board using requirements set forth in National Pollutant Discharge Elimination System (NPDES) regulations promulgated by the Environmental Protection Agency (EPA). Planned drainage system improvements must consider Best Management Practices (BMPs) for reduction of pollutant discharges into these bodies of water. The City's discharges into the bay are also regulated under the Contra Costa County NPDES Municipal Stormwater Permit. This countywide permit was recently amended with new requirements that will affect some existing developments and some future developments. This report will identify new NPDES regulations set forth in the recent NPDES Permit Amendment and how the regulations impact storm drainage planning.

Collecting and holding stormwater runoff in retention basins provides an opportunity to eliminate discharges into the bay. Locations of the basins are typically determined by surface topography and runoff patterns. Retention basins are sometimes heavily influenced by the high groundwater levels as a result of the tidal influence.

Storm drainage master planning for Richmond began with selection of locations for retention basins. Once the basins were located, a pipeline drainage system was determined to direct runoff to the basins. Selecting the best locations for future basins is crucial. The best locations allow economic routing of storm drain pipelines and intercepting surface flow runoff. They also have permeable soils for percolation of captured runoff and opportunity for recreational use. Retention basins also fit within best management practices for reduction of pollutant discharges to the bay.

A primary deficiency found in the existing Richmond storm drain system is the amount of storm drainage runoff in the City's streets. The total runoff volume generated by a 10-year rainfall event significantly exceeds the flow capacities available in the existing pipes, causing the excess flow to flood the streets. This Master Plan includes a review of the existing storm drain piping system analysis and recommendations for additional storm drain system improvements to provide the

capacity required to reduce street flooding. This Master Plan also identifies areas throughout the City that have the potential to undergo severe street flooding as determined based on the hydrologic analysis and topographic data provided by the City.

Based on the results of the storm drain system analysis with the hydraulic computer model, improvements to correct deficiencies in the existing storm drainage system have been proposed in Section 5 of this report. The recommended capital improvement projects, shown in Figures 5-1 through 5-9, were identified to alleviate existing system deficiencies and improve the capacity of conveyance facilities throughout the system. A summary of the proposed capital improvements is outlined in the following table.

Proposed Existing System Improvements	Priority
New 54-inch pipeline along Potrero Ave. and additional collector inlets to collect surface flows in Drainage Zone M and convey stormwater across I-80.	1
New 54-inch pipeline along Canal Blvd. and additional collector inlets to collect surface flows in Drainage Zone I to alleviate possible severe street flooding along Canal Blvd.	2
Supplemental 48-inch pipeline along Harbour Way and additional collector inlets to reduce surface flows along Harbour Way in Drainage Zone D.	3
New 54-inch pipeline along Marina Way and additional collector inlets to collect and divert surface flows toward Marina Bay.	4
Two new basins and lateral pipe connections discharging into basins to reduce amount of surface flows along Carlson Blvd. in Drainage Zone E.	5
Supplemental 66-inch pipe along 24th St. to alleviate possible severe street flooding on 24th St. in Drainage Zone E.	6
Supplemental 84-inch pipeline along Gertrude Ave. and additional grated manhole to alleviate possible severe street flooding on Gertrude in Drainage Zone A.	7
Replacement of existing 30-inch pipe with 72-inch pipeline along Bayview Ave. and additional collector inlets to reduce surface flows along Bayview Ave. in Drainage Zone M.	8
Replacement of existing 4-inch pipe with 12-inch pipeline along Crest Ave. and replacement of inlets to increase inlet capacity along Crest Ave. in Point Richmond.	9

Project priorities have been developed for the recommended capital improvements based on the relative severity of existing system conditions, the anticipated timing of future road-repaving schedules throughout the City, and input from City staff.

This Storm Drain Master Plan provides a plan for expansion and improvement of the City's existing storm drain system and is intended to be used as a guide for preliminary planning and budgeting purposes. As additional field information becomes available through further research resulting from CCTV efforts, GIS efforts, and regular maintenance activities, the Master Plan and associated files and computer model should be updated accordingly.

Section 1
Introduction

1.1 Background

The City of Richmond is located on a peninsula along the westernmost border of Contra Costa County in the San Francisco Bay area (see Figure 1-1). The City is bordered by San Francisco Bay on the southwest, San Pablo Bay on the northwest, the City of San Pablo on the north, the City of Pinole on the northeast, and the City of El Cerrito on the east and south. The December 2004 population of Richmond was 93,000 residents, and the population has been relatively steady over the past few years. A Storm Drain Master Plan entitled *Richmond Storm Drainage Report – Emergency, Essential, and Ultimate Storm Drainage Construction Requirements and Their Costs* was prepared in 1954 by the firm Clyde C. Kennedy, based in San Francisco, CA. The 1954 Master Plan split the City into 10 distinct drainage zones and comprised a total area of approximately 10 square miles. Since the 1954 Master Plan, the City and the storm drainage system have expanded. This Master Plan addresses these changes and provides the City with a plan for orderly expansion of the system as needed to provide for future growth and correction of existing system deficiencies. As the City continues to develop, the storm drain requirements will increase proportionately. This Master Plan is necessary to provide the City with an efficient method of providing drainage service to accommodate the City's growth.

1.2 Authorization

In July 2004, Veolia Water North America (Veolia), with City of Richmond approval, authorized Boyle to evaluate the existing storm drainage system and prepare a new Storm Drain Master Plan.

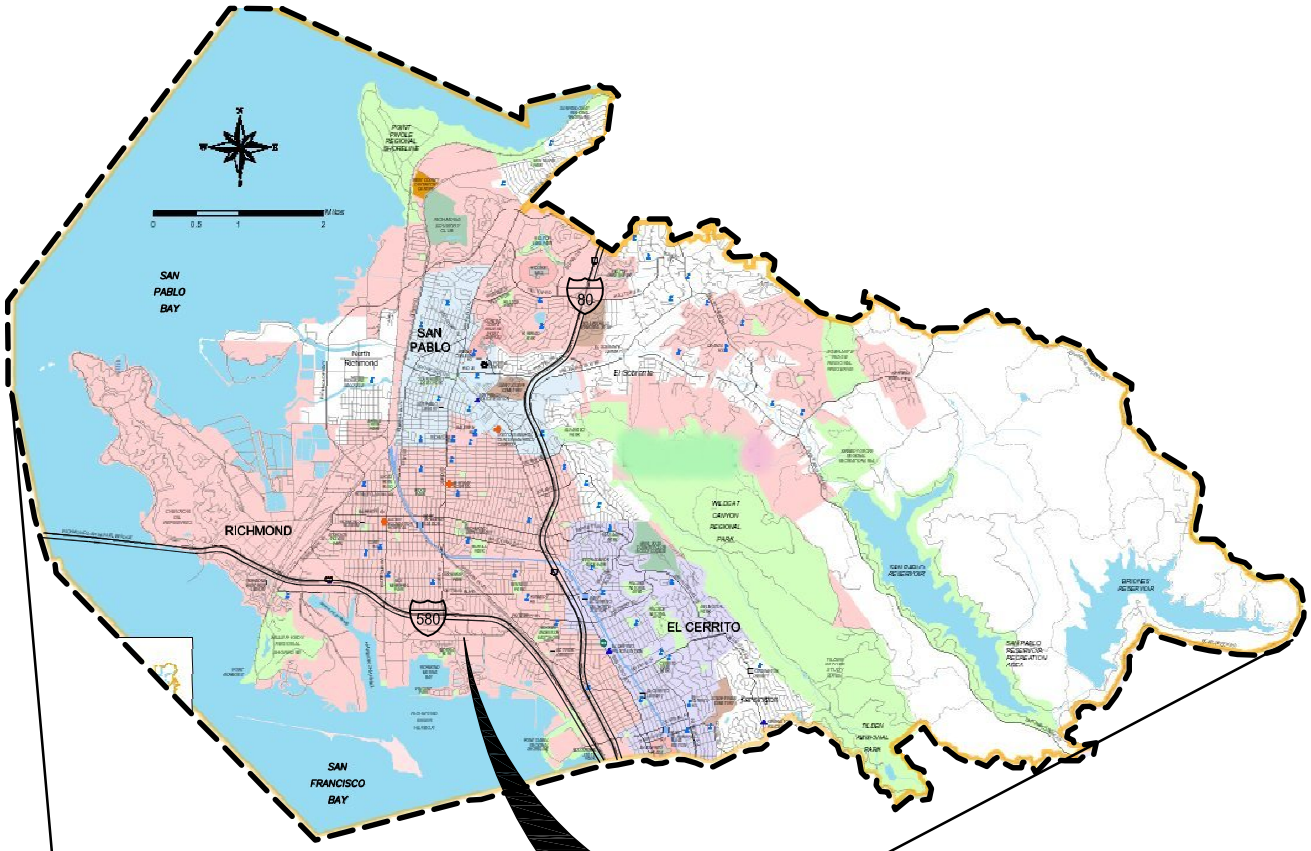
1.3 Report Goals

This Storm Drain Master Plan provides the City of Richmond with a tool for correcting current deficiencies and for planning future improvements to the storm drain system. The plan focuses on accomplishing the following goals:

1. Identification of the most cost-effective and logical methods to provide/improve drainage service in coordination with existing facilities and the previous plan. Note that the results and conclusions defined in this analysis solely rely on the accuracy of the data provided by the City and Veolia, and more detailed analysis is recommended to evaluate the specific requirements for the system.

2. Coordination with the most recently approved General Plan and Land Use Element of the City of Richmond (updated December of 2004).

3. Coordination with local public agencies associated with Richmond.



PROJECT LOCATION

LOCATION MAP
NTS

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
LOCATION MAP

BOYLE ENGINEERING CORPORATION

FIGURE 1-1

DWG: V:\V04 (SC)\10002\CAD\PLANSET\FIG 1-1 location map.dwg USER: hliang
DATE: Nov 15, 2006 10:54am XREFS: G-BD8x11h_2 IMAGES: CC-Co.jpg Contra Costa County.jpg

4. Discussion of measures for compliance with NPDES regulations.

5. Providing the City with tools to quickly modify and update the Master Plan as necessary in the future in a flexible manner by the use of GIS-based mapping and analysis tools.

1.4 Acknowledgements

Boyle would like to thank and acknowledge Rich Davidson, City Engineer; Mary Phelps, Senior City Staff; Roi Evron, GIS Services; and Richard Perna and Ryan Johnson, Veolia Project Managers. All of their efforts aiding Boyle in the completion of this Storm Drain Master Plan are greatly appreciated.

1.5 Project Team

The following Boyle staff were involved in the preparation of this Storm Drain Master Plan:

Project Manager:	Dave Ogden, PE
Project Engineers:	Mark Ysusi, PE Henry Liang, PE Noé Martinez, PE Richard Relyea
Project CAD Operators:	Michael Thorne Robert Badilla Julie Dunham

Section 2
Watershed Area

2.1 Watershed Area Characteristics

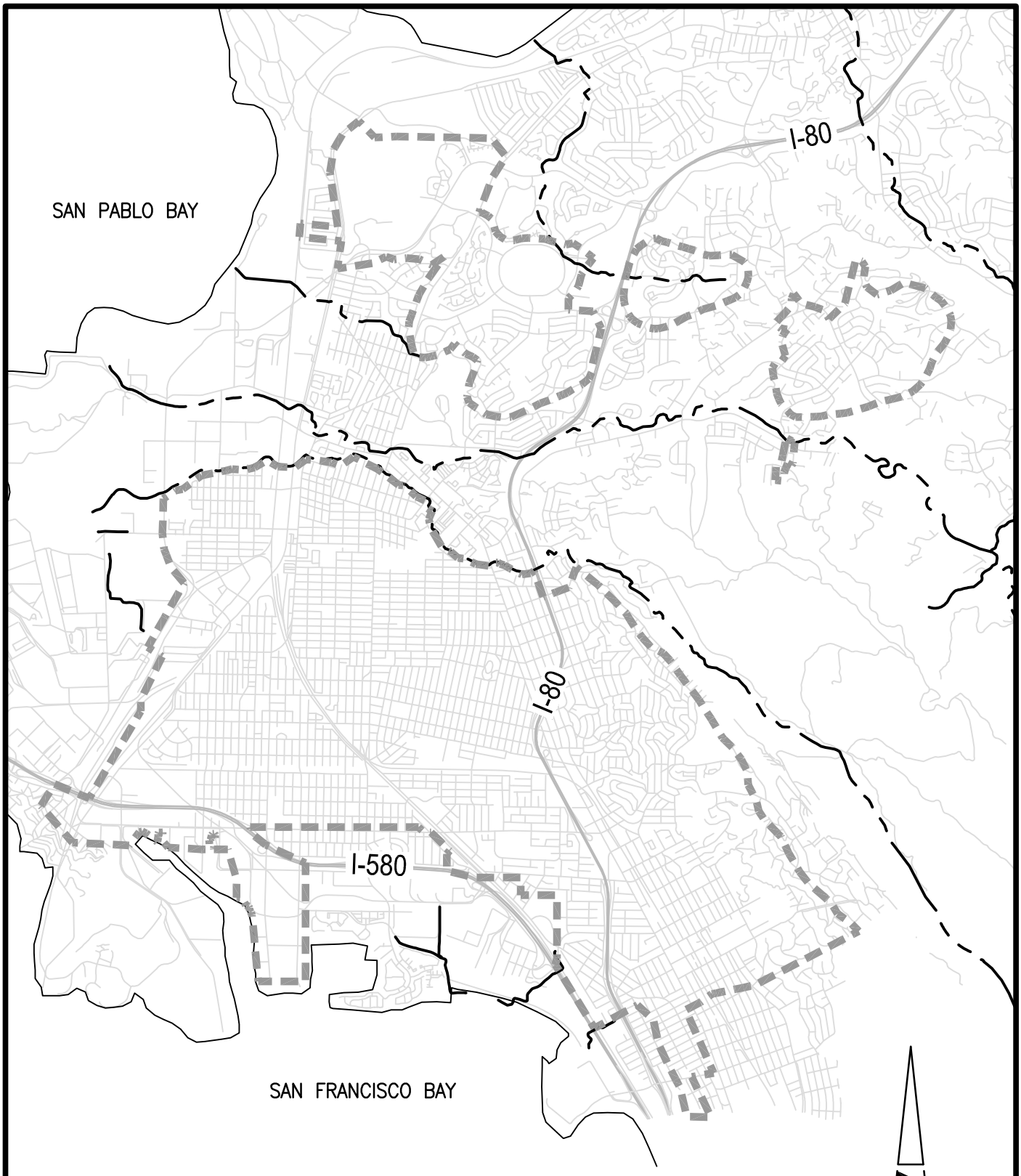
The effective watershed area for this Storm Drain Master Plan consists of the areas that are tributary to the City of Richmond's existing storm drain system. Portions of the watershed area are outside the city limits because the peripheral areas along the hills east of the City slope toward Richmond. Some small areas within the city limits have also been excluded from the watershed area because they are not tributary to the City's storm drain system, such as the areas near San Francisco Bay. The watershed area is generally bounded on the west by Richmond Parkway, Manor Drive and Road 20 on the north, Arlington Boulevard on the east, and San Francisco Bay on the south (see Figure 2-1). There are also three separate watershed areas north of the primary City area that have independent storm drain systems and are not connected to the City's main system. Four independent watershed areas near the Hilltop Regional Shopping Center (Hilltop Mall) area discharge into local storm drain basin or creeks. The total watershed area tributary to the Richmond storm drainage system is approximately 7,200 acres.

For this Storm Drain Master Plan, the watershed area is considered to be the total effective watershed area for all analyses and is used in the investigation of existing system capacity and determination of drainage improvements needed for growth within this area. Runoff from areas outside the planning area is not considered. The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps do not designate areas within the City to be in the 100-year floodplain. The City has been designated by FEMA to be Zone X. The majority of the Zone X areas are determined to be outside of the 500-year floodplain. A few patches throughout the City have been designated as 500-year flood or 100-year flood areas with average depths of less than 1 foot or with drainage areas less than 1 square mile as well as areas protected by levees from 100-year flood.

2.2 Land Use

Land use areas are used in storm drain planning since different land uses exhibit different runoff characteristics. The rainfall runoff characteristics of the various surfaces (inherent in different land uses) that stormwater must travel across before entering the storm drain system catch basins directly affects the volume and time of concentration of stormwater runoff entering the system. The primary factor affecting runoff is the permeability of the surface. For purposes of this Master Plan, surface permeability is considered to be a function of land use. Dense land use development, such as commercial or high-density residential uses, will exhibit a greater abundance of smooth, less-permeable surfaces such as paved parking lots and curb and gutter systems within the streets. Therefore, a higher percentage of the total rainfall landing on dense land use areas will flow into the storm drain system.

Less dense land use areas, such as parks and schools, have a greater abundance of loose soils and rough surfaces to restrict and absorb flow across the surface since these areas tend to have more



LEGEND

WATERSHED AREA

CREEKS

SCALE: 1"=5000'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
WATERSHED AREA

BOYLE ENGINEERING CORPORATION

FIGURE 2-1

DWG: V:\V04 (SC)\10002\CAD\PLANSET\FIG 2-1 watershed area.dwg USER: hliang
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unpaved surfaces (i.e., grassy areas or dirt fields). Therefore, a smaller percentage of the total rainfall will result from less dense land use areas and flow into the storm drain system. Existing and planned land use taken from the General Plan are classified according to runoff characteristics and assigned a coefficient of runoff or "C-Value." The land use areas of the City of Richmond were used to estimate the amount of stormwater that enters the storm drain system by the designated runoff coefficient values further discussed in Section 3.

2.3 Land Use Categories

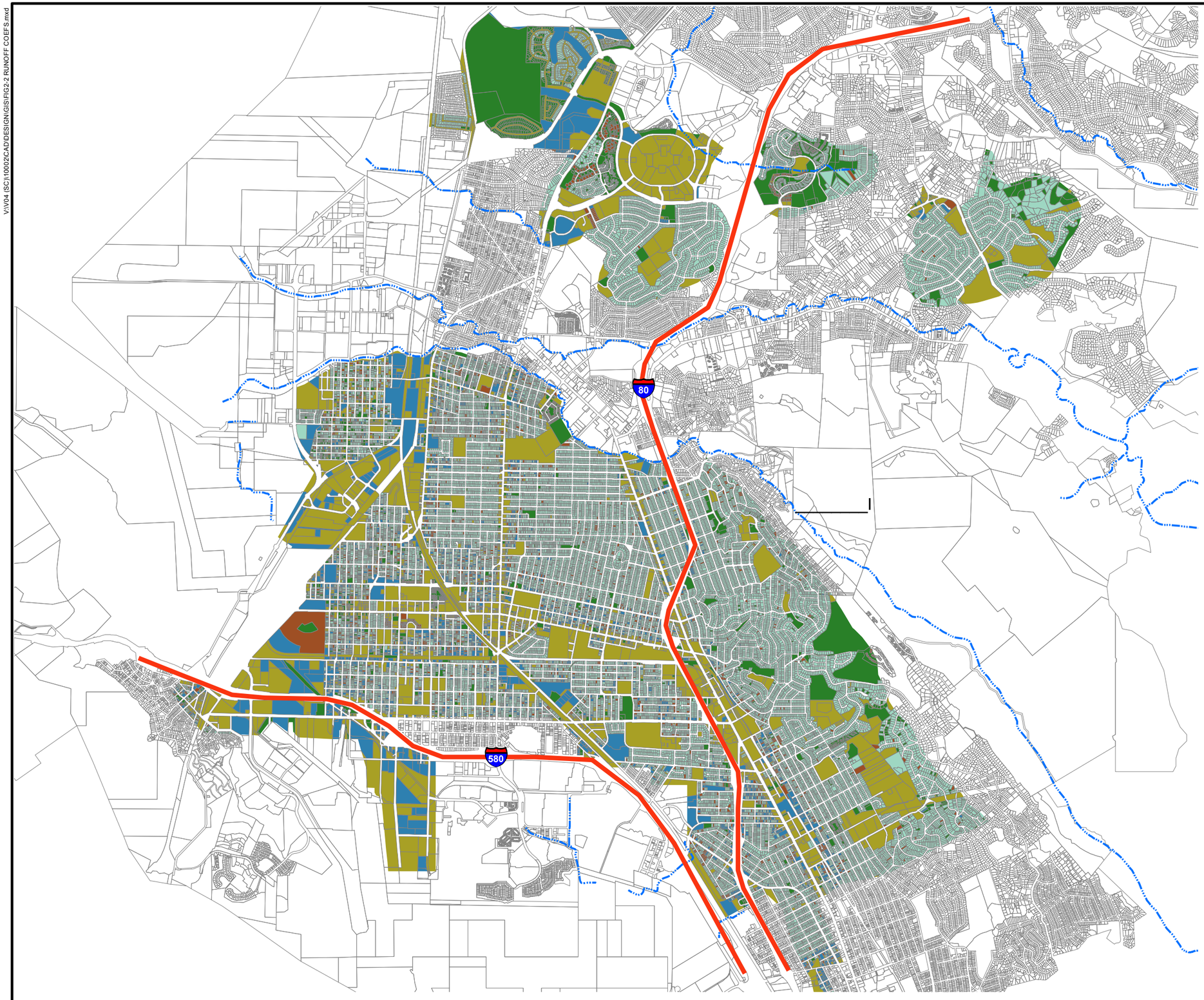
Currently, the City of Richmond General Plan accounts for 70 unique land use types within the city limits (referred to as "usecodes" in the City's GIS database). Several of the various land uses are comparable and will have similar runoff characteristics. To optimize the computer modeling analysis, the 70 various land use types were consolidated into 12 categories with distinct and similar runoff coefficient values (see Figure 2-2). The land use areas from the General Plan were digitized using computer-aided design (CAD) techniques. Geographic information system (GIS) software was then used to quantify and summarize the land use areas for calculation of stormwater runoff.

The City's existing land use classifications used for modeling are as follows:

- **Commercial (C)**. The Commercial land use category is used to indicate areas of concentrated retail use, generally located adjacent to major streets. C uses, as shown below, include restaurants, retail, hotels/motels, and service-related uses such as medical and professional offices.

Bowling alleys	**C**
Churches	
Combinations (e.g., single and a double)	
Commercial stores (not supermarkets)	
Drive-in restaurants (hamburger, taco, etc.)	
Financial buildings (insurance and title companies, banks, savings & loans)	
Fraternal and service organizations	
Garages	
Medical and dental	
Mini-warehouse (public storage)	
Multiple and commercial; miscellaneously improved	
New car auto agencies	
Office buildings	
Public and private parking	
Research and development, with or without structures	
Restaurants (not drive-in; inside service only)	
Service stations, car washes, bulk plants	
Shopping centers (all parcels include vacant for future shopping center)	
Small grocery stores (mom and pop, quick stop)	
Supermarkets (not in shopping centers)	
Theaters	

V:\V04 (SC)\10002\CAD\DESIGN\GIS\FIG2-2 RUNOFF COEFS.mxd



Legend

- 0.25 - Agriculture, Vacant, Recreation
- 0.30 - Single Family Residential
- 0.50 - Medium Family Residential
- 0.70 - Light Industrial, Heavy Family Residential
- 0.90 - Heavy Industrial, Public Facilities, Commercial, Streets
- Creeks

N
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CITY OF RICHMOND
STORM DRAIN MASTER PLAN
RUNOFF COEFFICIENTS

BY: HWL	DATE: NOVEMBER 2006
BOYLE	FIGURE **2-2**

- **Estate Residential (ER)**. This designation applies to developments with two dwelling units or less per acre.

Rural, residential improved, 1 to 10 acres	**ER**
Rural, with or without miscellaneous structures, 1 to 10 acres	

- **Heavy Industrial (IH)**. This land use category applies to high-volume manufacturing and processing development areas that are densely occupied. Typical IH land use areas include the Chevron facilities on the west side of the City.

Heavy industrial	**IH**
Industrial park (with or without structures)	
Miscellaneous improvements, including light or heavy industrial	

- **Light Industrial (IL)**. This land use category applies to low-volume manufacturing and processing development areas that are less densely occupied.

Industrial vacant land (not part of industrial park or P and D)	**IL**
Light industrial	
Miscellaneous improvements, 1 site	
Pipelines and canals	

- **Public Facilities (PF)**. This category includes City, County or other governmental and agency owned properties, such as the civic center, prisons, public schools, hospitals, airport, wastewater treatment plant, water tanks, and fire stations.

Convalescent hospitals and rest homes	**PF**
Cultural uses (libraries)	
Government-owned, with or without buildings (federal, state, city, BART)	
Hospitals, with or without improvements	
Schools, public or private, with or without improvements	
Taxable municipally-owned property	
Utilities, with or without buildings (not assessed by SBE)	

- **Recreational Facilities (RC)**. This land use category applies to public and private recreation facilities including public parks, golf courses, and equestrian centers.

Boat harbors	**RC**
Cemeteries, mortuaries	
Common area parcels in PUDs (open spaces, recreational facilities)	
Community facilities, recreational, swimming pool association	
Golf courses	
Parks and playgrounds	
Urban acreage, 10 to 40 acres	
Urban acreage, more than 40 acres	

- **Residential Single Family (RSF)**. This designation applies to single-family detached housing units on lots with a minimum size of 6,000 square feet. The development density is from 2.1 to 5.0 dwelling units per gross acre.

Other; split parcels in different tax code areas	**RSF**
Single-family on other than single-family land	
Single family residential, detached, w/common area (normal subdivision type PUD), duets w/c	
Single family, 1 residential on 1 site and duets w/o common areas	
Single family, 1 residential on 2 or more sites	
Single family, 2 or more residential on 1 or more sites	

- **Residential Medium Family (RMF)**. This designation is for single-family small-lot (<6,000 square feet) subdivisions and attached townhouses. RMF includes areas designated as duplexes, mobile homes, retirement complex homes, and condos.

Attached PUDs, cluster homes, co-ops, condos, townhouses, etc.	**RMF**
Duplex	
Mobile home	
Retirement housing complex	

- **Residential High Family (RHF)**. This designation is for high-density residential subdivisions or apartments. RHF includes areas designated as apartments, triplexes, fourplexes, or motels/hotels.

Apartments, 13-24 units, inclusive	**RHF**
Apartments, 25-59 units, inclusive	
Apartments, 5-12 units, inclusive	
Apartments, 60 units or more	
Fourplex	
Motels, hotels, and mobile home parks	
Triplex	

- **Vacant (V)**. This designation applies to vacant space.

Commercial vacant	**V**
Multiple vacant	
Residential vacant, 1 site (includes PUD sites)	
Residential vacant, 2 or more sites	
Residential vacant, unbuildable	
State Board assessed parcels	

- **Street (ST)**. ST is not a standard land use of the City and was created to represent all of the private streets and roads in the City. Areas within streets are not assigned loading factors.

Private roads	**ST**

The land use areas are summarized as follows:

Land Use	Description	Area (acres)
AG	Agriculture	0.14
C	Commercial	705.03
IH	Heavy Industrial	232.27
IL	Light Industrial	325.33
PF	Public Facilities	1,013.97
RC	Recreation	342.55
RHF	High-Density Residential	361.98
RMF	Medium-Density Residential	237.81
RSF	Single-Family Residential	3449.57
ST	Streets	264.98
V	Vacant	224.42
	Total	7,158.05

[1]Existing refers to the effective areas currently tributary to the City's existing storm drainage system.

The runoff coefficients assigned to each of the land uses are explained in Section 3.2.

2.4 NPDES Permit and Requirements

2.4.1 Introduction

The City, classified as a small, separate storm sewer system (MS4) regulated entity under the Phase II NPDES Program, obtained Contra Costa Countywide NPDES Municipal Stormwater Permit, NPDES Permit No. CA0029912 by completing a Stormwater Management Program (SWMP) in 1999. Classification MS4s are designated as separate storm sewer systems serving populations under 100,000 and discharging into local rivers and/or streams without treatment. Under the Phase II Small MS4 Program Requirements, the City was required to implement a program to reduce, eliminate, or improve the conditions of direct discharges of polluted stormwater to the "maximum extent practicable" (MEP), protect water quality of the receiving waters (i.e. San Francisco Bay), and fulfill the water quality requirements of the Clean Water Act.

The City's storm drain system is currently operating under the guidelines of the SWMP identified as the Contra Costa Clean Water Program. As part of the Phase II regulations, the City was required to implement Stormwater Pollution Prevention Plans (SWPPPs) to reduce or eliminate pollutants from entering adjacent receiving waters via City discharges. A SWPPP was developed on a county-wide level, and the City is currently implementing the Contra Costa Clean Water Program's SWMP. The SWMP lists specific goals and programs being implemented to fulfill NPDES requirements, and identifies "performance standards" that govern specific types of potential development in Richmond.

2.4.2 Effects on City Development and Regulation Implementation Schedule

The requirements in the original SWMP and recent NPDES Permit Amendment targets primarily new development or, in the case of Richmond where vacant land is limited, the amendment targets redevelopment. The permit amendment defines redevelopment as "a previously developed site that results in the addition or replacement of impervious surface." Any party responsible for development or redevelopment shall ensure that stormwater pollutant discharges are reduced by some form of treatment to the "maximum extent practicable," and increases in runoff are managed in accordance to the specifications within the NPDES Permit Amendment. The types of projects that are governed by the NPDES Permit Amendment regulations fall under two general groups:

Group 1 Projects

- Any commercial, industrial, or residential development that results in 1 acre or more of impervious surface.
- Any streets, roads, highways, freeways, or paved surface projects used for automobile traffic that results in 1 acre or more of impervious surface.
- Any redevelopment project resulting in 1 acre or more of impervious surface on an already developed site.

Group 2 Projects

- Group 2 project types are equivalent to the Group 1 projects, except the resultant increase in impervious surface is 10,000 square feet to less than once acre.

Implementation of the Group 1 Project Regulations began on February 15, 2005. Therefore, any Group 1 projects that occur thereafter will fall under the NPDES Permit Amendment Regulations. Implementation of the Group 2 Project Regulations began on August 15, 2006. Therefore, smaller size projects that increase impervious surface area by 10,000 square feet or more will be governed by the NPDES Permit Amendment Regulations.

2.4.3 NPDES Permit Amendment Design Criteria for Basins and/or Stormwater Conveyance Treatment Facilities

Any detention/retention basins or infiltration structures will be designed using the formula and volume capture coefficients set forth in *Urban Runoff Quality Management, WEF Manual of Practice No. 23/ASCE Manual of Practice No. 87, (1998)*, pages 175-178 or the volume of annual runoff required to achieve 80 percent or more capture using the method described in Appendix D of the *California Stormwater Best Management Practices Handbook (1993)* using local rainfall data.

The *Urban Runoff Quality Management* approach uses the following equation:

$$P_o = (a * C) * P_6$$

Where:

P_o = maximized detention volume determined using either the event capture ratio or the volume capture ratio as its basis, watershed in. (mm)

a = regression constant from least-squares analysis (Table 5.4 on Page 177)

C = watershed runoff coefficient calculated from Eq. 5.1 on Page 175 based on percentage of impervious surfaces area

P_6 = mean storm precipitation volume, watershed in. (mm), from Figure 5.3 on Page 176

Any treatment facilities that need to be designed based on a flow capacity (i.e. swales, filters) shall be designed to meet one of the following:

- 10 percent of the 50-year rainfall event peak flow rate.
- The runoff flow from a rainfall event equivalent to two times the 85th percentile hourly rainfall intensity based on historical rainfall data.
- The flow from a rainfall event equal to an intensity of at least 0.2 inches per hour.

Section 3
Analysis Criteria

3.1 System Characteristics

The Richmond watershed area exhibits an undulating terrain with topographic surface elevations ranging from 700+ feet down to 0 feet (sea level). The City of Richmond is situated immediately adjacent to San Francisco and San Pablo Bays, and the prevailing surface terrain slopes generally from east to west. The upper watersheds are located near the East Richmond Heights area, and the lower watersheds fan westward toward the bay. The general slopes within the high watershed areas (from the high ridgeline along the east of the City down to the beginning of the lower watersheds where slopes are milder) range from 10 to 20 percent grades. The majority of the City is situated within the lower watershed areas, and the general slope is approximately 1 percent from east to west.

Currently, the City's storm drain system consists of several independent networks of storm drain catch basins and pipes that discharge into basins, creeks, or the bay. Throughout the system, portions of the storm drain system drain very small areas and have not been a historical problem. Therefore, they will not be analyzed. The portions of the system deemed insignificant include pipes that are very small in diameter used to convey stormwater across streets lacking valley gutters (not used as a collection system pipe) and select non-main pipes. Storm drain networks discharging into ponds include the system discharging into the Booker T Anderson Jr. Park and the Hilltop Mall area system, which discharges into Hilltop Lake. Other storm drain networks also discharge into some type of open channel (either canal or swales) and are collected by a downstream storm drain system. The remaining networks discharge into the bay.

Analysis Numbering System

The majority of the streets in the developed areas have curb and gutter street systems with gutter inlets collecting the stormwater. The City's storm drain system is primarily an "open system," where the majority of the stormwater runoff is collected but is then discharged into creeks or the bay, so the runoff is not contained within each drainage zone. In the zones where stormwater is collected and discharged into basins, the basins can only exhaust stormwater by evaporation/ percolation or by pumping water out of the basins into another zone.

The entire system was divided into 32 distinct drainage zones for analysis. Each drainage zone contains its own pipe network and outlet to a canal, pond, or the bay. Each zone has been assigned one or two letters of the alphabet as the primary drainage zone. Each drainage area within the drainage zones was assigned an identification number based on the configuration of the pipe network. Each drainage area was assigned a six- or seven-digit ID number, which consists of the first one or two digits representing the drainage zone and the following four numbers representing pipe network configuration numbers. The two numbers following immediately after the drainage zone designation represent the pipe branch, and the last two numbers represent the series of inlets along each subbranch.

3.2 Storm Drain Analysis Criteria

The capacity of the storm drain system was determined based upon specific analysis criteria applied to the entire developed watershed area. In general, a drainage system should convey the design storm runoff through the storm drain system to the retention basins or discharge points without severely impacting surface conditions.

The storm drain conveyance system analysis criteria are as follows:

- **Precipitation, Intensity-Duration-Frequency (IDF) Data, and Recurrence Intervals.** Precipitation data was taken from the 1954 Richmond Storm Drainage Report by Clyde C. Kennedy. The rainfall data used in the 1954 report was developed from Standard Oil Company's Richmond refinery in June of 1954. The IDF curves have been compared with IDF rainfall data from gauging stations throughout Alameda and Contra Costa County from 1950 to 1989 and found to be representative of rainfall in Richmond.

- **Rational Method.** The Rational Method was used to calculate peak flows in the storm drain system. See Section 3.3.

- **Runoff Coefficients**. Runoff coefficients were reviewed and approved by the City. The City provided Drawing No. A-85, Runoff Coefficients for Rational Method, Contra Costa County Flood Control and Water Conservation District. In order to develop a composite runoff coefficient for each watershed tributary area, the City's existing land uses were matched with the given land descriptions in this publication, and a composite coefficient was calculated on an area weighted basis. The runoff coefficients are based on a design storm having a 10-year recurrence period.

  The runoff coefficient values are meant to account for the typical abstractions that exist in every surface. Common abstractions include vegetation, water percolation into the ground surface, depression areas that form puddles preventing water inside the puddle from continuing along the flow path, and evaporation into the atmosphere. The runoff coefficients that were used in the computer model will be composite C values that consider the weighted value of each runoff coefficient depending on the land use composition in each drainage area.

- **Time of Concentration (TOC)**. TOC refers to the time it takes for a drop of rainfall at the most remote point in a drainage area to reach the inlet within the drainage area. TOC was calculated for each tributary drainage area. Infosewer (the storm drain analysis computer software used) calculates the time of concentration internally using three variables: 1) the longest flow path length, 2) the average slope of the flow path, and 3) the drainage area surface runoff properties (runoff coefficient) to determine the time of concentration. The three variables are manually entered and are based on the drainage area shapes, the zoning, and topographic data provided by the City. The minimum TOC is 10 minutes.

- **Surface Flow**. Surface flow paths have been assumed based on the mapping and limited topographic information available for the City. Actual surface flow conditions may vary,

and accumulated flow volumes within the various streets may differ with the flows reported in this Master Plan.

- **Flooding Criteria.** By agreement with City staff, street flood depths should not exceed 2 inches above the top of curb elevation. For areas with inadequate pipes resulting in street flooding, a more precise flood depth analysis was performed to determine the sufficiency of the street curb and gutter conveyance system. The flood depth analysis first compared street flows to curb and gutter channel capacities at minimum slope (S=0.0015 ft/ft). If the street flow exceeded the channel capacity at minimum slope, the street cross-sectional properties and the longitudinal slope were further examined to estimate a flood depth. The City's streets were divided into two street cross-section classifications:

  - **Typical 40-foot-wide road** – 2 percent grade from the crown of the road out 20 feet to the flowline. Approximately 80-cfs capacity when flood depth is equal to 8 inches above the flowline at minimum longitudinal slope of S=0.0015

  - **Typical 60-foot-wide road** – 2 percent grade from the crown of the road out 30 feet to the flow line. Approximately 100-cfs capacity when flood depth is equal to 8 inches above the flowline at minimum longitudinal slope of S=0.0015

  If street flows exceeded the 80 and 100 cfs curb and gutter capacities, respectively, at minimum longitudinal slopes, a more precise longitudinal slope and cross-sectional area of the curb and gutter was researched to determine more accurate capacities for evaluation of the curb and gutter system to convey stormwater.

- **Design Storm for Storm Drain System Elements**. City of Richmond Municipal Code, Article 15, Section 15.08.570, Part 2, "Capacity of Channels and Conduits" designates the recurrence interval of the design storm for the following types of drainage systems:

  - Major drainage channels: 50-year design storm
  - Secondary drainage channels: 25-year design storm
  - Minor drainage channels: 10-year design storm

  The Municipal Code does not define what is considered to be major, secondary, and minor drainage channels other than that minor drainage facilities are those serving a watershed area less than 1 square mile. A 10-year design storm is an appropriate design criteria for new construction/new subdivisions and was used for the analysis and design of the storm drain pipeline system. The 50-year and 25-year rainfall events may be too conservative to evaluate the existing storm drainage system and result in extensive replacement or improvement projects.

  For the existing system, a 10-year design storm is recommended as the basis to determine the capacity of the storm drain system. Analyzing the effects of a 100-year design storm to determine the level of damage, if any, is also recommended.

- **Detention Basins**. Detention basins, if necessary and applicable, would be designed in accordance with the NPDES basin sizing references. The sizing analysis is described in Section 2 of this report.

- **Hydraulic Criteria for Pipes and Inlets**. The City of Richmond Municipal Code, Article 15, Section 15.08.570, Part 7, "Design Flow in V-Ditches" stipulates that the water surface shall be at least 1 inch below the top of the ditch. A Manning's roughness coefficient of 0.013 will be used for storm drain concrete pipes and all new pipes (proposed).

  The open channels (i.e. V-ditches, canals, swales) were not analyzed for capacity due to the size variability of open channels throughout the City. When V-ditches or swales are used to convey stormwater from an upstream to a downstream pipe system, the analysis assumed that the swale is capable of handling the entire amount of stormwater within the pipe.

  Inlets were not analyzed. The hydraulic analysis of the stormwater system assumed that the City's inlets are capable of capturing the volume of runoff that is equivalent to the capacity of the pipes. The pipe system analysis and design will reflect 100 percent of the runoff.

- **Minimum Pipe Diameter**. From the City of Richmond Municipal Code, Article 15, Section 15.08.570, Part 4:

  - Minimum conduit size shall be 12 inches. In general, all storm drain conduit shall be standard-strength reinforced-concrete pipe.

  - For future system developments, all planned pipes will be a minimum of 24 inches in diameter. Pipes smaller than 24 inches are specific to new developments, and pipes within potential development areas cannot be planned at the conceptual level addressed by this Storm Drain Master Plan.

- **Minimum Velocities**. The allowable flow velocity range for pipes at standard slopes is 2 feet/second minimum to provide self cleaning within the pipe to 10 feet/second maximum for preventing pipe abrasion. Minimum velocity of earthen channels shall be 3 feet/second. For overland flow time of concentration calculations, an assumed surface grading slope of 2 percent is used.

- **Headlosses.** An absolute headloss of 0.1 foot is applied at all manholes or inlets located along a series for the hydraulic modeling.

3.3 Hydrologic Analysis

The computer program Infosewer Pro was used to analyze the storm drain system. Infosewer Pro uses the Rational Method, an empirical method for estimating peak flow rates. The Rational Method is based on the following formula:

$$Q = CIA$$

Where:

Q = peak flow rate in cubic feet per second (cfs).
C = runoff coefficient representing the ratio of runoff to rainfall for a certain type of surface as follows:

Land Use	Coefficient (C)
AG V RC	0.25
RSF	0.3
RMF	0.5
IL RHF	0.7
IH PF C ST	0.9

I = average rainfall intensity in inches per hour for the selected rainfall frequency and for a duration equal to the time of concentration.

A = watershed area tributary to the point of concentration, in this case the point of concentration being each drain inlet.

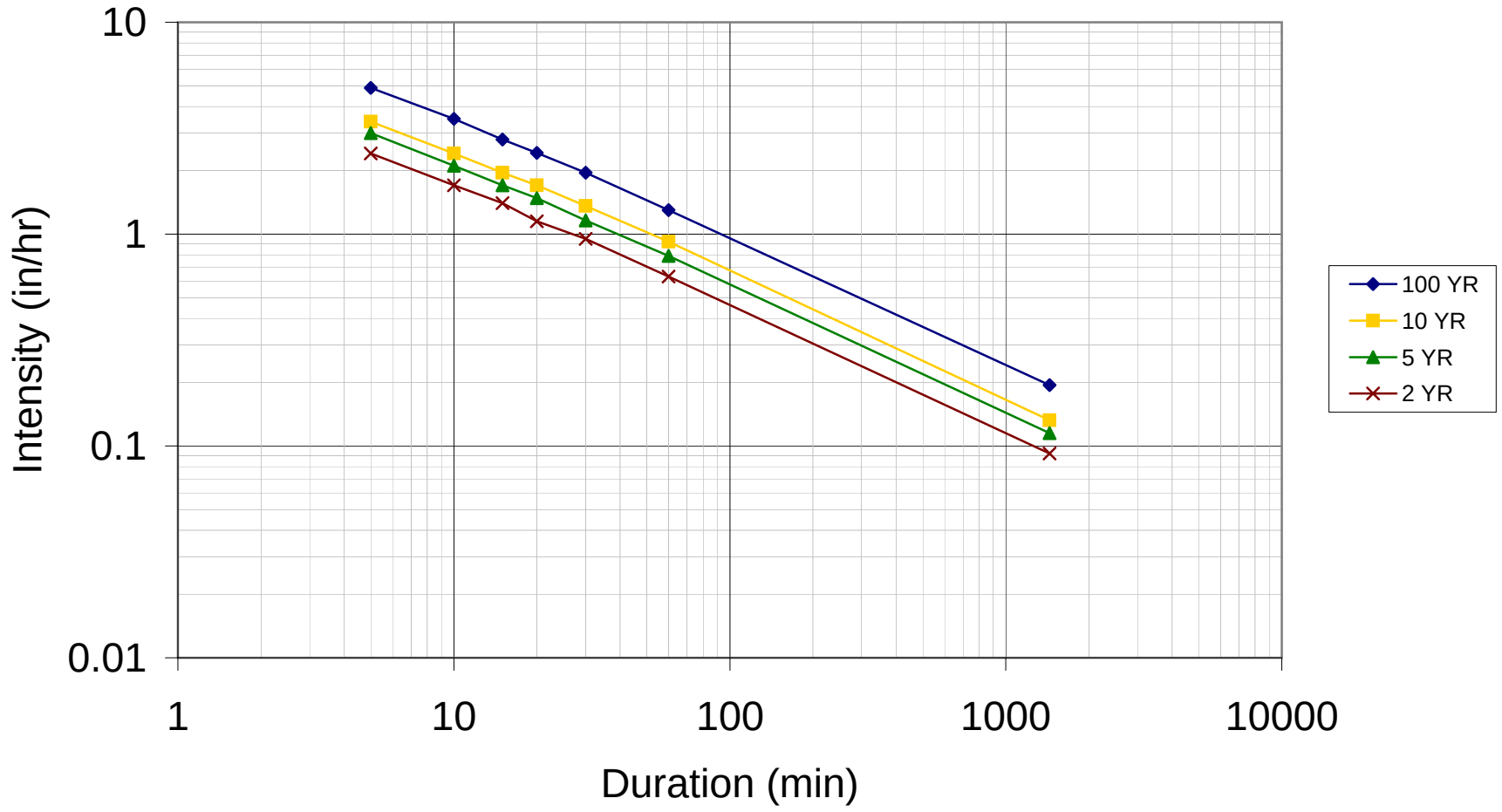
3.3.1 Intensity-Duration-Frequency Data

Infosewer Pro simulates peak runoff by user-entered IDF curve data input. IDF curve data indicate average rainfall intensity information depending on rainfall events. For example, a 100-year storm will have much higher rainfall intensities than a 2-year storm, and the values are determined by the IDF curve data. The IDF curves also factor in the time of concentration by scaling down the intensity as the time of concentration increases. The actual IDF curves are generated by the results from statistical analysis of historical rainfall data. The IDF curves being used for this master plan are from the 1954 Richmond Storm Drainage Report by Clyde C. Kennedy. The rainfall data used in the 1954 report was developed from Standard Oil Company's Richmond refinery in June 1954 and can be found on Figure 3-1.

3.3.2 Watershed Information

Infosewer Pro determines stormwater collection at each inlet depending on user-controlled watershed information. Information required includes drainage areas, time of concentration, and runoff coefficients. For the analysis, the effective watershed area was divided into independent drainage areas. Drainage areas are created based on the grading shown on contour mapping provided by the City for areas contributing runoff to a specific drainage inlet. Contour mapping was used to determine flow direction along every street and gutter and to generate a detailed flow path pattern map (see drainage area and flow path maps provided in Appendix A).

FIGURE 3-1
CITY OF RICHMOND - STORM DRAIN MASTER PLAN
RAINFALL INTENSITY - DURATION - FREQUENCY CURVES



Section 4
Existing Storm Drain System

In order to analyze the existing Richmond storm drain system, the watershed was divided into 32 drainage zones. The drainage zones are shown in Figure 4-1.

4.1 Drainage Zones

The 32 drainage zones used for the analysis are as follows (see Table 4-1):

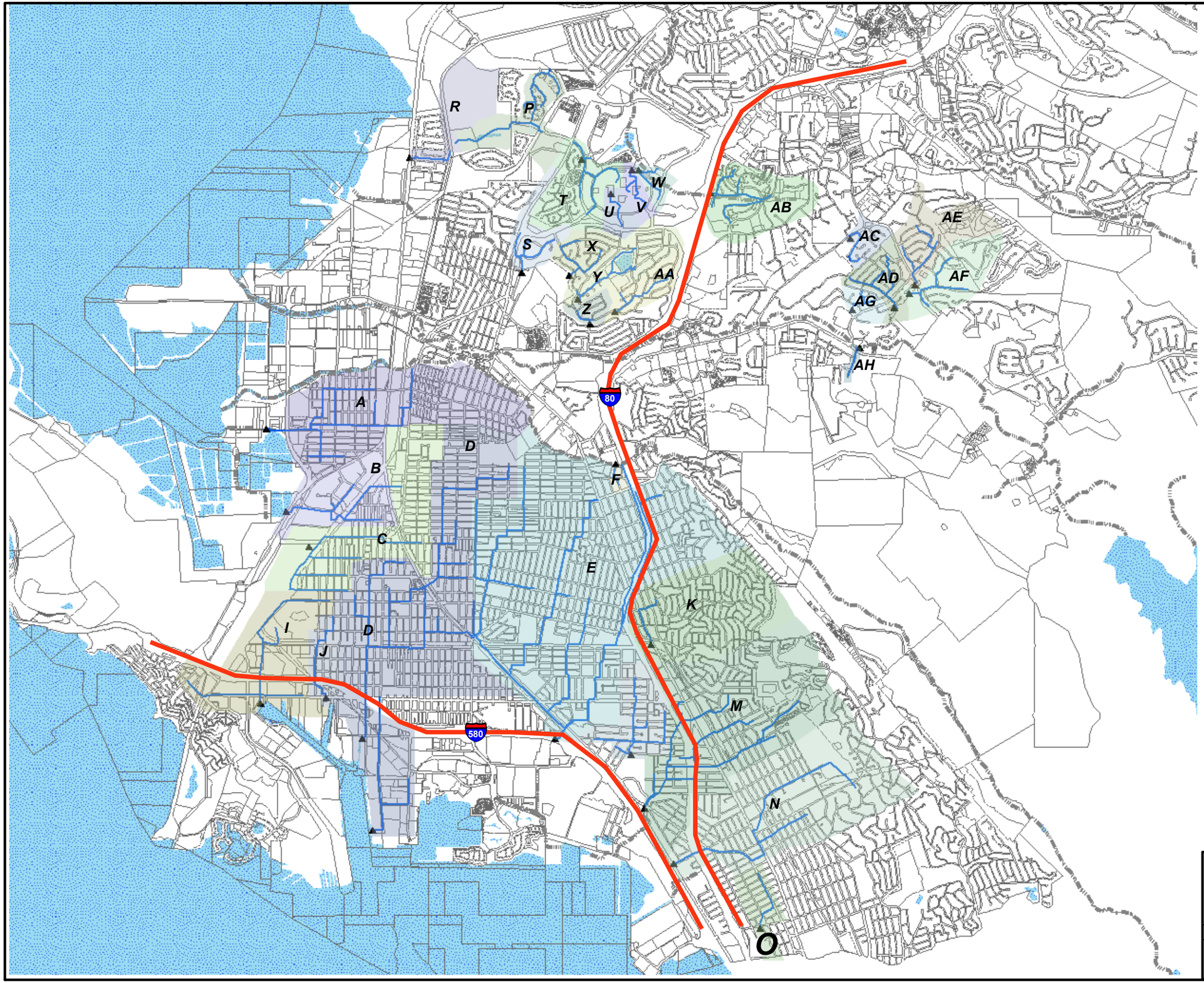
- **Drainage Zone A** consists of the pipe network serving the northwestern portion of Richmond and significant portions of San Pablo and encompasses approximately 584 acres of land. The zone's most extreme boundaries include Folsom on the north, Richmond Parkway on the west, BNSF railroad on the south, and Pinewood Terrace on the east. Approximately 80 percent of Drainage Zone A is in the city of San Pablo and is primarily single-family residential development with patches of commercial development. Storm drain pipes within Zone A are up to 84 inches in diameter, and the system discharges into an open channel that eventually leads into the bay.

- **Drainage Zone B** includes the area in northwest Richmond just east of the Chevron refinery and encompasses approximately 228 acres of land area. The zone is bounded by BNSF Railroad on the north, Castro Street on the west, the Garvin Street alignment on the south, and the Union Pacific Railroad on the east. The drainage zone consists of low and medium-density residential developments and heavy industrial areas. Storm drain pipes within Zone B are up to 60 inches in diameter, and the system discharges into the bay.

- **Drainage Zone C** includes some area in northwest Richmond and a small portion of San Pablo and encompasses approximately 437 acres of land area. The zone's most extreme boundaries include Chesley Avenue on the north, BNSF railroad on the west, Nevin Avenue on the south, and 18th Street on the east. The drainage zone consists of numerous distinct land use types such as commercial, low-density residential, medium-density residential, and heavy industrial developments. Storm drain pipes within Zone C are up to 54 inches in diameter, and the system discharges into an open channel leading out to the bay.

- **Drainage Zone D** consists of the central and southern portions of the City and encompasses approximately 1,330 acres of land area. The zone's most extreme boundaries include Pine Avenue on the north, 4th Street on the west, San Francisco Bay on the south, and 28th Street on the east. Being located in the center of the City and covering such a large area, this drainage zone includes several land use types, with no single land use type occupying the majority. Storm drain pipes within this zone are up to 72 inches in diameter near the downstream portions of the zone, and the system discharges into the bay.

V:\V04 (SC)\10002\CAD\DESIGN\GIS\FIG4-1 Drainage Zones



Legend

- Storm Drain Pipes
- Creeks
- ▲ Discharges in Creeks, Canals, or Bay

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
DRAINAGE ZONES

BY: HWL	DATE: NOVEMBER 2006
BOYLE	FIGURE 4-1

Table 4-1
Drainage Zone Summary
City of Richmond Storm Drain Master Plan

Drainage Zone	Area (acres)	Proximity	Boundaries 1	Primary Land Use Types	Max. Pipe Diameter (inches)	Ultimate Point of Discharge
A	584	NW Richmond and portions of SW San Pablo	Folsom Ave (N), Richmond Parkway (W), BNSF RR (S), Pinewood Ter (E)	RSF, C	84	Open channel along Gertrude Avenue discharging into the San Pablo Channel
B	228	NW Richmond east of Chevron Oil Refinery	BNSF RR (N), Castro St (W), Garvin St (S), UPRR (E)	RSF, RMF, IH	60	open channel west of Castro St. discharging into the Bay
C	437	NW Richmond and small portions of SW San Pablo	Chesley Ave (N), BNSF RR (W), Nevin Ave (S), 18th St (E)	C, RSF, RMF, IH	54	Open channel west of BNSF RR and north of Ripley Ave, discharging into the San Pablo Channel
D	1330	Central and S Richmond	Pine Ave (N), 4th St (W), SF Bay (S), 28th St (E)	mix	72	Harbour Channel
E	1651	Central and E Richmond and portions of N San Pablo	Alpine Ct and Pinewood Ter (N), 23rd St (W), Cypress Ave (S), I-80 and Bernhard Ave (E)	RHF, LDR, C	66	Concrete ditch discharging into canal along Regatta Blvd
F,G,H[2]	---	within S San Pablo	---	---	---	Wildcat Creek
I	409	SW Richmond	Nevin Ave (N), Marina Wy (W), SF Bay (S), 3rd St (E)	RMF, C	48	SF Bay
J	95	SW Richmond N of Point Richmond	Nevin Ave (N), 1st St (W), Cutting Blvd (S), 4th St (E)	RSF, RMF, IH	60	SF Bay
K	453	E Richmond	Sierra Ave (N), I-80 (W), Conlon Ave (S), Kensington Ave (E)	RSF	36	Concrete channel near San Pablo and Bissell Ave
L	174	SE Richmond, adjacent to city limits	Florida Ave (N), 45th St (W), Cypress Ave (S), Eastshore Blvd (E)	RSF, RMF	72	Open swale near Cypress Ave and 42nd St that eventually discharges into open-channel to the Bay
M	828	SE Richmond and portions of NW El Cerrito	Cutting Blvd (N), I-80 (W), Tehama Ave (S), Devonshire Dr (E)	RSF, RMF	66	Open channel along I-80 at Bayview Ave leading out to SF Bay
N	728	SE Richmond and portions of NW El Cerrito	Donal Ave (N), I-80 (W), Stockton Ave (S), Contra Costa Dr (E)	RSF	48	Open channel along I-80 at Burlingame Ave leading out to SF Bay
O	93	SE Richmond and portions of NW El Cerrito	Huntington Ave (N), San Mateo St (W), southern city limits (S), Carlson Blvd (E)	RSF, C	36	Open channel along Central Ave discharging into the SF Bay
P	158	NW Richmond east of Richmond Country Club	Atlas Rd. (N), Richmond Country Club (W), Richmond Pkwy (S & E),	RSF	48	Earthen swale south of Atlas Rd. and area west of Richmond Country Club
R	170	N Richmond, North Shoreline area	Banks Dr (N), UPRR (W), Williams Dr (S), BNSF RR (E)	RSF	36	Earthen channel along UPRR discharging into the San Pablo Bay
S	110	SW portion of Hilltop Mall area	---	RMF	42	Rheem Creek
T	185	NW portion of Hilltop Mall area	---	RMF, C	54	Open area to the west, tributary to Karlson Creek
U	48	Central Hilltop Mall area	Mall buildings and parking lot area	C	48	Open area to the west, tributary to Karlson Creek
V	41	NE Hilltop Mall area	Mall buildings and parking lot area	C	42	Open area to the north, overflows to Garrity Creek
W	38	NE Hilltop Mall area	Mall buildings and parking lot area	C	36	Open area to the north, overflows to Garrity Creek
X	84	S of Hilltop Mall area	---	RSF	36	Open area to the southwest, overflows to Rheem Creek
Y	144	S of Hilltop Mall area	---	RSF	36	Paved channel discharging into Rheem Creek
Z	37	S of Hilltop Mall area	---	RSF	21	Concrete box culvert discharging into Rheem Creek
AA	85	SE of Hilltop Mall area	---	RSF	36	Concrete box culvert discharging into Rheem Creek
AB	228	East of Hilltop Mall area, on opposite side of I-80	---	RSF, RMF, C	72	Garrity Creek
AC	134	NE Richmond and E of El Sobrante	---	RSF	18	Swale south of Appian Way tributary to San Pablo Creek
AD	97	NE Richmond and E of El Sobrante	---	RSF	24	Wilkie Creek
AE	171	NE Richmond and E of El Sobrante	---	RSF	42	Wilkie Creek
AF	162	NE Richmond and E of El Sobrante	---	RSF	90	Wilkie Creek
AG	46	N Richmond and SE El Sobrante	---	RSF	21	Wilkie Creek
AH	12	N Richmond and SE El Sobrante	---	RSF	36	San Pablo Creek

Notes:

1. Parenthesis represents the bounding side of the area. (N)=north, (W)=west, (S)=south, (E)=east
2. Drainage zones located in the San Pablo city limits, and are not Richmond's jurisdiction.

- **Drainage Zone E** is a large zone covering the central and eastern portions of the City as well as portions of San Pablo to the north and encompasses approximately 1,651 acres of land area. The zone's most extreme boundaries include Alpine Court and Pinewood Terrace to the north, 23rd Street on the west, Cypress Avenue on the south, and Interstate 80 and Bernhard Avenue on the east. The drainage zone predominantly consists of high-density residential development but also has areas of low-density residential and commercial developments. Storm drain pipes within this zone are up to 66 inches in diameter, and the system discharges into a concrete ditch that feeds into the creeks system leading out to the bay.

- **Drainage Zones F, G, and H** are located within the city of San Pablo and are tributary to Wildcat Creek. The storm drain facilities within these drainage zones are indicated on the City's storm drain system mapping but are not under the City's jurisdiction and were not analyzed as a part of this study.

- **Drainage Zone I** includes the area in the southwestern portion of the City and is located near the bay adjacent to Point Richmond and encompasses approximately 409 acres of land area. The zone's most extreme boundaries include Nevin Avenue on the north, Martina Way on the west, San Francisco Bay on the south, and 3rd Street on the east. This drainage zone consists primarily of medium-density residential developments and includes some strips of commercial development and pipes up to 48 inches in diameter that discharge directly into the bay.

- **Drainage Zone J** consists of the area in southwest Richmond adjacent to the bay immediately north of the Port of Richmond and encompasses approximately 95 acres of land area. The zone's most extreme boundaries include Nevin Avenue on the north, 1st Street on the west, Cutting Boulevard on the south, and 4th Street on the east. This drainage zone consists of predominantly low- and medium-density residential developments. The storm drain network in Zone J includes pipes up to 60 inches in diameter that discharge directly into the bay.

- **Drainage Zone K** in east Richmond also consists of significant portions of El Cerrito and encompasses approximately 453 acres of land area. This zone is bounded by Sierra Avenue on the north, Interstate 80 on the west, Conlon Avenue on the south, and Kensington Avenue on the east. This drainage zone is primarily low-density residential developments. The storm drain pipes in Zone K are up to 36 inches, but the downstream reaches consists of rectangular pipes that are 12 feet by 3 feet. The system discharges into a concrete channel that conveys the stormwater into Drainage Zone L.

- **Drainage Zone L** consists of the eastern and southeastern portions of Richmond immediately adjacent to the city limits before entering into El Cerrito and encompasses approximately 174 acres of land area. This zone's most extreme boundaries include Florida Avenue on the north, 45th Street on the west, Cypress Avenue on the south, and Eastshore Boulevard on the east. This drainage zone predominantly consists of low- and medium-density residential developments. Storm drain pipes in this zone are up to 54 inches in diameter, and the system discharges into an open swale that drains into a 72-inch pipeline

that discharges into an open channel leading out to the bay. This drainage zone also collects stormwater from Drainage Zone K, located immediately upstream.

- **Drainage Zone M** consists of portions of southeast Richmond and significant portions of El Cerrito and encompasses approximately 828 acres of land area. This zone's most extreme boundaries include Cutting Boulevard on the north, Interstate 80 on the west, Tehama Avenue on the south, and Devonshire Drive on the east. This drainage zone predominantly consists of low-density residential developments, with small portions of medium-density residential housing within the Richmond portion of the drainage zone. The pipe network consists of pipes up to 66 inches in diameter and discharges into an open channel flowing into the bay.

- **Drainage Zone N,** located just south of Zone M, also includes portions of southeast Richmond and significant portions of El Cerrito and encompasses approximately 728 acres of land area. The zone's most extreme boundaries include Donal Avenue on the north, Interstate 80 on the west, Stockton Avenue on the south, and Contra Costa Drive on the east. Located in the eastern portion on the City along the hillside, this drainage zone is mainly low-density residential development. The pipe network consists of pipes up to 48 inches in diameter, and runoff from Zone N is conveyed via an open channel flowing into the bay.

- **Drainage Zone O** consists of the farthest southeastern portions of the City and portions of El Cerrito and encompasses approximately 93 acres of land area. This zone is bounded by Huntington Avenue on the north, San Mateo Street on the west, the southern city limits on the south, and Carlson Boulevard on the east. This drainage zone is primarily low-density residential with minor spots of commercial development. The network consists of pipes up to 36 inches in diameter, and the system discharges into an open channel leading out to the bay.

- **Drainage Zone P** consists of northwestern portions of the City east of the Richmond Country Club. The zone is bounded by Atlas Road on the north, the Richmond Country Club on the west, and Richmond Parkway on the south and east. This drainage zone is primarily low-density residential. The two pipe networks within this zone consist of pipes up to 48 inches in diameter, and the system discharges into an earthen swale south of Atlas Road and an open area west of the Country Club.

- **Drainage Zone R** includes the area in north Richmond near the North Shoreline area and encompasses approximately 170 acres of land area. This zone is approximately bounded by Banks Drive on the north, the Union Pacific Railroad on the west, Williams Drive on the south, and the BNSF Railroad on the east. This drainage zone predominantly consists of low-density residential developments. The network within this zone includes pipes up to 36 inches in diameter, and the system discharges into an earthen channel that flows to the bay.

- **Drainage Zone S** includes the southwestern portion of the development around Hilltop Mall and encompasses approximately 110 acres of land area. This drainage zone is primarily medium-density residential and includes portions of San Pablo. The pipe network consists of pipes up to 42 inches in diameter, and the system discharges into Rheem Creek.

- **Drainage Zone T** includes the northwestern portion of the development around Hilltop Mall and encompasses approximately 185 acres of land area. This drainage zone consists of approximately equal areas of medium-density residential and commercial developments, with the commercial developments predominantly located in the Hilltop Mall area. The pipe network within this zone includes pipes up to 54 inches in diameter, and the system discharges into an open area west of the drainage zone tributary to Karlson Creek.

- **Drainage Zone U** includes central portions of the Hilltop Mall area ands encompasses approximately 48 acres of land area. This drainage zone is almost completely within the Hilltop Mall area and consists mainly of commercial development. The pipe network includes pipes up to 48 inches in diameter, and the system connects to an upstream portion of the pipe network within Drainage Zone T. Available record drawings indicate that the pipe system for Drainage Zone U was constructed after the Zone T system was already in place, and the Zone U system was tied into the Zone T system. Therefore, runoff within Zone U eventually also discharges into the open area west of Hilltop Mall tributary to Karlson Creek.

- **Drainage Zone V** includes the northeast portions of the Hilltop Mall area and encompasses approximately 41 acres of land area. This drainage zone is almost completely within the Hilltop Mall area and predominantly consists of commercial development. The pipe network includes pipes up to 42 inches in diameter, and the system discharges into the area north of Hilltop Mall, where the topography results in overland flow into Garrity Creek.

- **Drainage Zone W** includes the northeast area of Hilltop Mall and encompasses approximately 38 acres of land area. This drainage zone predominantly consists of commercial developments. The network has pipes up to 36 inches in diameter and discharges into the area north of Hilltop Mall, where the topography results in overland flow into Garrity Creek.

- **Drainage Zone X** includes the low-density residential area just south of Hilltop Mall and encompasses approximately 84 acres of land area. The network has pipes up to 36 inches in diameter and discharges into the open area to the southwest, where runoff overland flows into Rheem Creek.

- **Drainage Zone Y** includes the development immediately south of Hilltop Mall and encompasses approximately 144 acres of land area. This drainage zone primarily consists of low-density residential development with small patches of commercial uses. The network has pipes up to 36 inches in diameter, which discharge into a paved channel leading into Rheem Creek.

- **Drainage Zone Z** includes the southern portion of low-density residential developments south of the Hilltop Mall area and encompasses approximately 37 acres of land. The network within this zone has pipes up to 21 inches in diameter and discharges into a concrete box culvert leading into Rheem Creek.

- **Drainage Zone AA** includes the southeastern portion of the low-density residential developments south of the Hilltop Mall area and encompasses approximately 85 acres of

land area. The network within this zone has pipes up to 36 inches in diameter and discharges into a concrete box culvert leading into Rheem Creek.

- **Drainage Zone AB** includes the area east of Hilltop Mall on the opposite side of Interstate 80 and encompasses approximately 228 acres of land area. This drainage zone primarily consists of low- and medium-density residential developments with small portions of commercial development. The network within this zone includes pipes up to 72 inches in diameter at the downstream discharge pipes. The system discharges into Garrity Creek.

- **Drainage Zone AC** is east of El Sobrante and includes portions of northeast Richmond and encompasses approximately 134 acres of land area. The drainage zone primarily consists of low-density residential developments. The pipe network within this zone has pipes up to 18 inches in diameter and discharges into a swale immediately south of Appian Way that is tributary to San Pablo Creek.

- **Drainage Zone AD** includes the western portions of the El Sobrante area and primarily consists of low-density residential developments. This drainage zone encompasses approximately 97 acres of land area. The network within this zone has pipes up to 24 inches in diameter and discharges into Wilkie Creek, which is tributary to San Pablo Creek.

- **Drainage Zone AE** includes the northeastern portions of Richmond east of El Sobrante and encompasses approximately 171 acres of land area. The drainage zone is predominantly low-density residential developments. The network within this zone has pipes up to 42 inches in diameter and discharges into Wilkie Creek, which is tributary to San Pablo Creek.

- **Drainage Zone AF** includes the northeastern portions of Richmond east of El Sobrante and encompasses approximately 162 acres of land area. The drainage zone is predominantly low-density residential developments. The network within this zone has pipes up to 90 inches in diameter and discharges into the Wilkie Creek, which is tributary to San Pablo Creek.

- **Drainage Zone AG** includes the southeastern portion of El Sobrante and north Richmond consisting of primarily low-density residential developments. The drainage zone encompasses approximately 46 acres of land. The network within this zone has pipes up to 21 inches in diameter and discharges into Wilkie Creek, which is tributary to San Pablo Creek.

- **Drainage Zone AH** includes the southeastern portion of El Sobrante and north Richmond consisting of low-density residential development around Greenridge Drive immediately south of San Pablo Creek. The drainage zone encompasses approximately 12 acres of land. The network within this zone has pipes up to 36 inches in diameter and discharges into San Pablo Creek.

4.2 Pipes and Stormwater Conveyance

The existing storm drain system consists of pipes or some form of enclosed conveyance ranging from 8 to 90 inches in diameter and rectangular pipes as large as 120 inches by 108 inches (see Appendix A). The system also includes several locations where swales, lined channels, and concrete boxes/culverts are used to convey stormwater runoff. Dimensions vary for swales, channels, and boxes/culverts. Storm drain system information used in the model, such as pipe diameter, manhole rim elevations, and pipe invert elevations, are based on record drawings provided by the City. Assumptions were made for areas where information was not available. Some general assumptions that were necessary when data was not available included the following:

- Pipe slopes were set at minimum slope (S=0.0015 ft/ft) in areas where the surface grades above the pipe are less than S=0.0015 ft/ft.
- Pipe slopes were set equal to the surface grade slope in areas where surface grades exceed S=0.0015 ft/ft.
- Immediately downstream of lift stations, the pipe invert elevations were based on 3 feet of pipe cover, and the pipe invert assumptions continuing downstream of the lift station were based on the preceding criteria.

4.3 Computer Model Development

The computer model was developed from a compilation of several different sources and data that was either provided by the City, researched, or assumed. Since none of the storm drain system data was available electronically (GIS or AutoCAD), the primary "skeleton" of the pipe network was developed from the City's scanned storm drain base maps that have been digitized from hand-drawn maps. The remaining data and mapping was determined from several months of data gathering/ research through the City's record drawings. Critical areas not clearly shown on the City's base maps were further researched through the City's record drawings, and assumptions had to be made for areas without available data. The GIS inventory work performed by ATS Chester also aided in the location of manhole/inlet facilities throughout the system.

4.3.1 Pipe Network

The general pipe network/connectivity was established by selecting the critical pipes on the base maps. Critical pipes were determined based on size and relative connectivity within the overall system and the significance of the pipe. Pipes excluded from the model consisted of less critical pipes, where the hydraulic conditions would be very minimally impacted by any changes in the pipe. Typical examples of these pipes include storm drain laterals and pipes located in the very upstream portions of the system.

4.3.2 Data Research/Gathering

The majority of the pipe inverts and ground elevations were determined based on thorough data research and searching through the City's drawings on file. At critical manhole/junction locations and at the most upstream and downstream locations, pipe inverts were obtained from record drawings and input to the model. Pipe invert elevations between critical manhole/junctions were interpolated. For areas lacking adequate data, pipe inverts used were based on the assumptions mentioned in Section 4.2.

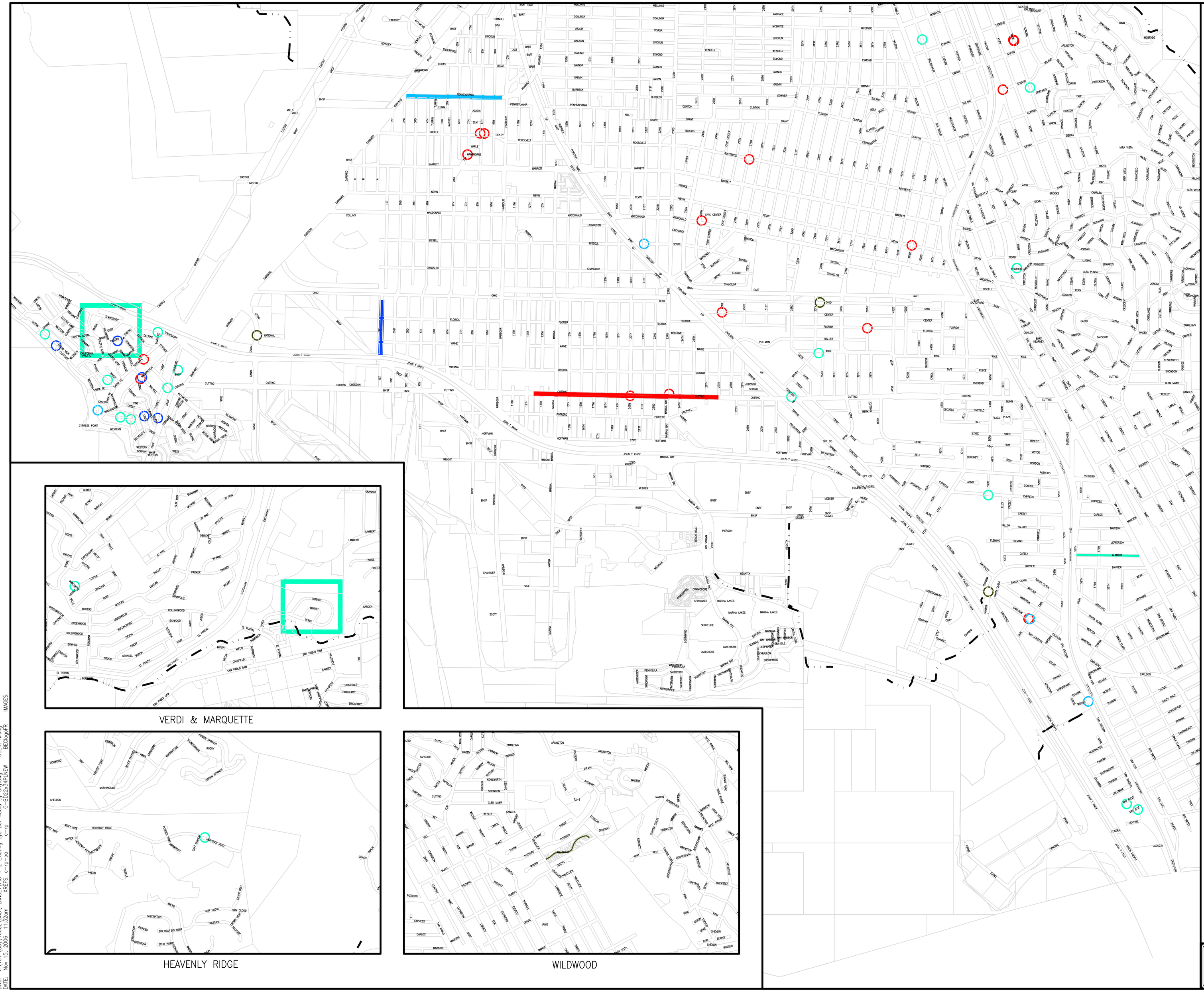
4.4 Existing System Deficiencies Noted by the City to be Maintained

According to information provided by the City, there are several flooding problem areas throughout Richmond (see Figure 4-2). These problem areas are primarily a result of four contributing factors.

- Undersized pipes where the runoff exceeds the pipe capacity even for minor storms.
- Damaged curb and gutters where the flow lines have been disrupted due to raised gutters and other obstructions.
- Flooding in areas throughout the City because the area is not served by a storm drain system.
- Damage to some of the storm drain pipes and debris or other large solids that may have built up within the pipe.

Coordination with City staff has made it possible to identify these system deficiencies that are causing problems in the storm drain system and need to be serviced for maintenance purposes. Meetings with City staff and review of available studies helped identify areas of manhole flooding, damaged catch basins, and inadequate conveyance facilities. The following list includes additional remaining problem areas identified by Veolia and City staff. These projects are in addition to those specifically identified by the hydraulic computer model and are being addressed separately by Veolia on a case-by-case basis.

- Flooding problems northeast of San Pablo Dam Road and Interstate 80. The area is currently not served by any belowground storm drainage facilities.
- Areas throughout Point Richmond area that undergo flooding problems since the majority of the storm drain system are surface drains such as ditches and curb & gutters. The City is experiencing blockage of these drainages as the drainages degrade and clog from debris.
- Flooding as a result of the pipeline along 1st Street near McDonald Avenue being damaged.
- Pipeline along Pennsylvania Avenue between 3rd and 9th Streets, which may be undersized.
- Damaged pipe and catch basins near 47 Crest Avenue in Point Richmond.
- Pipeline near 21st Street and Bissell Avenue, which may be undersized.



VERDI & MARQUETTE

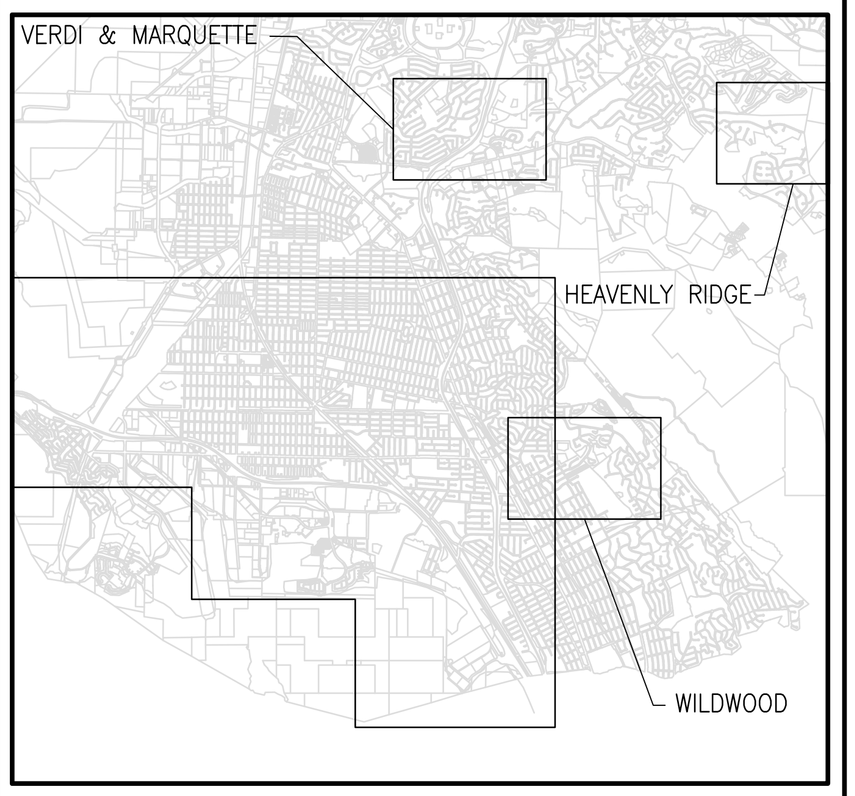
HEAVENLY RIDGE

WILDWOOD

LEGEND

- FLOODING PROBLEMS (UNKNOWN CAUSE)
- UNDERSIZED LINE
- CURB & GUTTER DAMAGE OR CATCH BASIN DAMAGE
- DAMAGED PIPELINE
- MAINTENANCE PROBLEMS

KEY MAP



SCALE 1"=1000'

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CITY OF RICHMOND

STORM DRAIN MASTER PLAN
EXISTING SYSTEM DEFICIENCIES
NOTED BY CITY

BEC PROJECT NO. FR-V04-100-02

FIGURE 4-2

DWG: V:\V04 (SC)\100\CAD\PLANSET\FIG 4-2 Existing Sys Def Noted By City.dwg
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Fig 4-2 Existing Sys Def Noted By City.dwg

- Culvert is often plugged, causing flooding and deposit of sediment onto portions of Wildwood Place.

- Pipeline near Carl Avenue and Carlson Avenue that may be undersized or require additional catch basins.

- Damaged pipe near 607 Grandview Court that is causing erosion of the existing bank.

- Damaged drainage swale causing flooding on residential property (5201 Prather Avenue).

- Curb and gutter damage along significant portions of Cutting Boulevard.

For deficiencies not identified in the computer model results, additional field investigations and, possibly, surveying of storm drain facilities should be performed to obtain more accurate data to be incorporated into the hydraulic model.

4.5 Computer Modeling Results

Flooding conditions are classified under the following:

- Pipe Capacity Adequate: Pipe size is sufficient, and the pipe flow remains under a free surface flow condition.

- Moderate Street Flooding (MSF) and Potential for Severe Street Flooding (PSSF): Pipe size is insufficient, and the pipe flow becomes pressurized. Stormwater runoff exceeds the pipe capacity. The runoff flows in excess of the pipe capacity are assumed to not enter the pipe conveyance system and are instead conveyed within the street curb and gutter system on the surface. In general, this would result in encroachment of drainage water into the road travel way and potentially damage property. Sections undergoing street flooding are further analyzed with a flood depth analysis by looking at the actual street cross-sections derived from the 2002 aerial topographic mapping to perform open-channel flow calculations and determine the actual severity of the flooding. The flood depth analysis includes assessing the cross-sectional areas of the problematic streets and general longitudinal slopes of the street to determine the flood depths resulting from a 10-year storm event. Streets where flooding conditions exceed 8 inches above the curb flowline are designated a “potential for severe street flooding” condition. Streets where flood depths do not exceed 8 inches above the curb flowline are designated a “moderate street flooding” condition.

4.5.1 Two-Year Storm Results

Approximately 40 percent of the pipe/channel conveyance system is hydraulically sufficient and capable of conveying stormwater completely within the pipe system. In the remaining 60 percent of the system, the pipes are undersized, resulting in backwater flow into the manholes or complete flooding of the manholes and flooding into the streets. However, only approximately 7 percent of

the system has the potential of undergoing severe street flooding where street flows exceed 100 cfs. See Table 4-2 for a summary of the total runoff for each drainage zone.

4.5.2 Five-Year Storm Results

Approximately 38 percent of the pipe/channel conveyance system is hydraulically sufficient and capable of conveying stormwater completely within the pipe system. In the remaining 62 percent of the system, the pipes are undersized, resulting in backwater flow into the manholes or complete flooding of the manholes causing flooding into the streets. However, approximately 15 percent of the system has the potential of undergoing severe street flooding where street flows exceed 100 cfs. See Table 4-2 for a summary of the total runoff for each drainage zone.

4.5.3 Ten-Year Storm Results (Design Criteria Storm Event)

The majority of the City's storm drain pipes do not have sufficient capacity for the 10-year storm. Approximately 29 percent of the pipe/channel conveyance system is hydraulically sufficient and capable of conveying stormwater completely within the pipe system. In the remaining 71 percent of the system, the pipes are undersized, resulting in backwater flow into the manholes or complete flooding of the manholes, causing flooding into the streets. The City's street curb and gutter system is heavily relied upon to convey stormwater throughout the City toward the outlets into the bay and storm drain basins. Approximately 20 percent of the system has the potential of undergoing severe street flooding and requires flood depth analyses. The following sections describe the predicted effects of the City's storm drain system and the resulting surface flow conditions. Table 4-3 is a summary of the street flow analysis. See Appendix B for complete calculations. The complete computer model gravity main output reports for each drainage zone can be found in Appendix C.

4.5.3.1 Drainage Zone A

Approximately two-thirds of the pipes within Drainage Zone A are inadequate, resulting in significant surface flows along the streets of Chesley Avenue, Gertrude Avenue, and Market Avenue. The streets potentially undergoing severe street flooding and requiring a flood depth analysis include Chesley Avenue between 1st Street and the BNSF railroad tracks, and Gertrude Avenue from the outfall into the bay to 1st Street. Along Chesley Avenue, with a predicted street flow of 120 cfs, a longitudinal slope of approximately 0.01 ft/ft yields a flood depth of 7 to 8 inches. Chesley Avenue is classified as MSF. Along the further downstream Gertrude Street, the predicted street flow is 270 cfs, and the street is also located within the milder grade portions of the watershed where the slope is approximately 0.003 ft/ft. The street has been classified as PSSF with a calculated flood depth exceeding 8 inches.

4.5.3.2 Drainage Zone B

Approximately half of the pipes within Drainage Zone B are inadequate, resulting in significant surface flows along Hensley Street and Lucas Avenue. The street curb and gutter systems are capable of managing the stormwater runoff within Zone B except for the storm drain main along Hensley Street from the outfall structure into the bay up to the eastern BNSF railroad tracks.

Table 4-2
Total Drainage Zone Runoff Summary
City of Richmond Storm Drain Master Plan

Drainage Zone	Q (cfs)			
	2-Year	5-Year	10-Year	100-Year
A	305	376	440	627
B	165	206	240	340
C	188	235	274	387
D	479	594	693	987
D	137	170	199	283
E	913	1118	1310	1876
F	11	14	16	23
I	286	351	411	588
J	66	82	96	137
K	264	339	389	555
L	121	155	178	254
M	559	714	822	1171
N	412	503	590	845
O	75	92	106	152
P	144	177	203	295
R	121	146	176	249
S	128	156	179	258
T	127	161	186	265
U	70	87	99	145
V	61	76	86	126
W	57	71	81	118
X	55	67	77	110
Y	132	162	186	269
Z	33	41	46	68
AA	73	90	103	150
AB	145	178	204	293
AC	43	53	60	88
AD	86	107	122	178
AE	118	146	166	243
AF	164	203	232	338
AG	35	44	50	73
AH	10	12	14	20

Table 4-3
10-Year Storm - Flood Depth Analysis Summary
City of Richmond Storm Drain Master Plan

Drainage Zone	Location	Street Cross-Section Type (60' or 40')	Longitudinal Slope (ft/ft)	Q (cfs)	Flood Depth (inches)	Flooding Classification[1]
A	Chesley (1st to BNSF RR)	60	0.01	120	7 - 8	MSF
A	Gertrude (McKosken to Ruby)	60	0.003	270	9 - 10	PSSF
B	Hensley (outfall to BNSF RR)	60	0.007	140	7 - 8	MSF
C	Garrard (Penn. to Ripley)	60	0.005	160	7 - 8	MSF
C	Penn. (BNSF RR to 11th)	60	0.007	120	7 - 8	MSF
D	8th (outfall to Ohio)	60	0.0022	300	9 - 10	PSSF
D	Hall (Harbour to Marina)	60	0.002	120	8 - 9	MSF
D	Harbour (outfall to Hall)	60	0.001	150	9 - 10	PSSF
D	Mcdonald (11th to 14th)	60	0.0076	215	7 - 8	MSF
D	18th (Barrett to Penn.)	60	0.005	140	7 - 8	MSF
E	Carlson (Broadway to I-580)	60	0.003	280	9 - 10	PSSF
E	24th (Broadway to Barrett)	60	0.0024	200	8 - 9	PSSF
E	41st & 42nd (Berk to Ohio)	60	0.007	230	7 - 8	MSF
I	Canal (Cutting to Ohio) [2]	underpass	---	190	---	PSSF
K	Barrett (San Pablo to Dimm)	40	0.02	150	6 - 7	MSF
M	Potrero (across I-80) [3]	underpass	---	170	---	PSSF
M	Ells (Creely to Bayview)	60	0.018	230	7 - 8	MSF
M	Bayview (outfall to Ells)	60	0.018	250	9 - 10	PSSF
N	Schmidt (Kearney to Navellier)	60	0.025	250	7 - 8	MSF
N	Burlingame/Carlson (outfall to San Pablo)	60	0.0055	195	8 - 9	MSF
R	Williams (Jenkins to Collins)	40	0.019	140	6 - 7	MSF
S	Del Camino (outfall to Lancaster)	60	0.029	120	6 - 7	MSF

[1] MSF=moderate street flooding and PSSF=potential for severe street flooding

[2] PSSF along Canal at the I-80 underpass due to inadequate pipe conditions east of Canal. Existing 48-inch line cannot convey the stormwater runoff, causing flows to continue down to Canal and flowing southward toward the outlet. The underpass across Interstate-580 is a smaller cross-section than the typical 60' wide road used for standard street curb and gutters. As a results this location has been classified as PSSF.

[3] PSSF at Potrero due to the inadequate pipe conditions at crossing of I-80 to the south of Potrero. Undersized dual 24-inch SD pipes. The underpass across Interstate-80 has a smaller street cross-section than the typical 60' wide road used for standard street curb and gutters. As a result this location has been classifed as PSSF.

This reach along Hensley Street has a predicted street flow of 140 cfs with a longitudinal slope of 0.007 ft/ft. The analysis indicates that the flood levels do not exceed 8 inches above the flowline and is therefore classified as MSF.

4.5.3.3 Drainage Zone C

The results indicate that approximately two-thirds of the storm drain system within Drainage Zone C are inadequate, resulting in significant surface flows along Pennsylvania Avenue, Nevin Avenue, and Garrard Boulevard. Garrard Boulevard and Pennsylvania Avenue are the two streets requiring a flood depth analysis with the streets having predicted street flows of 160 and 120 cfs, respectively. Further flood depth analyses indicate that flood levels do not exceed 8 inches above the flowline; therefore, the reaches are classified as MSF.

4.5.3.4 Drainage Zone D

The analysis results indicate that Drainage Zone D, which serves the primary central downstream portions of the City, undergoes significant surface flows throughout the majority of the streets. The streets requiring flood depth analyses include 8th Street from the outfall structure up to Ohio Avenue, Hall Avenue from Harbour Way to Marina Way, Harbour Way from the outfall structure up to Hall Avenue, MacDonald Avenue from 11th Street to 14th Street, and 18th Street from Barrett Avenue to Pennsylvania Avenue. The analysis indicates that 8th Street will undergo the most severe stormwater runoff since it is located in the downstream-most portion of the drainage zone. The surface flows are predicted to be approximately 300 cfs along 8th Street, which is a mildly sloped street located near the bay, resulting in a flood depth of 9 to 10 inches above the flowline. Eighth Street has been classified as PSSF. Harbour Way has also been classified as PSSF, resulting from the predicted flows along the downstream-located Harbour Way of approximately 150 cfs, causing a flood depth of 9 to 10 inches due to the mild grades of the street at S=0.001 ft/ft. The remaining problematic streets within Drainage Zone D requiring flood depth analyses were classified as MSF. Hall Avenue, MacDonald Avenue, and 18th Street have predicted surface flows of 105, 180, and 107 cfs, respectively, along fairly steep streets, resulting in flood depths less than 8 inches above the flowline.

4.5.3.5 Drainage Zone E

Drainage Zone E, also serving the primary central portion of Richmond, consists of pipes that are primarily inadequate. Approximately three-quarters of the drainage zone undergoes street flooding, and the primary streets requiring flood depth analyses include Swans Way between Nevin Avenue and Barrett Avenue, Carlson Boulevard between 36th Street and Maine Avenue, 24th Street between Broadway Avenue and Barrett Avenue, 41st/42nd Street from Cutting Boulevard to Ohio Avenue, and 4th Street from Nevin Avenue to Ohio Avenue. Carlson Boulevard has been classified as PSSF, resulting from predicted flows along Carlson Boulevard of approximately 280 cfs, causing a flood depth of 9 to 10 inches due to the mildness of the street at S=0.003 ft/ft. Twenty-Fourth Street has also been classified as PSSF, resulting from predicted flows along 24th Street of approximately 200 cfs, causing a flood depth of 8 to 9 inches due to the mildness of the street at S=0.0024 ft/ft. The remaining aforementioned

problematic streets within Drainage Zone E have been classified as MSF. Flood depths do not exceed 8 inches above the flowline in 41st/42nd Street, which are much steeper streets.

4.5.3.6 Drainage Zone I

Within Drainage Zone I, approximately four-fifths of the storm drain system is inadequate. Though most of the streets are capable of conveying stormwater within the allowance of the analysis criteria and only undergo MSF conditions, a portion of the watershed area flow path is restricted to the underpass along Canal Boulevard across Interstate-580. At this reach, stormwater runoff is predicted to be approximately 190 cfs for a 10-year rainfall event and has been classified as PSSF due to a more restricted channel at the underpass.

4.5.3.7 Drainage Zone M

Within Drainage Zone M, approximately two-thirds of the storm drain system is inadequate. However, due to the steepness of the watershed, the majority of the streets are capable of conveying stormwater within the allowance of the analysis criteria. The problematic streets include Potrero Avenue in the vicinity of where Potrero Avenue crosses underneath Interstate 80, Bayview Avenue between the outfall structure to Ells Street, and Ells Street between Creely Avenue to Bayview Avenue. At Potrero Avenue, the runoff flow within the watershed is restricted to the Potrero Avenue underpass across Interstate 80. Once the undersized existing storm drain facilities are at full capacity, the remaining runoff must be conveyed across the Potrero Avenue underpass. At this reach along Potrero Avenue, stormwater runoff is predicted to be approximately 170 cfs for a 10-year rainfall event and has been classified as PSSF. Bayview Avenue has also been classified as PSSF, resulting from predicted flows along Bayview Avenue of approximately 250 cfs, causing a flood depth of 9 to 10 inches due to the mild slope of the street at S=0.0015 ft/ft.

Ells Street has been classified as MSF, resulting from predicted flows along Ells Street of approximately 230 cfs, causing a flood depth of 7 to 8 inches due to the steep slope of the street at S=0.018 ft/ft.

4.5.3.8 Drainage Zone N

Approximately two-thirds of the storm drain system within Drainage Zone N is inadequate. However, the steepness of the watershed allows the streets to convey the stormwater runoff within the allowance of the analysis criteria. Only the reach along Schmidt Lane between Kearney Street and Richmond Parkway and Burlingame Avenue between the outfall structure to Interstate 80 requires a flood depth analysis. Both streets have been classified as only MSF, resulting from predicted flows along Schmidt Lane of approximately 250 cfs and predicted flows along Burlingame Avenue of approximately 195 cfs, causing flood depths of only 7 to 8 inches due to the steep slopes of the streets at S=0.025 ft/ft and S=0.0055 ft/ft, respectively.

4.5.3.9 Drainage Zone R

The majority of the storm drain system within Drainage Zone R is inadequate, causing street flooding throughout the drainage zone. The street requiring a flood depth analysis is the reach along Williams Drive between Jenkins Way and Collins Avenue. Williams Drive has been classified as MSF, resulting from predicted flows along Williams Drive of approximately 140 cfs. The relative steepness of Williams Drive at a slope of S=0.02 ft/ft results in a flood depth of only 6.5 inches.

4.5.3.10 Drainage Zone S

Approximately two-thirds of the storm drain system within Drainage Zone S is inadequate, but the steepness of the watershed allows the streets to convey stormwater runoff within the allowance of the analysis criteria. Only the reach in the downstream portion of the watershed area along Del Camino Drive between the outfall structure up to Lancaster Drive requires a flood depth analysis. Del Camino Drive has been classified as MSF, resulting from predicted flows along Del Camino Drive of approximately 120 cfs, causing a flood depth of 6 to 7 inches due to the steeper grades of the street at S=0.03 ft/ft.

4.5.4 Hundred-Year Storm Results

Approximately 20 percent of the pipe/channel conveyance system is hydraulically sufficient and is capable of conveying stormwater completely within the pipe system. In the remaining 80 percent of the system, the pipes are undersized, resulting in backwater flow into the manholes or complete flooding of the manholes and into the streets. However, 32 percent of the system has the potential of undergoing severe street flooding where street flows exceed 100 cfs. See Table 4-2 for a summary of the total runoff for each drainage area.

Section 5
Proposed Improvements for the Existing and Future System

5.1 Proposed Existing System Improvements

Improvements to the existing system can take place as one of three different possibilities. One method is to completely replace the deficient portions of the existing system with new storm drain facilities that are larger and capable of providing the capacity requirements. Another method is to supplement the deficient portions of the existing system by adding pipes or inlets that will work together with the existing system. The third method is to construct new facilities, such as pipes, inlets, and storm drain basins, in locations upstream of the flooding areas in order to intercept and reroute surface flow before it accumulates at the flooding areas. The proposed improvements in this Master Plan make maximum use of existing piping capacity where practical. In the case where construction in new alignments to divert flow from overloaded pipelines is not practical, replacement pipelines are shown.

This Master Plan is not a feasibility study of the proposed projects. The feasibility of recommended projects should be further evaluated in detail on a specific project basis. The analysis and recommendations in this Master Plan were based on data provided by the City and various assumptions (when data was unavailable) that need to be further verified for evaluation of future improvements.

5.1.1 Proposed Types of Facilities

Proposed pipes are assumed to be reinforced concrete pipe (RCP), one of the most commonly used storm drain pipes. The use of concrete-lined canals and/or culverts may also be used for stormwater conveyance and may be added to the system to supplement existing problematic areas with undersized lines or to direct runoff in areas with no storm drain system facilities.

Proposed manholes for existing system improvements will be standard 48 or 60 inches in diameter depending on the size of the connecting pipes. The pipe diameters and number of pipes connecting to the manholes dictates the need for Case I or II manholes. For special circumstances, custom junction structures are proposed in areas where multiple large-diameter pipes join at the same manhole. Proposed inlets are generally Type “D” inlets, typical inlets used for curb and gutter installations.

Proposed outfall structures will be standard outlets encased in reinforced concrete, be designed to “bubble up” out of a grated lid, and be compatible with fence cage construction around the outfall structure. The type of outfall structure is based on the size of the incoming pipe. Some pipe network discharges will not require an outfall structure. Certain discharges may be an open pipe freely discharging.

The unit costs used in this Master Plan are planning-level costs based on ENR construction cost indexes and recent contractor bids for various projects throughout California.

5.1.2 Traffic Control

With the majority of proposed improvements located within public streets and considering the heavy traffic conditions the City experiences, traffic control costs are significant and must be included in the cost of future construction of storm drainage facilities. Proposed improvements will incorporate an add-on equivalent to 10 percent of all construction costs for traffic control costs.

5.1.3 Proposed Improvement 1

Problem: Gertrude Avenue has the potential for severe street flooding from McKosken Road to Ruby Avenue.

Solution: Gertrude Avenue serves as the downstream-most reach within Drainage Zone A, and the entire drainage zone is tributary to this street out to the discharge into San Pablo Channel, resulting in significant surface flows. Proposed Improvement 1 consists of an additional 84-inch pipe to parallel the existing 84-inch pipe along Gertrude Avenue to double the pipe conveyance capacity (see Figure 5-1). A new junction structure would be required at the connection point in order to connect the large existing pipes and the proposed pipes. A grated lid can be used to allow the junction structure to serve as a large inlet to capture surface flows along Gertrude Avenue. The costs associated with this improvement are shown in Table 5-1.

5.1.4 Proposed Improvement 2

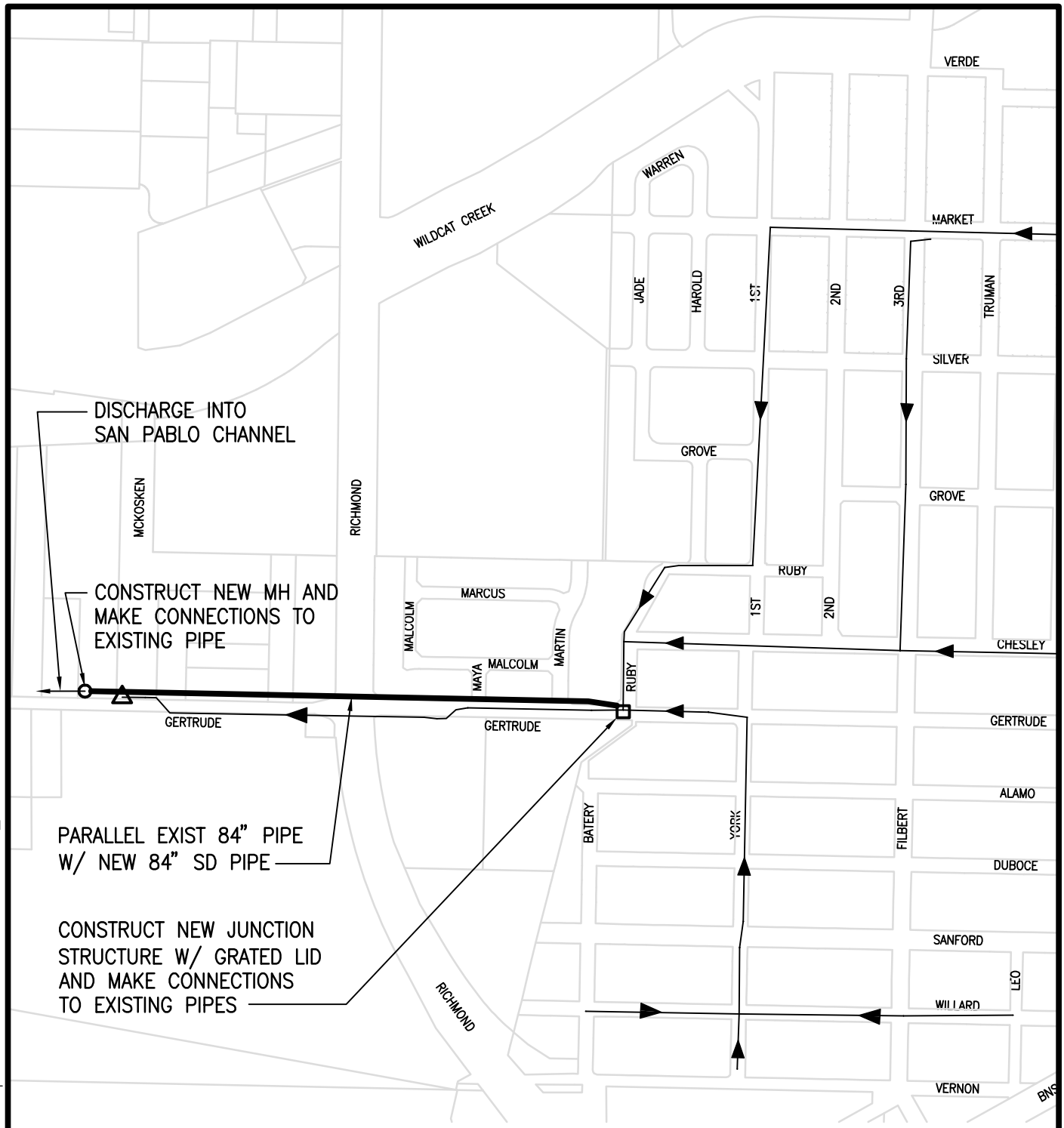
Problem: 8th Street has the potential for severe street flooding from the discharge point up to Ohio Avenue.

Solution: Due to the size of Drainage Zone D, the downstream areas of the watershed undergo significant surface flow. Intercepting the flows farther upstream and diverting the flows to a separate discharge location can reduce the surface flows along 8th Street (see Figure 5-2). Proposed Improvement 2 consists of a new 54-inch interceptor main along Marina Way with additional inlets at the intersections to intercept runoff flowing from east to west. The intercepted flow would then be piped to the south along Marina Way and discharge into the swale immediately south of Meeker Avenue, with a final discharge into Marina Bay. The costs associated with this improvement are shown in Table 5-2.

5.1.5 Proposed Improvement 3

Problem: Harbour Way has the potential for severe street flooding from the discharge point up to Hall Avenue.

Solution: Situated at the very downstream-most portion of Drainage Zone D, Harbour Way undergoes significant surface flows, but the existing storm drain pipe near the discharge is severely undersized. Currently, a single 42-inch-diameter pipe serves the downstream portion of this pipe network out to the discharge. By paralleling the existing 42-inch with an additional 48-inch pipe, the surface flows would be reduced by providing enough pipe conveyance capacity to reduce surface flows (see Figure 5-3). The costs associated with this improvement are shown in Table 5-3.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ·····→ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=500'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 1

BOYLE ENGINEERING CORPORATION

FIGURE 5-1

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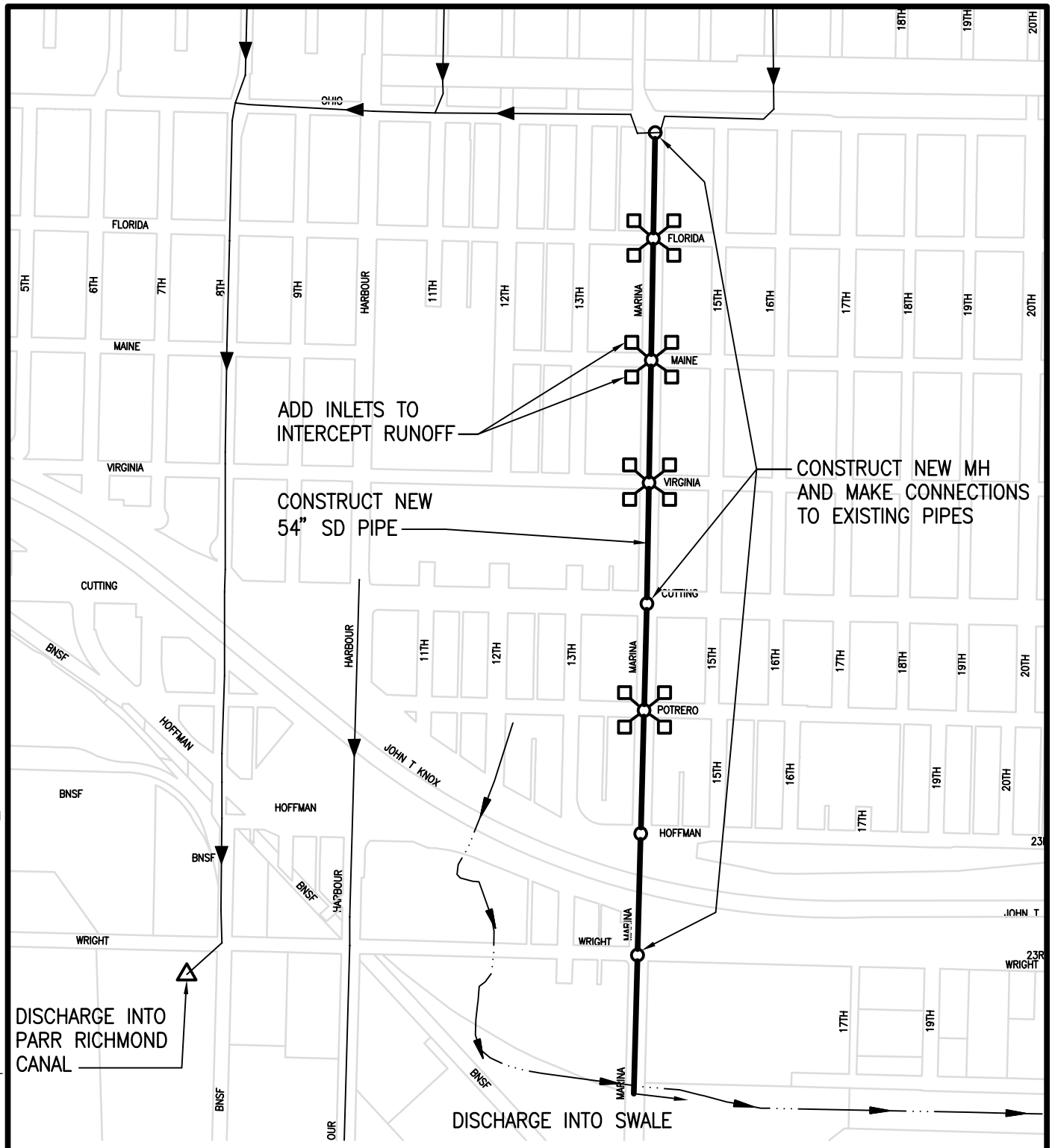
Table 5-1
Proposed Improvement 1 Capital Costs - Gertrude Avenue Improvement (Zone A)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 84" RCP along Gertrude Avenue from Ruby Ave. to McKosken Rd., in place and backfilled	1,900 LF	675	1,283,000
2. 9'x9' concrete junction structure with graded lid	1 EA	32,000	32,000
3. Connections to existing pipes	3 EA	2,500	8,000
4. Trench resurfacing	1,900 LF	125	238,000
5. Traffic control [1]	1 LS	156,100	157,000
		Subtotal	1,718,000
		Engineering Costs (20%)	344,000
		Contingencies (30%)	619,000
		Total Project Cost [2]	**2,681,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ┄→ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=600'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 2

BOYLE ENGINEERING CORPORATION

FIGURE 5-2

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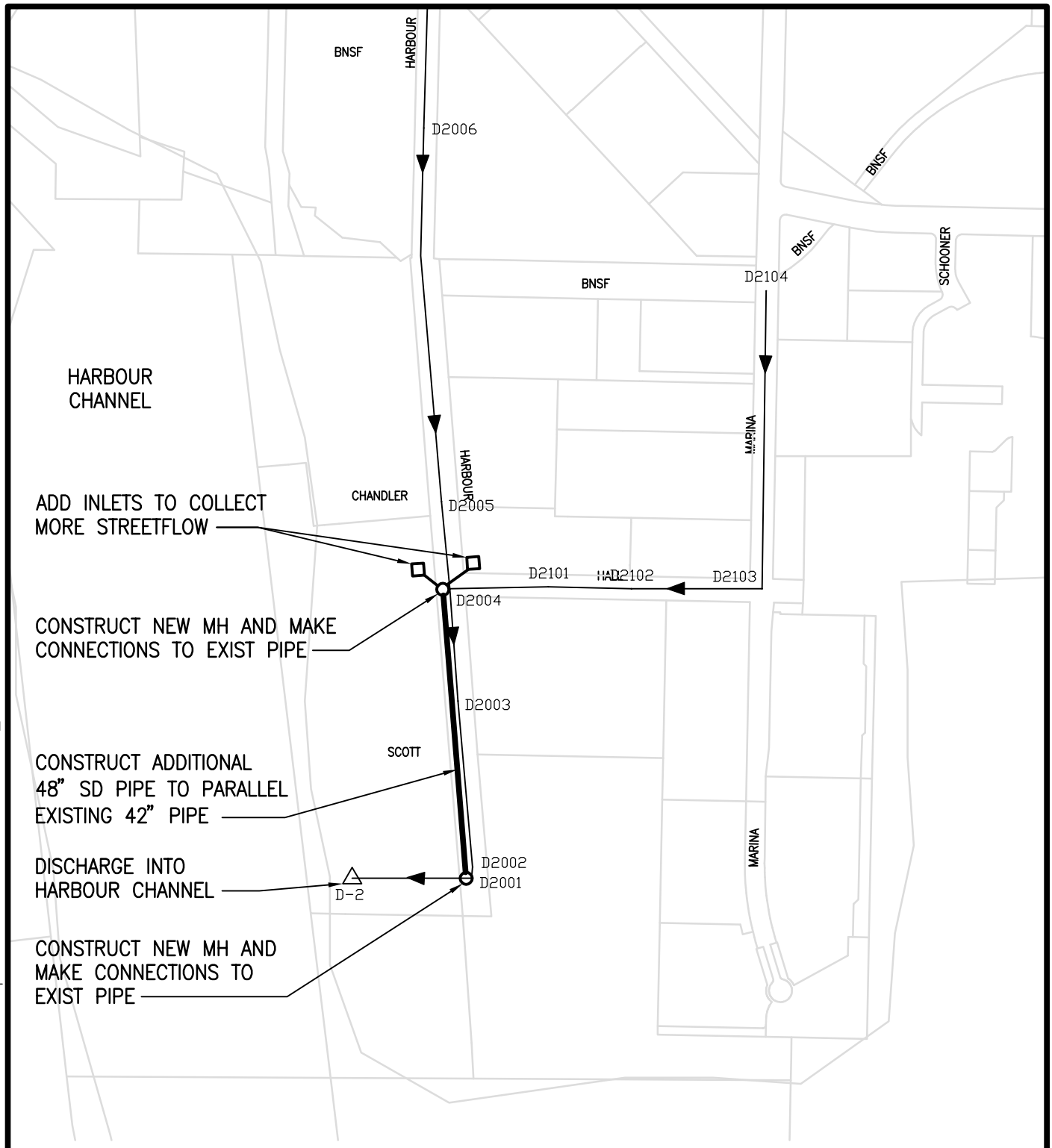
Table 5-2
Proposed Improvement 2 Capital Costs - Marina Way Improvement (Zone D)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 54" RCP along Marina Way from Ohio Ave. to Wright Ave., in place and backfilled	4,000 LF	310	1,240,000
2. 18" RCP pipe for laterals to inlets, in place and backfilled	650 LF	95	62,000
3. Standard storm drain manhole, in place and complete	8 EA	8,000	64,000
4. Storm drain catch basins, in place and complete	16 EA	3,000	48,000
5. Connections to existing pipes	6 EA	2,500	15,000
6. Traffic control [1]	1 LS	142,900	143,000
		Subtotal	1,572,000
		Engineering Costs (20%)	315,000
		Contingencies (30%)	567,000
		Total Project Cost [2]	**2,454,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ┄→ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=500'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 3

BOYLE ENGINEERING CORPORATION — FIGURE 5-3

DWG: V:\V04 (SC)\10002\CAD\PLANSET\FIG 5-3 PI 3.dwg USER: hliang
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Table 5-3
Proposed Improvement 3 Capital Costs - Harbour Way Improvement (Zone D)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 48" RCP along Harbour Way from the outfall structure to Hall Ave., in place and backfilled	1,000 LF	230	230,000
2. Standard storm drain manhole, in place and complete	2 EA	8,000	16,000
3. Connections to existing pipes	5 EA	2,500	13,000
4. Traffic control [1]	1 LS	51,800	52,000
		Subtotal	311,000
		Engineering Costs (20%)	63,000
		Contingencies (30%)	113,000
		Total Project Cost [2]	**487,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.

5.1.6 Proposed Improvement 4

Problem: Carlson Boulevard has the potential for severe street flooding from Broadway Avenue to Interstate 580.

Solution: The storm drain mains along Carlson receive several lateral pipes that cover extensive portions of the City to the north and northeast. Drainage Zone E is one of the larger drainage zones, and the three main branches serving the northern portions of the drainage zone all branch off the main along Carlson. Therefore, once the pipes are at capacity, a considerable amount of stormwater runoff flows onto Carlson. Proposed Improvement 4 consists of two basins further upstream into the drainage zone and two lateral storm drain pipes discharging into the basins to reduce the amount of stormwater flowing in the pipes along Carlson (see Figure 5-4). A potential site for one of the basins is in Nichol Park, where a basin could have dual use, serving as a park pond as well as providing approximately 70 acre-feet of storage for stormwater runoff. The basin in Nichol Park could receive stormwater from a lateral coming off the storm drain pipe along 3rd Avenue.

A potential site for another basin is immediately east of Carlson and south of Pullman Avenue, where a pocket of undeveloped land exists and could provide enough area for approximately 40 acre-feet of storage. However, the City has identified this site to be a contaminated site. An alternate location for a second basin that can reduce surface flows onto Carlson is near JFK Park, which has enough area for at least a 40 acre-feet basin. Currently, a 54-inch storm drain main travels down South 41st Street, and a lateral pipe off the 54-inch into a new basin at JFK Park is a possibility. The costs associated with these improvements are shown in Table 5-4.

5.1.7 Proposed Improvement 5

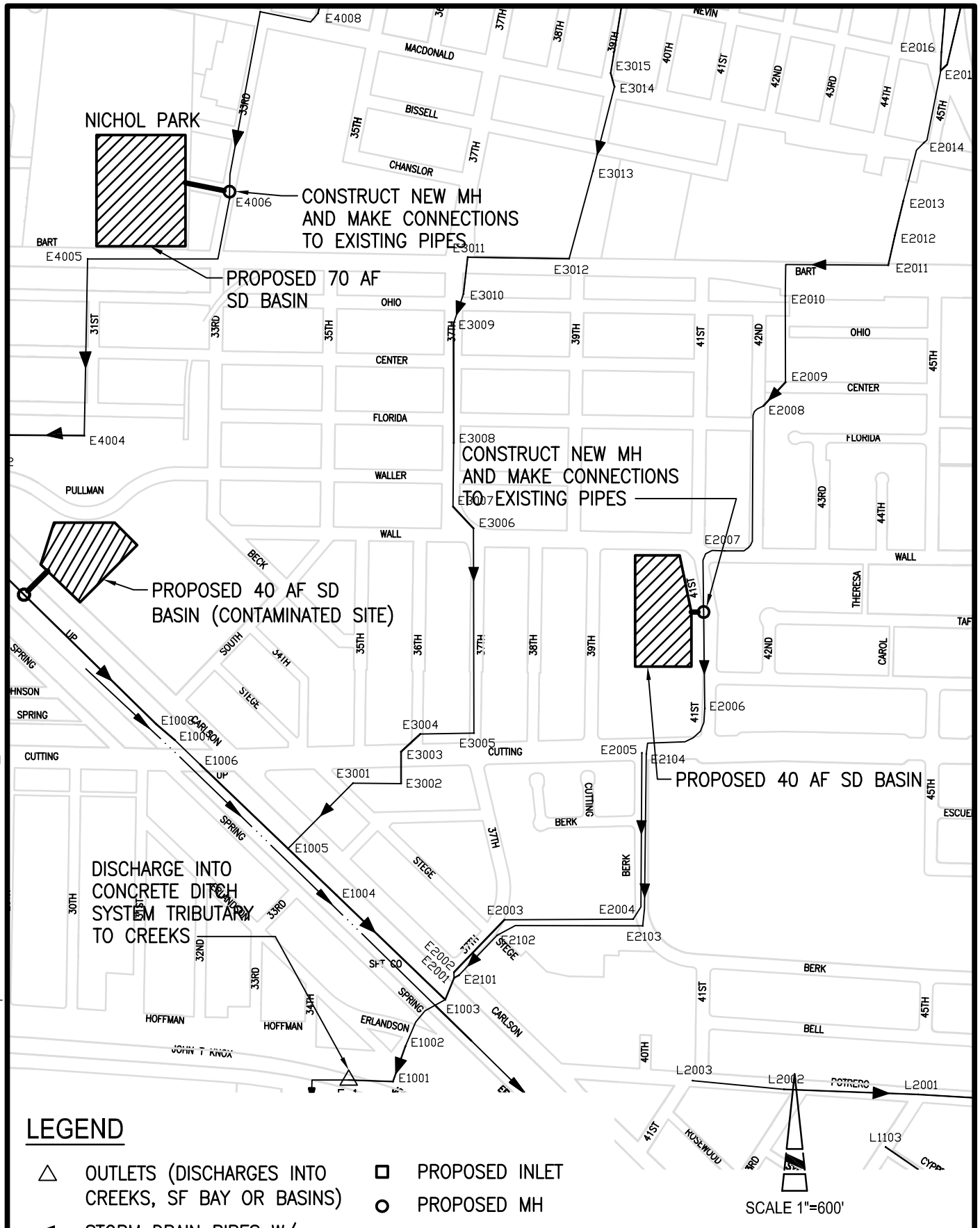
Problem: 24th Street has the potential for severe street flooding from Broadway Avenue to Barrett Avenue.

Solution: The storm drain pipe along 24th Street is the only pipeline serving the northern portions of Drainage Zone E, and only this single 54-inch pipe connects the pipe network in the northern areas to the storm drain main along Carlson. Proposed Improvement 5 consists of a 66-inch pipe to parallel the existing 54-inch pipe along 24th Street (see Figure 5-5). A new manhole would be constructed at the intersection of 24th and Barrett where three separate pipe branches join into the single pipe along 24th, and the proposed 66-inch line would receive some of the flows from the three incoming pipes. An additional 66-inch pipe would nearly triple the pipe flow capacity and reduce the amount of street flow. The costs associated with this improvement are shown in Table 5-5.

5.1.8 Proposed Improvement 6

Problem: Canal Boulevard has the potential for severe street flooding near the underpass across Interstate-580.

Solution: Currently, Drainage Zone I is bisected by the Interstate-580 freeway. The northern half of the drainage zone comprises approximately 80 percent of the entire zone, and the storm drain



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ┈┈→ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=600'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 4

BOYLE ENGINEERING CORPORATION — FIGURE 5-4

DWG: V:\V04 (SC)\10002\CAD\PLANSET\FIG 5-4 PI 4.dwg USER: hliang
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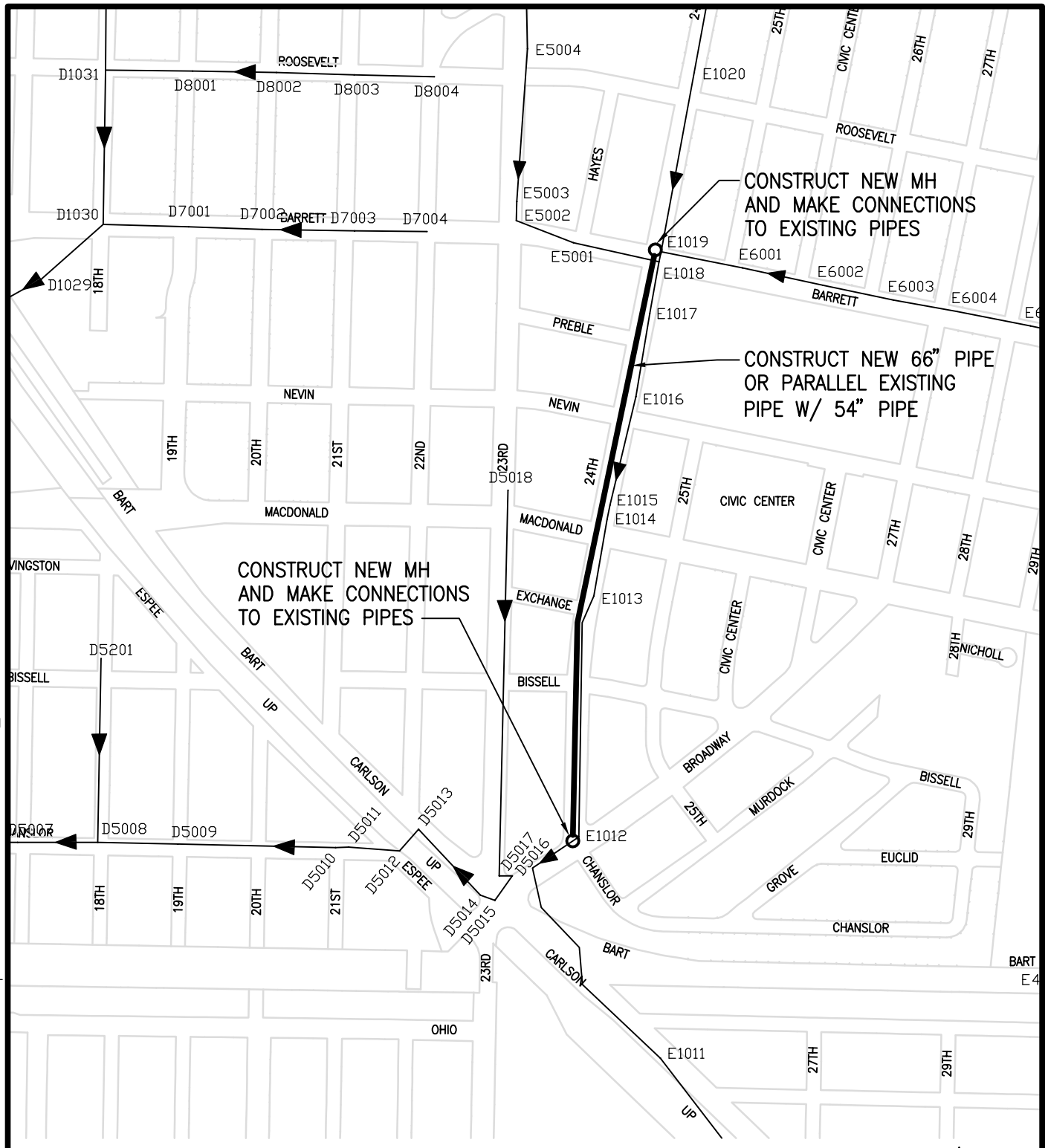
Table 5-4
Proposed Improvement 4 Capital Costs - Nichol Park and Pullman/Carlson Basin Improvement (Zone E)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. Basin, excavated and graded at Nichol Park	70 AF	21,000	1,470,000
2. Basin, excavated and graded at Pullman/Carlson	40 AF	21,000	840,000
3. 66" RCP from Carlson Blvd. to discharge into basin, in place and backfilled	100 LF	360	36,000
4. 42" RCP from 33rd St. to discharge into basin, in place and backfilled	250 LF	210	53,000
5. 72" storm drain manhole, in place and complete	2 EA	21,000	42,000
6. Outfall structure, in place and complete	2 EA	21,000	42,000
7. Connections to existing pipes	4 EA	2,500	10,000
8. Traffic control [1]	1 LS	249,300	250,000
9. Land acquisition for basins	7 AC	300,000	2,100,000
		Subtotal	4,843,000
		Engineering Costs (20%)	969,000
		Contingencies (30%)	1,744,000
		Total Project Cost [2]	**7,556,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ┄→ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=500'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 5

BOYLE ENGINEERING CORPORATION — FIGURE 5-5

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Table 5-5

Proposed Improvement 5 Capital Costs - 24th St. Improvement (Zone E)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 66" RCP along 24th St. from Barrett Ave. to Broadway Ave., in place and backfilled	1,450 LF	360	522,000
2. 72" storm drain manhole, in place and complete	2 EA	21,000	42,000
3. Connections to existing pipes	6 EA	2,500	15,000
4. Traffic control [1]	1 LS	57,900	58,000
		Subtotal	637,000
		Engineering Costs (20%)	128,000
		Contingencies (30%)	230,000
		Total Project Cost [2]	**995,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.

system serving the northern portion of the drainage zone consists of a single 48-inch storm drain pipe. Once the pipe is at capacity, the stormwater flow continues down to Canal Boulevard and flows to the south through the underpass across Interstate 580. The Interstate 580 underpass along Canal Boulevard is the only opening allowing stormwater flow toward the discharge point in the zone, and the underpass restricts the surface flows. Proposed Improvement 6 consists of a 54-inch pipeline along Canal Boulevard to eliminate/reduce the surface flows along Canal Boulevard and convey the stormwater underground within the pipes (see Figure 5-6). The improvement would also include several inlets along Canal Boulevard to collect the surface flows. The costs associated with this improvement are shown in Table 5-6.

5.1.9 Proposed Improvement 7

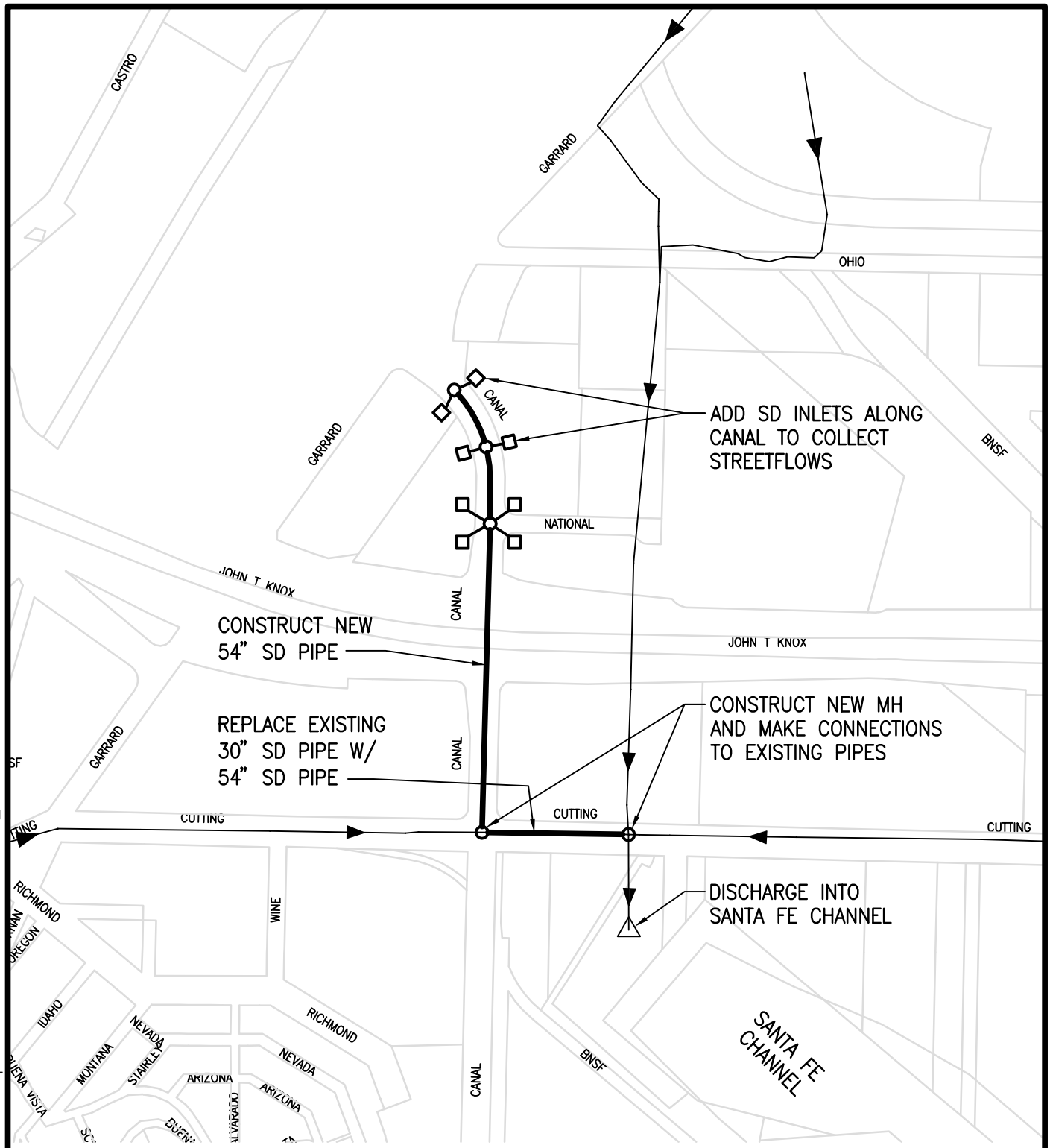
Problem: Potrero Avenue has the potential for severe street flooding near the underpass across Interstate-80.

Solution: Currently, Drainage Zone M is bisected by the Interstate 80 freeway. The northeastern half of the drainage zone comprises approximately 60 percent of the entire zone, and the storm drain system serving the northern portion of the drainage zone consists of a single 36-inch storm drain pipe and a 36-inch by 36-inch square pipe conveying stormwater across Interstate 80. Once the pipe is at capacity, the stormwater runoff floods into the streets, and surface flows are restricted to Potrero Avenue. Proposed Improvement 7 consists of a 54-inch pipeline along Potrero Boulevard to eliminate/reduce the surface flows and convey the stormwater underground within the pipes (see Figure 5-7). The improvement would also include several inlets along Potrero Avenue to collect the surface flows. The costs associated with this improvement are shown in Table 5-7.

5.1.10 Proposed Improvement 8

Problem: Bayview Avenue has the potential for severe street flooding from the outfall structure up to Ells Lane.

Solution: Bayview Avenue is located in the downstream portion of the drainage zone near the discharge into the creek, and this downstream reach undergoes significant surface flows. At this reach, a 30-inch and two 66-inch storm drain pipes are available to convey flows to the discharge. Proposed Improvement 8 consists of replacing the 30-inch pipe serving the small portion of the zone along Ells Avenue with a 72-inch pipeline (see Figure 5-8). An increase from 30 to 72 inches would increase the pipe conveyance capacity of the single pipeline by approximately 1,000 percent, and increase the total capacity of all three pipelines by 50 percent. The improvement would also include several inlets along Bayview Avenue to collect the surface flows and convey more runoff within the pipes. The costs associated with this improvement are shown in Table 5-8.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ┄→ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=500'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 6

BOYLE ENGINEERING CORPORATION

FIGURE 5-6

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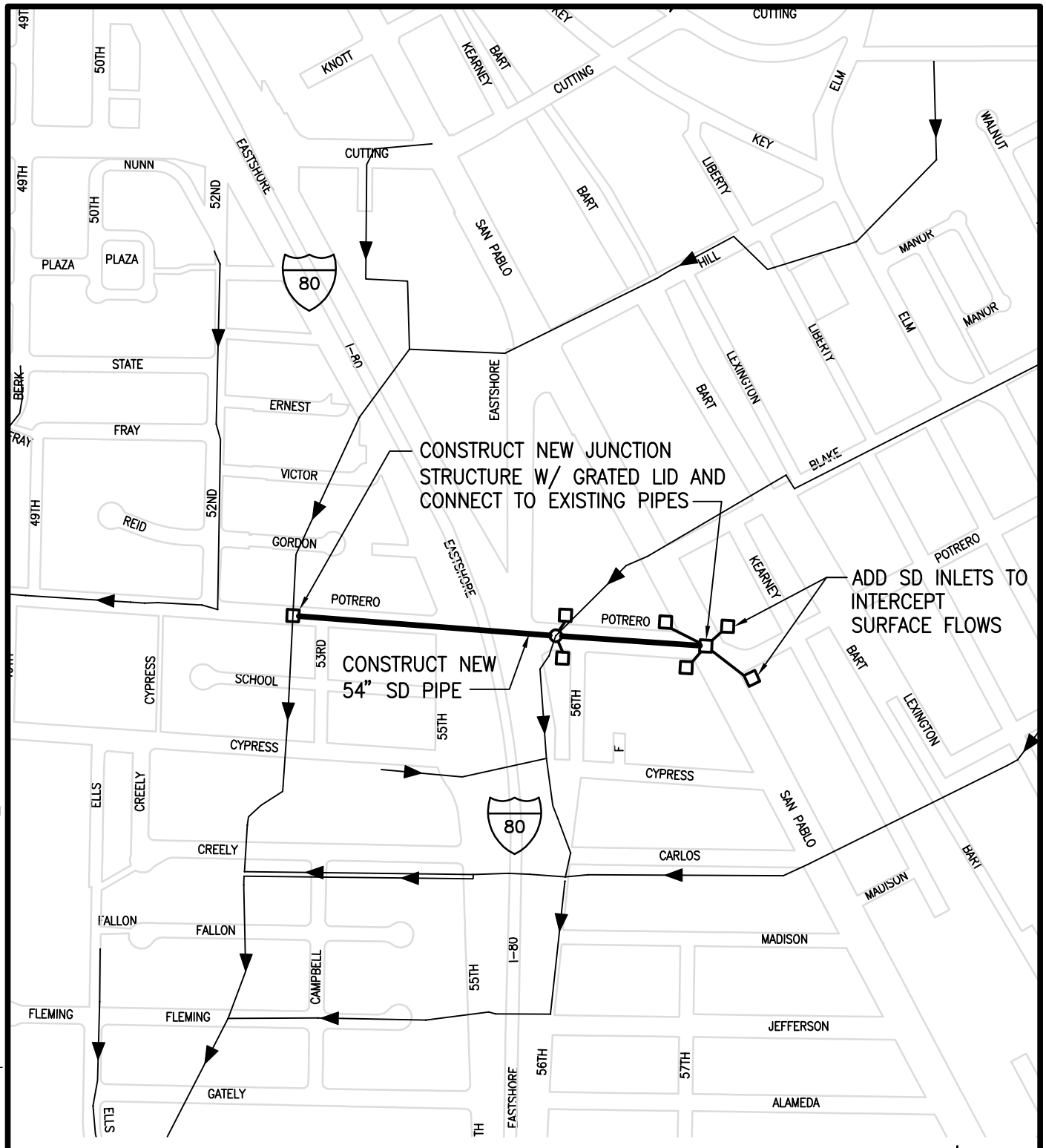
Table 5-6

Proposed Improvement 6 Capital Costs - Canal Blvd. Improvement (Zone I)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 54" RCP along Canal and Cutting Blvd. from Garrard Blvd. to 24th St. from Barrett Ave. to discharge pipe into Harbour, in place and backfilled	2,100 LF	300	630,000
2. 18" RCP for laterals to inlets, in place and backfilled	500 LF	90	45,000
3. Standard storm drain manhole, in place and complete	5 EA	8,000	40,000
4. Storm drain catch basins, in place and complete	8 EA	3,000	24,000
5. Connections to existing pipes	3 EA	2,000	6,000
6. Traffic control [1]	1 LS	74,500	75,000
		Subtotal	820,000
		Engineering Costs (20%)	164,000
		Contingencies (30%)	296,000
		Total Project Cost [2]	**1,280,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ←···– CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=500'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 7

BOYLE ENGINEERING CORPORATION — FIGURE 5-7

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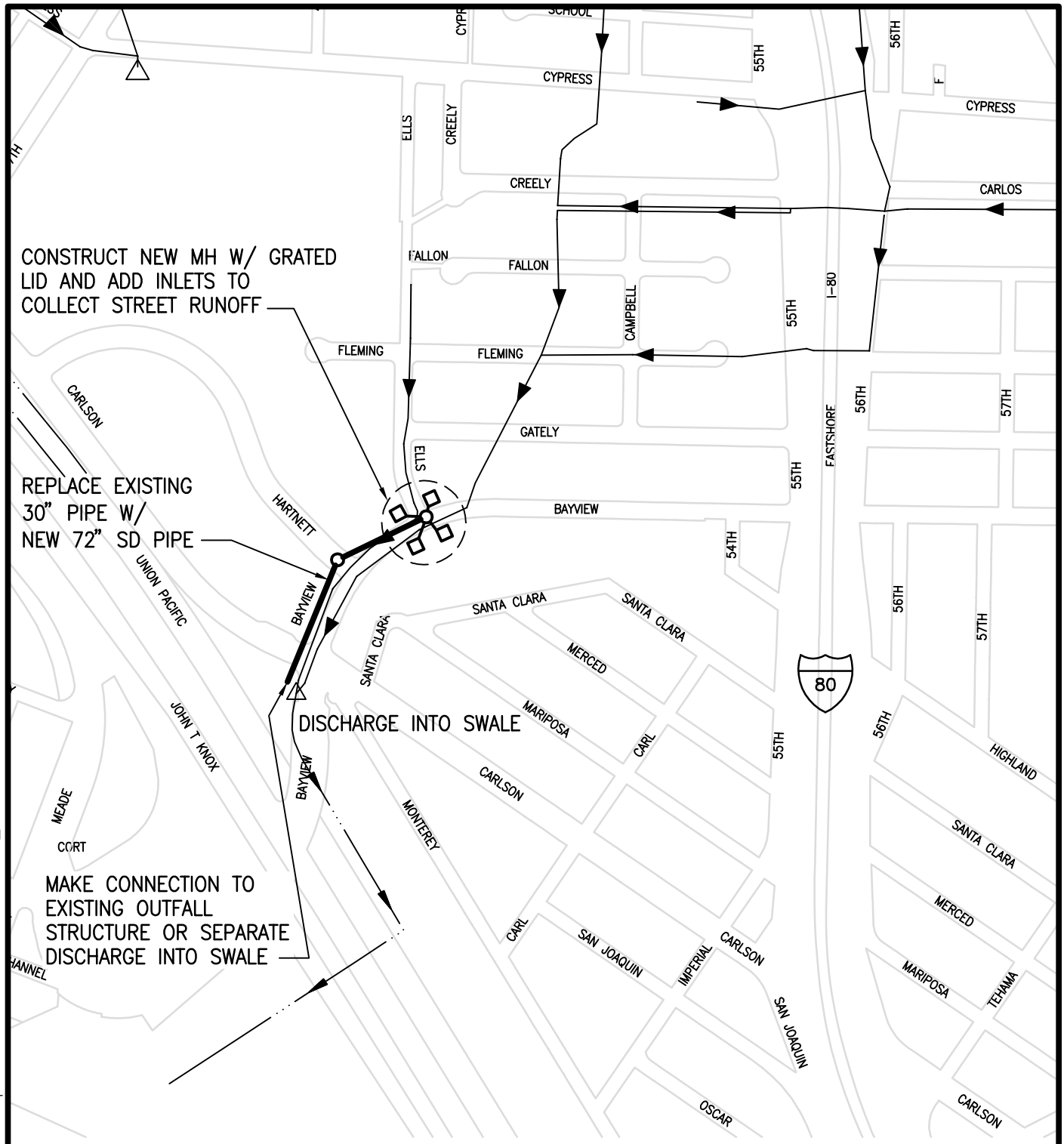
Table 5-7

Proposed Improvement 7 Capital Costs - Potrero Improvement (Zone M)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 54" RCP along Potrero Blvd. from San Pablo Ave. to 53rd St., in place and backfilled	1,450 LF	310	450,000
2. 9'x9' concrete junction structure with graded lid, in place and complete	1 EA	32,000	32,000
3. Standard storm drain manhole, in place and complete	1 EA	8,000	8,000
4. Storm drain catch basins, in place and complete	6 EA	3,000	18,000
5. Connections to existing pipes	4 EA	2,500	10,000
6. Traffic Control [1]	1 LS	51,800	52,000
		Subtotal	570,000
		Engineering Costs (20%)	114,000
		Contingencies (30%)	206,000
		Total Project Cost [2]	**890,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ┄→ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=500'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 8

BOYLE ENGINEERING CORPORATION — FIGURE 5-8

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Table 5-8

Proposed Improvement 8 Capital Costs - Bayview Ave. Improvement (Zone M)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 72" RCP Concrete Pipe along Bayview Blvd. from Ells St. to Discharge into Creek, in place and backfilled	900 LF	470	423,000
2. 72" Storm Drain Manhole, in place and complete	2 EA	21,000	42,000
3. Storm Drain Catch Basins, in place and complete	4 EA	3,000	12,000
4. Connections to Existing Pipes	2 EA	2,500	5,000
5. Traffic Control [1]	1 LS	482,000	482,000
		Subtotal	964,000
		Engineering Costs (20%)	193,000
		Contingencies (30%)	348,000
		Total Project Cost [2]	**1,505,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.

5.1.11 Proposed Improvement 9

Problem: The area near 47 Crest Avenue at Point Richmond is undergoing moderate street flooding.

Solution: The storm drain facilities in the Point Richmond area are primarily limited to small-diameter pipes that connect to inlets along the streets to collect surface runoff and discharge into the open areas below the streets to sheet flow toward the bay. In this area around 47 Crest Avenue, there is a slight depression in the road. The pipe connected to the catch basins in this depressed area is only a 4-inch VCP. The inlets are also undersized, which has resulted in slow drainage of this area and flooding within the streets. Proposed Improvement 9 consists of a new 12-inch pipe to replace the 4-inch VCP pipe and replacement of the two existing inlets with larger inlets to increase the capacity (see Figure 5-9). The costs associated with this improvement are shown in Table 5-9.

5.1.12 Basin Improvements

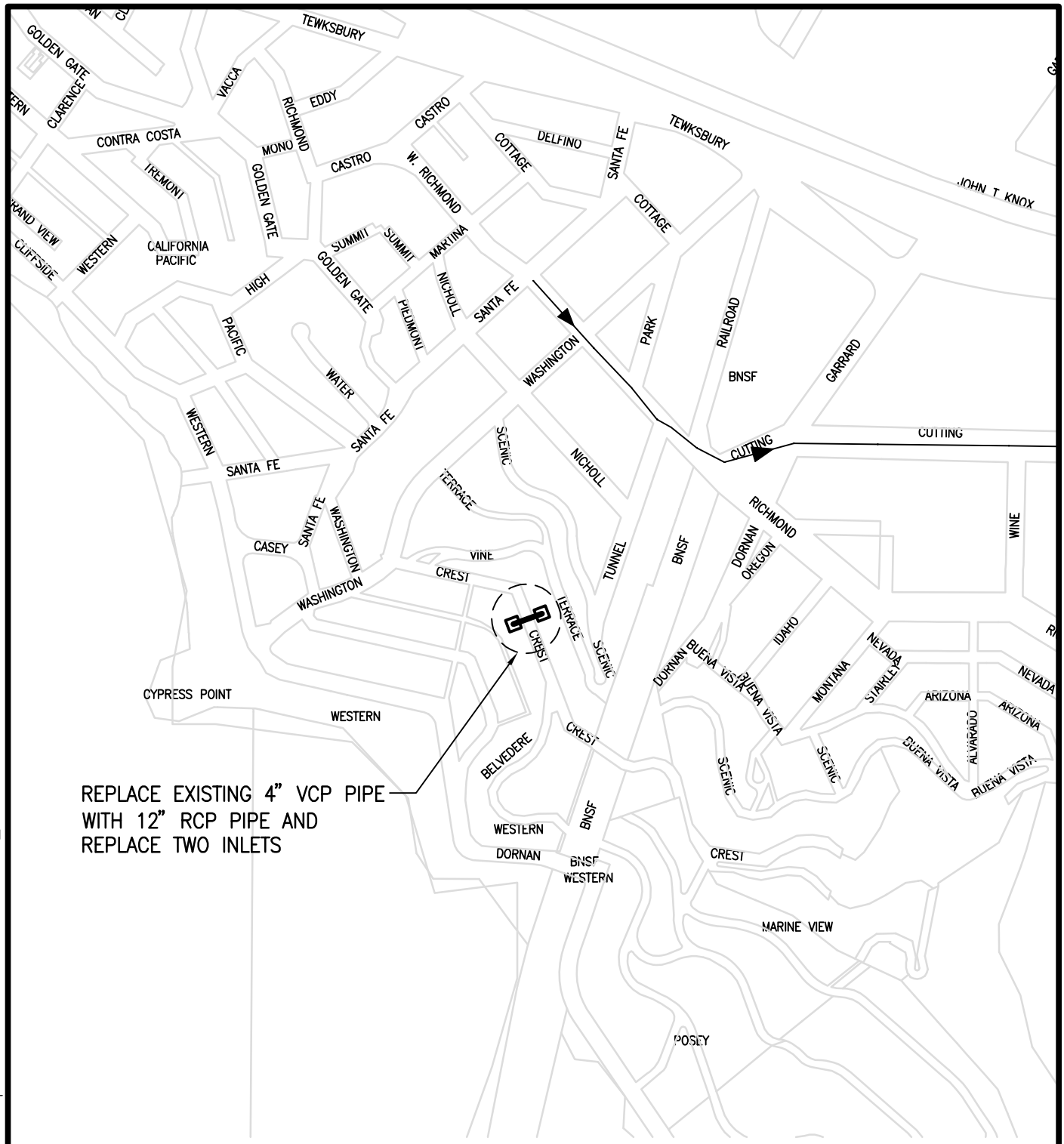
The City of Richmond's storm drain system consists of only a few detention/retention basins for stormwater storage. In the case of the basins that do exist in Richmond, most are landlocked, in which case the areas around the basins are developed and outward expansion is not a possibility. However, expanding existing basins outward is the simplest solution in most cases where land is available. It is not desirable to excavate several of the basins deeper because of the risk of encountering shallow groundwater conditions. Other basins are already at the maximum practical depths. For the basins that cannot be further excavated for expansion, the storage capacity required must be provided by a different basin with sufficient capacity where stormwater from the deficient basin can be diverted to the other basin. Basin improvements are listed in the proposed improvements above.

This Master Plan does not consider the percolation characteristics of the existing basins for determining sufficiency of capacity. Prior to construction of planned basin expansions or diversions, it is suggested that percolation testing be performed to verify the need for additional capacity if applicable (e.g., areas in higher topographic regions).

5.2 Proposed Future System Improvements

5.2.1 Future System Analysis

Planned improvements for the future system fulfill drainage requirements for the remainder of the planning area that is currently not serviced by the existing storm drain system and also for existing areas under the ultimate General Plan land use type. This remaining area primarily consists of undeveloped areas, but the majority of the City is already at buildout. As the Master Plan is implemented, it is expected that the precise boundaries of the evolving drainage zones will be refined and pipelines will be modified to conform to development configurations as they are planned and considered by the City.



LEGEND

- △ OUTLETS (DISCHARGES INTO CREEKS, SF BAY OR BASINS)
- ← STORM DRAIN PIPES W/ FLOW DIRECTION ARROW
- ━ PROPOSED STORM DRAIN PIPE
- □ PROPOSED INLET
- ○ PROPOSED MH
- ▨ PROPOSED BASIN
- ⟶ CREEK, OPEN CHANNEL, OR SWALE

SCALE 1"=500'

CITY OF RICHMOND
STORM DRAIN MASTER PLAN
PROPOSED IMPROVEMENT 9

BOYLE ENGINEERING CORPORATION — FIGURE 5-9

DWG: V:\V04 (SC)\10002\CAD\PLANSET\FIG 5-9 PI 9.dwg USER: hliang
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Table 5-9

Proposed Improvement 9 Capital Costs - Crest Ave. Improvement (Pt. Richmond)

Description	Quantity	Unit Cost ($)	Total Cost ($)
1. 12" RCP Concrete Pipe along Crest Ave., in place and backfilled	50 LF	70	4,000
2. Storm Drain Catch Basins, in place and complete	2 EA	3,000	6,000
3. Traffic Control [1]	1 LS	10,000	10,000
		Subtotal	20,000
		Engineering Costs (20%)	4,000
		Contingencies (30%)	8,000
		Total Project Cost [2]	**32,000**

[1] The traffic control estimate is 10% of the total construction cost.

[2] Costs represent 2006 dollars.

For the future system analysis, a computer model simulation of the system under ultimate land use zoning conditions was performed to verify if the City will impact the stormwater runoff peak flows at ultimate land use conditions. On a city-wide basis, the total stormwater runoff decreased by 15 percent. In general, the City's ultimate General Plan consists of areas that are less impervious, resulting in smaller peak runoff flows. On a specific zone-by-zone basis, only a few of the drainage zones resulted in slightly higher stormwater runoff flows. Therefore, storm drain system improvements will be analyzed and designed using the zoning classification and designations of the existing land use conditions.

5.2.2 Pipe Design Approach for Future Development

The alignment and sizes of storm drain pipes serving the planned drainage zones should be determined for primary "trunk" lines only. Pipelines smaller than 24 inches in diameter should not be included since they are generally used for collection within specific developments and their costs and specific alignments will be paid and determined by the developer within an approval process determined by the City. The layouts of the future developments cannot be predicted at this time, so the Master Plan remains at a schematic level for planning purposes. The alignments shown will be modified based on actual street alignments determined in conjunction with proposed development. However, this Master Plan includes sufficient pipeline lengths and sizes to determine the costs associated with the future storm drainage system to be constructed as development occurs and sets forth the specific drainage zones and basin locations to provide full buildout drainage service within the planning boundaries.

In potential drainage zones, pipe network design should begin at the basins and branch outward to provide connection capabilities to future subsystems. In an attempt to locate the proposed pipes along the alignments of future streets, the proposed pipe alignments follow major current parcel lines and section lines or fractional section lines. The pipes directly discharging into the basin (basin discharge pipes) are assumed to be at slopes equal to or greater than 0.005 ft/ft since outfall structures usually are located at the bottom of the basins, requiring steeper pipes connecting to the outfalls. The remaining pipes will be at a required minimum slope of 0.0015 or the slope of the surface profile unless otherwise noted for planning purposes. In general, pipeline slopes will follow the existing ground slope along the particular pipeline alignment to avoid unnecessarily deep pipe and to follow the runoff hydraulic grade line slope.

As set forth in Section 3, a 10-year rainfall event is used to determine pipeline sizes for required capacity. The pipe sizing procedure first assesses the properties (area, time of concentration, and composite C) of the watershed area serviced by each individual pipe network. Once the properties are obtained, the total flow generated by the runoff from each area can be calculated. This flow will determine the required pipe size for the most downstream pipe. Once the most downstream pipe has been sized, the remainder of the pipe system is sized, downstream to upstream, in 6-inch-diameter increments. Subwatershed areas are assessed to determine the required pipe capacities at different locations throughout the drainage zone. The farther upstream in the system, the smaller the subwatershed areas become, resulting in smaller runoffs and smaller pipes at the upstream locations. The pipe sizes and locations are refined through an iteration process, which involves generating various sized drainage areas in an increasing step-like manner to determine runoff flows

at different points in the drainage area. Ultimately, the goal is to accurately determine where each reach of different-sized pipe needs to be located throughout the drainage zone.

Once the system layout is complete, the final proposed pipe networks are analyzed in Infosewer Pro to verify that all pipe capacities are sufficient under the analysis criteria (see Appendix C). Any required changes are done in a final iteration process where the location of storm drain facilities are adjusted to maximize the system capabilities.

Other potential problems that may arise in the future or that may require future system improvements involve the effects of some studies that predict the rise of sea levels as a result of global warning. A thorough analysis of this potential phenomenon is beyond the scope of work of this project. The existing hydraulic computer models and the analysis performed for this Master Plan are not based on any predictions of rising sea levels, and additional analysis will be required if sea levels do rise.

Section 6
Capital Improvement Program

The cost estimates of the recommended improvements in Section 5 are presented in Table 6-1. The unit costs assumed for materials, labor, and construction are based on current market values as of 2005, ENR Cost Estimate Indexes, and recent contractor bid prices from various projects throughout California. The priority of these recommended improvements are subjective and may vary due to budgeting issues, construction scheduling, or City preferences. Current priorities shown in Table 6-1 are strictly based on the City's Pavement Management Program dated July 12, 2005 and input from the City.

The recommended capital improvements are not associated to any timeline and apply to the City of Richmond's ultimate growth. The overall timing of these improvements cannot be predicted and will depend on the evolution of the City's expansion/modification.

Depending on the location and timing of development, it is expected that the facilities identified in this Master Plan will be modified and refined to provide for staged development as it occurs. Further analysis of the existing and proposed storm drain system is recommended as the City and the system is expanded. It is recommended that this Master Plan be updated periodically to reflect changes.

Table 6-1
Capital Improvements Cost Summary
City of Richmond Storm Drain Master Plan

Proposed Existing System Improvements	Priority [1]	Total Cost [2]
1. Supplemental 84-inch pipeline along Gertrude Ave. and additional grated manhole to alleviate possible severe street flooding on Gertrude in Drainage Zone A.	7	$2,681,000
2. New 54-inch pipeline along Marina Way and additional collector inlets to collect and divert surface flows toward Marina Bay.	4	$2,454,000
3. Supplemental 48-inch pipeline along Harbour Way and additional collector inlets to reduce surface flows along Harbour Way in Drainage Zone D.	3	$487,000
4. Two new basins and lateral pipe connections discharging into basins to reduce amount of surface flows along Carlson Blvd. in Drainage Zone E.	5	$7,556,000
5. Supplemental 66-inch pipe along 24th St. to alleviate possible severe street flooding on 24th St. in Drainage Zone E.	6	$995,000
6. New 54-inch pipeline along Canal Blvd. and additional collector inlets to collect surface flows in Drainage Zone I to alleviate possible severe street flooding along Canal Blvd.	2	$1,280,000
7. New 54-inch pipeline along Potrero Ave. and additional collector inlets to collect surface flows in Drainage Zone M and convey stormwater across I-80.	1	$890,000
8. Replacement of existing 30-inch pipe with 72-inch pipeline along Bayview Ave. and additional collector inlets to reduce surface flows along Bayview Ave. in Drainage Zone M.	8	$1,505,000
9. Replacement of existing 4-inch pipe with 12-inch pipeline along Crest Ave. and replace inlets to increase inlet capacity along Crest Ave.. in Point Richmond.	9	$32,000
	Total [3]	$17,880,000

[1] Project priorities have been developed for the recommended capital improvements based on the relative severity of existing system conditions, the anticipated timing of future road-repaving schedules throughout the City, and input from City staff.
[2] Estimated costs include additional engineering and contingency costs.
[3] Costs represent 2006 dollars.

Appendix A
Storm Drain Atlases

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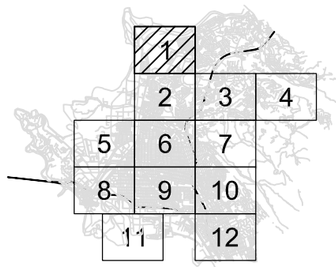
C-UP-1 c-rp IMAGES:

LEGEND

- DRAINAGE ZONE BOUNDARY
- DRAINAGE AREA
- E11050 DRAINAGE AREA ID
- CREEK/CANAL
- EXISTING BASIN
- PROPOSED BASIN
- 36" PROPOSED PIPE
- A1 OUTLET
- A1023 JUNCTION W/ ID
- PIPE

SCALE: 1"=800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

BOYLE ENGINEERING CORPORATION

PLATE 1

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BOYLE ENGINEERING CORPORATION

PLATE 2

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XREFS: G-BD11x17h_new
USER: hliang
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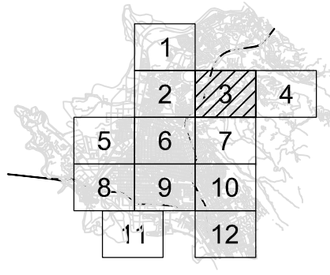
c-rp
C-UP-1
IMAGES:

LEGEND

- DRAINAGE ZONE BOUNDARY
- DRAINAGE AREA
- E11050 — DRAINAGE AREA ID
- CREEK/CANAL
- EXISTING BASIN
- PROPOSED BASIN
- 36" — PROPOSED PIPE
- A1 — OUTLET
- A1023 — JUNCTION W/ ID
- PIPE

SCALE: 1"=800'

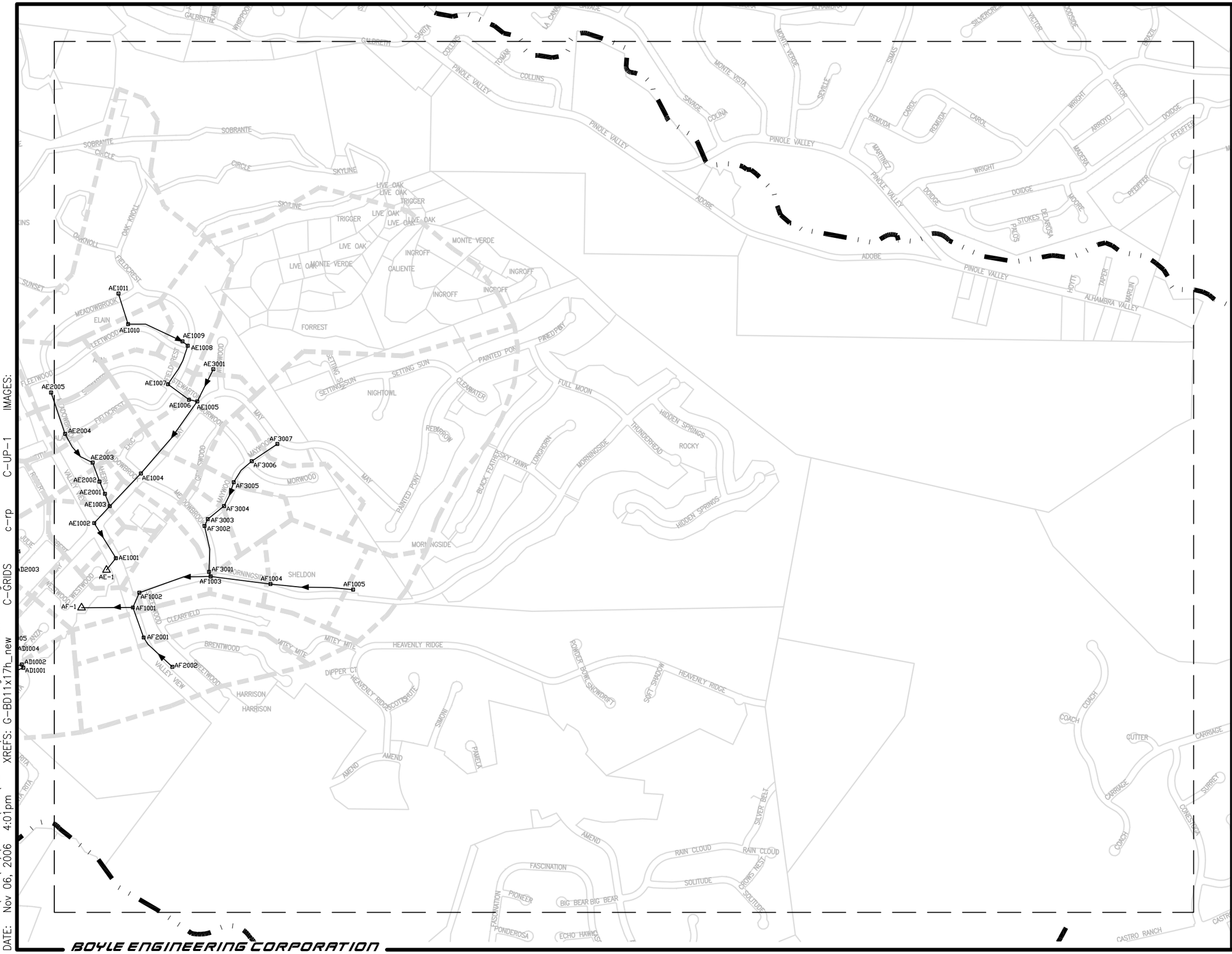
KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

BOYLE ENGINEERING CORPORATION

PLATE 3

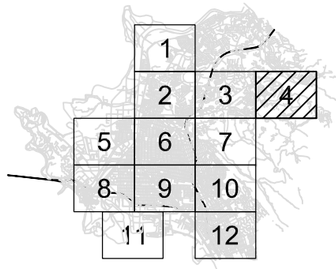


LEGEND

- DRAINAGE ZONE BOUNDARY
- DRAINAGE AREA
- E11050 — DRAINAGE AREA ID
- CREEK/CANAL
- EXISTING BASIN
- PROPOSED BASIN
- 36" — PROPOSED PIPE
- A1 — OUTLET
- A1023 — JUNCTION W/ ID
- PIPE

SCALE: 1"=800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

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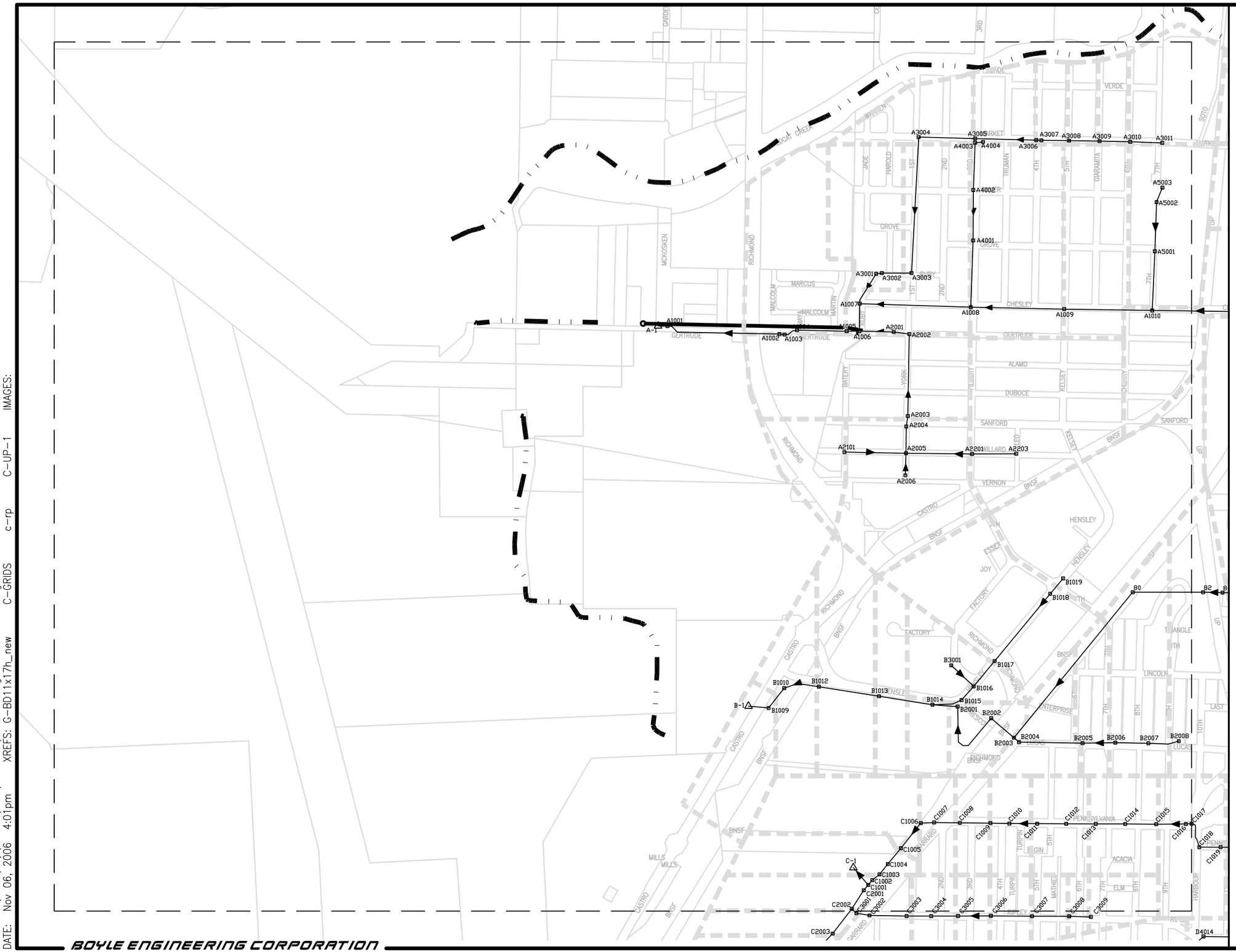
DATE: Nov 06, 2006 4:01pm
XREFS: G-BD11x17h_new C-GRIDS
USER: hliang
IMAGES: C-UP-1 c-rp

BOYLE ENGINEERING CORPORATION



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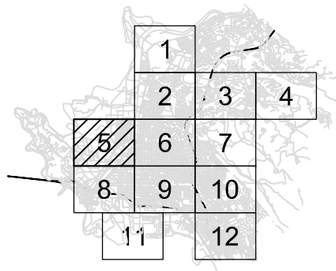
SCALE: 1" =800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

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DATE: Nov 06, 2006 4:01pm XREFS: G-BD11x17h_new C-GRIDS
C-UP-1 IMAGES: c-rp

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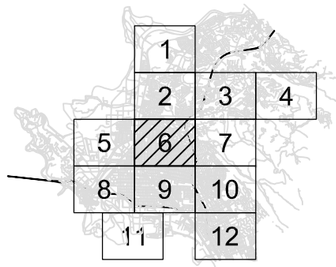
c-rp C-UP-1 IMAGES:

LEGEND

- DRAINAGE ZONE BOUNDARY
- DRAINAGE AREA
- E11050 — DRAINAGE AREA ID
- CREEK/CANAL
- EXISTING BASIN
- PROPOSED BASIN
- 36" — PROPOSED PIPE
- A1 — OUTLET
- A1023 — JUNCTION W/ ID
- PIPE

SCALE: 1"=800'

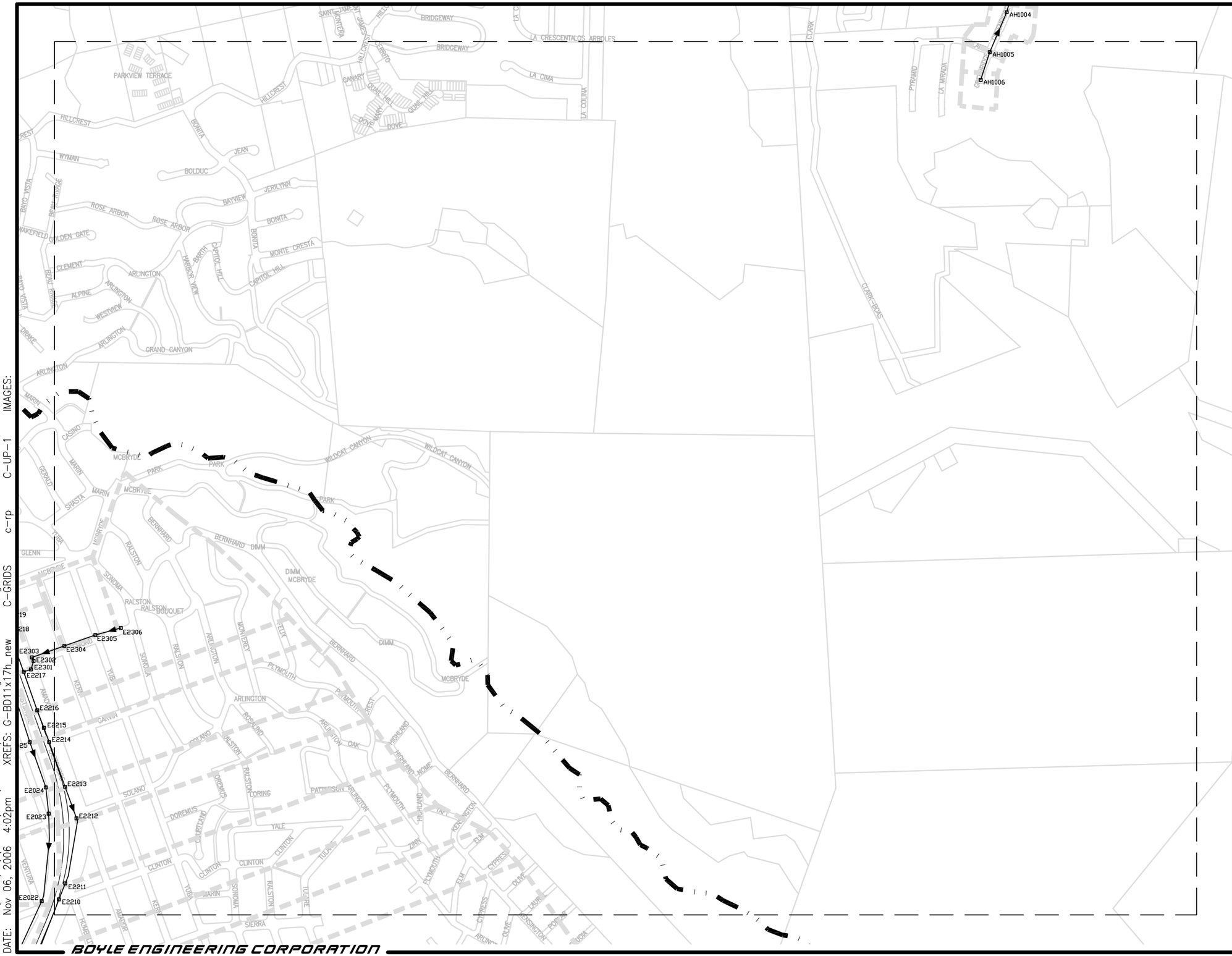
KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

BOYLE ENGINEERING CORPORATION

PLATE 6



LEGEND

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- DRAINAGE AREA
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- EXISTING BASIN
- PROPOSED BASIN
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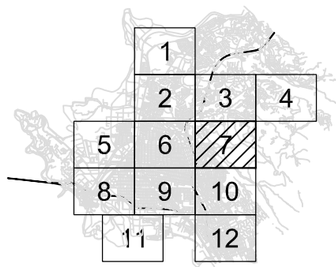
- A1023 — JUNCTION W/ ID
- PIPE

SCALE: 1"=800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

PLATE 7

BOYLE ENGINEERING CORPORATION

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C-GRIDS
c-rp
C-UP-1
IMAGES:

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c-rp C-UP-1

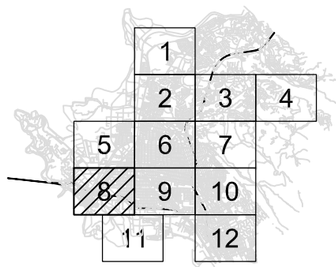
IMAGES:

LEGEND

- DRAINAGE ZONE BOUNDARY
- DRAINAGE AREA
- E11050 — DRAINAGE AREA ID
- CREEK/CANAL
- EXISTING BASIN
- PROPOSED BASIN
- 36" — PROPOSED PIPE
- A1 — OUTLET
- A1023 — JUNCTION W/ ID
- PIPE

SCALE: 1" =800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

BOYLE ENGINEERING CORPORATION

PLATE 8

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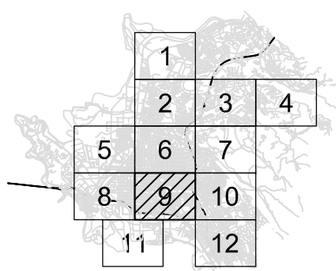
DATE: Nov 06, 2006 4:06pm XREFS: G-BD11x17h_new C-GRIDS
C-rp C-UP-1 IMAGES:

LEGEND

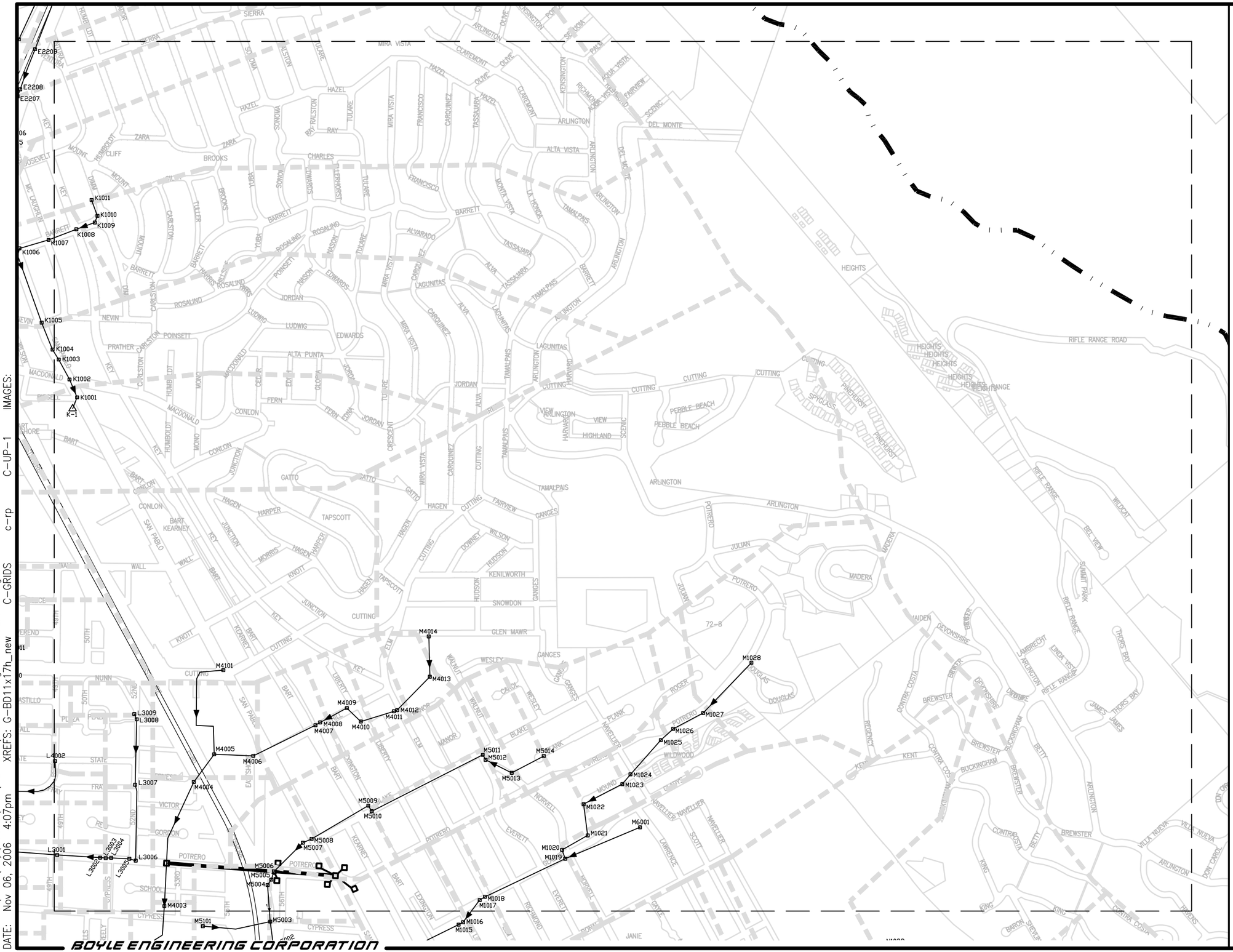
- DRAINAGE ZONE BOUNDARY
- DRAINAGE AREA
- E11050 DRAINAGE AREA ID
- CREEK/CANAL
- EXISTING BASIN
- PROPOSED BASIN
- 36" PROPOSED PIPE
- A1 OUTLET
- A1023 JUNCTION W/ ID
- PIPE

SCALE: 1"=800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES



LEGEND

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- DRAINAGE AREA
- E11050 — DRAINAGE AREA ID
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- EXISTING BASIN
- PROPOSED BASIN
- 36" — PROPOSED PIPE
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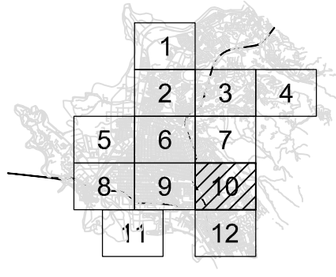
- PIPE

SCALE: 1" =800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

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DATE: Nov 06, 2006 4:07pm XREFS: G-BD11x17h_new C-GRIDS
IMAGES: C-UP-1 c-rp

BOYLE ENGINEERING CORPORATION

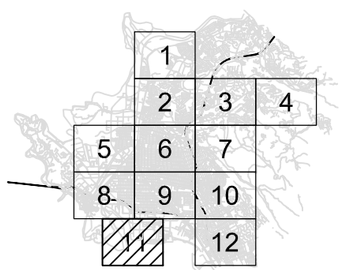
PLATE 10

LEGEND

- DRAINAGE ZONE BOUNDARY
- DRAINAGE AREA
- E11050 — DRAINAGE AREA ID
- CREEK/CANAL
- EXISTING BASIN
- PROPOSED BASIN
- 36" — PROPOSED PIPE
- A1 — OUTLET
- A1023 — JUNCTION W/ ID
- PIPE

SCALE: 1"=800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

PLATE 11

BOYLE ENGINEERING CORPORATION

DWG: V:\V04 (SC)\10002\CAD\PLANSET\PLATE 11.dwg USER: hliang
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c-rp
C-UP-1
IMAGES:

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DATE: Nov 06, 2006 4:07pm XREFS: G-BD11x17h_new C-GRIDS
c-rp C-UP-1

IMAGES:

LEGEND

- DRAINAGE ZONE BOUNDARY
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- EXISTING BASIN
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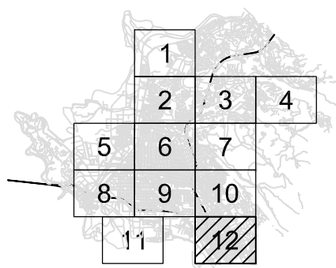
- PIPE

SCALE: 1"=800'

KEY MAP



CITY OF RICHMOND
STORM DRAIN MASTER PLAN
STORM DRAIN ATLASES

BOYLE ENGINEERING CORPORATION

PLATE 12

Appendix B
Street Flow Analysis

Appendix B
City of Richmond - Storm Drain Master Plan
Street Flow Analysis: 10-Year Rainfall Event

ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
11	D1001	D-1		48	72	197	0.0015	693.47	693.47	14.45	1.00	4.52	4.00	2.73	307.16	386
17	C2006	C2004	48			368	0.0015	74.89	74.89	5.96	1.00	1.36	4.00	2.23	55.14	20
21	B1009	B-1		66	114	174	0.0058	240.26	240.26	11.44	0.40	0.28	2.21	2.71	847.83	0
23	B1012	B1010	54			317	0.0014	219.50	219.50	13.80	1.00	2.95	4.50	2.52	74.35	145
29	86	84	48			468	0.0043	71.43	71.43	8.24	0.65	0.76	2.61	2.56	94.20	0
31	84	82		48	76	167	0.003	71.43	71.43	6.68	0.42	0.31	1.69	1.58	232.25	0
33	82	80	54			604	0.0074	71.43	71.43	10.23	0.45	0.42	2.03	2.47	170.17	0
39	R1001	R-1	36			1358	0.0007	176.16	176.16	24.92	1.00	9.71	3.00	1.36	18.15	158
35S	80	B2003	120			1611	0.0068	71.43	71.43	9.21	0.16	0.05	1.55	1.95	1370.05	0
P-1	A3011	A3010	12			275	0.0095	21.61	21.61	27.52	1.00	6.22	1.00	0.80	3.47	18
P-10	A3001	A1007	36			296	0.0015	62.05	62.05	8.78	1.00	2.38	3.00	1.65	26.08	36
P-100	C4006	C4005	21			194	0.0015	17.06	17.06	7.09	1.00	2.78	1.75	0.91	6.14	11
P-1000	E1005	E1004	66			302	0.0024	834.06	834.06	11.70	1.00	5.04	5.50	3.60	496.51	338
P-1001	E3001	E1005		36	58	415	0.0043	154.12	154.12	10.63	1.00	1.17	3.00	2.85	132.22	22
P-1002	E2006	E2104		48	76	409	0.015	407.81	407.81	16.08	0.50	0.78	2.00	3.18	1039.64	0
P-1003	E2007	E2006	54			786	0.0015	393.08	393.08	12.36	1.00	5.15	4.50	2.55	152.80	240
P-1004	E2008	E2007	54			778	0.0048	374.41	374.41	11.77	1.00	2.73	4.50	3.45	274.58	100
P-1005	E2101	E2001	12			26	1.0505	454.67	454.67	578.90	1.00	12.42	1.00	1.00	36.61	418
P-1006	E2102	E2101	42			247	0.0249	454.67	454.67	23.63	1.00	2.86	3.50	3.41	318.36	136
P-1007	E2103	E2102	45			667	0.0024	450.82	450.82	20.41	1.00	7.64	3.75	2.36	118.06	333
P-1008	E2104	E2103	45			773	0.0071	413.28	413.28	18.71	1.00	4.03	3.75	3.10	204.92	208
P-1009	E2005	E2004	36			757	0.0023	7.28	7.28	3.66	0.32	0.23	0.97	0.85	31.96	0
P-101	C4007	C4006	21			240	0.0015	12.55	12.55	5.22	1.00	2.04	1.75	0.91	6.16	6
P-1010	E2011	E2010		42	144	603	0.0073	388.83	388.83	13.86	0.67	0.56	2.34	3.19	697.68	0
P-1012	E2014	E2013		48	144	282	0.0035	369.56	369.56	10.65	0.72	0.63	2.89	3.09	587.29	0
P-1013	E2013	E2012		48	144	161	0.0062	378.80	378.80	12.99	0.61	0.49	2.43	3.14	776.48	0
P-1014	E2012	E2011		48	144	136	0.0037	378.80	378.80	10.86	0.73	0.63	2.91	3.14	596.91	0
P-1015	E2029	E2028	12			342	0.0088	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.35	0
P-1016	E2028	E2027	12			699	0.0014	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0
P-1017	E2027	E2026	12			540	0.0056	5.73	5.73	7.29	1.00	2.15	1.00	0.70	2.66	3
P-1018	F1001	F-1	18			537	0.0279	15.64	15.64	11.25	0.73	0.89	1.10	1.42	17.60	0
P-1019	E2016	E2015	12			83	0.0014	125.30	125.30	159.53	1.00	92.13	1.00	0.49	1.36	124
P-102	C4008	C4007	18			347	0.0015	12.55	12.55	7.10	1.00	3.08	1.50	0.77	4.08	8
P-1020	E2015	E2014		48	144	335	0.0015	359.06	359.06	7.80	0.96	0.94	3.84	3.03	381.07	0

Appendix B
City of Richmond - Storm Drain Master Plan
Street Flow Analysis: 10-Year Rainfall Event

ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-1021	E2201	E2015		36	60	715	0.0159	302.42	302.42	20.16	1.00	1.13	3.00	3.00	266.80	36
P-103	C4009	C4008	15			302	0.0015	4.51	4.51	3.67	1.00	1.80	1.25	0.63	2.50	2
P-1035	K1001	K-1		36	120	105	0.0051	389.41	389.41	12.98	1.00	1.05	3.00	3.00	371.76	18
P-1036	L1001	L-1	48			37	0.0269	178.07	178.07	15.66	0.34	0.75	1.37	2.32	709.30	0
P-1037	L4002	L4001	15			585	0.0015	5.95	5.95	4.84	1.00	2.38	1.25	0.63	2.50	3
P-1038	M2003	M2002	36			437	0.0015	36.95	36.95	5.23	1.00	1.42	3.00	1.65	25.99	11
P-1039	M1007	M1006	66			479	0.0046	676.39	676.39	14.23	1.00	2.97	5.50	4.22	455.21	221
P-104	C4010	C4009	12			270	0.0588	4.51	4.51	11.14	0.51	0.52	0.51	0.89	8.66	0
P-1040	M2001	M-1	12			46	0.0096	36.95	36.95	47.05	1.00	10.58	1.00	0.80	3.49	33
P-1041	M1001	M-1		36	72	46	0.0097	784.71	784.71	21.80	1.00	2.95	3.00	3.00	532.63	252
P-1042	M5101	M5003	48			587	0.0015	21.66	21.66	4.16	0.43	0.39	1.73	1.37	55.76	0
P-1043	M5003	M5002		48	48	215	0.0015	159.30	159.30	9.96	1.00	1.86	4.00	2.42	85.61	74
P-1044	M3004	M3003	4			25	0.0016	63.37	63.37	726.16	1.00	822.26	0.33	0.15	0.08	63
P-1045S	M1025	M1024	120			393	0.0652	116.16	116.16	23.49	0.11	0.03	1.14	2.50	4233.56	0
P-1046	N1001	N-1		48	96	920	0.0046	589.73	589.73	18.43	1.00	1.49	4.00	4.00	395.68	194
P-1046S	N1017	N1016	120			541	0.0203	311.64	311.64	20.87	0.25	0.13	2.45	4.17	2363.99	0
P-1047	O1001	O-1	36			103	0.0097	106.02	106.02	15.00	1.00	1.61	3.00	2.60	65.82	40
P-1048	O1005	O1004	36			595	0.0094	57.21	57.21	10.37	0.73	0.88	2.19	2.45	64.91	0
P-106	I1016	I1015	24			352	0.003	36.78	36.78	11.71	1.00	2.96	2.00	1.27	12.42	24
P-1062S	N1029	N1028	120			911	0.1856	99.89	99.89	32.35	0.08	0.01	0.83	2.32	7143.82	0
P-1063	M4101	M4005	36			1051	0.001	141.04	141.04	19.95	1.00	6.84	3.00	1.46	20.63	120
P-1064	M4005	M4004	24			295	0.012	318.40	318.40	50.67	1.00	12.82	2.00	1.76	49.69	269
P-1065	M4004	M4003	24			1114	0.0151	337.23	337.23	53.67	1.00	12.10	2.00	1.83	55.75	281
P-1066S	M4003	M4002	120			430	0.0028	337.23	337.23	10.45	0.43	0.38	4.30	4.34	879.70	0
P-1067	M4002	M4001	120			163	0.0095	343.88	343.88	16.35	0.31	0.21	3.13	4.39	1615.39	0
P-1068	M4001	M1008	42			803	0.0015	343.88	343.88	35.74	1.00	8.82	3.50	1.94	39.00	305
P-1069	AE1001	AE-1	42			129	0.0601	166.29	166.29	27.56	0.60	0.67	2.10	3.42	247.29	0
P-1070	AF1001	AF-1	90			440	0.0476	231.57	231.57	26.70	0.25	0.14	1.88	3.90	1680.31	0
P-1071	AE1007	AE1006	24			223	0.0245	50.07	50.07	15.94	1.00	1.41	2.00	1.92	35.53	15
P-1072	AE1006	AE1005	24			73	0.1506	50.07	50.07	28.93	0.54	0.57	1.08	1.98	88.02	0
P-1073	AG1001	AG-1	21			202	0.0148	49.74	49.74	20.68	1.00	2.57	1.75	1.58	19.36	30
P-1074	AD1003	AD1002	24			74	0.0136	121.78	121.78	38.76	1.00	4.61	2.00	1.80	26.42	95
P-1075	AD1002	AD1001	24			31	0.0323	121.78	121.78	38.76	1.00	2.99	2.00	1.96	40.76	81
P-1076	AD1001	AD-1	24			114	0.0088	121.78	121.78	38.76	1.00	5.72	2.00	1.65	21.28	100

Appendix B
City of Richmond - Storm Drain Master Plan
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ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-1077	AC1003	AC1002	12			167	0.036	56.43	56.43	71.85	1.00	8.33	1.00	0.97	6.77	50
P-1078	AC1002	AC1001	12			194	0.031	56.43	56.43	71.85	1.00	8.98	1.00	0.96	6.29	50
P-1079	AC1001	AC-1	12			101	0.0197	60.41	60.41	76.91	1.00	12.04	1.00	0.92	5.02	55
P-1080	AB1005	AB1004	42			1025	0.048	151.98	151.98	24.75	0.61	0.69	2.13	3.39	221.02	0
P-1081	T1001	T-1	54			144	0.0221	186.02	186.02	19.52	0.58	0.63	2.60	3.93	293.02	0
P-1082	U1001	U-1	48			54	0.002	99.28	99.28	7.90	1.00	1.53	4.00	2.43	65.01	34
P-1083	V1001	V-1	30			172	0.0015	86.49	86.49	17.62	1.00	5.40	2.50	1.35	16.00	70
P-1084	W1001	W-1	24			198	0.0467	51.20	51.20	16.30	1.00	1.04	2.00	1.98	49.00	2
P-1085	W1101	W-1	36			130	0.0905	29.84	29.84	20.41	0.26	0.15	0.78	1.77	201.19	0
P-1086	R1002	R1001	36			1127	0.0195	176.16	176.16	24.92	1.00	1.88	3.00	2.87	93.46	83
P-1087	S1001	S-1	42			536	0.0034	179.06	179.06	18.61	1.00	3.04	3.50	2.41	58.97	120
P-1088	X2004	X2003	30			50	0.015	24.13	24.13	10.15	0.49	0.48	1.22	1.67	50.35	0
P-1089	X2005	X2004	30			500	0.018	16.23	16.23	9.77	0.37	0.29	0.93	1.36	55.20	0
P-1090	X1002	X1001	36			209	0.1163	70.66	70.66	28.43	0.38	0.31	1.15	2.67	228.05	0
P-1091	X1001	X-1	36			326	0.1732	76.95	76.95	33.67	0.36	0.28	1.08	2.74	278.33	0
P-1092	Y1001	Y-1	36			123	0.0105	185.63	185.63	26.26	1.00	2.71	3.00	2.64	68.54	117
P-1093	Z1101	Z1001	12			22	0.0023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	0
P-1093S	Y1007	Y1006	120			250	0.0399	141.17	141.17	20.96	0.14	0.04	1.41	2.77	3313.65	0
P-1094	Z1002	Z1001	12			20	0.002	46.33	46.33	58.99	1.00	29.14	1.00	0.54	1.59	45
P-1095	Z1001	Z-1	12			30	0.0017	46.33	46.33	58.99	1.00	31.61	1.00	0.51	1.47	45
P-1096	AA1008	AA1007	36			882	0.0015	9.55	9.55	3.38	0.42	0.37	1.26	0.98	25.87	0
P-1097	AA1001	AA-1	36			106	0.0188	103.06	103.06	14.58	1.00	1.12	3.00	2.86	91.82	11
P-1098	AB1001	AB-1	72			217	0.0015	204.02	204.02	7.22	1.00	1.23	6.00	3.50	165.67	38
P-1099	AB1002	AB1001	12			29	6.2096	185.48	185.48	236.16	1.00	2.08	1.00	1.00	89.02	96
P-11	A1007	A1006	84			235	0.0015	339.10	339.10	8.81	1.00	1.37	7.00	4.12	247.02	92
P-110	D4012	D4010	24			542	0.0015	61.32	61.32	19.52	1.00	6.95	2.00	1.06	8.83	52
P-1100	AH1001	AH-1	36			96	0.0015	13.71	13.71	3.67	0.52	0.54	1.57	1.18	25.50	0
P-1101	C4002	C4001	27			167	0.0015	34.47	34.47	8.67	1.00	2.87	2.25	1.20	12.02	22
P-1102S	C4001	C2006	120			614	0.0015	34.47	34.47	4.35	0.16	0.05	1.57	1.35	641.95	0
P-111	D4011	D4010	24			528	0.0001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.61	0
P-112	D4010	D4009	36			86	0.0015	61.32	61.32	8.67	1.00	2.35	3.00	1.65	26.07	35
P-113	D4009	D4008	36			406	0.0016	61.32	61.32	8.67	1.00	2.31	3.00	1.66	26.54	35
P-114	D4008	D4007	36			105	0.0015	85.11	85.11	12.04	1.00	3.26	3.00	1.65	26.10	59
P-115	D4007	D4006	36			39	0.0015	85.11	85.11	12.04	1.00	3.25	3.00	1.65	26.16	59

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P-116	D4006	D4005	36			209	0.0015	85.11	85.11	12.04	1.00	3.25	3.00	1.65	26.15	59
P-117	D4005	D4004	36			251	0.0015	85.11	85.11	12.04	1.00	3.31	3.00	1.64	25.68	59
P-118	D4004	D4003	36			761	0.0015	124.82	124.82	17.66	1.00	4.80	3.00	1.65	26.00	99
P-119	D4003	D4002	42			642	0.0015	124.82	124.82	12.97	1.00	3.22	3.50	1.94	38.81	86
P-12	A1006	A1005	84			110	0.0015	419.07	419.07	10.89	1.00	1.71	7.00	4.10	244.68	174
P-120	D4002	D4001	42			393	0.0039	124.82	124.82	12.97	1.00	1.98	3.50	2.49	63.18	62
P-121	D4001	D1015	42			147	0.0061	124.82	124.82	12.97	1.00	1.58	3.50	2.78	79.00	46
P-122	D1015	D1014		48	72	73	0.0015	612.68	612.68	12.76	1.00	4.00	4.00	2.72	306.11	307
P-123	D1014	D1013		48	72	128	0.0015	612.68	612.68	12.76	1.00	4.03	4.00	2.71	303.93	309
P-124	D1013	D1012		48	72	367	0.0016	612.68	612.68	12.76	1.00	3.84	4.00	2.80	318.76	294
P-125	D1012	D1011		48	72	442	0.0017	629.92	629.92	13.12	1.00	3.88	4.00	2.83	324.49	305
P-126	D1011	D1010		48	72	448	0.0014	629.92	629.92	13.12	1.00	4.25	4.00	2.66	296.14	334
P-127	D1010	D1009		48	72	54	0.0016	640.24	640.24	13.34	1.00	4.01	4.00	2.80	319.06	321
P-128	D1009	D1008		48	72	438	0.0069	640.24	640.24	13.55	0.98	1.96	3.94	4.00	653.16	0
P-129	D1008	D1007		48	72	93	0.0027	662.39	662.39	13.80	1.00	3.24	4.00	3.30	408.91	253
P-13	A1005	A1004	84			426	0.0015	419.07	419.07	10.89	1.00	1.69	7.00	4.13	248.16	171
P-130	D1007	D1006		48	84	351	0.0032	662.39	662.39	11.83	1.00	2.42	4.00	3.62	547.13	115
P-131	D1006	D1005		48	84	306	0.0014	662.39	662.39	11.83	1.00	3.63	4.00	2.76	365.01	297
P-132	D1005	D1004		48	84	143	0.0016	662.39	662.39	11.83	1.00	3.40	4.00	2.89	389.72	273
P-133	D1004	D1003		48	84	154	0.0015	662.39	662.39	11.83	1.00	3.52	4.00	2.82	376.07	286
P-134	D1003	D1002		48	84	379	0.0015	670.99	670.99	11.98	1.00	3.55	4.00	2.83	377.58	293
P-135	D1002	D1001		48	84	129	0.0074	670.99	670.99	14.17	0.85	1.60	3.38	4.00	838.05	0
P-137	D1022	D1021	54			512	0.0037	315.23	315.23	19.82	1.00	2.62	4.50	3.23	120.48	195
P-138	D1021	D1020	84			622	0.002	335.73	335.73	8.72	1.00	1.18	7.00	4.44	284.85	51
P-139	D1020	D1019	84			531	0.0013	352.42	352.42	9.16	1.00	1.51	7.00	4.01	234.13	118
P-14	A1004	A1003	84			119	0.0015	439.91	439.91	11.43	1.00	1.77	7.00	4.14	249.15	191
P-140	D1019	D1018	84			141	0.0001	352.42	352.42	9.16	1.00	4.62	7.00	2.23	76.31	276
P-141	D1018	D1017	72			749	0.016	465.20	465.20	18.32	0.46	0.87	2.76	4.18	1074.74	0
P-142	D1017	D1016	72			581	0.002	485.68	485.68	8.59	1.00	2.57	6.00	3.75	377.93	108
P-143	D1016	D1015	72			71	0.0027	485.68	485.68	8.59	1.00	2.22	6.00	4.05	437.93	48
P-144	D6001	D1022	24			499	0.0015	19.62	19.62	6.24	1.00	2.23	2.00	1.06	8.79	11
P-145	D4104	D4103	15			348	0.0028	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40	0
P-146	D4103	D4102	21			501	0.0058	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.11	0
P-147	D4102	D4101	24			262	0.0038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.96	0

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P-148	D4101	D4003	24			277	0.0018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.74	0
P-15	A1003	A1002	84			44	0.0022	439.91	439.91	11.43	1.00	1.45	7.00	4.59	303.81	136
P-150	D2009	D2008	42			1408	0.0014	42.46	42.46	4.41	1.00	1.12	3.50	1.92	38.02	4
P-151	D2008	D2007	42			123	0.0108	42.46	42.46	10.32	0.44	0.40	1.55	2.03	104.94	0
P-152	D2007	D2006	42			1129	0.0015	66.32	66.32	6.89	1.00	1.71	3.50	1.94	38.80	28
P-153	D2006	D2005	42			1386	0.0014	66.32	66.32	6.89	1.00	1.73	3.50	1.92	38.33	28
P-154	D2005	D2004	42			235	0.0015	98.04	98.04	10.19	1.00	2.52	3.50	1.94	38.91	59
P-155	D2004	D2003	42			551	0.0015	187.96	187.96	19.54	1.00	4.74	3.50	1.96	39.63	148
P-156	D2003	D2002	42			552	0.0014	187.96	187.96	19.54	1.00	4.89	3.50	1.93	38.41	150
P-157	D2002	D2001	42			60	0.0017	187.96	187.96	19.54	1.00	4.55	3.50	2.00	41.27	147
P-16	A1002	A1001	78			984	0.001	439.91	439.91	13.26	1.00	2.71	6.50	3.38	162.45	277
P-164	J1018	J1017	18			579	0.0061	7.57	7.57	5.27	0.76	0.92	1.14	1.07	8.22	0
P-165	J1017	J1016	30			285	0.0031	11.67	11.67	4.66	0.51	0.51	1.27	1.15	22.74	0
P-166	J1016	J1015	30			52	0.0079	15.86	15.86	7.18	0.46	0.43	1.15	1.34	36.54	0
P-167	J1015	J1014	30			360	0.005	15.86	15.86	6.06	0.53	0.55	1.32	1.34	29.09	0
P-168	J1014	J1013	36			286	0.0052	15.86	15.86	6.13	0.39	0.33	1.18	1.27	48.42	0
P-169	J1013	J1012	36			54	0.0011	25.85	25.85	3.66	1.00	1.16	3.00	1.52	22.32	4
P-17	A4004	A4003	48			69	0.0015	39.78	39.78	4.76	0.63	0.72	2.52	1.88	54.90	0
P-170	J1012	J1011	36			140	0.0015	25.85	25.85	4.18	0.82	1.00	2.45	1.64	25.94	0
P-171	J1011	J1010	36			507	0.0014	25.85	25.85	3.66	1.00	1.02	3.00	1.63	25.38	0
P-172	J1010	J1009	36			27	0.0015	48.88	48.88	6.91	1.00	1.91	3.00	1.63	25.58	23
P-173	J1009	J1008	42			414	0.0019	48.88	48.88	5.08	1.00	1.10	3.50	2.08	44.35	5
P-174	J1008	J1007	42			32	0.0016	63.01	63.01	6.55	1.00	1.58	3.50	1.97	39.94	23
P-175	J1007	J1006	48			489	0.0047	63.01	63.01	8.34	0.58	0.64	2.32	2.39	98.78	0
P-176	J1006	J1005	48			85	0.0018	63.01	63.01	5.01	1.00	1.04	4.00	2.34	60.38	3
P-177	J1005	J1004	48			318	0.0016	63.01	63.01	5.01	1.00	1.10	4.00	2.27	57.13	6
P-178	J1004	J1003	54			145	0.0021	95.67	95.67	6.02	1.00	1.07	4.50	2.78	89.63	6
P-179	J1003	J1002	54			39	0.0026	95.67	95.67	7.14	0.79	0.96	3.53	2.87	99.69	0
P-18	A4003	A4002	48			405	0.0016	39.78	39.78	4.95	0.61	0.69	2.44	1.88	57.70	0
P-180	I1013	I1012	21			569	0.0027	84.07	84.07	34.95	1.00	10.18	1.75	1.07	8.26	76
P-181	I1012	I1011	21			623	0.0041	84.07	84.07	34.95	1.00	8.25	1.75	1.19	10.19	74
P-182	I1011	I1010	30			102	0.001	105.89	105.89	21.57	1.00	8.24	2.50	1.20	12.85	93
P-183	I1010	I1009	36			69	0.0013	105.89	105.89	14.98	1.00	4.39	3.00	1.58	24.15	82
P-184	I1009	I1008	36			266	0.0016	119.21	119.21	16.86	1.00	4.49	3.00	1.67	26.58	93

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P-185	I1008	I1007	36			43	0.0023	119.21	119.21	16.86	1.00	3.71	3.00	1.84	32.16	87
P-186	I1007	I1006	36			51	0.0039	119.21	119.21	16.86	1.00	2.86	3.00	2.10	41.69	78
P-187	I1006	I1005	36			197	0.0015	119.21	119.21	16.86	1.00	4.57	3.00	1.65	26.10	93
P-188	I1005	I1004	48			983	0.0015	232.94	232.94	18.54	1.00	4.14	4.00	2.26	56.26	177
P-189	I1004	I1003	48			441	0.0016	232.94	232.94	18.54	1.00	4.06	4.00	2.28	57.38	176
P-19	A4002	A4001	48			433	0.0015	39.78	39.78	4.82	0.62	0.71	2.50	1.88	55.79	0
P-190	I1003	I1002	48			405	0.0015	232.94	232.94	18.54	1.00	4.20	4.00	2.24	55.44	178
P-191	I1002	I1001	48			104	0.0005	232.94	232.94	18.54	1.00	7.37	4.00	1.67	31.63	201
P-193	I2014	I2013	18			312	0.0064	38.23	38.23	21.64	1.00	4.53	1.50	1.12	8.44	30
P-194	I2013	I2012	18			188	0.0212	38.23	38.23	21.64	1.00	2.49	1.50	1.41	15.34	23
P-195	I2012	I2011	12			141	0.0142	68.41	68.41	87.10	1.00	16.08	1.00	0.87	4.26	64
P-196	I2011	I2010	18			56	0.0062	68.41	68.41	38.71	1.00	8.23	1.50	1.12	8.31	60
P-197	I2010	I2009	12			113	0.0177	68.41	68.41	87.10	1.00	14.41	1.00	0.90	4.75	64
P-198	I2009	I2008	12			107	0.0017	68.41	68.41	87.10	1.00	46.69	1.00	0.51	1.47	67
P-199	I2008	I2007	24			248	0.0093	68.41	68.41	21.78	1.00	3.13	2.00	1.67	21.83	47
P-2	A3010	A3009	15			263	0.0027	26.98	26.98	21.99	1.00	8.01	1.25	0.74	3.37	24
P-20	A4001	A1008	48			574	0.0015	39.78	39.78	4.78	0.63	0.72	2.52	1.88	55.12	0
P-201	I2005	I2004	30			473	0.0015	119.89	119.89	24.42	1.00	7.42	2.50	1.36	16.15	104
P-202	I2004	I2003	30			46	0.0015	119.89	119.89	24.42	1.00	7.43	2.50	1.36	16.13	104
P-203	I2003	I2002	30			264	0.0015	136.97	136.97	27.90	1.00	8.55	2.50	1.35	16.02	121
P-204	I2002	I2001	30			409	0.0016	136.97	136.97	27.90	1.00	8.36	2.50	1.37	16.39	121
P-205	I2001	I1001	30			62	0.0015	136.97	136.97	27.90	1.00	8.72	2.50	1.34	15.71	121
P-206	I3001	I1001	12			37	0.0016	61.10	61.10	77.79	1.00	42.64	1.00	0.51	1.43	60
P-207	I3002	I3001	12			107	0.0213	61.10	61.10	77.79	1.00	11.73	1.00	0.93	5.21	56
P-208	I3003	I3002	12			443	0.0009	61.10	61.10	77.79	1.00	56.90	1.00	0.44	1.07	60
P-209	I3004	I3003	12			645	0.0006	51.22	51.22	65.22	1.00	57.59	1.00	0.40	0.89	50
P-21	A1008	A1007	72			953	0.0015	269.99	269.99	9.55	1.00	1.64	6.00	3.49	164.47	106
P-210	I3005	I3004	12			450	0.0004	35.75	35.75	45.52	1.00	47.48	1.00	0.36	0.75	35
P-211	R1004	R1003	24			391	0.0307	42.37	42.37	13.49	1.00	1.07	2.00	1.95	39.76	3
P-212	R1003	R1002	30			137	0.0219	167.77	167.77	34.18	1.00	2.76	2.50	2.40	60.83	107
P-215	T2003	T2002	15			379	0.039	33.32	33.32	27.15	1.00	2.60	1.25	1.22	12.80	21
P-216	T2002	T2001	18			395	0.0145	33.32	33.32	18.85	1.00	2.63	1.50	1.34	12.68	21
P-217	T2001	T1001	12			83	0.0216	33.32	33.32	42.42	1.00	6.34	1.00	0.93	5.25	28
P-218	T1002	T1001	54			129	0.022	149.30	149.30	18.50	0.51	0.51	2.28	3.59	292.70	0

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P-219	T1003	T1002	54			105	0.022	149.30	149.30	18.50	0.51	0.51	2.28	3.59	292.73	0
P-22	A1009	A1008	66			802	0.0015	247.76	247.76	10.43	1.00	1.87	5.50	3.20	132.42	115
P-220	T1004	T1003	54			291	0.0382	149.30	149.30	22.68	0.43	0.39	1.94	3.59	385.57	0
P-221	T4001	T1004	18			44	0.0041	63.33	63.33	35.84	1.00	9.45	1.50	1.00	6.70	57
P-222	T4002	T4001	15			573	0.019	63.33	63.33	51.61	1.00	7.09	1.25	1.15	8.93	54
P-223	T4003	T4002	15			416	0.0576	36.67	36.67	29.88	1.00	2.36	1.25	1.24	15.55	21
P-224	T3001	T1001	12			245	0.0033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.04	0
P-225	T1005	T1004	54			73	0.0015	106.62	106.62	6.70	1.00	1.40	4.50	2.55	76.43	30
P-226	T1006	T1005	54			114	0.0172	106.62	106.62	15.48	0.45	0.41	2.01	3.04	258.75	0
P-227	T1007	T1006	54			355	0.003	106.62	106.62	7.69	0.81	0.99	3.67	3.04	107.24	0
P-229	T5001	T1007	30			60	0.0321	63.60	63.60	16.89	0.72	0.86	1.79	2.41	73.68	0
P-23	A1010	A1009	60			755	0.0015	231.20	231.20	11.78	1.00	2.27	5.00	2.87	101.89	129
P-230	T5002	T5001	30			84	0.0393	63.60	63.60	18.38	0.66	0.78	1.66	2.41	81.55	0
P-231	T5003	T5002	30			61	0.0137	63.60	63.60	12.96	1.00	1.32	2.50	2.27	48.05	16
P-232	T5004	T5003	24			69	0.0118	63.60	63.60	20.24	1.00	2.58	2.00	1.75	24.62	39
P-233	T5005	T5004	24			61	0.013	63.60	63.60	20.24	1.00	2.45	2.00	1.78	25.91	38
P-234	T5006	T5005	24			65	0.0123	33.58	33.58	10.69	1.00	1.34	2.00	1.76	25.12	8
P-235	T5007	T5006	24			67	0.012	33.58	33.58	10.69	1.00	1.35	2.00	1.76	24.89	9
P-236	T5008	T5007	24			70	0.0116	33.58	33.58	10.69	1.00	1.37	2.00	1.75	24.48	9
P-237	T5009	T5008	24			72	0.0115	28.27	28.27	9.00	1.00	1.16	2.00	1.74	24.31	4
P-238	T5010	T5009	24			62	0.0133	28.27	28.27	9.00	1.00	1.08	2.00	1.79	26.20	2
P-239	T5011	T5010	24			63	0.0135	28.27	28.27	9.00	1.00	1.07	2.00	1.79	26.36	2
P-24	A5001	A1010	48			508	0.0015	33.83	33.83	4.62	0.56	0.61	2.26	1.73	55.34	0
P-240	T5012	T5011	24			204	0.0067	19.80	19.80	6.30	1.00	1.07	2.00	1.55	18.60	1
P-241	T5013	T5012	21			280	0.0161	19.80	19.80	9.55	0.80	0.98	1.41	1.59	20.16	0
P-242	T5014	T5013	21			258	0.003	19.80	19.80	8.23	1.00	2.27	1.75	1.10	8.73	11
P-244	V1002	V1001	12			72	0.0222	76.97	76.97	98.01	1.00	14.47	1.00	0.93	5.32	72
P-245	V1003	V1002	30			200	0.008	76.97	76.97	15.68	1.00	2.09	2.50	2.05	36.78	40
P-246	V1004	V1003	30			60	0.0067	76.97	76.97	15.68	1.00	2.29	2.50	1.97	33.58	43
P-247	V1005	V1004	42			96	0.0078	70.97	70.97	10.27	0.67	0.80	2.36	2.64	88.98	0
P-248	V1006	V1005	36			441	0.0083	52.38	52.38	9.66	0.72	0.86	2.15	2.35	60.74	0
P-249	V1007	V1006	36			104	0.1513	46.07	46.07	27.75	0.28	0.18	0.85	2.21	260.10	0
P-25	A5002	A5001	48			423	0.0015	33.83	33.83	4.70	0.56	0.60	2.23	1.73	56.44	0
P-250	V2001	V1005	30			310	0.0036	12.12	12.12	5.02	0.49	0.49	1.23	1.17	24.82	0

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P-251	V2002	V2001	24			148	0.0047	9.81	9.81	5.21	0.58	0.63	1.16	1.12	15.47	0
P-252	V2003	V2002	24			113	0.0044	7.02	7.02	4.72	0.48	0.46	0.96	0.94	15.11	0
P-253	V2004	V2003	15			132	0.0109	3.50	3.50	5.55	0.51	0.52	0.64	0.75	6.76	0
P-254	W1105	W1104	24			240	0.093	17.30	17.30	18.30	0.34	0.25	0.68	1.50	69.18	0
P-255	W1104	W1103	12			145	0.093	17.30	17.30	22.03	1.00	1.59	1.00	1.00	10.89	6
P-256	W1103	W1102	24			215	0.093	29.84	29.84	21.21	0.46	0.43	0.92	1.86	69.16	0
P-257	W1102	W1101	12			196	0.093	29.84	29.84	38.00	1.00	2.74	1.00	1.00	10.90	19
P-26	A5003	A5002	48			133	0.0015	33.83	33.83	4.65	0.56	0.61	2.25	1.73	55.78	0
P-260	W1002	W1001	12			216	0.0467	51.20	51.20	65.19	1.00	6.63	1.00	0.98	7.72	43
P-261	W1003	W1002	12			400	0.0467	51.20	51.20	65.19	1.00	6.63	1.00	0.98	7.72	43
P-262	W1004	W1003	12			428	0.06	22.30	22.30	28.39	1.00	2.55	1.00	0.99	8.75	14
P-263	W1005	W1004	24			170	0.0015	22.30	22.30	7.10	1.00	2.56	2.00	1.05	8.70	14
P-264	W1006	W1005	15			211	0.0015	22.30	22.30	18.17	1.00	8.83	1.25	0.64	2.53	20
P-265	T1008	T1007	54			666	0.0142	51.89	51.89	11.86	0.32	0.22	1.44	2.09	234.92	0
P-266	T1009	T1008	24			367	0.0122	51.89	51.89	16.52	1.00	2.07	2.00	1.76	25.05	27
P-267	T1010	T1009	24			145	0.0508	51.89	51.89	16.52	1.00	1.01	2.00	1.98	51.13	1
P-268	T1011	T1010	24			58	0.0722	36.95	36.95	20.32	0.56	0.61	1.12	1.94	60.94	0
P-269	T1012	T1011	24			344	0.0498	26.28	26.28	16.27	0.51	0.52	1.02	1.79	50.64	0
P-27	A2001	A1006	18			294	0.0015	92.26	92.26	52.21	1.00	22.37	1.50	0.78	4.12	88
P-270	T1013	T1012	24			93	0.0582	26.28	26.28	17.25	0.49	0.48	0.98	1.79	54.71	0
P-271	U1002	U1001	48			75	0.0021	99.28	99.28	7.90	1.00	1.49	4.00	2.46	66.62	33
P-272	U1003	U1002	48			61	0.0026	85.36	85.36	6.79	1.00	1.15	4.00	2.60	73.99	11
P-273	U1004	U1003	48			89	0.0018	85.36	85.36	6.79	1.00	1.40	4.00	2.36	61.15	24
P-274	U1005	U1004	48			103	0.0072	79.99	79.99	10.35	0.59	0.66	2.36	2.71	121.92	0
P-275	U1006	U1005	48			61	0.0031	79.99	79.99	7.28	0.82	1.00	3.27	2.71	80.32	0
P-276	U1007	U1006	48			64	0.0028	79.99	79.99	6.37	1.00	1.05	4.00	2.64	76.31	4
P-277	U1008	U1007	48			65	0.0029	79.99	79.99	6.37	1.00	1.03	4.00	2.67	77.71	2
P-278	U1009	U1008	48			55	0.0035	79.99	79.99	7.67	0.77	0.94	3.09	2.71	84.82	0
P-279	U1010	U1009	48			48	0.0034	71.75	71.75	7.47	0.71	0.86	2.86	2.56	83.44	0
P-28	A2002	A2001	18			135	0.0015	92.26	92.26	52.21	1.00	22.72	1.50	0.77	4.06	88
P-280	U1011	U1010	48			49	0.0033	71.75	71.75	7.40	0.72	0.87	2.88	2.56	82.63	0
P-281	U1012	U1011	48			47	0.0351	71.75	71.75	18.16	0.35	0.27	1.41	2.56	269.88	0
P-282	U1013	U1012	48			78	0.0182	71.75	71.75	14.31	0.42	0.37	1.68	2.56	194.41	0
P-283	U1014	U1013	36			84	0.038	64.10	64.10	18.36	0.50	0.49	1.49	2.57	130.43	0

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P-284	U1015	U1014	36			266	0.012	64.10	64.10	11.70	0.72	0.87	2.17	2.57	73.41	0
P-285	U1016	U1015	36			50	0.0283	46.12	46.12	15.13	0.45	0.41	1.34	2.21	112.59	0
P-286	U1017	U1016	18			363	0.0818	35.14	35.14	19.89	1.00	1.17	1.50	1.49	30.11	5
P-287	V1008	V1007	36			155	0.0015	46.07	46.07	6.52	1.00	1.79	3.00	1.64	25.75	20
P-288	V1009	V1008	36			101	0.0039	46.07	46.07	6.52	1.00	1.11	3.00	2.10	41.53	5
P-289	V1010	V1009	36			73	0.0467	46.07	46.07	18.16	0.39	0.32	1.16	2.21	144.45	0
P-29	A2003	A2002	12			704	0.0006	92.26	92.26	117.47	1.00	108.34	1.00	0.39	0.85	91
P-290	V1011	V1010	36			54	0.067	46.07	46.07	20.71	0.35	0.27	1.06	2.21	173.10	0
P-291	V1012	V1011	36			56	0.0608	37.03	37.03	18.81	0.32	0.22	0.97	1.98	164.88	0
P-292	V1013	V1012	24			314	0.0365	37.03	37.03	15.50	0.71	0.85	1.42	1.94	43.32	0
P-293	V1014	V1013	24			74	0.0539	23.28	23.28	16.26	0.47	0.44	0.93	1.71	52.68	0
P-294	V1015	V1014	24			128	0.0239	23.28	23.28	11.93	0.60	0.66	1.19	1.71	35.06	0
P-295	S1007	S1006	18			332	0.0633	39.60	39.60	22.41	1.00	1.50	1.50	1.49	26.49	13
P-296	S1006	S1005	18			193	0.088	45.82	45.82	25.93	1.00	1.47	1.50	1.49	31.25	15
P-297	S1005	S1004	18			123	0.0426	50.75	50.75	28.72	1.00	2.33	1.50	1.48	21.74	29
P-298	S1004	S1003	18			313	0.0607	50.75	50.75	28.72	1.00	1.96	1.50	1.49	25.94	25
P-299	S1003	S1002	18			105	0.0143	55.10	55.10	31.18	1.00	4.38	1.50	1.34	12.58	43
P-3	A3009	A3008	15			261	0.0037	31.29	31.29	25.50	1.00	7.93	1.25	0.80	3.95	27
P-30	A2004	A2003	12			91	0.0015	70.80	70.80	90.15	1.00	50.44	1.00	0.50	1.40	69
P-300	S1002	S1001	30			172	0.093	179.06	179.06	36.48	1.00	1.43	2.50	2.49	125.44	54
P-303	S2001	S1002	30			235	0.0532	118.73	118.73	24.19	1.00	1.25	2.50	2.48	94.89	24
P-304	S3001	S2001	24			177	0.0266	82.89	82.89	26.38	1.00	2.24	2.00	1.94	36.97	46
P-305	S3002	S3001	24			200	0.0432	82.89	82.89	26.38	1.00	1.76	2.00	1.97	47.12	36
P-306	S3003	S3002	24			377	0.1494	59.41	59.41	29.98	0.60	0.68	1.21	1.99	87.67	0
P-307	S3004	S3003	24			138	0.0725	39.29	39.29	20.64	0.58	0.64	1.17	1.95	61.07	0
P-308	S3005	S3004	18			158	0.0739	39.29	39.29	22.23	1.00	1.37	1.50	1.49	28.63	11
P-309	S3006	S3005	18			131	0.0853	27.66	27.66	19.70	0.74	0.90	1.11	1.49	30.76	0
P-31	A2005	A2004	12			229	0.0015	70.80	70.80	90.15	1.00	51.47	1.00	0.50	1.38	69
P-310	S3007	S3006	18			190	0.0692	27.66	27.66	17.87	0.82	1.00	1.23	1.49	27.71	0
P-311	S3008	S3007	18			176	0.0719	19.27	19.27	17.19	0.61	0.68	0.91	1.46	28.24	0
P-312	S2002	S2001	24			358	0.0166	38.24	38.24	12.17	1.00	1.31	2.00	1.85	29.19	9
P-313	S2003	S2002	24			132	0.0735	38.24	38.24	20.64	0.57	0.62	1.14	1.94	61.51	0
P-314	S2004	S2003	24			119	0.0671	28.88	28.88	18.61	0.50	0.49	0.99	1.84	58.78	0
P-315	X1008	X1007	24			235	0.0212	8.47	8.47	8.81	0.35	0.26	0.69	1.04	33.05	0

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P-316	X1007	X1006	24			229	0.0044	16.08	16.08	5.12	1.00	1.07	2.00	1.40	14.99	1
P-317	X1006	X1005	24			362	0.0193	16.08	16.08	10.09	0.51	0.51	1.01	1.45	31.55	0
P-318	X1005	X1004	24			587	0.0341	21.52	21.52	13.42	0.51	0.51	1.02	1.66	41.87	0
P-319	X1004	X1003	24			204	0.0441	35.56	35.56	16.61	0.64	0.75	1.29	1.92	47.61	0
P-32	A2006	A2005	12			190	0.0006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0
P-320	X1003	X1002	24			312	0.0369	41.96	41.96	15.80	0.79	0.96	1.58	1.96	43.58	0
P-321	X2001	X1002	30			281	0.0103	24.13	24.13	8.82	0.54	0.58	1.36	1.67	41.82	0
P-322	X2002	X2001	30			417	0.0073	24.13	24.13	7.72	0.61	0.69	1.52	1.67	35.16	0
P-323	X2003	X2002	30			290	0.1097	24.13	24.13	20.93	0.28	0.18	0.71	1.67	136.19	0
P-324	Y2002	Y2001	12			109	0.0733	10.63	10.63	13.53	1.00	1.10	1.00	0.99	9.67	1
P-325	Y2001	Y1003	18			148	0.0245	16.19	16.19	10.65	0.80	0.98	1.20	1.43	16.50	0
P-326	Y1004	Y1003	30			494	0.0334	165.23	165.23	33.66	1.00	2.20	2.50	2.45	75.15	90
P-327	Y1005	Y1004	30			528	0.0227	151.18	151.18	30.80	1.00	2.44	2.50	2.41	62.01	89
P-328	Y1006	Y1005	30			224	0.0134	146.94	146.94	29.93	1.00	3.09	2.50	2.27	47.63	99
P-329	Y1003	Y1002	36			35	0.0017	179.98	179.98	25.46	1.00	6.50	3.00	1.70	27.70	152
P-33	A2101	A2005	30			529	0.0015	17.12	17.12	3.49	1.00	1.08	2.50	1.35	15.90	1
P-330	Y1002	Y1001	36			87	0.0518	179.98	179.98	25.46	1.00	1.18	3.00	2.98	152.24	28
P-331	Y1008	Y1007	36			617	0.0859	82.65	82.65	26.55	0.45	0.42	1.36	2.79	196.05	0
P-332	Y1009	Y1008	30			156	0.0128	74.47	74.47	15.17	1.00	1.60	2.50	2.25	46.62	28
P-333	Y1010	Y1009	30			143	0.014	74.47	74.47	15.17	1.00	1.53	2.50	2.28	48.68	26
P-334	Y1011	Y1010	30			454	0.0088	66.58	66.58	13.56	1.00	1.72	2.50	2.10	38.62	28
P-335	Y1012	Y1011	30			81	0.0124	66.58	66.58	13.56	1.00	1.45	2.50	2.24	45.83	21
P-336	Y1013	Y1012	12			122	0.0082	54.21	54.21	69.03	1.00	16.78	1.00	0.77	3.23	51
P-337	Y1014	Y1013	12			104	0.0541	54.21	54.21	69.03	1.00	6.53	1.00	0.99	8.31	46
P-339	Y3001	Y1007	18			238	0.1809	47.76	47.76	27.02	1.00	1.07	1.50	1.50	44.80	3
P-34	A2201	A2005	21			567	0.0057	29.79	29.79	12.38	1.00	2.49	1.75	1.29	11.95	18
P-340	Y3002	Y3001	18			231	0.0043	41.98	41.98	23.76	1.00	6.05	1.50	1.02	6.94	35
P-341	Y3003	Y3002	18			464	0.0015	41.98	41.98	23.76	1.00	10.26	1.50	0.77	4.09	38
P-342	Y3004	Y3003	18			163	0.0015	28.97	28.97	16.39	1.00	7.16	1.50	0.77	4.04	25
P-343	Y3005	Y3004	12			137	0.0655	28.97	28.97	36.89	1.00	3.17	1.00	0.99	9.14	20
P-344	Y3006	Y3005	12			69	0.0145	28.97	28.97	36.89	1.00	6.74	1.00	0.87	4.30	25
P-345	Y3101	Y3004	12			223	0.0626	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.94	0
P-346	Z1007	Z1006	12			45	0.0045	22.92	22.92	29.18	1.00	9.61	1.00	0.66	2.38	21
P-347	Z1006	Z1005	15			226	0.0015	22.92	22.92	18.68	1.00	9.12	1.25	0.63	2.51	20

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P-348	Z1005	Z1004	15			65	0.0617	32.86	32.86	26.78	1.00	2.04	1.25	1.24	16.09	17
P-349	Z1004	Z1003	18			348	0.0015	32.86	32.86	18.60	1.00	8.07	1.50	0.77	4.07	29
P-35	A2203	A2201	21			378	0.0096	29.79	29.79	12.38	1.00	1.91	1.75	1.46	15.59	14
P-350	Z2001	Z1003	18			177	0.017	11.19	11.19	8.65	0.69	0.82	1.03	1.28	13.72	0
P-351	Z1003	Z1002	21			135	0.0148	45.60	45.60	18.96	1.00	2.36	1.75	1.58	19.35	26
P-353	AA1007	AA1006	36			483	0.1057	32.61	32.61	22.13	0.26	0.15	0.79	1.85	217.43	0
P-354	AA1006	AA1005	36			134	0.0372	45.37	45.37	16.65	0.41	0.35	1.23	2.19	128.96	0
P-355	AA1005	AA1004	36			463	0.0216	49.61	49.61	13.93	0.50	0.50	1.51	2.29	98.29	0
P-356	AA1004	AA1003	36			430	0.0163	61.24	61.24	13.13	0.63	0.72	1.88	2.52	85.37	0
P-357	AA1003	AA1002	36			419	0.0072	89.29	89.29	12.63	1.00	1.58	3.00	2.44	56.61	33
P-358	AA1002	AA1001	36			49	0.0203	96.57	96.57	13.66	1.00	1.01	3.00	2.88	95.32	1
P-359	AA2004	AA2003	24			257	0.1907	20.67	20.67	24.91	0.31	0.21	0.62	1.63	99.05	0
P-36	B1019	B1018	24			173	0.0015	61.67	61.67	19.63	1.00	7.01	2.00	1.06	8.79	53
P-360	AA2003	AA2002	30			40	0.0015	22.82	22.82	4.65	1.00	1.44	2.50	1.35	15.87	7
P-361	AA2002	AA2001	30			101	0.0198	22.82	22.82	11.09	0.44	0.39	1.09	1.63	57.88	0
P-362	AA2001	AA1003	30			146	0.0069	22.82	22.82	7.43	0.60	0.67	1.50	1.63	34.05	0
P-363	A1022	A1021	48			676	0.0367	12.90	12.90	11.21	0.15	0.05	0.59	1.05	275.96	0
P-364	A1021	A1020	36			75	0.0016	69.88	69.88	9.89	1.00	2.61	3.00	1.67	26.73	43
P-365	A1020	A1019	36			316	0.0015	69.88	69.88	9.89	1.00	2.68	3.00	1.65	26.07	44
P-366	A1019	A1018	36			220	0.0016	126.60	126.60	17.91	1.00	4.74	3.00	1.67	26.69	100
P-367	A1018	A1017	36			303	0.0015	126.60	126.60	17.91	1.00	4.91	3.00	1.64	25.78	101
P-368	A1017	A1016	18			30	0.001	175.69	175.69	99.42	1.00	52.53	1.50	0.70	3.34	172
P-369S	A1016	A1015	120			204	0.0016	175.69	175.69	7.07	0.35	0.27	3.54	3.10	655.99	0
P-370	A1015	A1014	18			36	0.0014	175.69	175.69	99.42	1.00	44.57	1.50	0.76	3.94	172
P-371	A6001	A1014	18			135	0.0015	17.68	17.68	10.01	1.00	4.36	1.50	0.77	4.06	14
P-372	A1014	A1013	30			714	0.0016	194.17	194.17	39.56	1.00	11.92	2.50	1.36	16.28	178
P-373	A1013	A1012	48			151	0.0015	194.17	194.17	15.45	1.00	3.46	4.00	2.26	56.19	138
P-374	A1012	A1011	48			177	0.0017	203.45	203.45	16.19	1.00	3.43	4.00	2.32	59.36	144
P-375	C1019	C1018	30			183	0.0107	142.72	142.72	29.07	1.00	3.35	2.50	2.18	42.57	100
P-376	C1020	C1019	30			176	0.0114	133.61	133.61	27.22	1.00	3.05	2.50	2.21	43.87	90
P-377	C1021	C1020	30			95	0.0015	133.61	133.61	27.22	1.00	8.48	2.50	1.34	15.75	118
P-378	C1022	C1021	30			86	0.0015	133.61	133.61	27.22	1.00	8.36	2.50	1.35	15.98	118
P-379	C1023	C1022	30			84	0.0016	133.61	133.61	27.22	1.00	8.23	2.50	1.36	16.23	117
P-38	B1016	B1015	36			157	0.0089	126.71	126.71	17.93	1.00	2.01	3.00	2.56	63.19	64

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P-380	C1024	C1023	30			70	0.0016	133.61	133.61	27.22	1.00	8.22	2.50	1.36	16.26	117
P-381	C1025	C1024	30			281	0.0026	124.56	124.56	25.37	1.00	5.98	2.50	1.55	20.81	104
P-382	C1026	C1025	21			236	0.0078	124.56	124.56	51.79	1.00	8.89	1.75	1.39	14.00	111
P-383	C1027	C1026	18			259	0.0077	56.70	56.70	32.09	1.00	6.13	1.50	1.18	9.25	47
P-384	D4013	D4012	24			75	0.0016	41.87	41.87	13.33	1.00	4.62	2.00	1.07	9.06	33
P-385	D4014	D4013	24			279	0.0015	41.87	41.87	13.33	1.00	4.70	2.00	1.07	8.91	33
P-386	D4015	D4014	18			276	0.0014	29.87	29.87	16.90	1.00	7.45	1.50	0.77	4.01	26
P-387	D4016	D4015	15			261	0.0014	17.72	17.72	14.44	1.00	7.36	1.25	0.62	2.41	15
P-388	D1050	D1049	18			203	0.0046	57.10	57.10	32.31	1.00	8.02	1.50	1.03	7.12	50
P-389	D1049	D1048	18			109	0.0038	57.10	57.10	32.31	1.00	8.74	1.50	0.99	6.53	51
P-39	B1015	B1014	36			248	0.004	126.71	126.71	17.93	1.00	2.98	3.00	2.12	42.47	84
P-390	D1048	D1047	18			192	0.0042	57.10	57.10	32.31	1.00	8.40	1.50	1.01	6.79	50
P-391	D1047	D1046	24			615	0.0085	77.17	77.17	24.56	1.00	3.70	2.00	1.64	20.86	56
P-392	D1046	D1045	12			555	0.0079	77.17	77.17	98.25	1.00	24.26	1.00	0.76	3.18	74
P-393	D1045	D1044	12			85	0.0082	92.73	92.73	118.07	1.00	28.67	1.00	0.77	3.23	89
P-395	D1044	D1043	36			277	0.0052	138.51	138.51	19.60	1.00	2.86	3.00	2.26	48.35	90
P-396	D1043	D1042	36			156	0.0114	138.51	138.51	19.60	1.00	1.94	3.00	2.68	71.54	67
P-399	D1042	D1041	36			764	0.0015	138.51	138.51	19.60	1.00	5.39	3.00	1.64	25.72	113
P-4	A3008	A3007	18			238	0.0041	36.44	36.44	20.62	1.00	5.42	1.50	1.00	6.72	30
P-40	B1014	B1013	60			466	0.0064	194.21	194.21	12.12	0.76	0.93	3.80	3.98	209.58	0
P-400	D1041	D1040	36			527	0.0052	138.51	138.51	19.60	1.00	2.86	3.00	2.27	48.41	90
P-401	D1040	D1039	48			514	0.002	168.47	168.47	13.41	1.00	2.60	4.00	2.43	64.81	104
P-402	D1039	D1038	48			298	0.0025	168.47	168.47	13.41	1.00	2.35	4.00	2.56	71.77	97
P-403	D1038	D1037	48			226	0.0025	183.44	183.44	14.60	1.00	2.56	4.00	2.56	71.75	112
P-404	D1037	D1036	48			239	0.003	183.44	183.44	14.60	1.00	2.34	4.00	2.68	78.45	105
P-405	D1036	D1035	48			240	0.0029	196.21	196.21	15.61	1.00	2.52	4.00	2.67	77.86	118
P-406	D1035	D1034	48			269	0.0031	196.21	196.21	15.61	1.00	2.45	4.00	2.71	79.95	116
P-407	D1034	D1033	48			414	0.0022	196.21	196.21	15.61	1.00	2.92	4.00	2.47	67.14	129
P-408	D9007	D9006	15			266	0.0044	14.49	14.49	11.81	1.00	3.39	1.25	0.84	4.27	10
P-409	D9006	D9005	18			314	0.0075	28.37	28.37	16.06	1.00	3.12	1.50	1.17	9.09	19
P-41	B1013	B1012	54			520	0.0011	202.05	202.05	12.70	1.00	3.15	4.50	2.33	64.10	138
P-410	D9005	D9004	21			88	0.0032	28.37	28.37	11.80	1.00	3.17	1.75	1.11	8.94	19
P-411	D9004	D9003	21			276	0.0036	28.37	28.37	11.80	1.00	3.00	1.75	1.15	9.47	19
P-412	D9003	D9002	24			265	0.0056	28.37	28.37	9.03	1.00	1.67	2.00	1.49	17.02	11

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P-413	D9002	D9001	24			80	0.0051	28.37	28.37	9.03	1.00	1.75	2.00	1.45	16.19	12
P-414	D9001	D1033	24			200	0.0058	28.37	28.37	9.03	1.00	1.64	2.00	1.50	17.30	11
P-415	D1033	D1032	48			125	0.0092	217.10	217.10	17.28	1.00	1.57	4.00	3.49	138.26	79
P-416	D1032	D1031	48			786	0.0042	217.10	217.10	17.28	1.00	2.31	4.00	2.94	93.89	123
P-417	D1031	D1030	54			541	0.0027	239.80	239.80	15.08	1.00	2.33	4.50	2.99	103.14	137
P-418	D1030	D1029	54			290	0.0045	280.51	280.51	17.64	1.00	2.13	4.50	3.38	131.94	149
P-419	D1029	D1028	54			354	0.0041	280.51	280.51	17.64	1.00	2.23	4.50	3.30	125.72	155
P-420	D1028	D1027	42			250	0.0073	282.22	282.22	29.33	1.00	3.27	3.50	2.89	86.29	196
P-421	D1027	D1026	42			344	0.0027	282.22	282.22	29.33	1.00	5.38	3.50	2.27	52.48	230
P-422	D1026	D1025	42			503	0.004	287.05	287.05	29.84	1.00	4.52	3.50	2.50	63.44	224
P-423	D1025	D1024	48			281	0.0028	301.60	301.60	24.00	1.00	3.95	4.00	2.65	76.42	225
P-424	D1024	D1023	48			287	0.0034	301.60	301.60	24.00	1.00	3.60	4.00	2.77	83.72	218
P-425	D1023	D1022	48			273	0.0036	301.60	301.60	24.00	1.00	3.49	4.00	2.82	86.30	215
P-430	D8001	D1031	24			305	0.0059	10.92	10.92	5.86	0.57	0.63	1.15	1.18	17.42	0
P-431	D8002	D8001	24			293	0.0044	10.92	10.92	5.24	0.63	0.72	1.26	1.18	15.10	0
P-432	D8003	D8002	21			273	0.0048	10.92	10.92	5.20	0.82	1.00	1.43	1.23	10.97	0
P-433	D8004	D8003	15			281	0.0076	10.92	10.92	8.90	1.00	1.93	1.25	0.96	5.66	5
P-434	D7001	D1030	24			299	0.0075	17.97	17.97	7.07	0.75	0.92	1.51	1.53	19.59	0
P-435	D7002	D7001	24			258	0.0081	17.97	17.97	7.32	0.73	0.88	1.46	1.53	20.36	0
P-436	D7003	D7002	15			324	0.0111	17.97	17.97	14.64	1.00	2.63	1.25	1.05	6.83	11
P-437	D7004	D7003	12			254	0.0114	17.97	17.97	22.88	1.00	4.70	1.00	0.83	3.82	14
P-438	E5014	E5013	21			153	0.0131	20.83	20.83	8.66	1.00	1.15	1.75	1.55	18.18	3
P-439	E5013	E5012	21			318	0.0037	20.83	20.83	8.66	1.00	2.15	1.75	1.16	9.68	11
P-44	B1010	B1009	72			186	0.0054	229.58	229.58	12.04	0.64	0.74	3.83	4.15	311.42	0
P-440	E5012	E5011	24			177	0.0046	20.83	20.83	6.63	1.00	1.35	2.00	1.42	15.42	5
P-441	E5011	E5010	21			283	0.0041	39.47	39.47	16.41	1.00	3.88	1.75	1.19	10.18	29
P-442	E5010	E5009	30			233	0.2225	39.47	39.47	30.98	0.31	0.20	0.77	2.12	193.98	0
P-443	E5009	E5008	30			243	0.0016	48.41	48.41	9.86	1.00	2.97	2.50	1.36	16.27	32
P-444	E5008	E5007	30			282	0.0015	62.68	62.68	12.77	1.00	3.90	2.50	1.35	16.06	47
P-445	E5007	E5006	36			227	0.0015	62.68	62.68	8.87	1.00	2.39	3.00	1.66	26.27	36
P-446	E5006	E5005	36			273	0.0015	73.75	73.75	10.43	1.00	2.81	3.00	1.65	26.22	48
P-447	E5005	E5004	36			257	0.0015	73.75	73.75	10.43	1.00	2.87	3.00	1.64	25.70	48
P-448	E5004	E5003	42			537	0.0002	73.75	73.75	7.67	1.00	5.36	3.50	1.13	13.76	60
P-449	E5003	E5002	42			66	0.0015	90.20	90.20	9.37	1.00	2.30	3.50	1.95	39.22	51

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P-450	E5002	E5001	42			215	0.002	90.20	90.20	9.37	1.00	2.00	3.50	2.09	45.12	45
P-451	E5001	E1018	42			307	0.0016	90.20	90.20	9.37	1.00	2.24	3.50	1.97	40.29	50
P-452	E1018	E1017	42			185	0.0067	311.62	311.62	32.39	1.00	3.78	3.50	2.83	82.48	229
P-453	E1017	E1016	42			294	0.0039	329.99	329.99	34.30	1.00	5.21	3.50	2.49	63.35	267
P-454	E1016	E1015	48			390	0.0069	329.99	329.99	26.26	1.00	2.75	4.00	3.30	120.02	210
P-455	E1015	E1014	48			50	0.0034	337.41	337.41	26.85	1.00	4.03	4.00	2.77	83.70	254
P-456	E1035	E1034	30			331	0.003	38.47	38.47	7.84	1.00	1.71	2.50	1.61	22.48	16
P-457	E1034	E1033	30			526	0.0027	80.56	80.56	16.41	1.00	3.76	2.50	1.57	21.43	59
P-458	E1033	E1032	30			199	0.0157	80.56	80.56	16.41	1.00	1.57	2.50	2.32	51.46	29
P-459	E1032	E1031	30			286	0.0028	97.12	97.12	19.79	1.00	4.43	2.50	1.59	21.91	75
P-460	E1031	E1030	42			211	0.0054	118.98	118.98	12.37	1.00	1.61	3.50	2.69	73.84	45
P-461	E1030	E1029	42			427	0.0038	118.98	118.98	12.37	1.00	1.91	3.50	2.47	62.35	57
P-462	E1029	E1028	42			252	0.0042	118.98	118.98	12.37	1.00	1.82	3.50	2.53	65.37	54
P-463	E1028	E1027	42			275	0.0046	138.18	138.18	14.36	1.00	2.02	3.50	2.59	68.29	70
P-464	E1027	E1026	42			642	0.0041	138.18	138.18	14.36	1.00	2.13	3.50	2.52	64.83	73
P-465	E1026	E1025	42			256	0.0035	140.66	140.66	14.62	1.00	2.36	3.50	2.42	59.51	81
P-466	E1025	E1024	48			389	0.0039	162.84	162.84	12.96	1.00	1.82	4.00	2.87	89.43	73
P-467	E1024	E1023	48			235	0.0203	162.84	162.84	18.11	0.67	0.79	2.69	3.69	205.02	0
P-468	E1023	E1022	48			313	0.008	162.84	162.84	12.96	1.00	1.27	4.00	3.40	128.66	34
P-469	E1022	E1021	48			94	0.0046	162.84	162.84	12.96	1.00	1.67	4.00	2.99	97.40	65
P-470	E1021	E1020	48			546	0.0046	162.84	162.84	12.96	1.00	1.67	4.00	2.99	97.49	65
P-471	E1020	E1019	54			638	0.0044	162.84	162.84	10.24	1.00	1.24	4.50	3.37	130.82	32
P-472	E6001	E1019	12			292	0.0104	62.81	62.81	79.97	1.00	17.25	1.00	0.81	3.64	59
P-473	E6002	E6001	12			288	0.0114	62.81	62.81	79.97	1.00	16.50	1.00	0.83	3.81	59
P-474	E6003	E6002	12			251	0.013	45.54	45.54	57.98	1.00	11.18	1.00	0.85	4.07	41
P-475	E6004	E6003	12			226	0.0145	45.54	45.54	57.98	1.00	10.60	1.00	0.87	4.29	41
P-476	E6005	E6004	12			263	0.0073	30.04	30.04	38.25	1.00	9.87	1.00	0.75	3.04	27
P-477	E6006	E6005	12			240	0.0132	30.04	30.04	38.25	1.00	7.33	1.00	0.86	4.10	26
P-478	E6007	E6006	12			293	0.0072	13.63	13.63	17.36	1.00	4.49	1.00	0.75	3.04	11
P-479	E4028	E4027	21			175	0.0087	41.30	41.30	17.17	1.00	2.79	1.75	1.43	14.79	27
P-480	E4027	E4026	21			148	0.0075	41.30	41.30	17.17	1.00	3.00	1.75	1.38	13.76	28
P-481	E4026	E4025	21			674	0.0118	55.57	55.57	23.10	1.00	3.22	1.75	1.52	17.24	38
P-482	E4025	E4024	24			244	0.0088	74.81	74.81	23.81	1.00	3.51	2.00	1.65	21.33	53
P-483	E4024	E4023	24			513	0.0127	74.81	74.81	23.81	1.00	2.93	2.00	1.78	25.55	49

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P-484	E4023	E4022	24			272	0.0118	74.81	74.81	23.81	1.00	3.04	2.00	1.75	24.59	50
P-485	E4022	E4021	24			268	0.0124	78.33	78.33	24.93	1.00	3.10	2.00	1.77	25.28	53
P-486	E4021	E4020	36			52	0.004	89.16	89.16	12.61	1.00	2.10	3.00	2.12	42.54	47
P-487	E4020	E4019	36			464	0.0111	89.16	89.16	12.61	1.00	1.26	3.00	2.66	70.53	19
P-488	E4019	E4018	36			89	0.0047	89.16	89.16	12.61	1.00	1.94	3.00	2.21	45.84	43
P-489	E4018	E4017	36			160	0.0045	89.16	89.16	12.61	1.00	1.99	3.00	2.18	44.92	44
P-490	E4017	E4016	36			105	0.0139	89.16	89.16	12.61	1.00	1.13	3.00	2.76	78.87	10
P-491	E4016	E4015	36			206	0.0138	89.16	89.16	12.61	1.00	1.13	3.00	2.76	78.67	10
P-492	E4015	E4014	36			18	0.0104	89.16	89.16	12.61	1.00	1.31	3.00	2.63	68.27	21
P-493	E4014	E4013	36			265	0.0139	89.16	89.16	12.61	1.00	1.13	3.00	2.76	78.78	10
P-494	E4013	E4012	30			542	0.0109	98.86	98.86	20.14	1.00	2.30	2.50	2.19	43.03	56
P-495	E4012	E4011	36			120	0.0108	107.72	107.72	15.24	1.00	1.55	3.00	2.65	69.53	38
P-496	E4011	E4010	42			607	0.0102	107.72	107.72	11.20	1.00	1.06	3.50	3.09	101.72	6
P-497	E4010	E4009	42			550	0.0129	128.71	128.71	13.38	1.00	1.12	3.50	3.21	114.42	14
P-498	E4101	E4010	12			247	0.009	18.04	18.04	22.97	1.00	5.33	1.00	0.79	3.38	15
P-499	E4102	E4101	12			279	0.0096	12.67	12.67	16.13	1.00	3.61	1.00	0.80	3.51	9
P-5	A3007	A3006	18			44	0.0115	36.44	36.44	20.62	1.00	3.23	1.50	1.28	11.28	25
P-500	E4103	E4102	12			57	0.0192	12.67	12.67	16.13	1.00	2.56	1.00	0.91	4.95	8
P-502	F1002	F1001	12			57	0.0175	15.64	15.64	19.92	1.00	3.31	1.00	0.90	4.73	11
P-503	F1003	F1002	18			113	0.0088	10.34	10.34	5.85	1.00	1.04	1.50	1.21	9.90	0
P-504	F1004	F1003	12			176	0.0057	10.34	10.34	13.16	1.00	3.84	1.00	0.70	2.70	8
P-505	F1005	F1004	12			101	0.0099	5.22	5.22	6.65	1.00	1.47	1.00	0.80	3.55	2
P-511	E2026	E2025	12			696	0.0015	19.78	19.78	25.19	1.00	14.33	1.00	0.50	1.38	18
P-512	E2025	E2024	12			410	0.0024	37.98	37.98	48.35	1.00	21.53	1.00	0.57	1.76	36
P-513	E2024	E2023	21			226	0.0266	49.66	49.66	20.65	1.00	1.92	1.75	1.69	25.90	24
P-514	E2023	E2022	42			752	0.01	57.70	57.70	10.83	0.54	0.57	1.90	2.38	100.76	0
P-515	E2022	E2021	48			462	0.0076	79.00	79.00	10.54	0.58	0.63	2.30	2.69	125.33	0
P-516	E2021	E2020		24	96	386	0.0091	87.46	87.46	9.91	0.55	0.41	1.10	1.55	211.41	0
P-517	E2020	E2019	48			251	0.002	93.23	93.23	7.42	1.00	1.45	4.00	2.42	64.33	29
P-518	E2019	E2018	48			660	0.0053	106.48	106.48	8.47	1.00	1.02	4.00	3.10	104.88	2
P-519	E2018	E2017	48			433	0.0015	113.71	113.71	9.05	1.00	2.04	4.00	2.25	55.82	58
P-52	B3001	B1016	12			264	0.0015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	0
P-520	E2219	E2218	30			97	0.0103	3.96	3.96	5.35	0.21	0.09	0.52	0.65	41.75	0
P-521	E2218	E2217	30			405	0.0124	8.17	8.17	7.05	0.29	0.18	0.72	0.95	45.70	0

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P-522	E2217	E2216	36			348	0.0015	75.16	75.16	10.63	1.00	2.91	3.00	1.64	25.84	49
P-523	E2216	E2215	36			160	0.0015	75.16	75.16	10.63	1.00	2.91	3.00	1.64	25.87	49
P-524	E2215	E2214	36			72	0.0698	91.63	91.63	25.24	0.51	0.52	1.53	2.86	176.65	0
P-525	E2214	E2213	42			463	0.0227	129.86	129.86	17.75	0.71	0.85	2.49	3.31	151.91	0
P-526	E2213	E2212	42			287	0.0017	157.30	157.30	16.35	1.00	3.74	3.50	2.02	42.11	115
P-527	E2212	E2211	54			569	0.0123	202.58	202.58	15.62	0.76	0.93	3.42	4.05	218.78	0
P-528	E2211	E2210	54			147	0.0341	202.58	202.58	23.52	0.53	0.56	2.40	4.05	364.22	0
P-529	E2210	E2209		48	60	557	0.0081	231.99	231.99	13.26	0.88	0.84	3.50	4.00	274.62	0
P-53	B2003	B2002	54			257	0.0012	124.10	124.10	7.80	1.00	1.84	4.50	2.39	67.34	57
P-530	E2209	E2208		36	96	367	0.0082	239.92	239.92	13.24	0.75	0.67	2.26	3.00	356.09	0
P-531	E2208	E2207		36	96	63	0.008	239.92	239.92	13.12	0.76	0.68	2.29	3.00	351.59	0
P-532	E2207	E2206		36	96	349	0.0029	285.61	285.61	11.90	1.00	1.35	3.00	2.78	210.86	75
P-533	E2206	E2205		36	96	55	0.0183	285.61	285.61	18.49	0.64	0.54	1.93	3.00	532.71	0
P-534	E2205	E2204		36	96	135	0.0074	285.61	285.61	13.47	0.88	0.84	2.65	3.00	339.21	0
P-535	E2204	E2203		36	96	113	0.0088	288.08	288.08	14.38	0.84	0.78	2.50	3.00	370.46	0
P-536	E2203	E2202		36	96	102	0.002	288.08	288.08	12.00	1.00	1.66	3.00	2.45	174.07	114
P-537	E2202	E2201		36	96	493	0.0057	294.82	294.82	12.36	0.99	0.99	2.98	3.00	296.94	0
P-538	E2301	E2217	24			65	0.0015	67.15	67.15	21.37	1.00	7.57	2.00	1.06	8.87	58
P-539	E2302	E2301	24			57	0.0014	67.15	67.15	21.37	1.00	7.91	2.00	1.04	8.49	59
P-54	B2004	B2003	54			58	0.0797	80.89	80.89	24.94	0.26	0.15	1.16	2.63	556.76	0
P-540	E2303	E2302	24			37	0.0016	67.15	67.15	21.37	1.00	7.33	2.00	1.08	9.17	58
P-541	E2304	E2303	24			304	0.0122	63.91	63.91	20.34	1.00	2.55	2.00	1.76	25.06	39
P-542	E2305	E2304	24			270	0.0552	63.91	63.91	20.34	1.00	1.20	2.00	1.98	53.29	11
P-543	E2306	E2305	24			224	0.0805	55.88	55.88	23.05	0.72	0.87	1.44	1.99	64.34	0
P-544	K1011	K1010	30			146	0.0206	117.53	117.53	23.94	1.00	1.99	2.50	2.39	59.07	58
P-545	K1010	K1009	30			61	0.0139	203.32	203.32	41.42	1.00	4.20	2.50	2.28	48.40	155
P-546	K1009	K1008	36			169	0.018	203.32	203.32	28.76	1.00	2.26	3.00	2.85	89.85	113
P-547	K1008	K1007	36			254	0.0256	203.32	203.32	28.76	1.00	1.90	3.00	2.92	106.95	96
P-548	K1007	K1006	36			260	0.0191	203.32	203.32	28.76	1.00	2.20	3.00	2.86	92.53	111
P-549	D2101	D2004	8			374	0.0015	123.01	123.01	352.40	1.00	264.75	0.67	0.32	0.46	123
P-55	B2005	B2004	24			545	0.0079	80.89	80.89	25.75	1.00	4.01	2.00	1.61	20.15	61
P-550	D2102	D2101	8			452	0.0015	123.01	123.01	352.40	1.00	258.06	0.67	0.32	0.48	123
P-551	D2103	D2102	6			266	0.0015	123.01	123.01	626.48	1.00	563.69	0.50	0.23	0.22	123
P-552	D2104	D2103	12			901	0.0014	50.08	50.08	63.76	1.00	36.91	1.00	0.49	1.36	49

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P-554	D5105	D5104	42			438	0.0015	3.04	3.04	2.43	0.19	0.08	0.66	0.52	39.44	0
P-555	D5104	D5103	42			91	0.0016	29.93	29.93	4.65	0.63	0.73	2.22	1.69	40.95	0
P-556	D5103	D5102	42			128	0.0013	29.93	29.93	4.26	0.69	0.81	2.40	1.69	36.75	0
P-557	D5102	D5101	42			397	0.005	29.93	29.93	7.08	0.45	0.42	1.58	1.69	71.26	0
P-558	D5101	D5006	30			665	0.0015	29.93	29.93	6.10	1.00	1.88	2.50	1.35	15.95	14
P-559	D5006	D5005	42			571	0.0015	88.09	88.09	9.16	1.00	2.25	3.50	1.95	39.16	49
P-56	B2006	B2005	21			282	0.0058	60.44	60.44	25.13	1.00	5.00	1.75	1.30	12.08	48
P-560	D5005	D5004	48			474	0.0015	109.97	109.97	8.75	1.00	1.97	4.00	2.25	55.73	54
P-561	D5004	D5003	48			70	0.0419	136.07	136.07	23.00	0.48	0.46	1.91	3.47	294.94	0
P-562	D5003	D5002	48			94	0.0015	136.07	136.07	10.83	1.00	2.45	4.00	2.24	55.51	81
P-563	D5002	D5001	48			84	0.0016	136.07	136.07	10.83	1.00	2.40	4.00	2.27	56.76	79
P-565	D5007	D5006	24			252	0.0015	68.75	68.75	21.88	1.00	7.80	2.00	1.06	8.81	60
P-566	D5008	D5007	24			281	0.007	68.75	68.75	21.88	1.00	3.62	2.00	1.57	18.99	50
P-567	D5009	D5008	24			280	0.007	61.78	61.78	19.66	1.00	3.26	2.00	1.57	18.97	43
P-568	D5010	D5009	24			553	0.0014	61.78	61.78	19.66	1.00	7.21	2.00	1.04	8.57	53
P-569	D5011	D5010	24			46	0.0109	61.78	61.78	19.66	1.00	2.61	2.00	1.72	23.63	38
P-57	B2007	B2006	21			283	0.0101	60.44	60.44	25.13	1.00	3.78	1.75	1.47	15.99	44
P-570	D5012	D5011	24			179	0.0017	34.59	34.59	11.01	1.00	3.72	2.00	1.09	9.29	25
P-571	D5013	D5012	30			101	0.0041	34.59	34.59	7.05	1.00	1.32	2.50	1.75	26.26	8
P-572	D5014	D5013	24			316	0.0041	34.59	34.59	11.01	1.00	2.39	2.00	1.37	14.49	20
P-573	D5015	D5014	24			54	0.0092	34.59	34.59	11.01	1.00	1.59	2.00	1.67	21.73	13
P-574	D5016	D5015	24			105	0.0029	34.59	34.59	11.01	1.00	2.85	2.00	1.25	12.12	22
P-575	D5017	D5016	24			45	0.0037	34.59	34.59	11.01	1.00	2.49	2.00	1.34	13.89	21
P-576	D5018	D5017	24			1352	0.0035	8.67	8.67	4.56	0.58	0.64	1.17	1.05	13.50	0
P-577	D5201	D5008	12			644	0.0066	13.01	13.01	16.56	1.00	4.49	1.00	0.73	2.90	10
P-578	E1014	E1013	54			274	0.0046	337.41	337.41	21.21	1.00	2.51	4.50	3.41	134.22	203
P-579	E1013	E1012	66			852	0.0028	359.44	359.44	15.13	1.00	2.00	5.50	3.75	179.41	180
P-58	B2008	B2007	12			265	0.0125	40.23	40.23	51.22	1.00	10.08	1.00	0.85	3.99	36
P-585	E1011	E1010	60			493	0.0023	408.88	408.88	10.41	1.00	3.26	5.00	3.21	251.22	158
P-586	E1010	E1009	60			745	0.0023	417.77	417.77	10.64	1.00	3.37	5.00	3.18	248.00	170
P-587	E1009	E1008	66			1302	0.0015	674.29	674.29	14.19	1.00	5.17	5.50	3.17	260.61	414
P-588	E1008	E1007	66			109	0.003	695.23	695.23	14.63	1.00	3.76	5.50	3.81	369.88	325
P-589	E1007	E1006	66			158	0.0029	695.23	695.23	14.63	1.00	3.87	5.50	3.75	359.61	336
P-59	C1016	C1015	30			255	0.0016	142.72	142.72	29.07	1.00	8.76	2.50	1.36	16.30	126

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P-591	E1004	E1003	66			678	0.0024	834.06	834.06	11.70	1.00	5.05	5.50	3.59	495.40	339
P-592	E4009	E4008	42			387	0.0049	146.45	146.45	15.22	1.00	2.07	3.50	2.63	70.64	76
P-593	E4008	E4007	42			283	0.0032	162.87	162.87	16.93	1.00	2.85	3.50	2.37	57.18	106
P-594	E4007	E4006	42			853	0.003	162.87	162.87	16.93	1.00	2.94	3.50	2.33	55.48	107
P-597	E4005	E4004	36			794	0.0036	235.65	235.65	33.34	1.00	5.89	3.00	2.06	40.00	196
P-598	E4004	E4003	36			469	0.0035	248.14	248.14	35.11	1.00	6.28	3.00	2.05	39.54	209
P-599	E4003	E4002	36			121	0.0065	256.20	256.20	36.24	1.00	4.76	3.00	2.38	53.79	202
P-60	C1015	C1014	30			266	0.0015	148.18	148.18	30.19	1.00	9.28	2.50	1.35	15.96	132
P-600	E3018	E3017	30			42	0.0118	55.13	55.13	11.23	1.00	1.23	2.50	2.22	44.67	10
P-601	E3017	E3016	30			586	0.0039	55.13	55.13	11.23	1.00	2.14	2.50	1.73	25.75	29
P-602	E3016	E3015	30			379	0.0049	64.13	64.13	13.07	1.00	2.22	2.50	1.83	28.83	35
P-603	E3015	E3014	30			63	0.0022	73.49	73.49	14.97	1.00	3.80	2.50	1.49	19.35	54
P-604	E3014	E3013	30			391	0.009	73.49	73.49	14.97	1.00	1.88	2.50	2.11	39.02	34
P-605	E3013	E3012	36			408	0.0044	90.70	90.70	12.83	1.00	2.04	3.00	2.17	44.52	46
P-606	E3012	E3011	36			456	0.0015	95.78	95.78	13.55	1.00	3.71	3.00	1.64	25.82	70
P-607	E3011	E3010	42			167	0.0015	103.46	103.46	10.75	1.00	2.65	3.50	1.94	39.06	64
P-608	E3010	E3009	42			142	0.0056	103.46	103.46	10.75	1.00	1.36	3.50	2.73	75.82	28
P-609	E3009	E3008	42			535	0.0015	116.61	116.61	12.12	1.00	2.99	3.50	1.94	39.01	78
P-61	C1014	C1013	36			253	0.0016	148.18	148.18	20.96	1.00	5.57	3.00	1.67	26.61	122
P-610	E3008	E3007	42			286	0.0064	116.61	116.61	12.12	1.00	1.45	3.50	2.80	80.45	36
P-611	E3007	E3006	42			135	0.0015	124.99	124.99	12.99	1.00	3.22	3.50	1.94	38.87	86
P-612	E3006	E3005	33			919	0.0039	124.99	124.99	21.04	1.00	3.78	2.75	1.91	33.09	92
P-613	E3005	E3004		36	58	241	0.0021	135.51	135.51	9.35	1.00	1.46	3.00	2.26	92.94	43
P-614	E3004	E3003		36	58	118	0.003	140.30	140.30	9.68	1.00	1.28	3.00	2.52	109.82	30
P-615	E3003	E3002		36	58	143	0.0073	144.27	144.27	11.40	0.87	0.84	2.62	3.00	172.41	0
P-616	E3002	E3001		36	58	216	0.007	144.27	144.27	11.20	0.89	0.86	2.67	3.00	168.40	0
P-618	E2017	E2016		36	60	633	0.013	125.30	125.30	13.58	0.62	0.52	1.85	2.69	240.71	0
P-62	C1013	C1012	36			253	0.0016	148.18	148.18	20.96	1.00	5.57	3.00	1.67	26.58	122
P-624	E2010	E2009	48			387	0.0054	388.83	388.83	15.47	1.00	3.66	4.00	3.12	212.29	177
P-625	E2009	E2008	48			146	0.0034	367.50	367.50	14.62	1.00	4.36	4.00	2.78	168.74	199
P-63	C1012	C1011	36			250	0.0016	153.21	153.21	21.67	1.00	5.80	3.00	1.66	26.42	127
P-635	E2004	E2003	42			578	0.0081	18.58	18.58	7.42	0.31	0.20	1.07	1.32	90.84	0
P-636	E2003	E2002	42			328	0.0046	27.79	27.79	6.73	0.44	0.41	1.56	1.63	68.26	0
P-637	E2002	E2001	5			25	0.0016	27.79	27.79	203.83	1.00	201.17	0.42	0.20	0.14	28

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ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-638	E2001	E1003		60	60	105	0.0015	472.31	472.31	18.89	1.00	3.01	5.00	3.13	156.93	315
P-64	C1011	C1010	36			239	0.0015	153.21	153.21	21.67	1.00	5.90	3.00	1.65	25.98	127
P-641	E1002	E1001	60			169	0.0031	1306.20	1306.20	22.17	1.00	9.00	5.00	3.45	435.19	871
P-642	K1006	K1005		30	66	675	0.0085	203.32	203.32	14.79	1.00	1.17	2.50	2.50	174.37	29
P-643	K1005	K1004		42	96	249	0.0028	227.69	227.69	8.92	0.91	0.88	3.19	2.93	258.08	0
P-644	K1004	K1003		36	120	101	0.0015	320.84	320.84	10.69	1.00	1.59	3.00	2.33	201.55	119
P-645	K1003	K1002		36	120	194	0.0048	320.84	320.84	11.68	0.92	0.88	2.75	3.00	363.82	0
P-646	K1002	K1001		36	120	167	0.0133	320.84	320.84	16.52	0.65	0.53	1.94	3.00	602.37	0
P-648	L1014	L1013	54			344	0.0104	27.35	27.35	8.83	0.25	0.14	1.12	1.49	200.73	0
P-649	L1013	L1012	7			408	0.005	39.35	39.35	147.25	1.00	65.30	0.58	0.38	0.60	39
P-65	C1010	C1009	36			162	0.0015	157.68	157.68	22.31	1.00	6.01	3.00	1.65	26.26	131
P-650	L1012	L1011	7			94	0.0134	47.97	47.97	179.49	1.00	48.78	0.58	0.48	0.98	47
P-651	L1011	L1010		36	84	217	0.006	60.21	60.21	6.17	0.23	0.23	0.70	0.83	513.13	0
P-652	L1010	L1009		36	84	195	0.006	60.21	60.21	6.18	0.23	0.23	0.70	0.83	513.63	0
P-653	L1009	L1008		36	84	246	0.006	68.09	68.09	6.46	0.25	0.26	0.75	0.90	514.19	0
P-654	L1008	L1007		36	84	526	0.0043	80.74	80.74	6.12	0.31	0.37	0.94	1.01	432.36	0
P-655	L1007	L1006		36	84	49	0.0163	80.74	80.74	9.46	0.20	0.19	0.61	1.01	846.66	0
P-656	L1006	L1005		36	84	410	0.0043	93.29	93.29	6.48	0.34	0.43	1.03	1.11	436.48	0
P-657	L1005	L1004		36	84	65	0.006	102.23	102.23	7.42	0.33	0.40	0.98	1.18	511.64	0
P-658	L1004	L1003		36	84	47	0.0089	106.43	106.43	8.58	0.30	0.34	0.89	1.22	624.51	0
P-659	L1003	L1002	48			367	0.0015	157.16	157.16	5.05	0.77	2.82	3.08	2.17	167.26	0
P-66	C1009	C1008	36			262	0.0015	161.22	161.22	22.81	1.00	6.17	3.00	1.65	26.11	135
P-660	L1002	L1001	48			206	0.0141	162.44	162.44	12.09	0.39	0.95	1.54	2.21	513.96	0
P-661	L1101	L1001	18			156	0.0006	10.29	10.29	5.82	1.00	3.86	1.50	0.62	2.67	8
P-662	L1102	L1101	18			45	0.0009	10.29	10.29	5.82	1.00	3.29	1.50	0.67	3.13	7
P-663	L1103	L1102	18			453	0.001	6.36	6.36	3.60	1.00	1.92	1.50	0.69	3.32	3
P-664	L2003	L2002	12			412	0.002	12.49	12.49	15.90	1.00	7.75	1.00	0.54	1.61	11
P-665	L2002	L2001	12			605	0.0024	18.92	18.92	24.09	1.00	10.85	1.00	0.56	1.74	17
P-666	L2001	L1003	12			574	0.0042	29.23	29.23	37.22	1.00	12.63	1.00	0.65	2.31	27
P-667	L3001	L1003	30			532	0.0015	37.56	37.56	7.65	1.00	2.35	2.50	1.35	15.95	22
P-668	L3002	L3001	24			370	0.0015	37.56	37.56	11.95	1.00	4.29	2.00	1.06	8.75	29
P-669	L3003	L3002	24			49	0.0094	27.45	27.45	8.74	1.00	1.25	2.00	1.68	22.03	5
P-67	C1008	C1007	36			220	0.0016	161.22	161.22	22.81	1.00	6.05	3.00	1.67	26.66	135
P-670	L3004	L3003	24			47	0.0129	27.45	27.45	8.74	1.00	1.07	2.00	1.78	25.73	2

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P-671	L3005	L3004	24			156	0.0035	27.45	27.45	8.74	1.00	2.04	2.00	1.32	13.48	14
P-672	L3006	L3005	24			57	0.0091	27.45	27.45	8.74	1.00	1.27	2.00	1.66	21.67	6
P-673	L3007	L3006	24			653	0.0039	14.48	14.48	4.61	1.00	1.03	2.00	1.35	14.10	0
P-674	L3008	L3007	24			562	0.0015	6.20	6.20	3.01	0.62	0.71	1.25	0.88	8.72	0
P-675	L3009	L3008	21			49	0.0026	6.20	6.20	3.74	0.65	0.76	1.14	0.92	8.17	0
P-676	L4001	L1006	15			150	0.0015	15.53	15.53	12.65	1.00	6.12	1.25	0.64	2.54	13
P-68	C1007	C1006	36			116	0.0016	165.67	165.67	23.44	1.00	6.28	3.00	1.66	26.39	139
P-680	M2006	M2005	24			185	0.0056	24.37	24.37	7.76	1.00	1.43	2.00	1.49	17.03	7
P-681	M2005	M2004	36			366	0.0015	36.95	36.95	5.23	1.00	1.43	3.00	1.64	25.91	11
P-682	M2004	M2003	36			207	0.0015	36.95	36.95	5.23	1.00	1.43	3.00	1.64	25.91	11
P-684	M2002	M2001	36			337	0.0173	36.95	36.95	11.92	0.45	0.42	1.36	1.98	88.07	0
P-685	M1008	M1007	54			850	0.0015	676.39	676.39	42.53	1.00	8.87	4.50	2.55	76.23	600
P-688	M1006	M1005	66			586	0.0009	710.49	710.49	14.95	1.00	7.10	5.50	2.76	200.10	510
P-689	M1005	M1004	66			181	0.003	716.93	716.93	15.09	1.00	3.88	5.50	3.80	369.25	348
P-69	C1006	C1005	36			275	0.0015	165.67	165.67	23.44	1.00	6.33	3.00	1.65	26.15	140
P-690	M1004	M1003	66			270	0.003	716.93	716.93	15.09	1.00	3.89	5.50	3.80	369.06	348
P-691	M1003	M1002		36	72	285	0.0075	716.93	716.93	19.91	1.00	3.06	3.00	3.00	468.07	249
P-692	M1002	M1001		36	72	125	0.0441	716.93	716.93	27.94	0.71	1.26	2.14	3.00	1135.53	0
P-693	M3001	M1006	30			315	0.003	65.61	65.61	13.37	1.00	2.91	2.50	1.62	22.58	43
P-694	M3002	M3001	30			379	0.0032	63.37	63.37	12.91	1.00	2.74	2.50	1.64	23.15	40
P-695	M3003	M3002	30			223	0.0493	63.37	63.37	20.08	0.61	0.69	1.53	2.41	91.30	0
P-697	AB3008	AB3007	24			170	0.0164	5.53	5.53	7.11	0.30	0.19	0.59	0.83	29.01	0
P-698	AB3007	AB3006	24			150	0.0133	9.01	9.01	7.57	0.40	0.34	0.81	1.07	26.20	0
P-699	AB3006	AB3005	24			146	0.0184	9.01	9.01	8.50	0.37	0.29	0.74	1.07	30.76	0
P-7	A3004	A3003	42			1169	0.0016	58.69	58.69	6.10	1.00	1.44	3.50	1.98	40.68	18
P-70	C1005	C1004	36			177	0.0015	178.78	178.78	25.29	1.00	6.84	3.00	1.65	26.13	153
P-700	AB3005	AB3004	30			49	0.0637	9.01	9.01	12.97	0.20	0.09	0.50	1.00	103.77	0
P-701	AB3004	AB3003	30			149	0.0074	13.48	13.48	6.71	0.43	0.38	1.07	1.23	35.34	0
P-702	AB3003	AB3002	36			69	0.004	19.42	19.42	5.88	0.47	0.46	1.42	1.41	42.53	0
P-703	AB3002	AB3001	36			292	0.0246	19.42	19.42	11.33	0.29	0.19	0.87	1.41	104.80	0
P-704	AB3001	AB1001	36			407	0.4664	19.42	19.42	32.07	0.14	0.04	0.42	1.41	456.72	0
P-705	AB2001	AB1001	18			153	0.0015	3.89	3.89	2.63	0.78	0.95	1.17	0.75	4.08	0
P-706	AB6002	AB6001	42			393	0.0015	70.34	70.34	7.31	1.00	1.80	3.50	1.94	39.09	31
P-707	AB6001	AB1005	42			33	0.0015	84.24	84.24	8.76	1.00	2.14	3.50	1.95	39.31	45

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P-709	AB1004	AB1003	54			553	0.0054	168.86	168.86	10.62	1.00	1.16	4.50	3.54	145.17	24
P-71	C1004	C1003	36			113	0.0015	187.60	187.60	26.54	1.00	7.24	3.00	1.64	25.90	162
P-710	AB1003	AB1002	54			259	0.003	168.86	168.86	10.62	1.00	1.56	4.50	3.06	108.28	61
P-711	AB4001	AB1002	15			203	0.012	18.56	18.56	15.12	1.00	2.61	1.25	1.07	7.11	11
P-712	AB4002	AB4001	12			231	0.0107	13.69	13.69	17.43	1.00	3.71	1.00	0.82	3.69	10
P-713	AB4003	AB4002	15			113	0.01	13.69	13.69	11.16	1.00	2.12	1.25	1.02	6.47	7
P-714	AB5002	AB5001	21			215	0.0614	7.57	7.57	12.63	0.30	0.19	0.52	1.02	39.37	0
P-715	AB5001	AB1004	21			429	0.1108	14.12	14.12	18.61	0.35	0.27	0.62	1.40	52.89	0
P-716	AB1006	AB1005	12			119	0.0619	72.09	72.09	91.79	1.00	8.11	1.00	0.99	8.89	63
P-717	AB1007	AB1006	15			211	0.0015	72.09	72.09	58.75	1.00	28.61	1.25	0.64	2.52	70
P-718	AB1008	AB1007	21			71	0.0014	57.28	57.28	23.81	1.00	9.64	1.75	0.90	5.94	51
P-719	AB1009	AB1008	21			84	0.0015	57.28	57.28	23.81	1.00	9.18	1.75	0.92	6.24	51
P-72	C1003	C1002	36			79	0.0015	187.60	187.60	26.54	1.00	7.20	3.00	1.65	26.04	162
P-720	AB1010	AB1009	24			158	0.0263	57.28	57.28	18.23	1.00	1.56	2.00	1.93	36.81	20
P-721	AB1011	AB1010	21			266	0.0909	54.99	54.99	22.86	1.00	1.15	1.75	1.74	47.89	7
P-722	AB1012	AB1011	21			354	0.0455	48.95	48.95	20.35	1.00	1.44	1.75	1.73	33.88	15
P-723	AB1013	AB1012	21			220	0.02	48.95	48.95	20.35	1.00	2.18	1.75	1.65	22.48	26
P-724	AB1014	AB1013	21			252	0.0198	48.95	48.95	20.35	1.00	2.19	1.75	1.65	22.38	27
P-725	AB1015	AB1014	18			362	0.0989	43.32	43.32	24.52	1.00	1.31	1.50	1.50	33.12	10
P-726	AB1016	AB1015	12			200	0.0689	30.70	30.70	39.09	1.00	3.28	1.00	0.99	9.37	21
P-727	AC1004	AC1003	18			88	0.0455	27.18	27.18	15.38	1.00	1.21	1.50	1.48	22.46	5
P-728	AC1005	AC1004	18			151	0.0993	27.18	27.18	20.95	0.69	0.82	1.03	1.49	33.20	0
P-729	AC1006	AC1005	18			391	0.0869	19.59	19.59	18.58	0.58	0.63	0.86	1.46	31.04	0
P-730	AC1007	AC1006	15			473	0.0845	7.51	7.51	14.49	0.44	0.40	0.55	1.09	18.83	0
P-731	AC1008	AC1007	15			349	0.0143	7.51	7.51	7.20	0.79	0.97	0.99	1.09	7.75	0
P-732	AC1009	AC1008	15			210	0.0571	3.50	3.50	10.19	0.32	0.23	0.40	0.75	15.47	0
P-733	AD1012	AD1011	12			334	0.021	6.80	6.80	8.65	1.00	1.31	1.00	0.93	5.17	2
P-734	AD1011	AD1010	15			313	0.0032	18.19	18.19	14.82	1.00	4.97	1.25	0.77	3.66	15
P-735	AD1010	AD1009	15			312	0.0866	26.05	26.05	21.23	1.00	1.37	1.25	1.24	19.06	7
P-736	AD1009	AD1008	15			384	0.0885	35.90	35.90	29.25	1.00	1.86	1.25	1.24	19.26	17
P-737	AD1008	AD1007	15			347	0.0922	40.20	40.20	32.75	1.00	2.04	1.25	1.25	19.67	21
P-738	AD1007	AD1006	21			188	0.0267	87.58	87.58	36.41	1.00	3.38	1.75	1.69	25.94	62
P-739	AD1006	AD1005	24			104	0.0193	91.60	91.60	29.16	1.00	2.91	2.00	1.88	31.48	60
P-74	C2002	C2001	54			190	0.0015	128.67	128.67	8.09	1.00	1.70	4.50	2.54	75.72	53

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P-740	AD1005	AD1004	24			138	0.0217	91.60	91.60	29.16	1.00	2.74	2.00	1.91	33.41	58
P-741	AD1004	AD1003	24			150	0.0133	96.85	96.85	30.83	1.00	3.70	2.00	1.79	26.20	71
P-742	AD3001	AD1009	12			324	0.0185	9.84	9.84	12.53	1.00	2.02	1.00	0.91	4.86	5
P-743	AD3002	AD3001	12			204	0.0196	2.64	2.64	6.46	0.52	0.53	0.52	0.70	5.00	0
P-744	AD3003	AD3002	12			241	0.0871	2.64	2.64	11.16	0.34	0.25	0.34	0.70	10.54	0
P-745	AD2001	AD1007	21			72	0.0417	47.39	47.39	19.70	1.00	1.46	1.75	1.72	32.44	15
P-746	AD2002	AD2001	21			243	0.0698	47.39	47.39	19.70	1.00	1.13	1.75	1.74	41.98	5
P-747	AD2003	AD2002	21			221	0.0227	43.66	43.66	18.15	1.00	1.83	1.75	1.67	23.92	20
P-748	AD2004	AD2003	18			218	0.1194	36.53	36.53	20.67	1.00	1.00	1.50	1.50	36.39	0
P-749	AD2005	AD2004	18			459	0.085	34.10	34.10	19.30	1.00	1.11	1.50	1.49	30.72	3
P-75	C2003	C2002	48			268	0.0015	90.40	90.40	7.19	1.00	1.63	4.00	2.24	55.62	35
P-750	AD2006	AD2005	18			161	0.0015	34.10	34.10	19.30	1.00	8.38	1.50	0.77	4.07	30
P-751	AD2007	AD2006	18			91	0.0441	34.10	34.10	19.30	1.00	1.54	1.50	1.48	22.11	12
P-752	AD2008	AD2007	18			167	0.0479	28.36	28.36	16.05	1.00	1.23	1.50	1.48	23.05	5
P-753	AD2009	AD2008	18			130	0.0015	28.36	28.36	16.05	1.00	7.04	1.50	0.77	4.03	24
P-754	AD2010	AD2009	18			212	0.0141	19.46	19.46	11.01	1.00	1.56	1.50	1.33	12.52	7
P-755	AG1006	AG1005	12			241	0.0166	7.50	7.50	9.55	1.00	1.63	1.00	0.89	4.60	3
P-756	AG1005	AG1004	12			80	0.0624	10.03	10.03	12.77	1.00	1.12	1.00	0.99	8.92	1
P-757	AG1004	AG1003	12			105	0.4288	10.03	10.03	28.63	0.46	0.43	0.46	0.99	23.39	0
P-758	AG1003	AG1002	12			128	0.2579	10.03	10.03	23.68	0.53	0.55	0.53	0.99	18.14	0
P-76	C2004	C2003	48			288	0.0016	82.56	82.56	6.57	1.00	1.45	4.00	2.27	56.91	26
P-760	AG1002	AG1001	18			442	0.0204	29.42	29.42	16.65	1.00	1.96	1.50	1.41	15.03	14
P-761	AG2001	AG1002	12			423	0.0544	11.79	11.79	15.01	1.00	1.41	1.00	0.99	8.33	3
P-762	AE1011	AE1010	18			274	0.0045	29.58	29.58	16.74	1.00	4.19	1.50	1.03	7.06	23
P-763	AE1010	AE1009	24			499	0.0511	34.43	34.43	17.51	0.60	0.67	1.20	1.92	51.26	0
P-764	AE1009	AE1008	24			59	0.0568	42.74	42.74	19.07	0.67	0.79	1.34	1.96	54.06	0
P-765	AE1008	AE1007	24			374	0.0929	42.74	42.74	23.18	0.57	0.62	1.14	1.96	69.15	0
P-767	AE3001	AE1005	36			308	0.1377	51.21	51.21	27.67	0.31	0.21	0.92	2.33	248.21	0
P-768	AE1005	AE1004	42			784	0.0326	111.29	111.29	19.86	0.56	0.61	1.98	3.18	182.03	0
P-769	AE1004	AE1003	42			386	0.0846	118.77	118.77	28.88	0.44	0.40	1.55	3.24	293.40	0
P-770	AE1003	AE1002	42			197	0.0015	158.67	158.67	16.49	1.00	4.03	3.50	1.95	39.34	119
P-771	AE1002	AE1001	42			353	0.068	158.67	158.67	28.62	0.56	0.60	1.96	3.41	263.09	0
P-773	AE2005	AE2004	24			374	0.0199	8.95	8.95	8.73	0.36	0.28	0.72	1.07	32.03	0
P-774	AE2004	AE2003	24			353	0.0724	15.26	15.26	16.15	0.34	0.25	0.68	1.41	61.05	0

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ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-775	AE2003	AE2002	24			173	0.0949	22.45	22.45	19.82	0.39	0.32	0.78	1.69	69.89	0
P-776	AE2002	AE2001	24			115	0.0628	25.69	25.69	17.62	0.47	0.45	0.94	1.78	56.83	0
P-777	AE2001	AE1003	24			113	0.2223	25.69	25.69	28.00	0.33	0.24	0.67	1.78	106.96	0
P-779	AF3007	AF3006	24			265	0.0655	72.46	72.46	23.06	1.00	1.25	2.00	1.99	58.07	14
P-780	AF3006	AF3005	24			239	0.0412	90.77	90.77	28.89	1.00	1.97	2.00	1.97	46.03	45
P-781	AF3005	AF3004	24			221	0.0784	102.74	102.74	32.70	1.00	1.62	2.00	1.99	63.50	39
P-782	AF3004	AF3003	24			179	0.0691	102.74	102.74	32.70	1.00	1.72	2.00	1.99	59.62	43
P-783	AF3003	AF3002	24			65	0.0386	109.62	109.62	34.89	1.00	2.46	2.00	1.97	44.56	65
P-784	AF3002	AF3001	30			398	0.042	109.62	109.62	22.33	1.00	1.30	2.50	2.47	84.24	25
P-785	AF3001	AF1003	30			42	0.0662	109.62	109.62	22.33	1.00	1.04	2.50	2.49	105.84	4
P-786	AF1003	AF1002	48			634	0.0334	166.78	166.78	22.15	0.58	0.63	2.31	3.71	263.04	0
P-787	AF1002	AF1001	48			137	0.0787	166.78	166.78	30.61	0.45	0.41	1.79	3.71	404.15	0
P-788	AF2001	AF1001	60			273	0.0015	54.90	54.90	5.26	0.52	0.54	2.62	2.08	101.20	0
P-789	AF2002	AF2001	54			354	0.0015	34.26	34.26	4.67	0.47	0.45	2.11	1.68	76.29	0
P-79	C2007	C2006	4			72	0.0015	33.46	33.46	383.43	1.00	447.63	0.33	0.15	0.07	33
P-791	AF1004	AF1003	48			517	0.0399	42.72	42.72	16.41	0.26	0.15	1.04	1.95	287.71	0
P-792	AF1005	AF1004	48			710	0.0158	37.30	37.30	11.34	0.31	0.21	1.23	1.82	180.87	0
P-794	AH1002	AH1001	36			134	0.0015	12.84	12.84	3.65	0.50	0.50	1.49	1.14	25.86	0
P-795	AH1003	AH1002	36			351	0.0513	12.84	12.84	13.06	0.20	0.08	0.59	1.14	151.49	0
P-796	AH1004	AH1003	36			189	0.1109	7.30	7.30	14.48	0.12	0.03	0.37	0.85	222.68	0
P-797	AH1005	AH1004	36			370	0.1107	7.30	7.30	14.45	0.12	0.03	0.37	0.85	222.50	0
P-798	AH1006	AH1005	21			249	0.1326	3.34	3.34	13.08	0.16	0.06	0.29	0.67	57.85	0
P-799	M4014	M4013	30			346	0.1365	145.86	145.86	35.28	0.79	0.96	1.96	2.50	151.96	0
P-8	A3003	A3002	36			255	0.0015	58.69	58.69	8.30	1.00	2.24	3.00	1.65	26.16	33
P-80	C2008	C2007	4			139	0.0014	33.46	33.46	383.43	1.00	462.58	0.33	0.15	0.07	33
P-800	M4013	M4012	30			401	0.0478	153.06	153.06	31.18	1.00	1.70	2.50	2.48	89.90	63
P-801	M4012	M4011	30			29	0.0343	158.57	158.57	32.30	1.00	2.08	2.50	2.46	76.15	82
P-802	M4011	M4010	30			298	0.0302	158.57	158.57	32.30	1.00	2.22	2.50	2.45	71.49	87
P-803	M4010	M4009	30			166	0.0015	166.92	166.92	34.00	1.00	10.47	2.50	1.35	15.94	151
P-804	M4009	M4008	30			261	0.023	166.92	166.92	34.00	1.00	2.68	2.50	2.41	62.39	105
P-805	M4008	M4007	30			46	0.0219	185.46	185.46	37.78	1.00	3.05	2.50	2.40	60.80	125
P-806	M4007	M4006	30			595	0.0134	185.46	185.46	37.78	1.00	3.89	2.50	2.27	47.67	138
P-807	M4006	M4005	30			336	0.0258	185.46	185.46	37.78	1.00	2.81	2.50	2.43	66.07	119
P-808	M5014	M5013	18			311	0.005	38.67	38.67	21.89	1.00	5.20	1.50	1.06	7.44	31

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P-809	M5013	M5012	18			250	0.008	43.92	43.92	24.85	1.00	4.66	1.50	1.19	9.42	34
P-81	C2009	C2008	4			242	0.0015	26.57	26.57	304.44	1.00	356.29	0.33	0.15	0.07	26
P-810	M5012	M5011	18			50	0.0014	43.92	43.92	24.85	1.00	11.09	1.50	0.76	3.96	40
P-811	M5011	M5010	18			1068	0.0372	43.92	43.92	24.85	1.00	2.16	1.50	1.47	20.32	24
P-812	M5010	M5009	18			56	0.0834	62.21	62.21	35.21	1.00	2.05	1.50	1.49	30.41	32
P-813	M5009	M5008		36	36	563	0.0114	103.33	103.33	12.07	0.95	0.94	2.85	3.00	109.98	0
P-814	M5008	M5007		36	36	82	0.0012	123.57	123.57	13.73	1.00	3.42	3.00	1.65	36.10	87
P-815	M5007	M5006		36	60	349	0.0143	123.57	123.57	14.02	0.59	0.49	1.76	2.67	253.04	0
P-816	M5006	M5005		36	60	74	0.004	136.42	136.42	9.09	1.00	1.02	3.00	2.82	134.21	2
P-817	M5005	M5004		36	60	56	0.0089	136.42	136.42	12.13	0.75	0.68	2.25	2.85	199.87	0
P-818	M5004	M5003		48	72	315	0.0033	136.42	136.42	8.39	0.68	0.60	2.71	2.52	227.63	0
P-82	C2010	C2009	3			270	0.0093	26.57	26.57	541.22	1.00	311.34	0.25	0.18	0.09	26
P-820	M5002	M5001		48	48	129	0.0064	159.30	159.30	10.90	0.91	0.89	3.65	3.67	178.11	0
P-821	M5001	M1011		48	48	86	0.0407	159.30	159.30	22.26	0.45	0.36	1.79	3.67	448.36	0
P-827	M1028	M1027	30			598	0.0958	93.02	93.02	28.31	0.63	0.73	1.59	2.48	127.32	0
P-828	M1027	M1026	30			290	0.1378	108.85	108.85	33.79	0.62	0.71	1.56	2.49	152.68	0
P-829	M1026	M1025	30			144	0.0903	108.85	108.85	28.41	0.73	0.88	1.82	2.49	123.58	0
P-83	C2011	C2010	3			209	0.0024	21.75	21.75	443.05	1.00	501.39	0.25	0.12	0.04	22
P-830	M1024	M1023	24			109	0.092	116.16	116.16	36.98	1.00	1.69	2.00	1.99	68.78	47
P-831	M1023	M1022	30			374	0.0535	121.75	121.75	24.80	1.00	1.28	2.50	2.48	95.13	27
P-832	M1022	M1021	30			270	0.0371	121.75	121.75	24.80	1.00	1.54	2.50	2.46	79.16	43
P-833	M1021	M1020	30			253	0.0752	121.75	121.75	24.80	1.00	1.08	2.50	2.49	112.75	9
P-834	M1020	M1019	30			80	0.0124	150.89	150.89	30.74	1.00	3.29	2.50	2.24	45.86	105
P-835	M6001	M1019	30			696	0.0431	72.67	72.67	19.53	0.71	0.85	1.77	2.45	85.40	0
P-836	M1019	M1018	36			763	0.0354	223.56	223.56	31.63	1.00	1.78	3.00	2.96	125.83	98
P-837	M1018	M1017	36			53	0.019	233.83	233.83	33.08	1.00	2.54	3.00	2.86	92.21	142
P-838	M1017	M1016	36			237	0.0211	233.83	233.83	33.08	1.00	2.41	3.00	2.88	97.04	137
P-839	M1016	M1015	36			43	0.0231	225.09	225.09	31.84	1.00	2.22	3.00	2.90	101.60	123
P-84	C2012	C2011	30			281	0.0018	14.21	14.21	3.94	0.69	0.82	1.72	1.27	17.34	0
P-840	M1015	M1014	36			780	0.0192	225.09	225.09	31.84	1.00	2.43	3.00	2.86	92.71	132
P-841	M1014	M1013	36			94	0.0107	244.48	244.48	34.59	1.00	3.54	3.00	2.64	69.02	175
P-842	M1013	M1012	42			686	0.019	244.48	244.48	25.41	1.00	1.76	3.50	3.35	138.88	106
P-843	M1012	M1011	42			79	0.0063	257.74	257.74	26.79	1.00	3.22	3.50	2.79	80.02	178
P-844	M1011	M1010		60	84	126	0.0015	403.87	403.87	11.54	1.00	1.61	5.00	3.42	251.62	152

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P-845	M1010	M1009		60	84	74	0.0015	403.87	403.87	11.54	1.00	1.61	5.00	3.41	250.48	153
P-846	M1009	M1008		60	84	124	0.0016	403.87	403.87	11.54	1.00	1.55	5.00	3.51	260.91	143
P-847	M3005	M3004	30			193	0.0052	63.37	63.37	12.91	1.00	2.14	2.50	1.86	29.61	34
P-85	C2013	C2012	24			311	0.0032	14.21	14.21	4.52	1.00	1.10	2.00	1.29	12.87	1
P-851	N1028	N1027	36			1012	0.0175	191.72	191.72	27.12	1.00	2.17	3.00	2.84	88.45	103
P-852	N1027	N1026	36			241	0.055	314.57	314.57	44.50	1.00	2.01	3.00	2.98	156.89	158
P-853	N1026	N1025	36			1087	0.032	306.47	306.47	43.36	1.00	2.56	3.00	2.95	119.66	187
P-854	N1025	N1024	36			322	0.0328	354.85	354.85	50.20	1.00	2.93	3.00	2.95	121.12	234
P-855	N1024	N1023	36			98	0.032	314.83	314.83	44.54	1.00	2.63	3.00	2.95	119.67	195
P-856	N1023	N1022	36			178	0.032	328.98	328.98	46.54	1.00	2.75	3.00	2.95	119.56	209
P-857	N1022	N1021	30			52	0.0321	328.98	328.98	67.02	1.00	4.46	2.50	2.45	73.73	255
P-858	N1021	N1020	30			440	0.0321	328.98	328.98	67.02	1.00	4.47	2.50	2.45	73.67	255
P-859	N1020	N1019	30			74	0.0199	311.64	311.64	63.49	1.00	5.37	2.50	2.38	57.98	254
P-86	C2014	C2013	21			255	0.0055	6.60	6.60	5.03	0.54	0.56	0.94	0.95	11.76	0
P-860	N1019	N1018	30			128	0.0064	311.64	311.64	63.49	1.00	9.47	2.50	1.95	32.90	279
P-861	N1018	N1017	30			112	0.0099	311.64	311.64	63.49	1.00	7.63	2.50	2.15	40.84	271
P-862	N1030	N1029	12			455	0.0015	99.89	99.89	127.19	1.00	72.29	1.00	0.50	1.38	99
P-863	N1031	N1030	12			66	0.0091	67.75	67.75	86.26	1.00	19.84	1.00	0.79	3.42	64
P-867	N1002	N1001		48	96	555	0.0094	515.86	515.86	17.23	0.94	0.92	3.74	4.00	563.81	0
P-868	N1003	N1002		48	96	409	0.0044	515.86	515.86	16.12	1.00	1.33	4.00	4.00	386.45	129
P-869	N1004	N1003		48	96	330	0.0091	515.86	515.86	17.02	0.95	0.93	3.79	4.00	554.90	0
P-87	C2015	C2014	18			284	0.0078	3.85	3.85	5.01	0.45	0.41	0.67	0.75	9.27	0
P-870	N1005	N1004		48	96	255	0.0157	502.37	502.37	20.66	0.76	0.69	3.04	4.00	728.75	0
P-871	N1006	N1005		48	96	312	0.0244	496.23	496.23	24.13	0.64	0.55	2.57	4.00	909.26	0
P-872	N1007	N1006		48	96	32	0.0016	496.23	496.23	15.51	1.00	2.15	4.00	2.96	230.81	265
P-873	N1008	N1007		48	96	270	0.0185	491.04	491.04	21.79	0.70	0.62	2.82	4.00	792.42	0
P-874	N1009	N1008		48	96	214	0.014	491.04	491.04	19.72	0.78	0.71	3.11	4.00	689.22	0
P-875	N1010	N1009		48	96	64	0.0016	484.25	484.25	15.13	1.00	2.11	4.00	2.95	230.01	254
P-876	N1011	N1010		48	96	571	0.0035	476.62	476.62	14.89	1.00	1.38	4.00	3.86	344.54	132
P-877	N1012	N1011		24	84	244	0.0041	473.41	473.41	33.82	1.00	3.92	2.00	2.00	120.74	353
P-878	N1013	N1012		24	84	281	0.0143	468.07	468.07	33.43	1.00	2.08	2.00	2.00	225.03	243
P-879	N1014	N1013	48			386	0.013	348.69	348.69	27.75	1.00	2.13	4.00	3.69	163.96	185
P-88	C3001	C2002	36			54	0.0015	36.50	36.50	5.16	1.00	1.42	3.00	1.64	25.69	11
P-880	N1015	N1014	48			99	0.0304	348.69	348.69	27.75	1.00	1.39	4.00	3.94	251.13	98

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P-881	N1016	N1015	48			184	0.0054	307.06	307.06	24.43	1.00	2.89	4.00	3.12	106.28	201
P-882	N2001	N1013	21			615	0.0179	158.93	158.93	66.07	1.00	7.48	1.75	1.63	21.25	138
P-883	N2002	N2001	18			426	0.0235	143.20	143.20	81.04	1.00	8.88	1.50	1.43	16.13	127
P-884	N2003	N2002	21			1178	0.0399	103.26	103.26	42.93	1.00	3.25	1.75	1.72	31.74	72
P-885	O1012	O1010	21			239	0.0078	13.59	13.59	6.65	0.79	0.97	1.39	1.37	14.04	0
P-886	O1010	O1009	24			223	0.0303	26.05	26.05	13.43	0.59	0.66	1.19	1.79	39.49	0
P-887	O1009	O1008	21			247	0.0015	26.05	26.05	10.83	1.00	4.24	1.75	0.91	6.15	20
P-888	O1008	O1007	36			259	0.0015	35.23	35.23	4.98	1.00	1.36	3.00	1.64	25.94	9
P-889	O1007	O1006	36			270	0.0083	44.87	44.87	9.43	0.64	0.74	1.91	2.18	60.95	0
P-89	C3002	C3001	36			114	0.0015	36.50	36.50	5.16	1.00	1.41	3.00	1.64	25.80	11
P-890	O1006	O1005	36			212	0.0099	54.56	54.56	10.51	0.69	0.82	2.07	2.40	66.61	0
P-893	O1004	O1003	30			90	0.031	67.49	67.49	16.76	0.76	0.93	1.91	2.43	72.38	0
P-894	O1003	O1002	36			325	0.0031	67.49	67.49	9.55	1.00	1.82	3.00	1.98	37.10	30
P-895	O1002	O1001	36			52	0.0096	80.23	80.23	11.35	1.00	1.23	3.00	2.59	65.40	15
P-9	A3002	A3001	36			49	0.0016	62.05	62.05	8.78	1.00	2.30	3.00	1.68	26.93	35
P-90	C3003	C3002	36			318	0.0015	36.50	36.50	5.16	1.00	1.41	3.00	1.65	25.98	11
P-91	C3004	C3003	36			211	0.0014	26.24	26.24	3.71	1.00	1.04	3.00	1.62	25.20	1
P-92	C3005	C3004	30			231	0.0014	20.34	20.34	4.14	1.00	1.31	2.50	1.33	15.56	5
P-93	C3006	C3005	24			281	0.0104	20.34	20.34	8.31	0.73	0.88	1.46	1.62	23.11	0
P-94	C3007	C3006	24			353	0.0062	16.34	16.34	6.46	0.75	0.91	1.50	1.46	17.90	0
P-95	C3008	C3007	24			319	0.0056	11.60	11.60	5.83	0.61	0.68	1.21	1.22	17.04	0
P-958	D5106	D5105	42			72	0.0015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.31	0
P-959	D5001	D1018	60			819	0.0079	136.07	136.07	12.30	0.55	0.59	2.75	3.34	232.45	0
P-96	C3009	C3008	24			187	0.0054	5.34	5.34	4.70	0.39	0.32	0.78	0.81	16.60	0
P-960	I1001	I-1		48	72	333	0.0023	410.87	410.87	17.12	1.00	2.20	4.00	3.11	186.94	224
P-961	M3006	M3005	4			469	0.0064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0
P-962	I2007	I2006	24			289	0.0016	68.41	68.41	21.78	1.00	7.65	2.00	1.07	8.95	59
P-963	I2006	I2005	24			452	0.0015	102.68	102.68	32.68	1.00	11.50	2.00	1.07	8.93	94
P-964	I4002	I4001	24			500	0.0015	30.67	30.67	9.76	1.00	3.45	2.00	1.06	8.90	22
P-965S	I4001	I1005	120			834	0.003	30.67	30.67	5.36	0.13	0.03	1.26	1.27	907.89	0
P-966	J1002	J1001	60			131	0.0015	95.67	95.67	5.90	0.77	0.94	3.85	2.78	101.90	0
P-967	J1001	J-1	60			163	0.0015	95.67	95.67	5.92	0.77	0.94	3.84	2.78	102.22	0
P-97	C4003	C4002	24			265	0.0015	22.95	22.95	7.31	1.00	2.61	2.00	1.06	8.81	14
P-970	I1015	I1014	24			366	0.0034	51.66	51.66	16.44	1.00	3.88	2.00	1.31	13.31	38

Appendix B
City of Richmond - Storm Drain Master Plan
Street Flow Analysis: 10-Year Rainfall Event

ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-971	I1014	I1013	24			401	0.0033	51.66	51.66	16.44	1.00	3.94	2.00	1.30	13.11	39
P-972	I1017	I1016	24			437	0.0028	22.05	22.05	7.02	1.00	1.82	2.00	1.25	12.11	10
P-973	I1019	I1018	15			282	0.0031	14.70	14.70	11.98	1.00	4.09	1.25	0.77	3.60	11
P-974	I1018	I1017	21			278	0.0031	14.70	14.70	6.11	1.00	1.66	1.75	1.10	8.84	6
P-975	C1002	C1001	36			54	0.0015	187.60	187.60	26.54	1.00	7.28	3.00	1.64	25.78	162
P-976	C2001	C1001	54			60	0.0015	128.67	128.67	8.09	1.00	1.68	4.50	2.55	76.43	52
P-977	C1001	C-1	84			196	0.0016	274.02	274.02	7.12	1.00	1.07	7.00	4.19	254.96	19
P-979	C1018	C1017	30			232	0.0016	142.72	142.72	29.07	1.00	8.68	2.50	1.37	16.44	126
P-98	C4004	C4003	24			180	0.0022	18.81	18.81	5.99	1.00	1.76	2.00	1.17	10.68	8
P-980	C1017	C1016	30			49	0.0016	142.72	142.72	29.07	1.00	8.63	2.50	1.37	16.54	126
P-984	B1018	B1017	24			748	0.0017	108.91	108.91	34.67	1.00	11.52	2.00	1.10	9.46	99
P-985	B1017	B1016	24			282	0.0092	108.91	108.91	34.67	1.00	5.00	2.00	1.67	21.78	87
P-986	B2001	B1014	12			209	0.0024	124.10	124.10	158.01	1.00	71.11	1.00	0.56	1.75	122
P-987	A1011	A1010	48			745	0.0015	203.45	203.45	16.19	1.00	3.68	4.00	2.24	55.34	148
P-987S	B2002	B2001	120			705	0.0015	124.10	124.10	6.33	0.30	0.19	2.98	2.59	642.87	0
P-988	A1001	A-1	78			80	0.0015	439.91	439.91	13.26	1.00	2.16	6.50	3.81	203.97	236
P-989	A3006	A3005	21			524	0.0021	45.50	45.50	18.92	1.00	6.25	1.75	1.00	7.28	38
P-99	C4005	C4004	24			299	0.0015	18.81	18.81	5.99	1.00	2.14	2.00	1.06	8.80	10
P-990	A3005	A3004	24			485	0.0072	58.69	58.69	18.68	1.00	3.05	2.00	1.58	19.26	39
P-991	D2001	D-2	36			397	0.0015	198.99	198.99	28.15	1.00	7.65	3.00	1.65	26.00	173
P-992	E1001	E-1	60			199	0.0032	1310.27	1310.27	22.24	1.00	8.93	5.00	3.47	440.35	870
P-993	E1003	E1002	60			287	0.089	1295.14	1295.14	40.69	0.53	1.66	2.66	4.92	2336.71	0
P-994	E1012	E1011	60			1037	0.0028	384.73	384.73	9.80	1.00	2.81	5.00	3.35	274.29	110
P-995	E1019	E1018	54			36	0.0031	230.90	230.90	14.52	1.00	2.11	4.50	3.08	109.30	122
P-996	E4002	E4001	36			261	0.0102	241.58	241.58	34.18	1.00	3.57	3.00	2.62	67.62	174
P-997	E4001	E1009	42			125	0.0539	241.58	241.58	25.11	1.00	1.03	3.50	3.48	234.18	7
P-998	E4006	E4005	4			860	0.0009	227.52	227.52	2607.24	1.00	3935.40	0.33	0.13	0.06	227
P-999	E1006	E1005	66			547	0.0019	695.23	695.23	9.75	1.00	4.78	5.50	3.36	436.13	259

Appendix B
City of Richmond - Storm Drain Master Plan
Street Flow Analysis: 100-Year Rainfall Event

ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
11	D1001	D-1		48	72	197	0.0015	986.70	986.70	20.56	1.00	6.42	4.00	2.73	307.16	680
17	C2006	C2004	48			368	0.0015	107.27	107.27	8.54	1.00	1.95	4.00	2.23	55.14	52
21	B1009	B-1		66	114	174	0.0058	339.56	339.56	12.70	0.51	0.40	2.81	3.41	847.83	0
23	B1012	B1010	54			317	0.0014	310.23	310.23	19.51	1.00	4.17	4.50	2.52	74.35	236
29	86	84	48			468	0.0043	100.95	100.95	8.03	1.00	1.07	4.00	2.94	94.20	7
31	84	82		48	76	167	0.003	100.95	100.95	7.41	0.54	0.43	2.15	1.99	232.25	0
33	82	80	54			604	0.0074	100.95	100.95	11.15	0.55	0.59	2.50	2.95	170.17	0
39	R1001	R-1	36			1358	0.0007	248.93	248.93	35.22	1.00	13.72	3.00	1.36	18.15	231
35S	80	B2003	120			1611	0.0068	100.95	100.95	10.20	0.18	0.07	1.84	2.33	1370.05	0
P-1	A3011	A3010	12			275	0.0095	30.86	30.86	39.29	1.00	8.88	1.00	0.80	3.47	27
P-10	A3001	A1007	36			296	0.0015	88.89	88.89	12.57	1.00	3.41	3.00	1.65	26.08	63
P-100	C4006	C4005	21			194	0.0015	24.59	24.59	10.22	1.00	4.01	1.75	0.91	6.14	18
P-1000	E1005	E1004	66			302	0.0024	1194.18	1194.18	16.75	1.00	7.22	5.50	3.60	496.51	698
P-1001	E3001	E1005		36	58	415	0.0043	220.53	220.53	15.21	1.00	1.67	3.00	2.85	132.22	88
P-1002	E2006	E2104		48	76	409	0.015	584.48	584.48	17.79	0.65	1.12	2.59	4.00	1039.64	0
P-1003	E2007	E2006	54			786	0.0015	563.37	563.37	17.71	1.00	7.37	4.50	2.55	152.80	411
P-1004	E2008	E2007	54			778	0.0048	536.61	536.61	16.87	1.00	3.91	4.50	3.45	274.58	262
P-1005	E2101	E2001	12			26	1.0505	651.64	651.64	829.70	1.00	17.80	1.00	1.00	36.61	615
P-1006	E2102	E2101	42			247	0.0249	651.64	651.64	33.87	1.00	4.09	3.50	3.41	318.36	333
P-1007	E2103	E2102	45			667	0.0024	646.13	646.13	29.25	1.00	10.95	3.75	2.36	118.06	528
P-1008	E2104	E2103	45			773	0.0071	592.32	592.32	26.82	1.00	5.78	3.75	3.10	204.92	387
P-1009	E2005	E2004	36			757	0.0023	10.53	10.53	4.05	0.40	0.33	1.19	1.03	31.96	0
P-101	C4007	C4006	21			240	0.0015	18.08	18.08	7.52	1.00	2.94	1.75	0.91	6.16	12
P-1010	E2011	E2010		42	144	603	0.0073	555.67	555.67	15.50	0.85	0.80	2.99	3.50	697.68	0
P-1012	E2014	E2013		48	144	282	0.0035	528.12	528.12	11.86	0.93	0.90	3.71	3.92	587.29	0
P-1013	E2013	E2012		48	144	161	0.0062	541.34	541.34	14.54	0.78	0.70	3.10	3.98	776.48	0
P-1014	E2012	E2011		48	144	136	0.0037	541.34	541.34	12.09	0.93	0.91	3.73	3.98	596.91	0
P-1015	E2029	E2028	12			342	0.0088	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.35	0
P-1016	E2028	E2027	12			699	0.0014	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.35	0
P-1017	E2027	E2026	12			540	0.0056	8.29	8.29	10.56	1.00	3.11	1.00	0.70	2.66	6
P-1018	F1001	F-1	18			537	0.0279	22.81	22.81	12.91	1.00	1.30	1.50	1.45	17.60	5
P-1019	E2016	E2015	12			83	0.0014	179.06	179.06	227.98	1.00	131.66	1.00	0.49	1.36	178
P-102	C4008	C4007	18			347	0.0015	18.08	18.08	10.23	1.00	4.44	1.50	0.77	4.08	14
P-1020	E2015	E2014		48	144	335	0.0015	513.13	513.13	10.69	1.00	1.35	4.00	3.15	381.07	132

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P-1021	E2201	E2015		36	60	715	0.0159	434.09	434.09	28.94	1.00	1.63	3.00	3.00	266.80	167
P-103	C4009	C4008	15			302	0.0015	6.49	6.49	5.29	1.00	2.60	1.25	0.63	2.50	4
P-1035	K1001	K-1		36	120	105	0.0051	554.52	554.52	18.48	1.00	1.49	3.00	3.00	371.76	183
P-1036	L1001	L-1	48			37	0.0269	253.78	253.78	17.24	0.41	1.07	1.65	2.79	709.30	0
P-1037	L4002	L4001	15			585	0.0015	8.67	8.67	7.07	1.00	3.47	1.25	0.63	2.50	6
P-1038	M2003	M2002	36			437	0.0015	53.06	53.06	7.51	1.00	2.04	3.00	1.65	25.99	27
P-1039	M1007	M1006	66			479	0.0046	964.54	964.54	20.30	1.00	4.24	5.50	4.22	455.21	509
P-104	C4010	C4009	12			270	0.0588	6.49	6.49	12.11	0.65	0.75	0.65	0.97	8.66	0
P-1040	M2001	M-1	12			46	0.0096	53.06	53.06	67.56	1.00	15.19	1.00	0.80	3.49	50
P-1041	M1001	M-1		36	72	46	0.0097	1117.76	1117.76	31.05	1.00	4.20	3.00	3.00	532.63	585
P-1042	M5101	M5003	48			587	0.0015	31.50	31.50	4.57	0.54	0.56	2.15	1.67	55.76	0
P-1043	M5003	M5002		48	48	215	0.0015	231.71	231.71	14.48	1.00	2.71	4.00	2.42	85.61	146
P-1044	M3004	M3003	4			25	0.0016	90.99	90.99	1042.66	1.00	1180.64	0.33	0.15	0.08	91
P-1045S	M1025	M1024	120			393	0.0652	169.41	169.41	26.27	0.14	0.04	1.37	3.04	4233.56	0
P-1046	N1001	N-1		48	96	920	0.0046	845.48	845.48	26.42	1.00	2.14	4.00	4.00	395.68	450
P-1046S	N1017	N1016	120			541	0.0203	445.37	445.37	23.12	0.29	0.19	2.94	5.02	2363.99	0
P-1047	O1001	O-1	36			103	0.0097	151.96	151.96	21.50	1.00	2.31	3.00	2.60	65.82	86
P-1048	O1005	O1004	36			595	0.0094	82.63	82.63	11.69	1.00	1.27	3.00	2.58	64.91	18
P-106	I1016	I1015	24			352	0.003	52.51	52.51	16.71	1.00	4.23	2.00	1.27	12.42	40
P-1062S	N1029	N1028	120			911	0.1856	145.67	145.67	36.23	0.10	0.02	0.99	2.81	7143.82	0
P-1063	M4101	M4005	36			1051	0.001	205.15	205.15	29.02	1.00	9.95	3.00	1.46	20.63	185
P-1064	M4005	M4004	24			295	0.012	454.04	454.04	72.26	1.00	18.28	2.00	1.76	49.69	404
P-1065	M4004	M4003	24			1114	0.0151	480.89	480.89	76.54	1.00	17.25	2.00	1.83	55.75	425
P-1066S	M4003	M4002	120			430	0.0028	480.89	480.89	11.45	0.53	0.55	5.27	5.23	879.70	0
P-1067	M4002	M4001	120			163	0.0095	490.38	490.38	18.04	0.38	0.30	3.78	5.28	1615.39	0
P-1068	M4001	M1008	42			803	0.0015	490.38	490.38	50.97	1.00	12.58	3.50	1.94	39.00	451
P-1069	AE1001	AE-1	42			129	0.0601	242.50	242.50	29.29	0.80	0.98	2.81	3.48	247.29	0
P-1070	AF1001	AF-1	90			440	0.0476	337.60	337.60	29.74	0.30	0.20	2.28	4.75	1680.31	0
P-1071	AE1007	AE1006	24			223	0.0245	73.02	73.02	23.24	1.00	2.06	2.00	1.92	35.53	37
P-1072	AE1006	AE1005	24			73	0.1506	73.02	73.02	31.32	0.70	0.83	1.39	2.00	88.02	0
P-1073	AG1001	AG-1	21			202	0.0148	72.53	72.53	30.16	1.00	3.75	1.75	1.58	19.36	53
P-1074	AD1003	AD1002	24			74	0.0136	177.59	177.59	56.53	1.00	6.72	2.00	1.80	26.42	151
P-1075	AD1002	AD1001	24			31	0.0323	177.59	177.59	56.53	1.00	4.36	2.00	1.96	40.76	137
P-1076	AD1001	AD-1	24			114	0.0088	177.59	177.59	56.53	1.00	8.34	2.00	1.65	21.28	156

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P-1077	AC1003	AC1002	12			167	0.036	82.30	82.30	104.79	1.00	12.15	1.00	0.97	6.77	76
P-1078	AC1002	AC1001	12			194	0.031	82.30	82.30	104.79	1.00	13.09	1.00	0.96	6.29	76
P-1079	AC1001	AC-1	12			101	0.0197	88.10	88.10	112.17	1.00	17.56	1.00	0.92	5.02	83
P-1080	AB1005	AB1004	42			1025	0.048	217.90	217.90	26.20	0.81	0.99	2.82	3.47	221.02	0
P-1081	T1001	T-1	54			144	0.0221	265.21	265.21	20.87	0.75	0.91	3.35	4.32	293.02	0
P-1082	U1001	U-1	48			54	0.002	144.70	144.70	11.52	1.00	2.23	4.00	2.43	65.01	80
P-1083	V1001	V-1	30			172	0.0015	126.13	126.13	25.69	1.00	7.88	2.50	1.35	16.00	110
P-1084	W1001	W-1	24			198	0.0467	74.67	74.67	23.77	1.00	1.52	2.00	1.98	49.00	26
P-1085	W1101	W-1	36			130	0.0905	43.52	43.52	22.72	0.32	0.22	0.95	2.15	201.19	0
P-1086	R1002	R1001	36			1127	0.0195	248.93	248.93	35.22	1.00	2.66	3.00	2.87	93.46	155
P-1087	S1001	S-1	42			536	0.0034	258.15	258.15	26.83	1.00	4.38	3.50	2.41	58.97	199
P-1088	X2004	X2003	30			50	0.015	35.19	35.19	11.09	0.62	0.70	1.54	2.01	50.35	0
P-1089	X2005	X2004	30			500	0.018	23.66	23.66	10.81	0.46	0.43	1.14	1.66	55.20	0
P-1090	X1002	X1001	36			209	0.1163	101.45	101.45	31.31	0.47	0.44	1.40	2.90	228.05	0
P-1091	X1001	X-1	36			326	0.1732	110.49	110.49	37.11	0.44	0.40	1.31	2.93	278.33	0
P-1092	Y1001	Y-1	36			123	0.0105	268.95	268.95	38.05	1.00	3.92	3.00	2.64	68.54	200
P-1093	Z1101	Z1001	12			22	0.0023	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.70	0
P-1093S	Y1007	Y1006	120			250	0.0399	204.53	204.53	23.41	0.17	0.06	1.68	3.35	3313.65	0
P-1094	Z1002	Z1001	12			20	0.002	67.56	67.56	86.02	1.00	42.49	1.00	0.54	1.59	66
P-1095	Z1001	Z-1	12			30	0.0017	67.56	67.56	86.02	1.00	46.10	1.00	0.51	1.47	66
P-1096	AA1008	AA1007	36			882	0.0015	13.93	13.93	3.73	0.52	0.54	1.57	1.19	25.87	0
P-1097	AA1001	AA-1	36			106	0.0188	150.29	150.29	21.26	1.00	1.64	3.00	2.86	91.82	58
P-1098	AB1001	AB-1	72			217	0.0015	292.51	292.51	10.35	1.00	1.77	6.00	3.50	165.67	127
P-1099	AB1002	AB1001	12			29	6.2096	265.93	265.93	338.59	1.00	2.99	1.00	1.00	89.02	177
P-11	A1007	A1006	84			235	0.0015	483.71	483.71	12.57	1.00	1.96	7.00	4.12	247.02	237
P-110	D4012	D4010	24			542	0.0015	87.64	87.64	27.90	1.00	9.93	2.00	1.06	8.83	79
P-1100	AH1001	AH-1	36			96	0.0015	20.00	20.00	3.99	0.67	0.78	2.00	1.44	25.50	0
P-1101	C4002	C4001	27			167	0.0015	49.20	49.20	12.37	1.00	4.09	2.25	1.20	12.02	37
P-1102S	C4001	C2006	120			614	0.0015	49.20	49.20	4.84	0.19	0.08	1.87	1.61	641.95	0
P-111	D4011	D4010	24			528	0.0001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.61	0
P-112	D4010	D4009	36			86	0.0015	87.64	87.64	12.40	1.00	3.36	3.00	1.65	26.07	62
P-113	D4009	D4008	36			406	0.0016	87.64	87.64	12.40	1.00	3.30	3.00	1.66	26.54	61
P-114	D4008	D4007	36			105	0.0015	121.26	121.26	17.15	1.00	4.65	3.00	1.65	26.10	95
P-115	D4007	D4006	36			39	0.0015	121.26	121.26	17.15	1.00	4.64	3.00	1.65	26.16	95

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P-116	D4006	D4005	36			209	0.0015	121.26	121.26	17.15	1.00	4.64	3.00	1.65	26.15	95
P-117	D4005	D4004	36			251	0.0015	121.26	121.26	17.15	1.00	4.72	3.00	1.64	25.68	96
P-118	D4004	D4003	36			761	0.0015	177.83	177.83	25.16	1.00	6.84	3.00	1.65	26.00	152
P-119	D4003	D4002	42			642	0.0015	177.83	177.83	18.48	1.00	4.58	3.50	1.94	38.81	139
P-12	A1006	A1005	84			110	0.0015	597.77	597.77	15.53	1.00	2.44	7.00	4.10	244.68	353
P-120	D4002	D4001	42			393	0.0039	177.83	177.83	18.48	1.00	2.81	3.50	2.49	63.18	115
P-121	D4001	D1015	42			147	0.0061	177.83	177.83	18.48	1.00	2.25	3.50	2.78	79.00	99
P-122	D1015	D1014		48	72	73	0.0015	876.96	876.96	18.27	1.00	5.73	4.00	2.72	306.11	571
P-123	D1014	D1013		48	72	128	0.0015	876.96	876.96	18.27	1.00	5.77	4.00	2.71	303.93	573
P-124	D1013	D1012		48	72	367	0.0016	876.96	876.96	18.27	1.00	5.50	4.00	2.80	318.76	558
P-125	D1012	D1011		48	72	442	0.0017	899.14	899.14	18.73	1.00	5.54	4.00	2.83	324.49	575
P-126	D1011	D1010		48	72	448	0.0014	899.14	899.14	18.73	1.00	6.07	4.00	2.66	296.14	603
P-127	D1010	D1009		48	72	54	0.0016	911.76	911.76	18.99	1.00	5.72	4.00	2.80	319.06	593
P-128	D1009	D1008		48	72	438	0.0069	911.76	911.76	18.99	1.00	2.79	4.00	4.00	653.16	259
P-129	D1008	D1007		48	72	93	0.0027	943.30	943.30	19.65	1.00	4.61	4.00	3.30	408.91	534
P-13	A1005	A1004	84			426	0.0015	597.77	597.77	15.53	1.00	2.41	7.00	4.13	248.16	350
P-130	D1007	D1006		48	84	351	0.0032	943.30	943.30	16.84	1.00	3.45	4.00	3.62	547.13	396
P-131	D1006	D1005		48	84	306	0.0014	943.30	943.30	16.84	1.00	5.17	4.00	2.76	365.01	578
P-132	D1005	D1004		48	84	143	0.0016	943.30	943.30	16.84	1.00	4.84	4.00	2.89	389.72	554
P-133	D1004	D1003		48	84	154	0.0015	943.30	943.30	16.84	1.00	5.02	4.00	2.82	376.07	567
P-134	D1003	D1002		48	84	379	0.0015	954.71	954.71	17.05	1.00	5.06	4.00	2.83	377.58	577
P-135	D1002	D1001		48	84	129	0.0074	954.71	954.71	17.05	1.00	2.28	4.00	4.00	838.05	117
P-137	D1022	D1021	54			512	0.0037	451.78	451.78	28.41	1.00	3.75	4.50	3.23	120.48	331
P-138	D1021	D1020	84			622	0.002	481.15	481.15	12.50	1.00	1.69	7.00	4.44	284.85	196
P-139	D1020	D1019	84			531	0.0013	505.08	505.08	13.12	1.00	2.16	7.00	4.01	234.13	271
P-14	A1004	A1003	84			119	0.0015	627.50	627.50	16.31	1.00	2.52	7.00	4.14	249.15	378
P-140	D1019	D1018	84			141	0.0001	505.08	505.08	13.12	1.00	6.62	7.00	2.23	76.31	429
P-141	D1018	D1017	72			749	0.016	665.86	665.86	20.03	0.57	1.24	3.42	4.96	1074.74	0
P-142	D1017	D1016	72			581	0.002	695.18	695.18	12.29	1.00	3.68	6.00	3.75	377.93	317
P-143	D1016	D1015	72			71	0.0027	695.18	695.18	12.29	1.00	3.17	6.00	4.05	437.93	257
P-144	D6001	D1022	24			499	0.0015	28.20	28.20	8.98	1.00	3.21	2.00	1.06	8.79	19
P-145	D4104	D4103	15			348	0.0028	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.40	0
P-146	D4103	D4102	21			501	0.0058	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.11	0
P-147	D4102	D4101	24			262	0.0038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.96	0

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P-148	D4101	D4003	24			277	0.0018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.74	0
P-15	A1003	A1002	84			44	0.0022	627.50	627.50	16.31	1.00	2.07	7.00	4.59	303.81	324
P-150	D2009	D2008	42			1408	0.0014	60.36	60.36	6.27	1.00	1.59	3.50	1.92	38.02	22
P-151	D2008	D2007	42			123	0.0108	60.36	60.36	11.29	0.54	0.58	1.90	2.43	104.94	0
P-152	D2007	D2006	42			1129	0.0015	94.28	94.28	9.80	1.00	2.43	3.50	1.94	38.80	55
P-153	D2006	D2005	42			1386	0.0014	94.28	94.28	9.80	1.00	2.46	3.50	1.92	38.33	56
P-154	D2005	D2004	42			235	0.0015	139.38	139.38	14.49	1.00	3.58	3.50	1.94	38.91	100
P-155	D2004	D2003	42			551	0.0015	267.20	267.20	27.77	1.00	6.74	3.50	1.96	39.63	228
P-156	D2003	D2002	42			552	0.0014	267.20	267.20	27.77	1.00	6.96	3.50	1.93	38.41	229
P-157	D2002	D2001	42			60	0.0017	267.20	267.20	27.77	1.00	6.47	3.50	2.00	41.27	226
P-16	A1002	A1001	78			984	0.001	627.50	627.50	18.91	1.00	3.86	6.50	3.38	162.45	465
P-164	J1018	J1017	18			579	0.0061	10.80	10.80	6.11	1.00	1.31	1.50	1.11	8.22	3
P-165	J1017	J1016	30			285	0.0031	16.63	16.63	5.06	0.63	0.73	1.59	1.38	22.74	0
P-166	J1016	J1015	30			52	0.0079	22.61	22.61	7.83	0.57	0.62	1.42	1.62	36.54	0
P-167	J1015	J1014	30			360	0.005	22.61	22.61	6.55	0.66	0.78	1.66	1.62	29.09	0
P-168	J1014	J1013	36			286	0.0052	22.61	22.61	6.73	0.48	0.47	1.44	1.53	48.42	0
P-169	J1013	J1012	36			54	0.0011	36.85	36.85	5.21	1.00	1.65	3.00	1.52	22.32	15
P-17	A4004	A4003	48			69	0.0015	57.49	57.49	4.57	1.00	1.05	4.00	2.23	54.90	3
P-170	J1012	J1011	36			140	0.0015	36.85	36.85	5.21	1.00	1.42	3.00	1.64	25.94	11
P-171	J1011	J1010	36			507	0.0014	36.85	36.85	5.21	1.00	1.45	3.00	1.63	25.38	11
P-172	J1010	J1009	36			27	0.0015	69.73	69.73	9.86	1.00	2.73	3.00	1.63	25.58	44
P-173	J1009	J1008	42			414	0.0019	69.73	69.73	7.25	1.00	1.57	3.50	2.08	44.35	25
P-174	J1008	J1007	42			32	0.0016	89.89	89.89	9.34	1.00	2.25	3.50	1.97	39.94	50
P-175	J1007	J1006	48			489	0.0047	89.89	89.89	8.92	0.75	0.91	2.99	2.87	98.78	0
P-176	J1006	J1005	48			85	0.0018	89.89	89.89	7.15	1.00	1.49	4.00	2.34	60.38	30
P-177	J1005	J1004	48			318	0.0016	89.89	89.89	7.15	1.00	1.57	4.00	2.27	57.13	33
P-178	J1004	J1003	54			145	0.0021	136.72	136.72	8.60	1.00	1.53	4.50	2.78	89.63	47
P-179	J1003	J1002	54			39	0.0026	136.72	136.72	8.60	1.00	1.37	4.50	2.93	99.69	37
P-18	A4003	A4002	48			405	0.0016	57.49	57.49	5.23	0.82	1.00	3.27	2.28	57.70	0
P-180	I1013	I1012	21			569	0.0027	119.88	119.88	49.84	1.00	14.51	1.75	1.07	8.26	112
P-181	I1012	I1011	21			623	0.0041	119.88	119.88	49.84	1.00	11.77	1.75	1.19	10.19	110
P-182	I1011	I1010	30			102	0.001	151.00	151.00	30.76	1.00	11.75	2.50	1.20	12.85	138
P-183	I1010	I1009	36			69	0.0013	151.00	151.00	21.36	1.00	6.25	3.00	1.58	24.15	127
P-184	I1009	I1008	36			266	0.0016	169.99	169.99	24.05	1.00	6.40	3.00	1.67	26.58	143

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P-185	I1008	I1007	36			43	0.0023	169.99	169.99	24.05	1.00	5.29	3.00	1.84	32.16	138
P-186	I1007	I1006	36			51	0.0039	169.99	169.99	24.05	1.00	4.08	3.00	2.10	41.69	128
P-187	I1006	I1005	36			197	0.0015	169.99	169.99	24.05	1.00	6.51	3.00	1.65	26.10	144
P-188	I1005	I1004	48			983	0.0015	333.45	333.45	26.54	1.00	5.93	4.00	2.26	56.26	277
P-189	I1004	I1003	48			441	0.0016	333.45	333.45	26.54	1.00	5.81	4.00	2.28	57.38	276
P-19	A4002	A4001	48			433	0.0015	57.49	57.49	4.57	1.00	1.03	4.00	2.25	55.79	2
P-190	I1003	I1002	48			405	0.0015	333.45	333.45	26.54	1.00	6.02	4.00	2.24	55.44	278
P-191	I1002	I1001	48			104	0.0005	333.45	333.45	26.54	1.00	10.54	4.00	1.67	31.63	302
P-193	I2014	I2013	18			312	0.0064	55.43	55.43	31.37	1.00	6.57	1.50	1.12	8.44	47
P-194	I2013	I2012	18			188	0.0212	55.43	55.43	31.37	1.00	3.61	1.50	1.41	15.34	40
P-195	I2012	I2011	12			141	0.0142	97.63	97.63	124.31	1.00	22.94	1.00	0.87	4.26	93
P-196	I2011	I2010	18			56	0.0062	97.63	97.63	55.25	1.00	11.74	1.50	1.12	8.31	89
P-197	I2010	I2009	12			113	0.0177	97.63	97.63	124.31	1.00	20.56	1.00	0.90	4.75	93
P-198	I2009	I2008	12			107	0.0017	97.63	97.63	124.31	1.00	66.63	1.00	0.51	1.47	96
P-199	I2008	I2007	24			248	0.0093	97.63	97.63	31.08	1.00	4.47	2.00	1.67	21.83	76
P-2	A3010	A3009	15			263	0.0027	38.53	38.53	31.40	1.00	11.44	1.25	0.74	3.37	35
P-20	A4001	A1008	48			574	0.0015	57.49	57.49	4.57	1.00	1.04	4.00	2.23	55.12	2
P-201	I2005	I2004	30			473	0.0015	170.69	170.69	34.77	1.00	10.57	2.50	1.36	16.15	155
P-202	I2004	I2003	30			46	0.0015	170.69	170.69	34.77	1.00	10.58	2.50	1.36	16.13	155
P-203	I2003	I2002	30			264	0.0015	195.01	195.01	39.73	1.00	12.17	2.50	1.35	16.02	179
P-204	I2002	I2001	30			409	0.0016	195.01	195.01	39.73	1.00	11.90	2.50	1.37	16.39	179
P-205	I2001	I1001	30			62	0.0015	195.01	195.01	39.73	1.00	12.42	2.50	1.34	15.71	179
P-206	I3001	I1001	12			37	0.0016	87.52	87.52	111.43	1.00	61.08	1.00	0.51	1.43	86
P-207	I3002	I3001	12			107	0.0213	87.52	87.52	111.43	1.00	16.80	1.00	0.93	5.21	82
P-208	I3003	I3002	12			443	0.0009	87.52	87.52	111.43	1.00	81.51	1.00	0.44	1.07	86
P-209	I3004	I3003	12			645	0.0006	73.37	73.37	93.42	1.00	82.49	1.00	0.40	0.89	72
P-21	A1008	A1007	72			953	0.0015	385.33	385.33	13.63	1.00	2.34	6.00	3.49	164.47	221
P-210	I3005	I3004	12			450	0.0004	51.21	51.21	65.21	1.00	68.02	1.00	0.36	0.75	50
P-211	R1004	R1003	24			391	0.0307	59.88	59.88	19.06	1.00	1.51	2.00	1.95	39.76	20
P-212	R1003	R1002	30			137	0.0219	237.07	237.07	48.30	1.00	3.90	2.50	2.40	60.83	176
P-215	T2003	T2002	15			379	0.039	48.59	48.59	39.59	1.00	3.80	1.25	1.22	12.80	36
P-216	T2002	T2001	18			395	0.0145	48.59	48.59	27.50	1.00	3.83	1.50	1.34	12.68	36
P-217	T2001	T1001	12			83	0.0216	48.59	48.59	61.87	1.00	9.25	1.00	0.93	5.25	43
P-218	T1002	T1001	54			129	0.022	212.86	212.86	20.06	0.63	0.73	2.85	4.12	292.70	0

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P-219	T1003	T1002	54			105	0.022	212.86	212.86	20.06	0.63	0.73	2.85	4.12	292.73	0
P-22	A1009	A1008	66			802	0.0015	353.61	353.61	14.88	1.00	2.67	5.50	3.20	132.42	221
P-220	T1004	T1003	54			291	0.0382	212.86	212.86	24.85	0.53	0.55	2.39	4.12	385.57	0
P-221	T4001	T1004	18			44	0.0041	90.29	90.29	51.09	1.00	13.47	1.50	1.00	6.70	84
P-222	T4002	T4001	15			573	0.019	90.29	90.29	73.57	1.00	10.11	1.25	1.15	8.93	81
P-223	T4003	T4002	15			416	0.0576	52.24	52.24	42.57	1.00	3.36	1.25	1.24	15.55	37
P-224	T3001	T1001	12			245	0.0033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.04	0
P-225	T1005	T1004	54			73	0.0015	153.43	153.43	9.65	1.00	2.01	4.50	2.55	76.43	77
P-226	T1006	T1005	54			114	0.0172	153.43	153.43	16.96	0.55	0.59	2.49	3.63	258.75	0
P-227	T1007	T1006	54			355	0.003	153.43	153.43	9.65	1.00	1.43	4.50	3.05	107.24	46
P-229	T5001	T1007	30			60	0.0321	92.56	92.56	18.86	1.00	1.26	2.50	2.45	73.68	19
P-23	A1010	A1009	60			755	0.0015	329.98	329.98	16.81	1.00	3.24	5.00	2.87	101.89	228
P-230	T5002	T5001	30			84	0.0393	92.56	92.56	18.86	1.00	1.13	2.50	2.47	81.55	11
P-231	T5003	T5002	30			61	0.0137	92.56	92.56	18.86	1.00	1.93	2.50	2.27	48.05	45
P-232	T5004	T5003	24			69	0.0118	92.56	92.56	29.46	1.00	3.76	2.00	1.75	24.62	68
P-233	T5005	T5004	24			61	0.013	92.56	92.56	29.46	1.00	3.57	2.00	1.78	25.91	67
P-234	T5006	T5005	24			65	0.0123	48.97	48.97	15.59	1.00	1.95	2.00	1.76	25.12	24
P-235	T5007	T5006	24			67	0.012	48.97	48.97	15.59	1.00	1.97	2.00	1.76	24.89	24
P-236	T5008	T5007	24			70	0.0116	48.97	48.97	15.59	1.00	2.00	2.00	1.75	24.48	24
P-237	T5009	T5008	24			72	0.0115	41.22	41.22	13.12	1.00	1.70	2.00	1.74	24.31	17
P-238	T5010	T5009	24			62	0.0133	41.22	41.22	13.12	1.00	1.57	2.00	1.79	26.20	15
P-239	T5011	T5010	24			63	0.0135	41.22	41.22	13.12	1.00	1.56	2.00	1.79	26.36	15
P-24	A5001	A1010	48			508	0.0015	49.08	49.08	4.98	0.73	0.89	2.93	2.10	55.34	0
P-240	T5012	T5011	24			204	0.0067	28.88	28.88	9.19	1.00	1.55	2.00	1.55	18.60	10
P-241	T5013	T5012	21			280	0.0161	28.88	28.88	12.01	1.00	1.43	1.75	1.60	20.16	9
P-242	T5014	T5013	21			258	0.003	28.88	28.88	12.01	1.00	3.31	1.75	1.10	8.73	20
P-244	V1002	V1001	12			72	0.0222	112.25	112.25	142.93	1.00	21.10	1.00	0.93	5.32	107
P-245	V1003	V1002	30			200	0.008	112.25	112.25	22.87	1.00	3.05	2.50	2.05	36.78	75
P-246	V1004	V1003	30			60	0.0067	112.25	112.25	22.87	1.00	3.34	2.50	1.97	33.58	79
P-247	V1005	V1004	42			96	0.0078	103.49	103.49	10.76	1.00	1.16	3.50	2.93	88.98	15
P-248	V1006	V1005	36			441	0.0083	76.39	76.39	10.81	1.00	1.26	3.00	2.51	60.74	16
P-249	V1007	V1006	36			104	0.1513	67.19	67.19	30.87	0.35	0.26	1.04	2.62	260.10	0
P-25	A5002	A5001	48			423	0.0015	49.08	49.08	5.06	0.72	0.87	2.88	2.10	56.44	0
P-250	V2001	V1005	30			310	0.0036	17.67	17.67	5.49	0.62	0.71	1.56	1.42	24.82	0

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P-251	V2002	V2001	24			148	0.0047	14.31	14.31	5.59	0.76	0.92	1.52	1.36	15.47	0
P-252	V2003	V2002	24			113	0.0044	10.24	10.24	5.17	0.60	0.68	1.21	1.15	15.11	0
P-253	V2004	V2003	15			132	0.0109	5.10	5.10	6.05	0.65	0.76	0.81	0.92	6.76	0
P-254	W1105	W1104	24			240	0.093	25.23	25.23	20.28	0.42	0.36	0.84	1.77	69.18	0
P-255	W1104	W1103	12			145	0.093	25.23	25.23	32.12	1.00	2.32	1.00	1.00	10.89	14
P-256	W1103	W1102	24			215	0.093	43.52	43.52	23.27	0.58	0.63	1.15	1.97	69.16	0
P-257	W1102	W1101	12			196	0.093	43.52	43.52	55.41	1.00	3.99	1.00	1.00	10.90	33
P-26	A5003	A5002	48			133	0.0015	49.08	49.08	5.01	0.73	0.88	2.91	2.10	55.78	0
P-260	W1002	W1001	12			216	0.0467	74.67	74.67	95.07	1.00	9.67	1.00	0.98	7.72	67
P-261	W1003	W1002	12			400	0.0467	74.67	74.67	95.07	1.00	9.67	1.00	0.98	7.72	67
P-262	W1004	W1003	12			428	0.06	32.52	32.52	41.40	1.00	3.72	1.00	0.99	8.75	24
P-263	W1005	W1004	24			170	0.0015	32.52	32.52	10.35	1.00	3.74	2.00	1.05	8.70	24
P-264	W1006	W1005	15			211	0.0015	32.52	32.52	26.50	1.00	12.88	1.25	0.64	2.53	30
P-265	T1008	T1007	54			666	0.0142	74.68	74.68	13.12	0.39	0.32	1.74	2.52	234.92	0
P-266	T1009	T1008	24			367	0.0122	74.68	74.68	23.77	1.00	2.98	2.00	1.76	25.05	50
P-267	T1010	T1009	24			145	0.0508	74.68	74.68	23.77	1.00	1.46	2.00	1.98	51.13	24
P-268	T1011	T1010	24			58	0.0722	53.18	53.18	21.87	0.72	0.87	1.45	1.98	60.94	0
P-269	T1012	T1011	24			344	0.0498	37.83	37.83	17.67	0.64	0.75	1.29	1.94	50.64	0
P-27	A2001	A1006	18			294	0.0015	132.23	132.23	74.83	1.00	32.07	1.50	0.78	4.12	128
P-270	T1013	T1012	24			93	0.0582	37.83	37.83	18.80	0.61	0.69	1.22	1.94	54.71	0
P-271	U1002	U1001	48			75	0.0021	144.70	144.70	11.52	1.00	2.17	4.00	2.46	66.62	78
P-272	U1003	U1002	48			61	0.0026	124.42	124.42	9.90	1.00	1.68	4.00	2.60	73.99	50
P-273	U1004	U1003	48			89	0.0018	124.42	124.42	9.90	1.00	2.03	4.00	2.36	61.15	63
P-274	U1005	U1004	48			103	0.0072	116.60	116.60	11.04	0.78	0.96	3.13	3.26	121.92	0
P-275	U1006	U1005	48			61	0.0031	116.60	116.60	9.28	1.00	1.45	4.00	2.72	80.32	36
P-276	U1007	U1006	48			64	0.0028	116.60	116.60	9.28	1.00	1.53	4.00	2.64	76.31	40
P-277	U1008	U1007	48			65	0.0029	116.60	116.60	9.28	1.00	1.50	4.00	2.67	77.71	39
P-278	U1009	U1008	48			55	0.0035	116.60	116.60	9.28	1.00	1.37	4.00	2.79	84.82	32
P-279	U1010	U1009	48			48	0.0034	104.58	104.58	8.32	1.00	1.25	4.00	2.77	83.44	21
P-28	A2002	A2001	18			135	0.0015	132.23	132.23	74.83	1.00	32.57	1.50	0.77	4.06	128
P-280	U1011	U1010	48			49	0.0033	104.58	104.58	8.32	1.00	1.27	4.00	2.75	82.63	22
P-281	U1012	U1011	48			47	0.0351	104.58	104.58	20.11	0.43	0.39	1.73	3.10	269.88	0
P-282	U1013	U1012	48			78	0.0182	104.58	104.58	15.74	0.52	0.54	2.09	3.10	194.41	0
P-283	U1014	U1013	36			84	0.038	93.42	93.42	20.07	0.63	0.72	1.88	2.87	130.43	0

Appendix B
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P-284	U1015	U1014	36			266	0.012	93.42	93.42	13.22	1.00	1.27	3.00	2.70	73.41	20
P-285	U1016	U1015	36			50	0.0283	67.22	67.22	16.63	0.56	0.60	1.67	2.62	112.59	0
P-286	U1017	U1016	18			363	0.0818	51.22	51.22	28.99	1.00	1.70	1.50	1.49	30.11	21
P-287	V1008	V1007	36			155	0.0015	67.19	67.19	9.51	1.00	2.61	3.00	1.64	25.75	41
P-288	V1009	V1008	36			101	0.0039	67.19	67.19	9.51	1.00	1.62	3.00	2.10	41.53	26
P-289	V1010	V1009	36			73	0.0467	67.19	67.19	20.06	0.48	0.47	1.44	2.62	144.45	0
P-29	A2003	A2002	12			704	0.0006	132.23	132.23	168.36	1.00	155.27	1.00	0.39	0.85	131
P-290	V1011	V1010	36			54	0.067	67.19	67.19	22.93	0.43	0.39	1.30	2.62	173.10	0
P-291	V1012	V1011	36			56	0.0608	54.01	54.01	20.87	0.39	0.33	1.18	2.39	164.88	0
P-292	V1013	V1012	24			314	0.0365	54.01	54.01	17.19	1.00	1.25	2.00	1.96	43.32	11
P-293	V1014	V1013	24			74	0.0539	33.95	33.95	17.82	0.58	0.64	1.17	1.91	52.68	0
P-294	V1015	V1014	24			128	0.0239	33.95	33.95	12.71	0.79	0.97	1.59	1.91	35.06	0
P-295	S1007	S1006	18			332	0.0633	57.09	57.09	32.31	1.00	2.16	1.50	1.49	26.49	31
P-296	S1006	S1005	18			193	0.088	66.06	66.06	37.38	1.00	2.11	1.50	1.49	31.25	35
P-297	S1005	S1004	18			123	0.0426	73.17	73.17	41.41	1.00	3.37	1.50	1.48	21.74	51
P-298	S1004	S1003	18			313	0.0607	73.17	73.17	41.41	1.00	2.82	1.50	1.49	25.94	47
P-299	S1003	S1002	18			105	0.0143	79.44	79.44	44.95	1.00	6.32	1.50	1.34	12.58	67
P-3	A3009	A3008	15			261	0.0037	44.68	44.68	36.41	1.00	11.32	1.25	0.80	3.95	41
P-30	A2004	A2003	12			91	0.0015	101.46	101.46	129.18	1.00	72.29	1.00	0.50	1.40	100
P-300	S1002	S1001	30			172	0.093	258.15	258.15	52.59	1.00	2.06	2.50	2.49	125.44	133
P-303	S2001	S1002	30			235	0.0532	172.37	172.37	35.12	1.00	1.82	2.50	2.48	94.89	77
P-304	S3001	S2001	24			177	0.0266	120.34	120.34	38.31	1.00	3.26	2.00	1.94	36.97	83
P-305	S3002	S3001	24			200	0.0432	120.34	120.34	38.31	1.00	2.55	2.00	1.97	47.12	73
P-306	S3003	S3002	24			377	0.1494	86.26	86.26	31.84	0.80	0.98	1.61	2.00	87.67	0
P-307	S3004	S3003	24			138	0.0725	57.30	57.30	22.09	0.77	0.94	1.54	1.99	61.07	0
P-308	S3005	S3004	18			158	0.0739	57.30	57.30	32.42	1.00	2.00	1.50	1.49	28.63	29
P-309	S3006	S3005	18			131	0.0853	40.34	40.34	22.83	1.00	1.31	1.50	1.49	30.76	10
P-31	A2005	A2004	12			229	0.0015	101.46	101.46	129.18	1.00	73.76	1.00	0.50	1.38	100
P-310	S3007	S3006	18			190	0.0692	40.34	40.34	22.83	1.00	1.46	1.50	1.49	27.71	13
P-311	S3008	S3007	18			176	0.0719	28.10	28.10	18.24	0.81	1.00	1.22	1.49	28.24	0
P-312	S2002	S2001	24			358	0.0166	55.77	55.77	17.75	1.00	1.91	2.00	1.85	29.19	27
P-313	S2003	S2002	24			132	0.0735	55.77	55.77	22.19	0.75	0.91	1.49	1.99	61.51	0
P-314	S2004	S2003	24			119	0.0671	42.11	42.11	20.35	0.63	0.72	1.25	1.96	58.78	0
P-315	X1008	X1007	24			235	0.0212	12.16	12.16	9.72	0.42	0.37	0.84	1.25	33.05	0

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P-316	X1007	X1006	24			229	0.0044	23.09	23.09	7.35	1.00	1.54	2.00	1.40	14.99	8
P-317	X1006	X1005	24			362	0.0193	23.09	23.09	10.96	0.64	0.73	1.27	1.71	31.55	0
P-318	X1005	X1004	24			587	0.0341	30.90	30.90	14.59	0.64	0.74	1.28	1.88	41.87	0
P-319	X1004	X1003	24			204	0.0441	51.05	51.05	16.25	1.00	1.07	2.00	1.98	47.61	3
P-32	A2006	A2005	12			190	0.0006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0
P-320	X1003	X1002	24			312	0.0369	60.25	60.25	19.18	1.00	1.38	2.00	1.97	43.58	17
P-321	X2001	X1002	30			281	0.0103	35.19	35.19	9.54	0.70	0.84	1.76	2.01	41.82	0
P-322	X2002	X2001	30			417	0.0073	35.19	35.19	7.17	1.00	1.00	2.50	2.01	35.16	0
P-323	X2003	X2002	30			290	0.1097	35.19	35.19	23.28	0.35	0.26	0.87	2.01	136.19	0
P-324	Y2002	Y2001	12			109	0.0733	15.50	15.50	19.74	1.00	1.60	1.00	0.99	9.67	6
P-325	Y2001	Y1003	18			148	0.0245	23.61	23.61	13.36	1.00	1.43	1.50	1.43	16.50	7
P-326	Y1004	Y1003	30			494	0.0334	239.39	239.39	48.77	1.00	3.19	2.50	2.45	75.15	164
P-327	Y1005	Y1004	30			528	0.0227	219.04	219.04	44.62	1.00	3.53	2.50	2.41	62.01	157
P-328	Y1006	Y1005	30			224	0.0134	212.89	212.89	43.37	1.00	4.47	2.50	2.27	47.63	165
P-329	Y1003	Y1002	36			35	0.0017	260.76	260.76	36.89	1.00	9.41	3.00	1.70	27.70	233
P-33	A2101	A2005	30			529	0.0015	24.74	24.74	5.04	1.00	1.56	2.50	1.35	15.90	9
P-330	Y1002	Y1001	36			87	0.0518	260.76	260.76	36.89	1.00	1.71	3.00	2.98	152.24	109
P-331	Y1008	Y1007	36			617	0.0859	119.75	119.75	29.12	0.56	0.61	1.69	2.95	196.05	0
P-332	Y1009	Y1008	30			156	0.0128	107.89	107.89	21.98	1.00	2.31	2.50	2.25	46.62	61
P-333	Y1010	Y1009	30			143	0.014	107.89	107.89	21.98	1.00	2.22	2.50	2.28	48.68	59
P-334	Y1011	Y1010	30			454	0.0088	96.46	96.46	19.65	1.00	2.50	2.50	2.10	38.62	58
P-335	Y1012	Y1011	30			81	0.0124	96.46	96.46	19.65	1.00	2.10	2.50	2.24	45.83	51
P-336	Y1013	Y1012	12			122	0.0082	78.55	78.55	100.01	1.00	24.31	1.00	0.77	3.23	75
P-337	Y1014	Y1013	12			104	0.0541	78.55	78.55	100.01	1.00	9.45	1.00	0.99	8.31	70
P-339	Y3001	Y1007	18			238	0.1809	69.24	69.24	39.18	1.00	1.55	1.50	1.50	44.80	24
P-34	A2201	A2005	21			567	0.0057	42.68	42.68	17.75	1.00	3.57	1.75	1.29	11.95	31
P-340	Y3002	Y3001	18			231	0.0043	60.87	60.87	34.44	1.00	8.77	1.50	1.02	6.94	54
P-341	Y3003	Y3002	18			464	0.0015	60.87	60.87	34.44	1.00	14.88	1.50	0.77	4.09	57
P-342	Y3004	Y3003	18			163	0.0015	42.00	42.00	23.77	1.00	10.39	1.50	0.77	4.04	38
P-343	Y3005	Y3004	12			137	0.0655	42.00	42.00	53.48	1.00	4.59	1.00	0.99	9.14	33
P-344	Y3006	Y3005	12			69	0.0145	42.00	42.00	53.48	1.00	9.77	1.00	0.87	4.30	38
P-345	Y3101	Y3004	12			223	0.0626	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.94	0
P-346	Z1007	Z1006	12			45	0.0045	33.43	33.43	42.56	1.00	14.02	1.00	0.66	2.38	31
P-347	Z1006	Z1005	15			226	0.0015	33.43	33.43	27.24	1.00	13.30	1.25	0.63	2.51	31

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P-348	Z1005	Z1004	15			65	0.0617	47.92	47.92	39.05	1.00	2.98	1.25	1.24	16.09	32
P-349	Z1004	Z1003	18			348	0.0015	47.92	47.92	27.12	1.00	11.77	1.50	0.77	4.07	44
P-35	A2203	A2201	21			378	0.0096	42.68	42.68	17.75	1.00	2.74	1.75	1.46	15.59	27
P-350	Z2001	Z1003	18			177	0.017	16.32	16.32	9.24	1.00	1.19	1.50	1.37	13.72	3
P-351	Z1003	Z1002	21			135	0.0148	66.50	66.50	27.65	1.00	3.44	1.75	1.58	19.35	47
P-353	AA1007	AA1006	36			483	0.1057	47.56	47.56	24.62	0.32	0.22	0.95	2.25	217.43	0
P-354	AA1006	AA1005	36			134	0.0372	66.17	66.17	18.36	0.51	0.51	1.52	2.60	128.96	0
P-355	AA1005	AA1004	36			463	0.0216	72.34	72.34	15.21	0.64	0.74	1.91	2.69	98.29	0
P-356	AA1004	AA1003	36			430	0.0163	89.31	89.31	12.63	1.00	1.05	3.00	2.82	85.37	4
P-357	AA1003	AA1002	36			419	0.0072	130.21	130.21	18.42	1.00	2.30	3.00	2.44	56.61	74
P-358	AA1002	AA1001	36			49	0.0203	140.83	140.83	19.92	1.00	1.48	3.00	2.88	95.32	46
P-359	AA2004	AA2003	24			257	0.1907	30.14	30.14	27.67	0.38	0.30	0.76	1.86	99.05	0
P-36	B1019	B1018	24			173	0.0015	87.86	87.86	27.97	1.00	9.99	2.00	1.06	8.79	79
P-360	AA2003	AA2002	30			40	0.0015	33.28	33.28	6.78	1.00	2.10	2.50	1.35	15.87	17
P-361	AA2002	AA2001	30			101	0.0198	33.28	33.28	12.20	0.54	0.58	1.36	1.96	57.88	0
P-362	AA2001	AA1003	30			146	0.0069	33.28	33.28	7.90	0.80	0.98	2.00	1.96	34.05	0
P-363	A1022	A1021	48			676	0.0367	18.44	18.44	12.47	0.18	0.07	0.70	1.26	275.96	0
P-364	A1021	A1020	36			75	0.0016	99.82	99.82	14.12	1.00	3.73	3.00	1.67	26.73	73
P-365	A1020	A1019	36			316	0.0015	99.82	99.82	14.12	1.00	3.83	3.00	1.65	26.07	74
P-366	A1019	A1018	36			220	0.0016	180.82	180.82	25.58	1.00	6.77	3.00	1.67	26.69	154
P-367	A1018	A1017	36			303	0.0015	180.82	180.82	25.58	1.00	7.01	3.00	1.64	25.78	155
P-368	A1017	A1016	18			30	0.001	250.76	250.76	141.90	1.00	74.97	1.50	0.70	3.34	247
P-369S	A1016	A1015	120			204	0.0016	250.76	250.76	7.80	0.43	0.38	4.29	3.72	655.99	0
P-370	A1015	A1014	18			36	0.0014	250.76	250.76	141.90	1.00	63.61	1.50	0.76	3.94	247
P-371	A6001	A1014	18			135	0.0015	25.72	25.72	14.55	1.00	6.34	1.50	0.77	4.06	22
P-372	A1014	A1013	30			714	0.0016	277.13	277.13	56.46	1.00	17.02	2.50	1.36	16.28	261
P-373	A1013	A1012	48			151	0.0015	277.13	277.13	22.05	1.00	4.93	4.00	2.26	56.19	221
P-374	A1012	A1011	48			177	0.0017	290.37	290.37	23.11	1.00	4.89	4.00	2.32	59.36	231
P-375	C1019	C1018	30			183	0.0107	201.70	201.70	41.09	1.00	4.74	2.50	2.18	42.57	159
P-376	C1020	C1019	30			176	0.0114	188.83	188.83	38.47	1.00	4.30	2.50	2.21	43.87	145
P-377	C1021	C1020	30			95	0.0015	188.83	188.83	38.47	1.00	11.99	2.50	1.34	15.75	173
P-378	C1022	C1021	30			86	0.0015	188.83	188.83	38.47	1.00	11.82	2.50	1.35	15.98	173
P-379	C1023	C1022	30			84	0.0016	188.83	188.83	38.47	1.00	11.64	2.50	1.36	16.23	173
P-38	B1016	B1015	36			157	0.0089	180.53	180.53	25.54	1.00	2.86	3.00	2.56	63.19	117

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P-380	C1024	C1023	30			70	0.0016	188.83	188.83	38.47	1.00	11.61	2.50	1.36	16.26	173
P-381	C1025	C1024	30			281	0.0026	176.03	176.03	35.86	1.00	8.46	2.50	1.55	20.81	155
P-382	C1026	C1025	21			236	0.0078	176.03	176.03	73.18	1.00	12.57	1.75	1.39	14.00	162
P-383	C1027	C1026	18			259	0.0077	80.13	80.13	45.34	1.00	8.66	1.50	1.18	9.25	71
P-384	D4013	D4012	24			75	0.0016	59.85	59.85	19.05	1.00	6.61	2.00	1.07	9.06	51
P-385	D4014	D4013	24			279	0.0015	59.85	59.85	19.05	1.00	6.72	2.00	1.07	8.91	51
P-386	D4015	D4014	18			276	0.0014	42.84	42.84	24.24	1.00	10.68	1.50	0.77	4.01	39
P-387	D4016	D4015	15			261	0.0014	25.64	25.64	20.89	1.00	10.65	1.25	0.62	2.41	23
P-388	D1050	D1049	18			203	0.0046	81.73	81.73	46.25	1.00	11.48	1.50	1.03	7.12	75
P-389	D1049	D1048	18			109	0.0038	81.73	81.73	46.25	1.00	12.51	1.50	0.99	6.53	75
P-39	B1015	B1014	36			248	0.004	180.53	180.53	25.54	1.00	4.25	3.00	2.12	42.47	138
P-390	D1048	D1047	18			192	0.0042	81.73	81.73	46.25	1.00	12.03	1.50	1.01	6.79	75
P-391	D1047	D1046	24			615	0.0085	110.45	110.45	35.16	1.00	5.29	2.00	1.64	20.86	90
P-392	D1046	D1045	12			555	0.0079	110.45	110.45	140.63	1.00	34.72	1.00	0.76	3.18	107
P-393	D1045	D1044	12			85	0.0082	132.73	132.73	169.00	1.00	41.03	1.00	0.77	3.23	129
P-395	D1044	D1043	36			277	0.0052	198.25	198.25	28.05	1.00	4.10	3.00	2.26	48.35	150
P-396	D1043	D1042	36			156	0.0114	198.25	198.25	28.05	1.00	2.77	3.00	2.68	71.54	127
P-399	D1042	D1041	36			764	0.0015	198.25	198.25	28.05	1.00	7.71	3.00	1.64	25.72	173
P-4	A3008	A3007	18			238	0.0041	52.03	52.03	29.44	1.00	7.74	1.50	1.00	6.72	45
P-40	B1014	B1013	60			466	0.0064	274.47	274.47	13.98	1.00	1.31	5.00	4.12	209.58	65
P-400	D1041	D1040	36			527	0.0052	198.25	198.25	28.05	1.00	4.10	3.00	2.27	48.41	150
P-401	D1040	D1039	48			514	0.002	241.22	241.22	19.20	1.00	3.72	4.00	2.43	64.81	176
P-402	D1039	D1038	48			298	0.0025	241.22	241.22	19.20	1.00	3.36	4.00	2.56	71.77	169
P-403	D1038	D1037	48			226	0.0025	262.66	262.66	20.90	1.00	3.66	4.00	2.56	71.75	191
P-404	D1037	D1036	48			239	0.003	262.66	262.66	20.90	1.00	3.35	4.00	2.68	78.45	184
P-405	D1036	D1035	48			240	0.0029	281.20	281.20	22.38	1.00	3.61	4.00	2.67	77.86	203
P-406	D1035	D1034	48			269	0.0031	281.20	281.20	22.38	1.00	3.52	4.00	2.71	79.95	201
P-407	D1034	D1033	48			414	0.0022	281.20	281.20	22.38	1.00	4.19	4.00	2.47	67.14	214
P-408	D9007	D9006	15			266	0.0044	20.76	20.76	16.92	1.00	4.86	1.25	0.84	4.27	16
P-409	D9006	D9005	18			314	0.0075	40.64	40.64	23.00	1.00	4.47	1.50	1.17	9.09	32
P-41	B1013	B1012	54			520	0.0011	285.55	285.55	17.95	1.00	4.46	4.50	2.33	64.10	221
P-410	D9005	D9004	21			88	0.0032	40.64	40.64	16.90	1.00	4.55	1.75	1.11	8.94	32
P-411	D9004	D9003	21			276	0.0036	40.64	40.64	16.90	1.00	4.29	1.75	1.15	9.47	31
P-412	D9003	D9002	24			265	0.0056	40.64	40.64	12.94	1.00	2.39	2.00	1.49	17.02	24

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P-413	D9002	D9001	24			80	0.0051	40.64	40.64	12.94	1.00	2.51	2.00	1.45	16.19	24
P-414	D9001	D1033	24			200	0.0058	40.64	40.64	12.94	1.00	2.35	2.00	1.50	17.30	23
P-415	D1033	D1032	48			125	0.0092	311.14	311.14	24.76	1.00	2.25	4.00	3.49	138.26	173
P-416	D1032	D1031	48			786	0.0042	311.14	311.14	24.76	1.00	3.31	4.00	2.94	93.89	217
P-417	D1031	D1030	54			541	0.0027	343.67	343.67	21.61	1.00	3.33	4.50	2.99	103.14	241
P-418	D1030	D1029	54			290	0.0045	402.02	402.02	25.28	1.00	3.05	4.50	3.38	131.94	270
P-419	D1029	D1028	54			354	0.0041	402.02	402.02	25.28	1.00	3.20	4.50	3.30	125.72	276
P-420	D1028	D1027	42			250	0.0073	404.47	404.47	42.04	1.00	4.69	3.50	2.89	86.29	318
P-421	D1027	D1026	42			344	0.0027	404.47	404.47	42.04	1.00	7.71	3.50	2.27	52.48	352
P-422	D1026	D1025	42			503	0.004	411.40	411.40	42.76	1.00	6.48	3.50	2.50	63.44	348
P-423	D1025	D1024	48			281	0.0028	432.24	432.24	34.40	1.00	5.66	4.00	2.65	76.42	356
P-424	D1024	D1023	48			287	0.0034	432.24	432.24	34.40	1.00	5.16	4.00	2.77	83.72	349
P-425	D1023	D1022	48			273	0.0036	432.24	432.24	34.40	1.00	5.01	4.00	2.82	86.30	346
P-430	D8001	D1031	24			305	0.0059	15.83	15.83	6.28	0.75	0.91	1.50	1.43	17.42	0
P-431	D8002	D8001	24			293	0.0044	15.83	15.83	5.04	1.00	1.05	2.00	1.40	15.10	1
P-432	D8003	D8002	21			273	0.0048	15.83	15.83	6.58	1.00	1.44	1.75	1.23	10.97	5
P-433	D8004	D8003	15			281	0.0076	15.83	15.83	12.90	1.00	2.80	1.25	0.96	5.66	10
P-434	D7001	D1030	24			299	0.0075	26.20	26.20	8.34	1.00	1.34	2.00	1.59	19.59	7
P-435	D7002	D7001	24			258	0.0081	26.20	26.20	8.34	1.00	1.29	2.00	1.62	20.36	6
P-436	D7003	D7002	15			324	0.0111	26.20	26.20	21.35	1.00	3.84	1.25	1.05	6.83	19
P-437	D7004	D7003	12			254	0.0114	26.20	26.20	33.36	1.00	6.86	1.00	0.83	3.82	22
P-438	E5014	E5013	21			153	0.0131	29.67	29.67	12.33	1.00	1.63	1.75	1.55	18.18	11
P-439	E5013	E5012	21			318	0.0037	29.67	29.67	12.33	1.00	3.06	1.75	1.16	9.68	20
P-44	B1010	B1009	72			186	0.0054	324.47	324.47	11.48	1.00	1.04	6.00	4.82	311.42	13
P-440	E5012	E5011	24			177	0.0046	29.67	29.67	9.44	1.00	1.92	2.00	1.42	15.42	14
P-441	E5011	E5010	21			283	0.0041	56.23	56.23	23.38	1.00	5.52	1.75	1.19	10.18	46
P-442	E5010	E5009	30			233	0.2225	56.23	56.23	34.22	0.37	0.29	0.92	2.37	193.98	0
P-443	E5009	E5008	30			243	0.0016	68.95	68.95	14.05	1.00	4.24	2.50	1.36	16.27	53
P-444	E5008	E5007	30			282	0.0015	89.29	89.29	18.19	1.00	5.56	2.50	1.35	16.06	73
P-445	E5007	E5006	36			227	0.0015	89.29	89.29	12.63	1.00	3.40	3.00	1.66	26.27	63
P-446	E5006	E5005	36			273	0.0015	105.05	105.05	14.86	1.00	4.01	3.00	1.65	26.22	79
P-447	E5005	E5004	36			257	0.0015	105.05	105.05	14.86	1.00	4.09	3.00	1.64	25.70	79
P-448	E5004	E5003	42			537	0.0002	105.05	105.05	10.92	1.00	7.63	3.50	1.13	13.76	91
P-449	E5003	E5002	42			66	0.0015	128.48	128.48	13.35	1.00	3.28	3.50	1.95	39.22	89

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P-450	E5002	E5001	42			215	0.002	128.48	128.48	13.35	1.00	2.85	3.50	2.09	45.12	83
P-451	E5001	E1018	42			307	0.0016	128.48	128.48	13.35	1.00	3.19	3.50	1.97	40.29	88
P-452	E1018	E1017	42			185	0.0067	445.44	445.44	46.30	1.00	5.40	3.50	2.83	82.48	363
P-453	E1017	E1016	42			294	0.0039	471.71	471.71	49.03	1.00	7.45	3.50	2.49	63.35	408
P-454	E1016	E1015	48			390	0.0069	471.71	471.71	37.54	1.00	3.93	4.00	3.30	120.02	352
P-455	E1015	E1014	48			50	0.0034	482.30	482.30	38.38	1.00	5.76	4.00	2.77	83.70	399
P-456	E1035	E1034	30			331	0.003	54.98	54.98	11.20	1.00	2.45	2.50	1.61	22.48	33
P-457	E1034	E1033	30			526	0.0027	115.15	115.15	23.46	1.00	5.37	2.50	1.57	21.43	94
P-458	E1033	E1032	30			199	0.0157	115.15	115.15	23.46	1.00	2.24	2.50	2.32	51.46	64
P-459	E1032	E1031	30			286	0.0028	138.83	138.83	28.28	1.00	6.34	2.50	1.59	21.91	117
P-460	E1031	E1030	42			211	0.0054	170.07	170.07	17.68	1.00	2.30	3.50	2.69	73.84	96
P-461	E1030	E1029	42			427	0.0038	170.07	170.07	17.68	1.00	2.73	3.50	2.47	62.35	108
P-462	E1029	E1028	42			252	0.0042	170.07	170.07	17.68	1.00	2.60	3.50	2.53	65.37	105
P-463	E1028	E1027	42			275	0.0046	197.51	197.51	20.53	1.00	2.89	3.50	2.59	68.29	129
P-464	E1027	E1026	42			642	0.0041	197.51	197.51	20.53	1.00	3.05	3.50	2.52	64.83	133
P-465	E1026	E1025	42			256	0.0035	201.06	201.06	20.90	1.00	3.38	3.50	2.42	59.51	142
P-466	E1025	E1024	48			389	0.0039	232.77	232.77	18.52	1.00	2.60	4.00	2.87	89.43	143
P-467	E1024	E1023	48			235	0.0203	232.77	232.77	18.52	1.00	1.14	4.00	3.86	205.02	28
P-468	E1023	E1022	48			313	0.008	232.77	232.77	18.52	1.00	1.81	4.00	3.40	128.66	104
P-469	E1022	E1021	48			94	0.0046	232.77	232.77	18.52	1.00	2.39	4.00	2.99	97.40	135
P-470	E1021	E1020	48			546	0.0046	232.77	232.77	18.52	1.00	2.39	4.00	2.99	97.49	135
P-471	E1020	E1019	54			638	0.0044	232.77	232.77	14.64	1.00	1.78	4.50	3.37	130.82	102
P-472	E6001	E1019	12			292	0.0104	89.55	89.55	114.02	1.00	24.60	1.00	0.81	3.64	86
P-473	E6002	E6001	12			288	0.0114	89.55	89.55	114.02	1.00	23.52	1.00	0.83	3.81	86
P-474	E6003	E6002	12			251	0.013	64.93	64.93	82.67	1.00	15.94	1.00	0.85	4.07	61
P-475	E6004	E6003	12			226	0.0145	64.93	64.93	82.67	1.00	15.12	1.00	0.87	4.29	61
P-476	E6005	E6004	12			263	0.0073	42.83	42.83	54.54	1.00	14.07	1.00	0.75	3.04	40
P-477	E6006	E6005	12			240	0.0132	42.83	42.83	54.54	1.00	10.45	1.00	0.86	4.10	39
P-478	E6007	E6006	12			293	0.0072	19.45	19.45	24.76	1.00	6.40	1.00	0.75	3.04	16
P-479	E4028	E4027	21			175	0.0087	58.89	58.89	24.48	1.00	3.98	1.75	1.43	14.79	44
P-480	E4027	E4026	21			148	0.0075	58.89	58.89	24.48	1.00	4.28	1.75	1.38	13.76	45
P-481	E4026	E4025	21			674	0.0118	79.45	79.45	33.03	1.00	4.61	1.75	1.52	17.24	62
P-482	E4025	E4024	24			244	0.0088	106.97	106.97	34.05	1.00	5.02	2.00	1.65	21.33	86
P-483	E4024	E4023	24			513	0.0127	106.97	106.97	34.05	1.00	4.19	2.00	1.78	25.55	81

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P-484	E4023	E4022	24			272	0.0118	106.97	106.97	34.05	1.00	4.35	2.00	1.75	24.59	82
P-485	E4022	E4021	24			268	0.0124	112.00	112.00	35.65	1.00	4.43	2.00	1.77	25.28	87
P-486	E4021	E4020	36			52	0.004	127.49	127.49	18.04	1.00	3.00	3.00	2.12	42.54	85
P-487	E4020	E4019	36			464	0.0111	127.49	127.49	18.04	1.00	1.81	3.00	2.66	70.53	57
P-488	E4019	E4018	36			89	0.0047	127.49	127.49	18.04	1.00	2.78	3.00	2.21	45.84	82
P-489	E4018	E4017	36			160	0.0045	127.49	127.49	18.04	1.00	2.84	3.00	2.18	44.92	83
P-490	E4017	E4016	36			105	0.0139	127.49	127.49	18.04	1.00	1.62	3.00	2.76	78.87	49
P-491	E4016	E4015	36			206	0.0138	127.49	127.49	18.04	1.00	1.62	3.00	2.76	78.67	49
P-492	E4015	E4014	36			18	0.0104	127.49	127.49	18.04	1.00	1.87	3.00	2.63	68.27	59
P-493	E4014	E4013	36			265	0.0139	127.49	127.49	18.04	1.00	1.62	3.00	2.76	78.78	49
P-494	E4013	E4012	30			542	0.0109	141.36	141.36	28.80	1.00	3.28	2.50	2.19	43.03	98
P-495	E4012	E4011	36			120	0.0108	154.02	154.02	21.79	1.00	2.22	3.00	2.65	69.53	84
P-496	E4011	E4010	42			607	0.0102	154.02	154.02	16.01	1.00	1.51	3.50	3.09	101.72	52
P-497	E4010	E4009	42			550	0.0129	184.04	184.04	19.13	1.00	1.61	3.50	3.21	114.42	70
P-498	E4101	E4010	12			247	0.009	26.17	26.17	33.32	1.00	7.73	1.00	0.79	3.38	23
P-499	E4102	E4101	12			279	0.0096	18.38	18.38	23.40	1.00	5.24	1.00	0.80	3.51	15
P-5	A3007	A3006	18			44	0.0115	52.03	52.03	29.44	1.00	4.61	1.50	1.28	11.28	41
P-500	E4103	E4102	12			57	0.0192	18.38	18.38	23.40	1.00	3.71	1.00	0.91	4.95	13
P-502	F1002	F1001	12			57	0.0175	22.81	22.81	29.04	1.00	4.82	1.00	0.90	4.73	18
P-503	F1003	F1002	18			113	0.0088	15.08	15.08	8.53	1.00	1.52	1.50	1.21	9.90	5
P-504	F1004	F1003	12			176	0.0057	15.08	15.08	19.20	1.00	5.59	1.00	0.70	2.70	12
P-505	F1005	F1004	12			101	0.0099	7.62	7.62	9.70	1.00	2.14	1.00	0.80	3.55	4
P-511	E2026	E2025	12			696	0.0015	28.27	28.27	35.99	1.00	20.48	1.00	0.50	1.38	27
P-512	E2025	E2024	12			410	0.0024	54.27	54.27	69.10	1.00	30.77	1.00	0.57	1.76	53
P-513	E2024	E2023	21			226	0.0266	70.97	70.97	29.50	1.00	2.74	1.75	1.69	25.90	45
P-514	E2023	E2022	42			752	0.01	82.46	82.46	11.67	0.69	0.82	2.41	2.83	100.76	0
P-515	E2022	E2021	48			462	0.0076	112.90	112.90	11.29	0.74	0.90	2.97	3.21	125.33	0
P-516	E2021	E2020		24	96	386	0.0091	124.99	124.99	11.17	0.70	0.59	1.40	1.96	211.41	0
P-517	E2020	E2019	48			251	0.002	133.24	133.24	10.60	1.00	2.07	4.00	2.42	64.33	69
P-518	E2019	E2018	48			660	0.0053	152.16	152.16	12.11	1.00	1.45	4.00	3.10	104.88	47
P-519	E2018	E2017	48			433	0.0015	162.49	162.49	12.93	1.00	2.91	4.00	2.25	55.82	107
P-52	B3001	B1016	12			264	0.0015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	0
P-520	E2219	E2218	30			97	0.0103	5.77	5.77	5.98	0.25	0.14	0.63	0.79	41.75	0
P-521	E2218	E2217	30			405	0.0124	11.92	11.92	7.83	0.35	0.26	0.87	1.16	45.70	0

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ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-522	E2217	E2216	36			348	0.0015	109.47	109.47	15.49	1.00	4.24	3.00	1.64	25.84	84
P-523	E2216	E2215	36			160	0.0015	109.47	109.47	15.49	1.00	4.23	3.00	1.64	25.87	84
P-524	E2215	E2214	36			72	0.0698	133.46	133.46	27.47	0.65	0.76	1.95	2.97	176.65	0
P-525	E2214	E2213	42			463	0.0227	189.13	189.13	19.66	1.00	1.25	3.50	3.39	151.91	37
P-526	E2213	E2212	42			287	0.0017	229.10	229.10	23.81	1.00	5.44	3.50	2.02	42.11	187
P-527	E2212	E2211	54			569	0.0123	295.04	295.04	18.55	1.00	1.35	4.50	4.15	218.78	76
P-528	E2211	E2210	54			147	0.0341	295.04	295.04	25.51	0.68	0.81	3.07	4.38	364.22	0
P-529	E2210	E2209		48	60	557	0.0081	336.10	336.10	16.80	1.00	1.22	4.00	4.00	274.62	61
P-53	B2003	B2002	54			257	0.0012	175.39	175.39	11.03	1.00	2.60	4.50	2.39	67.34	108
P-530	E2209	E2208		36	96	367	0.0082	344.37	344.37	14.69	0.98	0.97	2.93	3.00	356.09	0
P-531	E2208	E2207		36	96	63	0.008	344.37	344.37	14.56	0.99	0.98	2.96	3.00	351.59	0
P-532	E2207	E2206		36	96	349	0.0029	409.95	409.95	17.08	1.00	1.94	3.00	2.78	210.86	199
P-533	E2206	E2205		36	96	55	0.0183	409.95	409.95	20.60	0.83	0.77	2.49	3.00	532.71	0
P-534	E2205	E2204		36	96	135	0.0074	409.95	409.95	17.08	1.00	1.21	3.00	3.00	339.21	71
P-535	E2204	E2203		36	96	113	0.0088	413.51	413.51	17.23	1.00	1.12	3.00	3.00	370.46	43
P-536	E2203	E2202		36	96	102	0.002	413.51	413.51	17.23	1.00	2.38	3.00	2.45	174.07	239
P-537	E2202	E2201		36	96	493	0.0057	423.18	423.18	17.63	1.00	1.43	3.00	3.00	296.94	126
P-538	E2301	E2217	24			65	0.0015	97.80	97.80	31.13	1.00	11.03	2.00	1.06	8.87	89
P-539	E2302	E2301	24			57	0.0014	97.80	97.80	31.13	1.00	11.53	2.00	1.04	8.49	89
P-54	B2004	B2003	54			58	0.0797	115.48	115.48	27.61	0.31	0.21	1.39	3.16	556.76	0
P-540	E2303	E2302	24			37	0.0016	97.80	97.80	31.13	1.00	10.67	2.00	1.08	9.17	89
P-541	E2304	E2303	24			304	0.0122	93.07	93.07	29.63	1.00	3.71	2.00	1.76	25.06	68
P-542	E2305	E2304	24			270	0.0552	93.07	93.07	29.63	1.00	1.75	2.00	1.98	53.29	40
P-543	E2306	E2305	24			224	0.0805	81.38	81.38	25.90	1.00	1.26	2.00	1.99	64.34	17
P-544	K1011	K1010	30			146	0.0206	167.37	167.37	34.10	1.00	2.83	2.50	2.39	59.07	108
P-545	K1010	K1009	30			61	0.0139	289.53	289.53	58.98	1.00	5.98	2.50	2.28	48.40	241
P-546	K1009	K1008	36			169	0.018	289.53	289.53	40.96	1.00	3.22	3.00	2.85	89.85	200
P-547	K1008	K1007	36			254	0.0256	289.53	289.53	40.96	1.00	2.71	3.00	2.92	106.95	183
P-548	K1007	K1006	36			260	0.0191	289.53	289.53	40.96	1.00	3.13	3.00	2.86	92.53	197
P-549	D2101	D2004	8			374	0.0015	175.98	175.98	504.13	1.00	378.74	0.67	0.32	0.46	176
P-55	B2005	B2004	24			545	0.0079	115.48	115.48	36.76	1.00	5.73	2.00	1.61	20.15	95
P-550	D2102	D2101	8			452	0.0015	175.98	175.98	504.13	1.00	369.18	0.67	0.32	0.48	175
P-551	D2103	D2102	6			266	0.0015	175.98	175.98	896.23	1.00	806.41	0.50	0.23	0.22	176
P-552	D2104	D2103	12			901	0.0014	71.64	71.64	91.22	1.00	52.80	1.00	0.49	1.36	70

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P-554	D5105	D5104	42			438	0.0015	4.43	4.43	2.71	0.23	0.11	0.79	0.63	39.44	0
P-555	D5104	D5103	42			91	0.0016	43.65	43.65	4.54	1.00	1.07	3.50	1.99	40.95	3
P-556	D5103	D5102	42			128	0.0013	43.65	43.65	4.54	1.00	1.19	3.50	1.88	36.75	7
P-557	D5102	D5101	42			397	0.005	43.65	43.65	7.78	0.57	0.61	1.98	2.06	71.26	0
P-558	D5101	D5006	30			665	0.0015	43.65	43.65	8.89	1.00	2.74	2.50	1.35	15.95	28
P-559	D5006	D5005	42			571	0.0015	126.09	126.09	13.11	1.00	3.22	3.50	1.95	39.16	87
P-56	B2006	B2005	21			282	0.0058	86.28	86.28	35.87	1.00	7.14	1.75	1.30	12.08	74
P-560	D5005	D5004	48			474	0.0015	157.41	157.41	12.53	1.00	2.82	4.00	2.25	55.73	102
P-561	D5004	D5003	48			70	0.0419	194.76	194.76	25.08	0.59	0.66	2.37	3.83	294.94	0
P-562	D5003	D5002	48			94	0.0015	194.76	194.76	15.50	1.00	3.51	4.00	2.24	55.51	139
P-563	D5002	D5001	48			84	0.0016	194.76	194.76	15.50	1.00	3.43	4.00	2.27	56.76	138
P-565	D5007	D5006	24			252	0.0015	98.41	98.41	31.32	1.00	11.17	2.00	1.06	8.81	90
P-566	D5008	D5007	24			281	0.007	98.41	98.41	31.32	1.00	5.18	2.00	1.57	18.99	79
P-567	D5009	D5008	24			280	0.007	88.43	88.43	28.15	1.00	4.66	2.00	1.57	18.97	69
P-568	D5010	D5009	24			553	0.0014	88.43	88.43	28.15	1.00	10.32	2.00	1.04	8.57	80
P-569	D5011	D5010	24			46	0.0109	88.43	88.43	28.15	1.00	3.74	2.00	1.72	23.63	65
P-57	B2007	B2006	21			283	0.0101	86.28	86.28	35.87	1.00	5.40	1.75	1.47	15.99	70
P-570	D5012	D5011	24			179	0.0017	49.50	49.50	15.76	1.00	5.33	2.00	1.09	9.29	40
P-571	D5013	D5012	30			101	0.0041	49.50	49.50	10.09	1.00	1.89	2.50	1.75	26.26	23
P-572	D5014	D5013	24			316	0.0041	49.50	49.50	15.76	1.00	3.42	2.00	1.37	14.49	35
P-573	D5015	D5014	24			54	0.0092	49.50	49.50	15.76	1.00	2.28	2.00	1.67	21.73	28
P-574	D5016	D5015	24			105	0.0029	49.50	49.50	15.76	1.00	4.09	2.00	1.25	12.12	37
P-575	D5017	D5016	24			45	0.0037	49.50	49.50	15.76	1.00	3.56	2.00	1.34	13.89	36
P-576	D5018	D5017	24			1352	0.0035	12.35	12.35	4.87	0.75	0.91	1.50	1.26	13.50	0
P-577	D5201	D5008	12			644	0.0066	18.97	18.97	24.15	1.00	6.55	1.00	0.73	2.90	16
P-578	E1014	E1013	54			274	0.0046	482.30	482.30	30.33	1.00	3.59	4.50	3.41	134.22	348
P-579	E1013	E1012	66			852	0.0028	513.80	513.80	21.63	1.00	2.86	5.50	3.75	179.41	334
P-58	B2008	B2007	12			265	0.0125	57.37	57.37	73.04	1.00	14.38	1.00	0.85	3.99	53
P-585	E1011	E1010	60			493	0.0023	585.98	585.98	14.92	1.00	4.67	5.00	3.21	251.22	335
P-586	E1010	E1009	60			745	0.0023	598.73	598.73	15.25	1.00	4.83	5.00	3.18	248.00	351
P-587	E1009	E1008	66			1302	0.0015	965.42	965.42	20.32	1.00	7.41	5.50	3.17	260.61	705
P-588	E1008	E1007	66			109	0.003	995.40	995.40	20.95	1.00	5.38	5.50	3.81	369.88	626
P-589	E1007	E1006	66			158	0.0029	995.40	995.40	20.95	1.00	5.54	5.50	3.75	359.61	636
P-59	C1016	C1015	30			255	0.0016	201.70	201.70	41.09	1.00	12.38	2.50	1.36	16.30	185

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P-591	E1004	E1003	66			678	0.0024	1194.18	1194.18	16.75	1.00	7.23	5.50	3.59	495.40	699
P-592	E4009	E4008	42			387	0.0049	209.41	209.41	21.77	1.00	2.96	3.50	2.63	70.64	139
P-593	E4008	E4007	42			283	0.0032	232.89	232.89	24.21	1.00	4.07	3.50	2.37	57.18	176
P-594	E4007	E4006	42			853	0.003	232.89	232.89	24.21	1.00	4.20	3.50	2.33	55.48	177
P-597	E4005	E4004	36			794	0.0036	336.95	336.95	47.67	1.00	8.42	3.00	2.06	40.00	297
P-598	E4004	E4003	36			469	0.0035	354.82	354.82	50.20	1.00	8.97	3.00	2.05	39.54	315
P-599	E4003	E4002	36			121	0.0065	366.33	366.33	51.83	1.00	6.81	3.00	2.38	53.79	313
P-60	C1015	C1014	30			266	0.0015	209.41	209.41	42.66	1.00	13.12	2.50	1.35	15.96	193
P-600	E3018	E3017	30			42	0.0118	78.89	78.89	16.07	1.00	1.77	2.50	2.22	44.67	34
P-601	E3017	E3016	30			586	0.0039	78.89	78.89	16.07	1.00	3.06	2.50	1.73	25.75	53
P-602	E3016	E3015	30			379	0.0049	91.77	91.77	18.70	1.00	3.18	2.50	1.83	28.83	63
P-603	E3015	E3014	30			63	0.0022	105.15	105.15	21.42	1.00	5.43	2.50	1.49	19.35	86
P-604	E3014	E3013	30			391	0.009	105.15	105.15	21.42	1.00	2.69	2.50	2.11	39.02	66
P-605	E3013	E3012	36			408	0.0044	129.78	129.78	18.36	1.00	2.91	3.00	2.17	44.52	85
P-606	E3012	E3011	36			456	0.0015	137.05	137.05	19.39	1.00	5.31	3.00	1.64	25.82	111
P-607	E3011	E3010	42			167	0.0015	148.05	148.05	15.39	1.00	3.79	3.50	1.94	39.06	109
P-608	E3010	E3009	42			142	0.0056	148.05	148.05	15.39	1.00	1.95	3.50	2.73	75.82	72
P-609	E3009	E3008	42			535	0.0015	166.85	166.85	17.34	1.00	4.28	3.50	1.94	39.01	128
P-61	C1014	C1013	36			253	0.0016	209.41	209.41	29.63	1.00	7.87	3.00	1.67	26.61	183
P-610	E3008	E3007	42			286	0.0064	166.85	166.85	17.34	1.00	2.07	3.50	2.80	80.45	86
P-611	E3007	E3006	42			135	0.0015	178.84	178.84	18.59	1.00	4.60	3.50	1.94	38.87	140
P-612	E3006	E3005	33			919	0.0039	178.84	178.84	30.11	1.00	5.40	2.75	1.91	33.09	146
P-613	E3005	E3004		36	58	241	0.0021	193.90	193.90	13.37	1.00	2.09	3.00	2.26	92.94	101
P-614	E3004	E3003		36	58	118	0.003	200.76	200.76	13.85	1.00	1.83	3.00	2.52	109.82	91
P-615	E3003	E3002		36	58	143	0.0073	206.44	206.44	14.24	1.00	1.20	3.00	3.00	172.41	34
P-616	E3002	E3001		36	58	216	0.007	206.44	206.44	14.24	1.00	1.23	3.00	3.00	168.40	38
P-618	E2017	E2016		36	60	633	0.013	179.06	179.06	14.94	0.80	0.74	2.40	3.00	240.71	0
P-62	C1013	C1012	36			253	0.0016	209.41	209.41	29.63	1.00	7.88	3.00	1.67	26.58	183
P-624	E2010	E2009	48			387	0.0054	555.67	555.67	22.11	1.00	5.24	4.00	3.12	212.29	343
P-625	E2009	E2008	48			146	0.0034	526.70	526.70	20.96	1.00	6.24	4.00	2.78	168.74	358
P-63	C1012	C1011	36			250	0.0016	216.52	216.52	30.63	1.00	8.19	3.00	1.66	26.42	190
P-635	E2004	E2003	42			578	0.0081	26.85	26.85	8.22	0.37	0.30	1.30	1.60	90.84	0
P-636	E2003	E2002	42			328	0.0046	40.17	40.17	7.38	0.55	0.59	1.93	1.97	68.26	0
P-637	E2002	E2001	5			25	0.0016	40.17	40.17	294.57	1.00	290.72	0.42	0.20	0.14	40

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P-638	E2001	E1003		60	60	105	0.0015	676.92	676.92	27.08	1.00	4.31	5.00	3.13	156.93	520
P-64	C1011	C1010	36			239	0.0015	216.52	216.52	30.63	1.00	8.33	3.00	1.65	25.98	191
P-641	E1002	E1001	60			169	0.0031	1870.17	1870.17	31.75	1.00	12.89	5.00	3.45	435.19	1435
P-642	K1006	K1005		30	66	675	0.0085	289.53	289.53	21.06	1.00	1.66	2.50	2.50	174.37	115
P-643	K1005	K1004		42	96	249	0.0028	324.23	324.23	11.58	1.00	1.26	3.50	3.19	258.08	66
P-644	K1004	K1003		36	120	101	0.0015	456.88	456.88	15.23	1.00	2.27	3.00	2.33	201.55	255
P-645	K1003	K1002		36	120	194	0.0048	456.88	456.88	15.23	1.00	1.26	3.00	3.00	363.82	93
P-646	K1002	K1001		36	120	167	0.0133	456.88	456.88	18.48	0.82	0.76	2.47	3.00	602.37	0
P-648	L1014	L1013	54			344	0.0104	39.72	39.72	9.82	0.30	0.20	1.36	1.81	200.73	0
P-649	L1013	L1012	7			408	0.005	57.16	57.16	213.88	1.00	94.85	0.58	0.38	0.60	57
P-65	C1010	C1009	36			162	0.0015	222.84	222.84	31.53	1.00	8.49	3.00	1.65	26.26	197
P-650	L1012	L1011	7			94	0.0134	69.68	69.68	260.72	1.00	70.86	0.58	0.48	0.98	69
P-651	L1011	L1010		36	84	217	0.006	85.81	85.81	7.00	0.29	0.33	0.88	1.05	513.13	0
P-652	L1010	L1009		36	84	195	0.006	85.81	85.81	7.00	0.29	0.33	0.88	1.05	513.63	0
P-653	L1009	L1008		36	84	246	0.006	97.05	97.05	7.31	0.32	0.38	0.95	1.14	514.19	0
P-654	L1008	L1007		36	84	526	0.0043	115.07	115.07	6.91	0.40	0.53	1.19	1.28	432.36	0
P-655	L1007	L1006		36	84	49	0.0163	115.07	115.07	10.74	0.26	0.27	0.77	1.28	846.66	0
P-656	L1006	L1005		36	84	410	0.0043	132.95	132.95	7.29	0.43	0.61	1.30	1.41	436.48	0
P-657	L1005	L1004		36	84	65	0.006	145.69	145.69	8.36	0.42	0.57	1.25	1.50	511.64	0
P-658	L1004	L1003		36	84	47	0.0089	151.68	151.68	9.68	0.37	0.49	1.12	1.54	624.51	0
P-659	L1003	L1002	48			367	0.0015	223.98	223.98	5.94	1.00	4.02	4.00	2.25	167.26	57
P-66	C1009	C1008	36			262	0.0015	227.84	227.84	32.23	1.00	8.73	3.00	1.65	26.11	202
P-660	L1002	L1001	48			206	0.0141	231.51	231.51	13.27	0.47	1.35	1.88	2.66	513.96	0
P-661	L1101	L1001	18			156	0.0006	15.00	15.00	8.49	1.00	5.62	1.50	0.62	2.67	12
P-662	L1102	L1101	18			45	0.0009	15.00	15.00	8.49	1.00	4.79	1.50	0.67	3.13	12
P-663	L1103	L1102	18			453	0.001	9.28	9.28	5.25	1.00	2.80	1.50	0.69	3.32	6
P-664	L2003	L2002	12			412	0.002	18.09	18.09	23.03	1.00	11.22	1.00	0.54	1.61	16
P-665	L2002	L2001	12			605	0.0024	27.37	27.37	34.84	1.00	15.70	1.00	0.56	1.74	26
P-666	L2001	L1003	12			574	0.0042	42.28	42.28	53.83	1.00	18.27	1.00	0.65	2.31	40
P-667	L3001	L1003	30			532	0.0015	54.77	54.77	11.16	1.00	3.43	2.50	1.35	15.95	39
P-668	L3002	L3001	24			370	0.0015	54.77	54.77	17.43	1.00	6.26	2.00	1.06	8.75	46
P-669	L3003	L3002	24			49	0.0094	40.03	40.03	12.74	1.00	1.82	2.00	1.68	22.03	18
P-67	C1008	C1007	36			220	0.0016	227.84	227.84	32.23	1.00	8.55	3.00	1.67	26.66	201
P-670	L3004	L3003	24			47	0.0129	40.03	40.03	12.74	1.00	1.56	2.00	1.78	25.73	14

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ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-671	L3005	L3004	24			156	0.0035	40.03	40.03	12.74	1.00	2.97	2.00	1.32	13.48	27
P-672	L3006	L3005	24			57	0.0091	40.03	40.03	12.74	1.00	1.85	2.00	1.66	21.67	18
P-673	L3007	L3006	24			653	0.0039	21.11	21.11	6.72	1.00	1.50	2.00	1.35	14.10	7
P-674	L3008	L3007	24			562	0.0015	9.04	9.04	2.88	1.00	1.04	2.00	1.05	8.72	0
P-675	L3009	L3008	21			49	0.0026	9.04	9.04	3.76	1.00	1.11	1.75	1.06	8.17	1
P-676	L4001	L1006	15			150	0.0015	22.46	22.46	18.31	1.00	8.86	1.25	0.64	2.54	20
P-68	C1007	C1006	36			116	0.0016	234.12	234.12	33.12	1.00	8.87	3.00	1.66	26.39	208
P-680	M2006	M2005	24			185	0.0056	35.44	35.44	11.28	1.00	2.08	2.00	1.49	17.03	18
P-681	M2005	M2004	36			366	0.0015	53.06	53.06	7.51	1.00	2.05	3.00	1.64	25.91	27
P-682	M2004	M2003	36			207	0.0015	53.06	53.06	7.51	1.00	2.05	3.00	1.64	25.91	27
P-684	M2002	M2001	36			337	0.0173	53.06	53.06	13.04	0.56	0.60	1.68	2.37	88.07	0
P-685	M1008	M1007	54			850	0.0015	964.54	964.54	60.65	1.00	12.65	4.50	2.55	76.23	888
P-688	M1006	M1005	66			586	0.0009	1012.05	1012.05	21.30	1.00	10.12	5.50	2.76	200.10	812
P-689	M1005	M1004	66			181	0.003	1021.21	1021.21	21.49	1.00	5.53	5.50	3.80	369.25	652
P-69	C1006	C1005	36			275	0.0015	234.12	234.12	33.12	1.00	8.95	3.00	1.65	26.15	208
P-690	M1004	M1003	66			270	0.003	1021.21	1021.21	21.49	1.00	5.53	5.50	3.80	369.06	652
P-691	M1003	M1002		36	72	285	0.0075	1021.21	1021.21	28.37	1.00	4.36	3.00	3.00	468.07	553
P-692	M1002	M1001		36	72	125	0.0441	1021.21	1021.21	30.71	0.92	1.80	2.77	3.00	1135.53	0
P-693	M3001	M1006	30			315	0.003	93.46	93.46	19.04	1.00	4.14	2.50	1.62	22.58	71
P-694	M3002	M3001	30			379	0.0032	90.99	90.99	18.54	1.00	3.93	2.50	1.64	23.15	68
P-695	M3003	M3002	30			223	0.0493	90.99	90.99	21.21	0.82	1.00	2.04	2.48	91.30	0
P-697	AB3008	AB3007	24			170	0.0164	8.07	8.07	7.91	0.36	0.28	0.72	1.01	29.01	0
P-698	AB3007	AB3006	24			150	0.0133	13.13	13.13	8.35	0.50	0.50	1.00	1.30	26.20	0
P-699	AB3006	AB3005	24			146	0.0184	13.13	13.13	9.41	0.46	0.43	0.91	1.30	30.76	0
P-7	A3004	A3003	42			1169	0.0016	83.81	83.81	8.71	1.00	2.06	3.50	1.98	40.68	43
P-70	C1005	C1004	36			177	0.0015	252.66	252.66	35.74	1.00	9.67	3.00	1.65	26.13	227
P-700	AB3005	AB3004	30			49	0.0637	13.13	13.13	14.47	0.24	0.13	0.60	1.22	103.77	0
P-701	AB3004	AB3003	30			149	0.0074	19.65	19.65	7.39	0.53	0.56	1.33	1.50	35.34	0
P-702	AB3003	AB3002	36			69	0.004	28.31	28.31	6.44	0.60	0.67	1.79	1.72	42.53	0
P-703	AB3002	AB3001	36			292	0.0246	28.31	28.31	12.59	0.36	0.27	1.06	1.72	104.80	0
P-704	AB3001	AB1001	36			407	0.4664	28.31	28.31	35.88	0.17	0.06	0.51	1.72	456.72	0
P-705	AB2001	AB1001	18			153	0.0015	5.67	5.67	3.21	1.00	1.39	1.50	0.77	4.08	2
P-706	AB6002	AB6001	42			393	0.0015	102.58	102.58	10.66	1.00	2.62	3.50	1.94	39.09	63
P-707	AB6001	AB1005	42			33	0.0015	122.85	122.85	12.77	1.00	3.13	3.50	1.95	39.31	84

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P-709	AB1004	AB1003	54			553	0.0054	242.09	242.09	15.22	1.00	1.67	4.50	3.54	145.17	97
P-71	C1004	C1003	36			113	0.0015	265.13	265.13	37.51	1.00	10.24	3.00	1.64	25.90	239
P-710	AB1003	AB1002	54			259	0.003	242.09	242.09	15.22	1.00	2.24	4.50	3.06	108.28	134
P-711	AB4001	AB1002	15			203	0.012	27.06	27.06	22.05	1.00	3.81	1.25	1.07	7.11	20
P-712	AB4002	AB4001	12			231	0.0107	19.97	19.97	25.42	1.00	5.41	1.00	0.82	3.69	16
P-713	AB4003	AB4002	15			113	0.01	19.97	19.97	16.27	1.00	3.09	1.25	1.02	6.47	13
P-714	AB5002	AB5001	21			215	0.0614	11.04	11.04	14.04	0.36	0.28	0.63	1.24	39.37	0
P-715	AB5001	AB1004	21			429	0.1108	20.58	20.58	20.61	0.43	0.39	0.76	1.61	52.89	0
P-716	AB1006	AB1005	12			119	0.0619	103.36	103.36	131.60	1.00	11.63	1.00	0.99	8.89	94
P-717	AB1007	AB1006	15			211	0.0015	103.36	103.36	84.23	1.00	41.01	1.25	0.64	2.52	101
P-718	AB1008	AB1007	21			71	0.0014	82.12	82.12	34.14	1.00	13.82	1.75	0.90	5.94	76
P-719	AB1009	AB1008	21			84	0.0015	82.12	82.12	34.14	1.00	13.16	1.75	0.92	6.24	76
P-72	C1003	C1002	36			79	0.0015	265.13	265.13	37.51	1.00	10.18	3.00	1.65	26.04	239
P-720	AB1010	AB1009	24			158	0.0263	82.12	82.12	26.14	1.00	2.23	2.00	1.93	36.81	45
P-721	AB1011	AB1010	21			266	0.0909	78.84	78.84	32.78	1.00	1.65	1.75	1.74	47.89	31
P-722	AB1012	AB1011	21			354	0.0455	70.18	70.18	29.18	1.00	2.07	1.75	1.73	33.88	36
P-723	AB1013	AB1012	21			220	0.02	70.18	70.18	29.18	1.00	3.12	1.75	1.65	22.48	48
P-724	AB1014	AB1013	21			252	0.0198	70.18	70.18	29.18	1.00	3.14	1.75	1.65	22.38	48
P-725	AB1015	AB1014	18			362	0.0989	62.11	62.11	35.15	1.00	1.88	1.50	1.50	33.12	29
P-726	AB1016	AB1015	12			200	0.0689	44.02	44.02	56.05	1.00	4.70	1.00	0.99	9.37	35
P-727	AC1004	AC1003	18			88	0.0455	39.64	39.64	22.43	1.00	1.76	1.50	1.48	22.46	17
P-728	AC1005	AC1004	18			151	0.0993	39.64	39.64	22.43	1.00	1.19	1.50	1.50	33.20	6
P-729	AC1006	AC1005	18			391	0.0869	28.57	28.57	19.93	0.76	0.92	1.13	1.49	31.04	0
P-730	AC1007	AC1006	15			473	0.0845	10.96	10.96	15.92	0.55	0.58	0.68	1.20	18.83	0
P-731	AC1008	AC1007	15			349	0.0143	10.96	10.96	8.93	1.00	1.41	1.25	1.10	7.75	3
P-732	AC1009	AC1008	15			210	0.0571	5.10	5.10	11.31	0.40	0.33	0.49	0.92	15.47	0
P-733	AD1012	AD1011	12			334	0.021	9.91	9.91	12.62	1.00	1.92	1.00	0.93	5.17	5
P-734	AD1011	AD1010	15			313	0.0032	26.53	26.53	21.62	1.00	7.25	1.25	0.77	3.66	23
P-735	AD1010	AD1009	15			312	0.0866	38.00	38.00	30.96	1.00	1.99	1.25	1.24	19.06	19
P-736	AD1009	AD1008	15			384	0.0885	52.35	52.35	42.66	1.00	2.72	1.25	1.24	19.26	33
P-737	AD1008	AD1007	15			347	0.0922	58.62	58.62	47.77	1.00	2.98	1.25	1.25	19.67	39
P-738	AD1007	AD1006	21			188	0.0267	127.73	127.73	53.10	1.00	4.92	1.75	1.69	25.94	102
P-739	AD1006	AD1005	24			104	0.0193	133.59	133.59	42.52	1.00	4.24	2.00	1.88	31.48	102
P-74	C2002	C2001	54			190	0.0015	184.43	184.43	11.60	1.00	2.44	4.50	2.54	75.72	109

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P-740	AD1005	AD1004	24			138	0.0217	133.59	133.59	42.52	1.00	4.00	2.00	1.91	33.41	100
P-741	AD1004	AD1003	24			150	0.0133	141.24	141.24	44.96	1.00	5.39	2.00	1.79	26.20	115
P-742	AD3001	AD1009	12			324	0.0185	14.35	14.35	18.27	1.00	2.95	1.00	0.91	4.86	9
P-743	AD3002	AD3001	12			204	0.0196	3.85	3.85	7.02	0.66	0.77	0.66	0.83	5.00	0
P-744	AD3003	AD3002	12			241	0.0871	3.85	3.85	12.37	0.42	0.37	0.42	0.83	10.54	0
P-745	AD2001	AD1007	21			72	0.0417	69.11	69.11	28.73	1.00	2.13	1.75	1.72	32.44	37
P-746	AD2002	AD2001	21			243	0.0698	69.11	69.11	28.73	1.00	1.65	1.75	1.74	41.98	27
P-747	AD2003	AD2002	21			221	0.0227	63.68	63.68	26.47	1.00	2.66	1.75	1.67	23.92	40
P-748	AD2004	AD2003	18			218	0.1194	53.27	53.27	30.15	1.00	1.46	1.50	1.50	36.39	17
P-749	AD2005	AD2004	18			459	0.085	49.73	49.73	28.14	1.00	1.62	1.50	1.49	30.72	19
P-75	C2003	C2002	48			268	0.0015	129.49	129.49	10.30	1.00	2.33	4.00	2.24	55.62	74
P-750	AD2006	AD2005	18			161	0.0015	49.73	49.73	28.14	1.00	12.23	1.50	0.77	4.07	46
P-751	AD2007	AD2006	18			91	0.0441	49.73	49.73	28.14	1.00	2.25	1.50	1.48	22.11	28
P-752	AD2008	AD2007	18			167	0.0479	41.36	41.36	23.40	1.00	1.79	1.50	1.48	23.05	18
P-753	AD2009	AD2008	18			130	0.0015	41.36	41.36	23.40	1.00	10.26	1.50	0.77	4.03	37
P-754	AD2010	AD2009	18			212	0.0141	28.39	28.39	16.06	1.00	2.27	1.50	1.33	12.52	16
P-755	AG1006	AG1005	12			241	0.0166	10.93	10.93	13.92	1.00	2.38	1.00	0.89	4.60	6
P-756	AG1005	AG1004	12			80	0.0624	14.62	14.62	18.62	1.00	1.64	1.00	0.99	8.92	6
P-757	AG1004	AG1003	12			105	0.4288	14.62	14.62	31.44	0.57	0.63	0.57	1.00	23.39	0
P-758	AG1003	AG1002	12			128	0.2579	14.62	14.62	25.68	0.68	0.81	0.68	1.00	18.14	0
P-76	C2004	C2003	48			288	0.0016	118.26	118.26	9.41	1.00	2.08	4.00	2.27	56.91	61
P-760	AG1002	AG1001	18			442	0.0204	42.90	42.90	24.28	1.00	2.85	1.50	1.41	15.03	28
P-761	AG2001	AG1002	12			423	0.0544	17.19	17.19	21.89	1.00	2.06	1.00	0.99	8.33	9
P-762	AE1011	AE1010	18			274	0.0045	43.13	43.13	24.41	1.00	6.11	1.50	1.03	7.06	36
P-763	AE1010	AE1009	24			499	0.0511	50.21	50.21	18.60	0.80	0.98	1.60	1.98	51.26	0
P-764	AE1009	AE1008	24			59	0.0568	62.32	62.32	19.84	1.00	1.15	2.00	1.99	54.06	8
P-765	AE1008	AE1007	24			374	0.0929	62.32	62.32	24.93	0.74	0.90	1.48	1.99	69.15	0
P-767	AE3001	AE1005	36			308	0.1377	74.68	74.68	30.74	0.38	0.30	1.13	2.72	248.21	0
P-768	AE1005	AE1004	42			784	0.0326	162.30	162.30	21.37	0.74	0.89	2.58	3.42	182.03	0
P-769	AE1004	AE1003	42			386	0.0846	173.21	173.21	31.75	0.55	0.59	1.93	3.44	293.40	0
P-770	AE1003	AE1002	42			197	0.0015	231.39	231.39	24.05	1.00	5.88	3.50	1.95	39.34	192
P-771	AE1002	AE1001	42			353	0.068	231.39	231.39	30.86	0.73	0.88	2.55	3.48	263.09	0
P-773	AE2005	AE2004	24			374	0.0199	13.06	13.06	9.67	0.44	0.41	0.89	1.30	32.03	0
P-774	AE2004	AE2003	24			353	0.0724	22.25	22.25	17.91	0.42	0.36	0.84	1.68	61.05	0

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P-775	AE2003	AE2002	24			173	0.0949	32.74	32.74	21.88	0.48	0.47	0.96	1.90	69.89	0
P-776	AE2002	AE2001	24			115	0.0628	37.46	37.46	19.31	0.59	0.66	1.19	1.94	56.83	0
P-777	AE2001	AE1003	24			113	0.2223	37.46	37.46	31.02	0.41	0.35	0.82	1.94	106.96	0
P-779	AF3007	AF3006	24			265	0.0655	105.64	105.64	33.63	1.00	1.82	2.00	1.99	58.07	48
P-780	AF3006	AF3005	24			239	0.0412	132.33	132.33	42.12	1.00	2.87	2.00	1.97	46.03	86
P-781	AF3005	AF3004	24			221	0.0784	149.79	149.79	47.68	1.00	2.36	2.00	1.99	63.50	86
P-782	AF3004	AF3003	24			179	0.0691	149.79	149.79	47.68	1.00	2.51	2.00	1.99	59.62	90
P-783	AF3003	AF3002	24			65	0.0386	159.82	159.82	50.87	1.00	3.59	2.00	1.97	44.56	115
P-784	AF3002	AF3001	30			398	0.042	159.82	159.82	32.56	1.00	1.90	2.50	2.47	84.24	76
P-785	AF3001	AF1003	30			42	0.0662	159.82	159.82	32.56	1.00	1.51	2.50	2.49	105.84	54
P-786	AF1003	AF1002	48			634	0.0334	243.14	243.14	23.77	0.76	0.92	3.04	3.93	263.04	0
P-787	AF1002	AF1001	48			137	0.0787	243.14	243.14	33.65	0.56	0.60	2.24	3.93	404.15	0
P-788	AF2001	AF1001	60			273	0.0015	80.06	80.06	5.72	0.67	0.79	3.35	2.53	101.20	0
P-789	AF2002	AF2001	54			354	0.0015	49.97	49.97	5.12	0.59	0.65	2.65	2.05	76.29	0
P-79	C2007	C2006	4			72	0.0015	47.72	47.72	546.86	1.00	638.43	0.33	0.15	0.07	48
P-791	AF1004	AF1003	48			517	0.0399	62.30	62.30	18.29	0.32	0.22	1.26	2.38	287.71	0
P-792	AF1005	AF1004	48			710	0.0158	54.40	54.40	12.59	0.38	0.30	1.50	2.22	180.87	0
P-794	AH1002	AH1001	36			134	0.0015	18.73	18.73	3.99	0.63	0.72	1.89	1.39	25.86	0
P-795	AH1003	AH1002	36			351	0.0513	18.73	18.73	14.59	0.24	0.12	0.71	1.39	151.49	0
P-796	AH1004	AH1003	36			189	0.1109	10.64	10.64	16.19	0.15	0.05	0.45	1.03	222.68	0
P-797	AH1005	AH1004	36			370	0.1107	10.64	10.64	16.19	0.15	0.05	0.45	1.03	222.50	0
P-798	AH1006	AH1005	21			249	0.1326	4.88	4.88	14.63	0.20	0.08	0.34	0.81	57.85	0
P-799	M4014	M4013	30			346	0.1365	208.00	208.00	42.37	1.00	1.37	2.50	2.50	151.96	56
P-8	A3003	A3002	36			255	0.0015	83.81	83.81	11.86	1.00	3.20	3.00	1.65	26.16	58
P-80	C2008	C2007	4			139	0.0014	47.72	47.72	546.86	1.00	659.75	0.33	0.15	0.07	48
P-800	M4013	M4012	30			401	0.0478	218.26	218.26	44.46	1.00	2.43	2.50	2.48	89.90	128
P-801	M4012	M4011	30			29	0.0343	226.13	226.13	46.07	1.00	2.97	2.50	2.46	76.15	150
P-802	M4011	M4010	30			298	0.0302	226.13	226.13	46.07	1.00	3.16	2.50	2.45	71.49	155
P-803	M4010	M4009	30			166	0.0015	238.03	238.03	48.49	1.00	14.93	2.50	1.35	15.94	222
P-804	M4009	M4008	30			261	0.023	238.03	238.03	48.49	1.00	3.82	2.50	2.41	62.39	176
P-805	M4008	M4007	30			46	0.0219	264.47	264.47	53.88	1.00	4.35	2.50	2.40	60.80	204
P-806	M4007	M4006	30			595	0.0134	264.47	264.47	53.88	1.00	5.55	2.50	2.27	47.67	217
P-807	M4006	M4005	30			336	0.0258	264.47	264.47	53.88	1.00	4.00	2.50	2.43	66.07	198
P-808	M5014	M5013	18			311	0.005	56.40	56.40	31.92	1.00	7.58	1.50	1.06	7.44	49

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ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-809	M5013	M5012	18			250	0.008	64.05	64.05	36.24	1.00	6.80	1.50	1.19	9.42	55
P-81	C2009	C2008	4			242	0.0015	37.89	37.89	434.20	1.00	508.16	0.33	0.15	0.07	38
P-810	M5012	M5011	18			50	0.0014	64.05	64.05	36.24	1.00	16.17	1.50	0.76	3.96	60
P-811	M5011	M5010	18			1068	0.0372	64.05	64.05	36.24	1.00	3.15	1.50	1.47	20.32	44
P-812	M5010	M5009	18			56	0.0834	90.73	90.73	51.34	1.00	2.98	1.50	1.49	30.41	60
P-813	M5009	M5008		36	36	563	0.0114	150.69	150.69	16.74	1.00	1.37	3.00	3.00	109.98	41
P-814	M5008	M5007		36	36	82	0.0012	180.20	180.20	20.02	1.00	4.99	3.00	1.65	36.10	144
P-815	M5007	M5006		36	60	349	0.0143	180.20	180.20	15.53	0.77	0.71	2.32	3.00	253.04	0
P-816	M5006	M5005		36	60	74	0.004	198.95	198.95	13.26	1.00	1.48	3.00	2.82	134.21	65
P-817	M5005	M5004		36	60	56	0.0089	198.95	198.95	13.32	1.00	1.00	2.99	3.00	199.87	0
P-818	M5004	M5003		48	72	315	0.0033	198.95	198.95	9.20	0.90	0.87	3.61	3.24	227.63	0
P-82	C2010	C2009	3			270	0.0093	37.89	37.89	771.92	1.00	444.05	0.25	0.18	0.09	38
P-820	M5002	M5001		48	48	129	0.0064	231.71	231.71	14.48	1.00	1.30	4.00	3.95	178.11	54
P-821	M5001	M1011		48	48	86	0.0407	231.71	231.71	24.43	0.59	0.52	2.37	4.00	448.36	0
P-827	M1028	M1027	30			598	0.0958	135.66	135.66	27.64	1.00	1.07	2.50	2.49	127.32	8
P-828	M1027	M1026	30			290	0.1378	158.74	158.74	32.34	1.00	1.04	2.50	2.50	152.68	6
P-829	M1026	M1025	30			144	0.0903	158.74	158.74	32.34	1.00	1.28	2.50	2.49	123.58	35
P-83	C2011	C2010	3			209	0.0024	31.02	31.02	631.89	1.00	715.10	0.25	0.12	0.04	31
P-830	M1024	M1023	24			109	0.092	169.41	169.41	53.92	1.00	2.46	2.00	1.99	68.78	101
P-831	M1023	M1022	30			374	0.0535	177.55	177.55	36.17	1.00	1.87	2.50	2.48	95.13	82
P-832	M1022	M1021	30			270	0.0371	177.55	177.55	36.17	1.00	2.24	2.50	2.46	79.16	98
P-833	M1021	M1020	30			253	0.0752	177.55	177.55	36.17	1.00	1.57	2.50	2.49	112.75	65
P-834	M1020	M1019	30			80	0.0124	220.05	220.05	44.83	1.00	4.80	2.50	2.24	45.86	174
P-835	M6001	M1019	30			696	0.0431	105.98	105.98	21.59	1.00	1.24	2.50	2.47	85.40	21
P-836	M1019	M1018	36			763	0.0354	326.03	326.03	46.12	1.00	2.59	3.00	2.96	125.83	200
P-837	M1018	M1017	36			53	0.019	341.00	341.00	48.24	1.00	3.70	3.00	2.86	92.21	249
P-838	M1017	M1016	36			237	0.0211	341.00	341.00	48.24	1.00	3.51	3.00	2.88	97.04	244
P-839	M1016	M1015	36			43	0.0231	327.41	327.41	46.32	1.00	3.22	3.00	2.90	101.60	226
P-84	C2012	C2011	30			281	0.0018	20.33	20.33	4.14	1.00	1.17	2.50	1.41	17.34	3
P-840	M1015	M1014	36			780	0.0192	327.41	327.41	46.32	1.00	3.53	3.00	2.86	92.71	235
P-841	M1014	M1013	36			94	0.0107	353.39	353.39	49.99	1.00	5.12	3.00	2.64	69.02	284
P-842	M1013	M1012	42			686	0.019	353.39	353.39	36.73	1.00	2.54	3.50	3.35	138.88	215
P-843	M1012	M1011	42			79	0.0063	372.55	372.55	38.72	1.00	4.66	3.50	2.79	80.02	293
P-844	M1011	M1010		60	84	126	0.0015	583.78	583.78	16.68	1.00	2.32	5.00	3.42	251.62	332

Appendix B
City of Richmond - Storm Drain Master Plan
Street Flow Analysis: 100-Year Rainfall Event

ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-845	M1010	M1009		60	84	74	0.0015	583.78	583.78	16.68	1.00	2.33	5.00	3.41	250.48	333
P-846	M1009	M1008		60	84	124	0.0016	583.78	583.78	16.68	1.00	2.24	5.00	3.51	260.91	323
P-847	M3005	M3004	30			193	0.0052	90.99	90.99	18.54	1.00	3.07	2.50	1.86	29.61	61
P-85	C2013	C2012	24			311	0.0032	20.33	20.33	6.47	1.00	1.58	2.00	1.29	12.87	7
P-851	N1028	N1027	36			1012	0.0175	279.59	279.59	39.55	1.00	3.16	3.00	2.84	88.45	191
P-852	N1027	N1026	36			241	0.055	458.75	458.75	64.90	1.00	2.92	3.00	2.98	156.89	302
P-853	N1026	N1025	36			1087	0.032	444.05	444.05	62.82	1.00	3.71	3.00	2.95	119.66	324
P-854	N1025	N1024	36			322	0.0328	511.61	511.61	72.38	1.00	4.22	3.00	2.95	121.12	390
P-855	N1024	N1023	36			98	0.032	448.90	448.90	63.51	1.00	3.75	3.00	2.95	119.67	329
P-856	N1023	N1022	36			178	0.032	469.07	469.07	66.36	1.00	3.92	3.00	2.95	119.56	350
P-857	N1022	N1021	30			52	0.0321	469.07	469.07	95.56	1.00	6.36	2.50	2.45	73.73	395
P-858	N1021	N1020	30			440	0.0321	469.07	469.07	95.56	1.00	6.37	2.50	2.45	73.67	395
P-859	N1020	N1019	30			74	0.0199	445.37	445.37	90.73	1.00	7.68	2.50	2.38	57.98	387
P-86	C2014	C2013	21			255	0.0055	9.45	9.45	5.43	0.68	0.80	1.19	1.14	11.76	0
P-860	N1019	N1018	30			128	0.0064	445.37	445.37	90.73	1.00	13.54	2.50	1.95	32.90	412
P-861	N1018	N1017	30			112	0.0099	445.37	445.37	90.73	1.00	10.91	2.50	2.15	40.84	405
P-862	N1030	N1029	12			455	0.0015	145.67	145.67	185.48	1.00	105.43	1.00	0.50	1.38	144
P-863	N1031	N1030	12			66	0.0091	98.80	98.80	125.80	1.00	28.93	1.00	0.79	3.42	95
P-867	N1002	N1001		48	96	555	0.0094	739.59	739.59	23.11	1.00	1.31	4.00	4.00	563.81	176
P-868	N1003	N1002		48	96	409	0.0044	739.59	739.59	23.11	1.00	1.91	4.00	4.00	386.45	353
P-869	N1004	N1003		48	96	330	0.0091	739.59	739.59	23.11	1.00	1.33	4.00	4.00	554.90	185
P-87	C2015	C2014	18			284	0.0078	5.61	5.61	5.50	0.56	0.60	0.84	0.91	9.27	0
P-870	N1005	N1004		48	96	255	0.0157	720.25	720.25	22.71	0.99	0.99	3.96	4.00	728.75	0
P-871	N1006	N1005		48	96	312	0.0244	711.45	711.45	26.66	0.83	0.78	3.34	4.00	909.26	0
P-872	N1007	N1006		48	96	32	0.0016	711.45	711.45	22.23	1.00	3.08	4.00	2.96	230.81	481
P-873	N1008	N1007		48	96	270	0.0185	704.00	704.00	24.02	0.92	0.89	3.66	4.00	792.42	0
P-874	N1009	N1008		48	96	214	0.014	704.00	704.00	22.00	1.00	1.02	4.00	4.00	689.22	15
P-875	N1010	N1009		48	96	64	0.0016	694.26	694.26	21.70	1.00	3.02	4.00	2.95	230.01	464
P-876	N1011	N1010		48	96	571	0.0035	683.33	683.33	21.35	1.00	1.98	4.00	3.86	344.54	339
P-877	N1012	N1011		24	84	244	0.0041	678.72	678.72	48.48	1.00	5.62	2.00	2.00	120.74	558
P-878	N1013	N1012		24	84	281	0.0143	671.07	671.07	47.93	1.00	2.98	2.00	2.00	225.03	446
P-879	N1014	N1013	48			386	0.013	499.91	499.91	39.78	1.00	3.05	4.00	3.69	163.96	336
P-88	C3001	C2002	36			54	0.0015	52.03	52.03	7.36	1.00	2.03	3.00	1.64	25.69	26
P-880	N1015	N1014	48			99	0.0304	499.91	499.91	39.78	1.00	1.99	4.00	3.94	251.13	249

Appendix B
City of Richmond - Storm Drain Master Plan
Street Flow Analysis: 100-Year Rainfall Event

ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-881	N1016	N1015	48			184	0.0054	440.23	440.23	35.03	1.00	4.14	4.00	3.12	106.28	334
P-882	N2001	N1013	21			615	0.0179	228.48	228.48	94.99	1.00	10.75	1.75	1.63	21.25	207
P-883	N2002	N2001	18			426	0.0235	205.88	205.88	116.50	1.00	12.76	1.50	1.43	16.13	190
P-884	N2003	N2002	21			1178	0.0399	148.89	148.89	61.90	1.00	4.69	1.75	1.72	31.74	117
P-885	O1012	O1010	21			239	0.0078	19.83	19.83	8.24	1.00	1.41	1.75	1.39	14.04	6
P-886	O1010	O1009	24			223	0.0303	37.99	37.99	14.32	0.79	0.96	1.57	1.94	39.49	0
P-887	O1009	O1008	21			247	0.0015	37.99	37.99	15.80	1.00	6.18	1.75	0.91	6.15	32
P-888	O1008	O1007	36			259	0.0015	51.37	51.37	7.27	1.00	1.98	3.00	1.64	25.94	25
P-889	O1007	O1006	36			270	0.0083	65.43	65.43	9.26	1.00	1.07	3.00	2.52	60.95	4
P-89	C3002	C3001	36			114	0.0015	52.03	52.03	7.36	1.00	2.02	3.00	1.64	25.80	26
P-890	O1006	O1005	36			212	0.0099	79.56	79.56	11.26	1.00	1.19	3.00	2.61	66.61	13
P-893	O1004	O1003	30			90	0.031	97.47	97.47	19.86	1.00	1.35	2.50	2.45	72.38	25
P-894	O1003	O1002	36			325	0.0031	97.47	97.47	13.79	1.00	2.63	3.00	1.98	37.10	60
P-895	O1002	O1001	36			52	0.0096	115.87	115.87	16.39	1.00	1.77	3.00	2.59	65.40	50
P-9	A3002	A3001	36			49	0.0016	88.89	88.89	12.57	1.00	3.30	3.00	1.68	26.93	62
P-90	C3003	C3002	36			318	0.0015	52.03	52.03	7.36	1.00	2.00	3.00	1.65	25.98	26
P-91	C3004	C3003	36			211	0.0014	37.40	37.40	5.29	1.00	1.48	3.00	1.62	25.20	12
P-92	C3005	C3004	30			231	0.0014	28.98	28.98	5.90	1.00	1.86	2.50	1.33	15.56	13
P-93	C3006	C3005	24			281	0.0104	28.98	28.98	9.23	1.00	1.25	2.00	1.71	23.11	6
P-94	C3007	C3006	24			353	0.0062	23.30	23.30	7.42	1.00	1.30	2.00	1.52	17.90	5
P-95	C3008	C3007	24			319	0.0056	16.54	16.54	6.18	0.79	0.97	1.59	1.47	17.04	0
P-958	D5106	D5105	42			72	0.0015	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.31	0
P-959	D5001	D1018	60			819	0.0079	194.76	194.76	13.26	0.70	0.84	3.50	3.99	232.45	0
P-96	C3009	C3008	24			187	0.0054	7.61	7.61	5.16	0.48	0.46	0.95	0.98	16.60	0
P-960	I1001	I-1		48	72	333	0.0023	588.16	588.16	24.51	1.00	3.15	4.00	3.11	186.94	401
P-961	M3006	M3005	4			469	0.0064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0
P-962	I2007	I2006	24			289	0.0016	97.63	97.63	31.08	1.00	10.91	2.00	1.07	8.95	89
P-963	I2006	I2005	24			452	0.0015	146.54	146.54	46.64	1.00	16.42	2.00	1.07	8.93	138
P-964	I4002	I4001	24			500	0.0015	44.46	44.46	14.15	1.00	5.00	2.00	1.06	8.90	36
P-965S	I4001	I1005	120			834	0.003	44.46	44.46	5.99	0.15	0.05	1.51	1.53	907.89	0
P-966	J1002	J1001	60			131	0.0015	136.72	136.72	6.96	1.00	1.34	5.00	2.87	101.90	35
P-967	J1001	J-1	60			163	0.0015	136.72	136.72	6.96	1.00	1.34	5.00	2.88	102.22	34
P-97	C4003	C4002	24			265	0.0015	32.91	32.91	10.47	1.00	3.74	2.00	1.06	8.81	24
P-970	I1015	I1014	24			366	0.0034	73.74	73.74	23.47	1.00	5.54	2.00	1.31	13.31	60

Appendix B
City of Richmond - Storm Drain Master Plan
Street Flow Analysis: 100-Year Rainfall Event

ID	From ID	To ID	Dia (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope (ft/ft)	Total Flow (cfs)	Storm Flow (cfs)	Vel (ft/s)	d/D	q/Q	Water Depth (ft)	Critical Depth (ft)	Full Flow (cfs)	Street Flow (cfs)
P-971	I1014	I1013	24			401	0.0033	73.74	73.74	23.47	1.00	5.63	2.00	1.30	13.11	61
P-972	I1017	I1016	24			437	0.0028	32.16	32.16	10.24	1.00	2.66	2.00	1.25	12.11	20
P-973	I1019	I1018	15			282	0.0031	21.43	21.43	17.46	1.00	5.96	1.25	0.77	3.60	18
P-974	I1018	I1017	21			278	0.0031	21.43	21.43	8.91	1.00	2.42	1.75	1.10	8.84	13
P-975	C1002	C1001	36			54	0.0015	265.13	265.13	37.51	1.00	10.28	3.00	1.64	25.78	239
P-976	C2001	C1001	54			60	0.0015	184.43	184.43	11.60	1.00	2.41	4.50	2.55	76.43	108
P-977	C1001	C-1	84			196	0.0016	387.26	387.26	10.06	1.00	1.52	7.00	4.19	254.96	132
P-979	C1018	C1017	30			232	0.0016	201.70	201.70	41.09	1.00	12.27	2.50	1.37	16.44	185
P-98	C4004	C4003	24			180	0.0022	26.97	26.97	8.59	1.00	2.52	2.00	1.17	10.68	16
P-980	C1017	C1016	30			49	0.0016	201.70	201.70	41.09	1.00	12.19	2.50	1.37	16.54	185
P-984	B1018	B1017	24			748	0.0017	155.16	155.16	49.39	1.00	16.41	2.00	1.10	9.46	146
P-985	B1017	B1016	24			282	0.0092	155.16	155.16	49.39	1.00	7.13	2.00	1.67	21.78	133
P-986	B2001	B1014	12			209	0.0024	175.39	175.39	223.32	1.00	100.50	1.00	0.56	1.75	174
P-987	A1011	A1010	48			745	0.0015	290.37	290.37	23.11	1.00	5.25	4.00	2.24	55.34	235
P-987S	B2002	B2001	120			705	0.0015	175.39	175.39	6.97	0.36	0.27	3.57	3.09	642.87	0
P-988	A1001	A-1	78			80	0.0015	627.50	627.50	18.91	1.00	3.08	6.50	3.81	203.97	424
P-989	A3006	A3005	21			524	0.0021	64.98	64.98	27.01	1.00	8.93	1.75	1.00	7.28	58
P-99	C4005	C4004	24			299	0.0015	26.97	26.97	8.59	1.00	3.07	2.00	1.06	8.80	18
P-990	A3005	A3004	24			485	0.0072	83.81	83.81	26.68	1.00	4.35	2.00	1.58	19.26	65
P-991	D2001	D-2	36			397	0.0015	282.89	282.89	40.02	1.00	10.88	3.00	1.65	26.00	257
P-992	E1001	E-1	60			199	0.0032	1876.00	1876.00	31.85	1.00	12.78	5.00	3.47	440.35	1436
P-993	E1003	E1002	60			287	0.089	1854.34	1854.34	43.99	0.67	2.38	3.36	4.98	2336.71	0
P-994	E1012	E1011	60			1037	0.0028	551.38	551.38	14.04	1.00	4.02	5.00	3.35	274.29	277
P-995	E1019	E1018	54			36	0.0031	330.05	330.05	20.75	1.00	3.02	4.50	3.08	109.30	221
P-996	E4002	E4001	36			261	0.0102	346.10	346.10	48.96	1.00	5.12	3.00	2.62	67.62	278
P-997	E4001	E1009	42			125	0.0539	346.10	346.10	35.97	1.00	1.48	3.50	3.48	234.18	112
P-998	E4006	E4005	4			860	0.0009	325.33	325.33	3728.06	1.00	5627.18	0.33	0.13	0.06	325
P-999	E1006	E1005	66			547	0.0019	995.40	995.40	13.97	1.00	6.85	5.50	3.36	436.13	559

Appendix C
Gravity Main Output Report

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 2-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
35S	80	B2003	120			1611.4	0.0068	48.9	8.2	0.13	0.04	1370.1
33	82	80	54			604.2	0.0074	48.9	9.2	0.37	0.29	170.2
31	84	82		48	76	167.0	0.0030	48.9	5.9	0.33	0.21	232.3
29	86	84	48			467.6	0.0043	48.9	7.6	0.51	0.52	94.2
P-988	A1001	A-1	78			79.7	0.0015	305.1	9.2	1.00	1.50	204.0
P-16	A1002	A1001	78			984.4	0.0010	305.1	9.2	1.00	1.88	162.4
P-15	A1003	A1002	84			44.5	0.0022	305.1	7.9	1.00	1.00	303.8
P-14	A1004	A1003	84			119.0	0.0015	305.1	7.9	1.00	1.22	249.2
P-13	A1005	A1004	84			426.4	0.0015	290.7	7.6	1.00	1.17	248.2
P-12	A1006	A1005	84			109.7	0.0015	290.7	7.6	1.00	1.19	244.7
P-11	A1007	A1006	84			235.4	0.0015	235.2	7.3	0.78	0.95	247.0
P-21	A1008	A1007	72			953.4	0.0015	187.4	6.6	1.00	1.14	164.5
P-22	A1009	A1008	66			801.7	0.0015	172.0	7.2	1.00	1.30	132.4
P-23	A1010	A1009	60			755.4	0.0015	160.5	8.2	1.00	1.58	101.9
P-987	A1011	A1010	48			745.2	0.0015	141.2	11.2	1.00	2.55	55.3
P-374	A1012	A1011	48			176.6	0.0017	141.2	11.2	1.00	2.38	59.4
P-373	A1013	A1012	48			151.1	0.0015	134.8	10.7	1.00	2.40	56.2
P-372	A1014	A1013	30			714.3	0.0016	134.8	27.5	1.00	8.28	16.3
P-370	A1015	A1014	18			35.7	0.0014	122.0	69.0	1.00	30.94	3.9
P-369S	A1016	A1015	120			204.5	0.0016	122.0	6.4	0.29	0.19	656.0
P-368	A1017	A1016	18			29.7	0.0010	122.0	69.0	1.00	36.46	3.3
P-367	A1018	A1017	36			302.8	0.0015	88.0	12.4	1.00	3.41	25.8
P-366	A1019	A1018	36			219.7	0.0016	88.0	12.4	1.00	3.30	26.7
P-365	A1020	A1019	36			315.9	0.0015	48.6	6.9	1.00	1.86	26.1
P-364	A1021	A1020	36			75.1	0.0016	48.6	6.9	1.00	1.82	26.7
P-363	A1022	A1021	48			676.1	0.0367	8.9	10.0	0.12	0.03	276.0
P-27	A2001	A1006	18			293.5	0.0015	64.4	36.4	1.00	15.62	4.1
P-28	A2002	A2001	18			134.6	0.0015	64.4	36.4	1.00	15.86	4.1
P-29	A2003	A2002	12			703.8	0.0006	64.4	82.0	1.00	75.63	0.9
P-30	A2004	A2003	12			90.7	0.0015	49.3	62.8	1.00	35.14	1.4
P-31	A2005	A2004	12			229.3	0.0015	49.3	62.8	1.00	35.86	1.4
P-32	A2006	A2005	12			189.9	0.0006	0.0	0.0	0.00	0.00	0.9
P-33	A2101	A2005	30			528.7	0.0015	12.2	3.6	0.66	0.77	15.9
P-34	A2201	A2005	21			567.0	0.0057	20.8	8.6	1.00	1.74	12.0
P-35	A2203	A2201	21			377.9	0.0096	20.8	8.6	1.00	1.33	15.6
P-10	A3001	A1007	36			295.9	0.0015	43.3	6.1	1.00	1.66	26.1
P-9	A3002	A3001	36			49.3	0.0016	43.3	6.1	1.00	1.61	26.9
P-8	A3003	A3002	36			254.9	0.0015	40.6	5.7	1.00	1.55	26.2
P-7	A3004	A3003	42			1168.7	0.0016	40.6	4.8	0.82	1.00	40.7
P-990	A3005	A3004	24			485.3	0.0072	40.6	12.9	1.00	2.11	19.3
P-989	A3006	A3005	21			524.4	0.0021	31.5	13.1	1.00	4.32	7.3
P-5	A3007	A3006	18			43.6	0.0115	25.2	14.3	1.00	2.23	11.3
P-4	A3008	A3007	18			238.2	0.0041	25.2	14.3	1.00	3.75	6.7
P-3	A3009	A3008	15			261.5	0.0037	21.6	17.6	1.00	5.48	3.9
P-2	A3010	A3009	15			262.7	0.0027	18.7	15.2	1.00	5.54	3.4
P-1	A3011	A3010	12			274.8	0.0095	14.9	19.0	1.00	4.30	3.5
P-20	A4001	A1008	48			573.5	0.0015	28.4	4.4	0.51	0.52	55.1

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 2-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-19	A4002	A4001	48			433.2	0.0015	28.4	4.5	0.51	0.51	55.8
P-18	A4003	A4002	48			405.0	0.0016	28.4	4.6	0.50	0.49	57.7
P-17	A4004	A4003	48			68.8	0.0015	28.4	4.4	0.51	0.52	54.9
P-24	A5001	A1010	48			508.0	0.0015	24.1	4.2	0.46	0.44	55.3
P-25	A5002	A5001	48			423.3	0.0015	24.1	4.3	0.46	0.43	56.4
P-26	A5003	A5002	48			133.4	0.0015	24.1	4.3	0.46	0.43	55.8
P-371	A6001	A1014	18			134.7	0.0015	12.6	7.1	1.00	3.09	4.1
P-1097	AA1001	AA-1	36			106.1	0.0188	73.0	14.4	0.67	0.80	91.8
P-358	AA1002	AA1001	36			49.2	0.0203	68.4	14.7	0.63	0.72	95.3
P-357	AA1003	AA1002	36			418.7	0.0072	63.2	8.9	1.00	1.12	56.6
P-356	AA1004	AA1003	36			429.6	0.0163	43.4	12.1	0.50	0.51	85.4
P-355	AA1005	AA1004	36			463.0	0.0216	35.1	12.7	0.41	0.36	98.3
P-354	AA1006	AA1005	36			134.5	0.0372	32.1	15.1	0.34	0.25	129.0
P-353	AA1007	AA1006	36			482.5	0.1057	23.1	20.0	0.22	0.11	217.4
P-1096	AA1008	AA1007	36			882.3	0.0015	6.8	3.1	0.35	0.26	25.9
P-362	AA2001	AA1003	30			145.9	0.0069	16.2	6.8	0.49	0.47	34.0
P-361	AA2002	AA2001	30			101.0	0.0198	16.2	10.1	0.36	0.28	57.9
P-360	AA2003	AA2002	30			40.3	0.0015	16.2	3.3	1.00	1.02	15.9
P-359	AA2004	AA2003	24			257.0	0.1907	14.6	22.6	0.26	0.15	99.0
P-1098	AB1001	AB-1	72			216.8	0.0015	145.0	6.6	0.72	0.88	165.7
P-1099	AB1002	AB1001	12			29.5	6.2096	131.8	167.8	1.00	1.48	89.0
P-710	AB1003	AB1002	54			258.7	0.0030	120.0	7.5	1.00	1.11	108.3
P-709	AB1004	AB1003	54			553.5	0.0054	120.0	10.2	0.69	0.83	145.2
P-1080	AB1005	AB1004	42			1025.0	0.0480	108.0	22.8	0.49	0.49	221.0
P-716	AB1006	AB1005	12			118.8	0.0619	51.2	65.2	1.00	5.76	8.9
P-717	AB1007	AB1006	15			211.3	0.0015	51.2	41.7	1.00	20.33	2.5
P-718	AB1008	AB1007	21			71.5	0.0014	40.7	16.9	1.00	6.85	5.9
P-719	AB1009	AB1008	21			84.3	0.0015	40.7	16.9	1.00	6.52	6.2
P-720	AB1010	AB1009	24			157.6	0.0263	40.7	13.0	1.00	1.11	36.8
P-721	AB1011	AB1010	21			266.3	0.0909	39.1	22.2	0.69	0.82	47.9
P-722	AB1012	AB1011	21			354.0	0.0455	34.8	14.5	1.00	1.03	33.9
P-723	AB1013	AB1012	21			219.9	0.0200	34.8	14.5	1.00	1.55	22.5
P-724	AB1014	AB1013	21			252.0	0.0198	34.8	14.5	1.00	1.55	22.4
P-725	AB1015	AB1014	18			362.0	0.0989	30.8	21.3	0.76	0.93	33.1
P-726	AB1016	AB1015	12			199.5	0.0689	21.8	27.8	1.00	2.33	9.4
P-705	AB2001	AB1001	18			153.4	0.0015	2.8	2.5	0.60	0.68	4.1
P-704	AB3001	AB1001	36			406.8	0.4664	13.8	28.9	0.12	0.03	456.7
P-703	AB3002	AB3001	36			292.4	0.0246	13.8	10.3	0.24	0.13	104.8
P-702	AB3003	AB3002	36			69.2	0.0040	13.8	5.4	0.39	0.32	42.5
P-701	AB3004	AB3003	30			149.0	0.0074	9.5	6.1	0.36	0.27	35.3
P-700	AB3005	AB3004	30			48.7	0.0637	6.4	11.7	0.17	0.06	103.8
P-699	AB3006	AB3005	24			145.7	0.0184	6.4	7.7	0.31	0.21	30.8
P-698	AB3007	AB3006	24			149.9	0.0133	6.4	6.9	0.34	0.24	26.2
P-697	AB3008	AB3007	24			169.9	0.0164	3.9	6.4	0.25	0.14	29.0
P-711	AB4001	AB1002	15			202.7	0.0120	13.1	10.7	1.00	1.85	7.1
P-712	AB4002	AB4001	12			231.4	0.0107	9.7	12.3	1.00	2.63	3.7
P-713	AB4003	AB4002	15			113.3	0.0100	9.7	7.9	1.00	1.50	6.5

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-715	AB5001	AB1004	21			429.4	0.1108	10.0	16.9	0.29	0.19	52.9
P-714	AB5002	AB5001	21			214.6	0.0614	5.4	11.5	0.25	0.14	39.4
P-707	AB6001	AB1005	42			32.9	0.0015	59.7	6.2	1.00	1.52	39.3
P-706	AB6002	AB6001	42			393.0	0.0015	49.8	5.2	1.00	1.27	39.1
P-1079	AC1001	AC-1	12			101.4	0.0197	42.8	54.5	1.00	8.53	5.0
P-1078	AC1002	AC1001	12			193.7	0.0310	40.0	50.9	1.00	6.36	6.3
P-1077	AC1003	AC1002	12			166.9	0.0360	40.0	50.9	1.00	5.90	6.8
P-727	AC1004	AC1003	18			87.9	0.0455	19.3	14.3	0.71	0.86	22.5
P-728	AC1005	AC1004	18			151.0	0.0993	19.3	19.5	0.55	0.58	33.2
P-729	AC1006	AC1005	18			391.4	0.0869	13.9	17.1	0.47	0.45	31.0
P-730	AC1007	AC1006	15			473.2	0.0845	5.3	13.2	0.36	0.28	18.8
P-731	AC1008	AC1007	15			349.2	0.0143	5.3	6.8	0.61	0.69	7.8
P-732	AC1009	AC1008	15			210.3	0.0571	2.5	9.2	0.27	0.16	15.5
P-1076	AD1001	AD-1	24			113.6	0.0088	86.3	27.5	1.00	4.05	21.3
P-1075	AD1002	AD1001	24			31.0	0.0323	86.3	27.5	1.00	2.12	40.8
P-1074	AD1003	AD1002	24			73.7	0.0136	86.3	27.5	1.00	3.27	26.4
P-741	AD1004	AD1003	24			149.9	0.0133	68.6	21.8	1.00	2.62	26.2
P-740	AD1005	AD1004	24			138.2	0.0217	64.9	20.7	1.00	1.94	33.4
P-739	AD1006	AD1005	24			103.9	0.0193	64.9	20.7	1.00	2.06	31.5
P-738	AD1007	AD1006	21			187.6	0.0267	62.0	25.8	1.00	2.39	25.9
P-737	AD1008	AD1007	15			347.1	0.0922	28.5	23.2	1.00	1.45	19.7
P-736	AD1009	AD1008	15			384.4	0.0885	25.4	20.7	1.00	1.32	19.3
P-735	AD1010	AD1009	15			311.8	0.0866	18.5	17.7	0.79	0.97	19.1
P-734	AD1011	AD1010	15			313.3	0.0032	12.9	10.5	1.00	3.52	3.7
P-733	AD1012	AD1011	12			333.8	0.0210	4.8	7.5	0.76	0.93	5.2
P-745	AD2001	AD1007	21			72.0	0.0417	33.6	14.0	1.00	1.03	32.4
P-746	AD2002	AD2001	21			243.4	0.0698	33.6	19.4	0.68	0.80	42.0
P-747	AD2003	AD2002	21			220.6	0.0227	30.9	12.9	1.00	1.29	23.9
P-748	AD2004	AD2003	18			217.8	0.1194	25.9	22.4	0.62	0.71	36.4
P-749	AD2005	AD2004	18			458.6	0.0850	24.2	19.3	0.67	0.79	30.7
P-750	AD2006	AD2005	18			160.9	0.0015	24.2	13.7	1.00	5.94	4.1
P-751	AD2007	AD2006	18			90.8	0.0441	24.2	13.7	1.00	1.09	22.1
P-752	AD2008	AD2007	18			167.0	0.0479	20.1	14.7	0.72	0.87	23.0
P-753	AD2009	AD2008	18			129.7	0.0015	20.1	11.4	1.00	4.98	4.0
P-754	AD2010	AD2009	18			212.4	0.0141	13.8	7.8	1.00	1.10	12.5
P-742	AD3001	AD1009	12			324.0	0.0185	7.0	8.9	1.00	1.43	4.9
P-743	AD3002	AD3001	12			204.2	0.0196	1.9	5.9	0.42	0.37	5.0
P-744	AD3003	AD3002	12			241.1	0.0871	1.9	10.1	0.29	0.18	10.5
P-1069	AE1001	AE-1	42			129.5	0.0601	117.8	25.4	0.49	0.48	247.3
P-771	AE1002	AE1001	42			352.9	0.0680	112.4	26.3	0.46	0.43	263.1
P-770	AE1003	AE1002	42			197.2	0.0015	112.4	11.7	1.00	2.86	39.3
P-769	AE1004	AE1003	42			386.5	0.0846	84.1	26.3	0.37	0.29	293.4
P-768	AE1005	AE1004	42			783.5	0.0326	78.8	18.2	0.46	0.43	182.0
P-1072	AE1006	AE1005	24			72.6	0.1506	35.5	26.5	0.44	0.40	88.0
P-1071	AE1007	AE1006	24			223.0	0.0245	35.5	12.9	0.82	1.00	35.5
P-765	AE1008	AE1007	24			374.4	0.0929	30.3	21.3	0.46	0.44	69.2
P-764	AE1009	AE1008	24			58.6	0.0568	30.3	17.7	0.54	0.56	54.1

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P-763	AE1010	AE1009	24			498.9	0.0511	24.4	16.1	0.49	0.48	51.3
P-762	AE1011	AE1010	18			273.9	0.0045	20.9	11.9	1.00	2.97	7.1
P-777	AE2001	AE1003	24			113.3	0.2223	18.2	25.4	0.28	0.17	107.0
P-776	AE2002	AE2001	24			114.7	0.0628	18.2	16.1	0.39	0.32	56.8
P-775	AE2003	AE2002	24			172.7	0.0949	15.9	18.0	0.32	0.23	69.9
P-774	AE2004	AE2003	24			352.6	0.0724	10.8	14.6	0.28	0.18	61.0
P-773	AE2005	AE2004	24			374.2	0.0199	6.3	7.9	0.30	0.20	32.0
P-767	AE3001	AE1005	36			308.3	0.1377	36.3	25.1	0.26	0.15	248.2
P-1070	AF1001	AF-1	90			440.1	0.0476	164.1	24.2	0.21	0.10	1680.3
P-787	AF1002	AF1001	48			137.2	0.0787	118.2	27.9	0.37	0.29	404.1
P-786	AF1003	AF1002	48			634.4	0.0334	118.2	20.4	0.47	0.45	263.0
P-791	AF1004	AF1003	48			516.8	0.0399	30.3	14.9	0.22	0.11	287.7
P-792	AF1005	AF1004	48			710.2	0.0158	26.4	10.3	0.26	0.15	180.9
P-788	AF2001	AF1001	60			273.0	0.0015	38.9	4.8	0.43	0.38	101.2
P-789	AF2002	AF2001	54			354.0	0.0015	24.3	4.3	0.39	0.32	76.3
P-785	AF3001	AF1003	30			41.5	0.0662	77.7	23.6	0.64	0.73	105.8
P-784	AF3002	AF3001	30			397.8	0.0420	77.7	19.5	0.76	0.92	84.2
P-783	AF3003	AF3002	24			64.8	0.0386	77.7	24.7	1.00	1.74	44.6
P-782	AF3004	AF3003	24			179.5	0.0691	72.8	23.2	1.00	1.22	59.6
P-781	AF3005	AF3004	24			220.8	0.0784	72.8	23.2	1.00	1.15	63.5
P-780	AF3006	AF3005	24			239.2	0.0412	64.3	20.5	1.00	1.40	46.0
P-779	AF3007	AF3006	24			264.7	0.0655	51.3	20.9	0.73	0.88	58.1
P-1073	AG1001	AG-1	21			202.1	0.0148	35.2	14.6	1.00	1.82	19.4
P-760	AG1002	AG1001	18			442.1	0.0204	20.8	11.8	1.00	1.39	15.0
P-758	AG1003	AG1002	12			128.0	0.2579	7.1	21.7	0.43	0.39	18.1
P-757	AG1004	AG1003	12			104.9	0.4288	7.1	26.1	0.38	0.30	23.4
P-756	AG1005	AG1004	12			80.1	0.0624	7.1	12.6	0.67	0.80	8.9
P-755	AG1006	AG1005	12			241.1	0.0166	5.3	6.8	1.00	1.15	4.6
P-761	AG2001	AG1002	12			422.5	0.0544	8.3	10.6	1.00	1.00	8.3
P-1100	AH1001	AH-1	36			96.3	0.0015	9.7	3.4	0.43	0.38	25.5
P-794	AH1002	AH1001	36			133.7	0.0015	9.1	3.3	0.41	0.35	25.9
P-795	AH1003	AH1002	36			350.8	0.0513	9.1	11.8	0.17	0.06	151.5
P-796	AH1004	AH1003	36			189.4	0.1109	5.2	13.0	0.11	0.02	222.7
P-797	AH1005	AH1004	36			370.4	0.1107	5.2	13.0	0.11	0.02	222.5
P-798	AH1006	AH1005	21			248.9	0.1326	2.4	11.8	0.14	0.04	57.9
21	B1009	B-1		66	114	173.7	0.0058	164.5	10.1	0.31	0.19	847.8
P-44	B1010	B1009	72			185.9	0.0054	157.2	11.0	0.50	0.50	311.4
23	B1012	B1010	54			316.5	0.0014	150.3	9.5	1.00	2.02	74.3
P-41	B1013	B1012	54			520.5	0.0011	138.4	8.7	1.00	2.16	64.1
P-40	B1014	B1013	60			465.8	0.0064	133.0	11.3	0.58	0.63	209.6
P-39	B1015	B1014	36			247.9	0.0040	86.2	12.2	1.00	2.03	42.5
P-38	B1016	B1015	36			156.8	0.0089	86.2	12.2	1.00	1.36	63.2
P-985	B1017	B1016	24			282.1	0.0092	74.1	23.6	1.00	3.40	21.8
P-984	B1018	B1017	24			748.0	0.0017	74.1	23.6	1.00	7.84	9.5
P-36	B1019	B1018	24			173.0	0.0015	42.0	13.4	1.00	4.77	8.8
P-986	B2001	B1014	12			209.5	0.0024	85.0	108.2	1.00	48.70	1.7
P-987S	B2002	B2001	120			705.2	0.0015	85.0	5.7	0.25	0.13	642.9

Appendix C
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-53	B2003	B2002	54			257.2	0.0012	85.0	5.3	1.00	1.26	67.3
P-54	B2004	B2003	54			57.7	0.0797	55.4	22.3	0.21	0.10	556.8
P-55	B2005	B2004	24			544.8	0.0079	55.4	17.6	1.00	2.75	20.2
P-56	B2006	B2005	21			281.9	0.0058	41.4	17.2	1.00	3.43	12.1
P-57	B2007	B2006	21			283.4	0.0101	41.4	17.2	1.00	2.59	16.0
P-58	B2008	B2007	12			264.6	0.0125	27.4	34.9	1.00	6.88	4.0
P-52	B3001	B1016	12			264.1	0.0015	0.0	0.0	0.00	0.00	1.4
P-977	C1001	C-1	84			195.7	0.0016	187.7	7.2	0.64	0.74	255.0
P-975	C1002	C1001	36			53.8	0.0015	128.5	18.2	1.00	4.98	25.8
P-72	C1003	C1002	36			79.1	0.0015	128.5	18.2	1.00	4.93	26.0
P-71	C1004	C1003	36			113.3	0.0015	128.5	18.2	1.00	4.96	25.9
P-70	C1005	C1004	36			176.8	0.0015	122.4	17.3	1.00	4.69	26.1
P-69	C1006	C1005	36			274.7	0.0015	113.5	16.1	1.00	4.34	26.2
P-68	C1007	C1006	36			115.6	0.0016	113.5	16.1	1.00	4.30	26.4
P-67	C1008	C1007	36			220.3	0.0016	110.4	15.6	1.00	4.14	26.7
P-66	C1009	C1008	36			262.4	0.0015	110.4	15.6	1.00	4.23	26.1
P-65	C1010	C1009	36			162.2	0.0015	108.0	15.3	1.00	4.11	26.3
P-64	C1011	C1010	36			238.5	0.0015	104.9	14.8	1.00	4.04	26.0
P-63	C1012	C1011	36			249.8	0.0016	104.9	14.8	1.00	3.97	26.4
P-62	C1013	C1012	36			253.1	0.0016	101.5	14.4	1.00	3.82	26.6
P-61	C1014	C1013	36			252.6	0.0016	101.5	14.4	1.00	3.81	26.6
P-60	C1015	C1014	30			265.5	0.0015	101.5	20.7	1.00	6.36	16.0
P-59	C1016	C1015	30			254.7	0.0016	97.7	19.9	1.00	6.00	16.3
P-980	C1017	C1016	30			49.4	0.0016	97.7	19.9	1.00	5.91	16.5
P-979	C1018	C1017	30			231.7	0.0016	97.7	19.9	1.00	5.95	16.4
P-375	C1019	C1018	30			182.9	0.0107	97.7	19.9	1.00	2.30	42.6
P-376	C1020	C1019	30			175.7	0.0114	91.5	18.6	1.00	2.09	43.9
P-377	C1021	C1020	30			95.4	0.0015	91.5	18.6	1.00	5.81	15.8
P-378	C1022	C1021	30			86.1	0.0015	91.5	18.6	1.00	5.73	16.0
P-379	C1023	C1022	30			83.5	0.0016	91.5	18.6	1.00	5.64	16.2
P-380	C1024	C1023	30			70.4	0.0016	91.5	18.6	1.00	5.63	16.3
P-381	C1025	C1024	30			281.1	0.0026	85.3	17.4	1.00	4.10	20.8
P-382	C1026	C1025	21			235.5	0.0078	85.3	35.5	1.00	6.09	14.0
P-383	C1027	C1026	18			259.4	0.0077	38.8	22.0	1.00	4.20	9.2
P-976	C2001	C1001	54			59.9	0.0015	89.8	5.6	1.00	1.18	76.4
P-74	C2002	C2001	54			189.9	0.0015	89.8	5.6	1.00	1.19	75.7
P-75	C2003	C2002	48			268.3	0.0015	62.9	5.0	1.00	1.13	55.6
P-76	C2004	C2003	48			288.2	0.0016	57.4	4.6	1.00	1.01	56.9
17	C2006	C2004	48			368.5	0.0015	52.1	5.0	0.77	0.94	55.1
P-79	C2007	C2006	4			71.7	0.0015	22.9	262.9	1.00	306.89	0.1
P-80	C2008	C2007	4			139.2	0.0014	22.9	262.9	1.00	317.13	0.1
P-81	C2009	C2008	4			242.3	0.0015	18.2	208.7	1.00	244.27	0.1
P-82	C2010	C2009	3			269.5	0.0093	18.2	371.1	1.00	213.45	0.1
P-83	C2011	C2010	3			208.6	0.0024	14.9	303.7	1.00	343.74	0.0
P-84	C2012	C2011	30			281.4	0.0018	9.9	3.7	0.54	0.57	17.3
P-85	C2013	C2012	24			310.6	0.0032	9.9	4.5	0.66	0.77	12.9
P-86	C2014	C2013	21			255.4	0.0055	4.6	4.6	0.44	0.39	11.8

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P-87	C2015	C2014	18			283.7	0.0078	2.7	4.6	0.37	0.29	9.3
P-88	C3001	C2002	36			54.2	0.0015	24.8	4.1	0.79	0.97	25.7
P-89	C3002	C3001	36			114.2	0.0015	24.8	4.2	0.79	0.96	25.8
P-90	C3003	C3002	36			318.1	0.0015	24.8	4.2	0.78	0.96	26.0
P-91	C3004	C3003	36			211.2	0.0014	17.9	3.9	0.62	0.71	25.2
P-92	C3005	C3004	30			230.6	0.0014	13.8	3.6	0.73	0.89	15.6
P-93	C3006	C3005	24			281.2	0.0104	13.8	7.7	0.56	0.60	23.1
P-94	C3007	C3006	24			353.1	0.0062	11.1	6.0	0.57	0.62	17.9
P-95	C3008	C3007	24			319.0	0.0056	7.9	5.3	0.48	0.46	17.0
P-96	C3009	C3008	24			186.8	0.0054	3.6	4.2	0.32	0.22	16.6
P-1102S	C4001	C2006	120			613.8	0.0015	23.6	3.9	0.13	0.04	642.0
P-1101	C4002	C4001	27			167.0	0.0015	23.6	5.9	1.00	1.96	12.0
P-97	C4003	C4002	24			265.4	0.0015	16.3	5.2	1.00	1.85	8.8
P-98	C4004	C4003	24			180.3	0.0022	13.4	4.3	1.00	1.25	10.7
P-99	C4005	C4004	24			299.3	0.0015	13.4	4.3	1.00	1.52	8.8
P-100	C4006	C4005	21			194.4	0.0015	12.2	5.1	1.00	1.99	6.1
P-101	C4007	C4006	21			239.5	0.0015	9.0	3.7	1.00	1.46	6.2
P-102	C4008	C4007	18			347.3	0.0015	9.0	5.1	1.00	2.20	4.1
P-103	C4009	C4008	15			301.6	0.0015	3.2	2.6	1.00	1.29	2.5
P-104	C4010	C4009	12			270.1	0.0588	3.2	10.2	0.42	0.37	8.7
11	D1001	D-1		48	72	197.5	0.0015	479.4	10.0	1.00	3.12	307.2
P-135	D1002	D1001		48	84	129.4	0.0074	463.8	12.9	0.64	1.11	838.1
P-134	D1003	D1002		48	84	378.6	0.0015	463.8	8.3	1.00	2.46	377.6
P-133	D1004	D1003		48	84	154.0	0.0015	458.4	8.2	1.00	2.44	376.1
P-132	D1005	D1004		48	84	143.4	0.0016	458.4	8.2	1.00	2.35	389.7
P-131	D1006	D1005		48	84	305.6	0.0014	458.4	8.2	1.00	2.51	365.0
P-130	D1007	D1006		48	84	351.1	0.0032	458.4	9.4	0.88	1.68	547.1
P-129	D1008	D1007		48	72	92.9	0.0027	458.4	9.6	1.00	2.24	408.9
P-128	D1009	D1008		48	72	438.2	0.0069	443.1	12.4	0.74	1.36	653.2
P-127	D1010	D1009		48	72	53.7	0.0016	443.1	9.2	1.00	2.78	319.1
P-126	D1011	D1010		48	72	447.5	0.0014	437.3	9.1	1.00	2.95	296.1
P-125	D1012	D1011		48	72	442.3	0.0017	437.3	9.1	1.00	2.70	324.5
P-124	D1013	D1012		48	72	366.7	0.0016	427.0	8.9	1.00	2.68	318.8
P-123	D1014	D1013		48	72	127.7	0.0015	427.0	8.9	1.00	2.81	303.9
P-122	D1015	D1014		48	72	72.9	0.0015	427.0	8.9	1.00	2.79	306.1
P-143	D1016	D1015	72			71.5	0.0027	338.5	8.5	0.66	1.55	437.9
P-142	D1017	D1016	72			580.8	0.0020	338.5	7.6	0.74	1.79	377.9
P-141	D1018	D1017	72			749.4	0.0160	324.2	16.6	0.38	0.60	1074.7
P-140	D1019	D1018	84			140.9	0.0001	245.7	6.4	1.00	3.22	76.3
P-139	D1020	D1019	84			531.4	0.0013	245.7	6.4	1.00	1.05	234.1
P-138	D1021	D1020	84			622.0	0.0020	234.0	8.3	0.69	0.82	284.8
P-137	D1022	D1021	54			511.6	0.0037	219.8	13.8	1.00	1.82	120.5
P-425	D1023	D1022	48			273.0	0.0036	210.3	16.7	1.00	2.44	86.3
P-424	D1024	D1023	48			287.1	0.0034	210.3	16.7	1.00	2.51	83.7
P-423	D1025	D1024	48			280.6	0.0028	210.3	16.7	1.00	2.75	76.4
P-422	D1026	D1025	42			503.2	0.0040	200.1	20.8	1.00	3.15	63.4
P-421	D1027	D1026	42			343.6	0.0027	196.7	20.4	1.00	3.75	52.5

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P-420	D1028	D1027	42			250.1	0.0073	196.7	20.4	1.00	2.28	86.3
P-419	D1029	D1028	54			354.2	0.0041	195.6	12.3	1.00	1.56	125.7
P-418	D1030	D1029	54			290.4	0.0045	195.6	12.3	1.00	1.48	131.9
P-417	D1031	D1030	54			540.9	0.0027	167.2	10.5	1.00	1.62	103.1
P-416	D1032	D1031	48			786.0	0.0042	151.3	12.0	1.00	1.61	93.9
P-415	D1033	D1032	48			124.8	0.0092	151.3	12.0	1.00	1.09	138.3
P-407	D1034	D1033	48			414.2	0.0022	136.8	10.9	1.00	2.04	67.1
P-406	D1035	D1034	48			269.3	0.0031	136.8	10.9	1.00	1.71	80.0
P-405	D1036	D1035	48			239.6	0.0029	136.8	10.9	1.00	1.76	77.9
P-404	D1037	D1036	48			239.3	0.0030	127.4	10.1	1.00	1.62	78.4
P-403	D1038	D1037	48			225.7	0.0025	127.4	10.1	1.00	1.78	71.8
P-402	D1039	D1038	48			298.1	0.0025	117.0	9.3	1.00	1.63	71.8
P-401	D1040	D1039	48			513.6	0.0020	117.0	9.3	1.00	1.80	64.8
P-400	D1041	D1040	36			526.7	0.0052	96.0	13.6	1.00	1.98	48.4
P-399	D1042	D1041	36			763.9	0.0015	96.0	13.6	1.00	3.73	25.7
P-396	D1043	D1042	36			156.4	0.0114	96.0	13.6	1.00	1.34	71.5
P-395	D1044	D1043	36			277.4	0.0052	96.0	13.6	1.00	1.99	48.3
P-393	D1045	D1044	12			85.4	0.0082	64.3	81.8	1.00	19.87	3.2
P-392	D1046	D1045	12			554.7	0.0079	53.5	68.1	1.00	16.81	3.2
P-391	D1047	D1046	24			614.8	0.0085	53.5	17.0	1.00	2.56	20.9
P-390	D1048	D1047	18			192.3	0.0042	39.6	22.4	1.00	5.83	6.8
P-389	D1049	D1048	18			109.2	0.0038	39.6	22.4	1.00	6.06	6.5
P-388	D1050	D1049	18			203.4	0.0046	39.6	22.4	1.00	5.56	7.1
P-991	D2001	D-2	36			397.0	0.0015	137.4	19.4	1.00	5.28	26.0
P-157	D2002	D2001	42			59.7	0.0017	129.8	13.5	1.00	3.14	41.3
P-156	D2003	D2002	42			552.0	0.0014	129.8	13.5	1.00	3.38	38.4
P-155	D2004	D2003	42			550.8	0.0015	129.8	13.5	1.00	3.27	39.6
P-154	D2005	D2004	42			235.2	0.0015	67.7	7.0	1.00	1.74	38.9
P-153	D2006	D2005	42			1385.7	0.0014	45.8	4.8	1.00	1.19	38.3
P-152	D2007	D2006	42			1128.8	0.0015	45.8	4.8	1.00	1.18	38.8
P-151	D2008	D2007	42			122.9	0.0108	29.3	9.4	0.36	0.28	104.9
P-150	D2009	D2008	42			1407.9	0.0014	29.3	4.4	0.66	0.77	38.0
P-549	D2101	D2004	8			374.0	0.0015	85.1	243.7	1.00	183.09	0.5
P-550	D2102	D2101	8			452.3	0.0015	85.1	243.7	1.00	178.47	0.5
P-551	D2103	D2102	6			265.8	0.0015	85.1	433.3	1.00	389.83	0.2
P-552	D2104	D2103	12			901.1	0.0014	34.6	44.1	1.00	25.52	1.4
P-121	D4001	D1015	42			146.7	0.0061	84.9	8.8	1.00	1.08	79.0
P-120	D4002	D4001	42			392.7	0.0039	84.9	8.8	1.00	1.34	63.2
P-119	D4003	D4002	42			641.8	0.0015	84.9	8.8	1.00	2.19	38.8
P-118	D4004	D4003	36			760.9	0.0015	84.9	12.0	1.00	3.27	26.0
P-117	D4005	D4004	36			251.0	0.0015	57.9	8.2	1.00	2.26	25.7
P-116	D4006	D4005	36			209.3	0.0015	57.9	8.2	1.00	2.22	26.1
P-115	D4007	D4006	36			39.2	0.0015	57.9	8.2	1.00	2.21	26.2
P-114	D4008	D4007	36			105.1	0.0015	57.9	8.2	1.00	2.22	26.1
P-113	D4009	D4008	36			406.3	0.0016	42.7	6.0	1.00	1.61	26.5
P-112	D4010	D4009	36			85.6	0.0015	42.7	6.0	1.00	1.64	26.1
P-111	D4011	D4010	24			527.7	0.0001	0.0	0.0	0.00	0.00	2.6

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P-110	D4012	D4010	24			541.5	0.0015	42.7	13.6	1.00	4.83	8.8
P-384	D4013	D4012	24			75.3	0.0016	29.1	9.3	1.00	3.22	9.1
P-385	D4014	D4013	24			278.9	0.0015	29.1	9.3	1.00	3.27	8.9
P-386	D4015	D4014	18			275.9	0.0014	21.3	12.0	1.00	5.31	4.0
P-387	D4016	D4015	15			260.6	0.0014	12.6	10.3	1.00	5.25	2.4
P-148	D4101	D4003	24			276.8	0.0018	0.0	0.0	0.00	0.00	9.7
P-147	D4102	D4101	24			261.5	0.0038	0.0	0.0	0.00	0.00	14.0
P-146	D4103	D4102	21			500.8	0.0058	0.0	0.0	0.00	0.00	12.1
P-145	D4104	D4103	15			348.1	0.0028	0.0	0.0	0.00	0.00	3.4
P-959	D5001	D1018	60			819.1	0.0079	94.8	11.2	0.44	0.41	232.5
P-563	D5002	D5001	48			83.7	0.0016	94.8	7.5	1.00	1.67	56.8
P-562	D5003	D5002	48			94.2	0.0015	94.8	7.5	1.00	1.71	55.5
P-561	D5004	D5003	48			70.1	0.0419	94.8	20.9	0.39	0.32	294.9
P-560	D5005	D5004	48			474.3	0.0015	76.6	6.1	1.00	1.38	55.7
P-559	D5006	D5005	42			570.9	0.0015	61.4	6.4	1.00	1.57	39.2
P-565	D5007	D5006	24			251.9	0.0015	47.9	15.3	1.00	5.44	8.8
P-566	D5008	D5007	24			281.0	0.0070	47.9	15.3	1.00	2.52	19.0
P-567	D5009	D5008	24			280.2	0.0070	43.1	13.7	1.00	2.27	19.0
P-568	D5010	D5009	24			553.1	0.0014	43.1	13.7	1.00	5.02	8.6
P-569	D5011	D5010	24			46.1	0.0109	43.1	13.7	1.00	1.82	23.6
P-570	D5012	D5011	24			178.8	0.0017	24.1	7.7	1.00	2.59	9.3
P-571	D5013	D5012	30			100.6	0.0041	24.1	6.1	0.75	0.92	26.3
P-572	D5014	D5013	24			316.2	0.0041	24.1	7.7	1.00	1.66	14.5
P-573	D5015	D5014	24			54.5	0.0092	24.1	7.7	1.00	1.11	21.7
P-574	D5016	D5015	24			105.2	0.0029	24.1	7.7	1.00	1.99	12.1
P-575	D5017	D5016	24			45.3	0.0037	24.1	7.7	1.00	1.74	13.9
P-576	D5018	D5017	24			1351.8	0.0035	5.9	4.2	0.46	0.44	13.5
P-558	D5101	D5006	30			665.2	0.0015	21.2	4.3	1.00	1.33	15.9
P-557	D5102	D5101	42			396.9	0.0050	21.2	6.5	0.37	0.30	71.3
P-556	D5103	D5102	42			128.1	0.0013	21.2	4.0	0.54	0.58	36.7
P-555	D5104	D5103	42			91.0	0.0016	21.2	4.3	0.51	0.52	41.0
P-554	D5105	D5104	42			438.3	0.0015	2.2	2.2	0.16	0.05	39.4
P-958	D5106	D5105	42			72.5	0.0015	0.0	0.0	0.00	0.00	39.3
P-577	D5201	D5008	12			644.0	0.0066	9.2	11.7	1.00	3.18	2.9
P-144	D6001	D1022	24			499.4	0.0015	14.1	4.5	1.00	1.60	8.8
P-434	D7001	D1030	24			299.1	0.0075	12.7	6.6	0.59	0.65	19.6
P-435	D7002	D7001	24			258.3	0.0081	12.7	6.8	0.57	0.63	20.4
P-436	D7003	D7002	15			323.9	0.0111	12.7	10.4	1.00	1.86	6.8
P-437	D7004	D7003	12			253.5	0.0114	12.7	16.2	1.00	3.33	3.8
P-430	D8001	D1031	24			305.0	0.0059	7.8	5.4	0.47	0.45	17.4
P-431	D8002	D8001	24			293.3	0.0044	7.8	4.8	0.51	0.51	15.1
P-432	D8003	D8002	21			272.7	0.0048	7.8	4.9	0.62	0.71	11.0
P-433	D8004	D8003	15			281.2	0.0076	7.8	6.3	1.00	1.37	5.7
P-414	D9001	D1033	24			199.5	0.0058	20.0	6.4	1.00	1.16	17.3
P-413	D9002	D9001	24			80.5	0.0051	20.0	6.4	1.00	1.24	16.2
P-412	D9003	D9002	24			264.6	0.0056	20.0	6.4	1.00	1.18	17.0
P-411	D9004	D9003	21			275.8	0.0036	20.0	8.3	1.00	2.12	9.5

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 2-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-410	D9005	D9004	21			88.4	0.0032	20.0	8.3	1.00	2.24	8.9
P-409	D9006	D9005	18			314.0	0.0075	20.0	11.3	1.00	2.20	9.1
P-408	D9007	D9006	15			266.5	0.0044	10.2	8.3	1.00	2.39	4.3
P-992	E1001	E-1	60			199.4	0.0032	913.5	15.5	1.00	6.22	440.4
P-641	E1002	E1001	60			168.5	0.0031	910.6	15.5	1.00	6.28	435.2
P-993	E1003	E1002	60			287.2	0.0890	902.9	37.1	0.43	1.16	2336.7
P-591	E1004	E1003	66			677.7	0.0024	581.5	8.2	1.00	3.52	495.4
P-1000	E1005	E1004	66			302.2	0.0024	581.5	8.2	1.00	3.51	496.5
P-999	E1006	E1005	66			547.2	0.0019	484.7	6.8	1.00	3.33	436.1
P-589	E1007	E1006	66			157.8	0.0029	484.7	10.2	1.00	2.70	359.6
P-588	E1008	E1007	66			109.4	0.0030	484.7	10.2	1.00	2.62	369.9
P-587	E1009	E1008	66			1302.1	0.0015	470.1	9.9	1.00	3.61	260.6
P-586	E1010	E1009	60			745.1	0.0023	291.6	7.4	1.00	2.35	248.0
P-585	E1011	E1010	60			492.7	0.0023	285.4	7.3	1.00	2.27	251.2
P-994	E1012	E1011	60			1037.0	0.0028	268.6	8.0	0.80	1.96	274.3
P-579	E1013	E1012	66			852.4	0.0028	247.7	10.4	1.00	1.38	179.4
P-578	E1014	E1013	54			274.1	0.0046	232.5	14.6	1.00	1.73	134.2
P-455	E1015	E1014	48			50.3	0.0034	232.5	18.5	1.00	2.78	83.7
P-454	E1016	E1015	48			390.3	0.0069	227.4	18.1	1.00	1.89	120.0
P-453	E1017	E1016	42			294.1	0.0039	227.4	23.6	1.00	3.59	63.4
P-452	E1018	E1017	42			185.5	0.0067	214.7	22.3	1.00	2.60	82.5
P-995	E1019	E1018	54			35.8	0.0031	159.1	10.0	1.00	1.46	109.3
P-471	E1020	E1019	54			638.4	0.0044	112.2	9.3	0.71	0.86	130.8
P-470	E1021	E1020	48			545.6	0.0046	112.2	8.9	1.00	1.15	97.5
P-469	E1022	E1021	48			94.0	0.0046	112.2	8.9	1.00	1.15	97.4
P-468	E1023	E1022	48			313.3	0.0080	112.2	11.5	0.72	0.87	128.7
P-467	E1024	E1023	48			235.4	0.0203	112.2	16.7	0.53	0.55	205.0
P-466	E1025	E1024	48			389.1	0.0039	112.2	8.9	1.00	1.25	89.4
P-465	E1026	E1025	42			255.7	0.0035	96.9	10.1	1.00	1.63	59.5
P-464	E1027	E1026	42			641.6	0.0041	95.2	9.9	1.00	1.47	64.8
P-463	E1028	E1027	42			275.0	0.0046	95.2	9.9	1.00	1.39	68.3
P-462	E1029	E1028	42			252.5	0.0042	82.0	8.5	1.00	1.25	65.4
P-461	E1030	E1029	42			426.7	0.0038	82.0	8.5	1.00	1.32	62.3
P-460	E1031	E1030	42			210.9	0.0054	82.0	8.5	1.00	1.11	73.8
P-459	E1032	E1031	30			285.5	0.0028	66.9	13.6	1.00	3.06	21.9
P-458	E1033	E1032	30			199.3	0.0157	55.5	11.3	1.00	1.08	51.5
P-457	E1034	E1033	30			526.5	0.0027	55.5	11.3	1.00	2.59	21.4
P-456	E1035	E1034	30			331.3	0.0030	26.5	5.4	1.00	1.18	22.5
P-638	E2001	E1003		60	60	105.4	0.0015	329.7	13.2	1.00	2.10	156.9
P-637	E2002	E2001	5			25.1	0.0016	19.8	145.5	1.00	143.63	0.1
P-636	E2003	E2002	42			327.6	0.0046	19.8	6.2	0.37	0.29	68.3
P-635	E2004	E2003	42			578.5	0.0081	13.3	6.7	0.26	0.15	90.8
P-1009	E2005	E2004	36			757.4	0.0023	5.2	3.3	0.27	0.16	32.0
P-1002	E2006	E2104		48	76	408.7	0.0150	284.7	14.4	0.39	0.55	1039.6
P-1003	E2007	E2006	54			786.0	0.0015	274.4	8.6	1.00	3.59	152.8
P-1004	E2008	E2007	54			777.6	0.0048	261.4	9.8	0.78	1.90	274.6
P-625	E2009	E2008	48			145.7	0.0034	256.6	10.2	1.00	3.04	168.7

Appendix C
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P-624	E2010	E2009	48			386.7	0.0054	267.7	10.6	1.00	2.52	212.3
P-1010	E2011	E2010		42	144	603.2	0.0073	267.7	12.2	0.52	0.38	697.7
P-1014	E2012	E2011		48	144	136.5	0.0037	260.8	9.6	0.56	0.44	596.9
P-1013	E2013	E2012		48	144	161.3	0.0062	260.8	11.5	0.47	0.34	776.5
P-1012	E2014	E2013		48	144	282.0	0.0035	254.4	9.5	0.56	0.43	587.3
P-1020	E2015	E2014		48	144	334.9	0.0015	247.2	7.0	0.74	0.65	381.1
P-1019	E2016	E2015	12			82.8	0.0014	86.2	109.8	1.00	63.42	1.4
P-618	E2017	E2016		36	60	632.6	0.0130	86.2	12.2	0.47	0.36	240.7
P-519	E2018	E2017	48			432.8	0.0015	78.3	6.2	1.00	1.40	55.8
P-518	E2019	E2018	48			660.1	0.0053	73.3	9.0	0.62	0.70	104.9
P-517	E2020	E2019	48			250.7	0.0020	64.2	5.8	0.82	1.00	64.3
P-516	E2021	E2020		24	96	386.5	0.0091	60.2	8.7	0.43	0.28	211.4
P-515	E2022	E2021	48			462.2	0.0076	54.4	9.6	0.46	0.43	125.3
P-514	E2023	E2022	42			751.8	0.0100	39.7	9.9	0.44	0.39	100.8
P-513	E2024	E2023	21			225.7	0.0266	34.2	14.2	1.00	1.32	25.9
P-512	E2025	E2024	12			410.2	0.0024	26.1	33.3	1.00	14.82	1.8
P-511	E2026	E2025	12			696.4	0.0015	13.6	17.3	1.00	9.86	1.4
P-1017	E2027	E2026	12			540.0	0.0056	4.1	5.2	1.00	1.53	2.7
P-1016	E2028	E2027	12			699.2	0.0014	0.0	0.0	0.00	0.00	1.4
P-1015	E2029	E2028	12			342.0	0.0088	0.0	0.0	0.00	0.00	3.3
P-1005	E2101	E2001	12			25.8	1.0505	317.4	404.2	1.00	8.67	36.6
P-1006	E2102	E2101	42			247.0	0.0249	317.4	18.9	0.82	1.99	318.4
P-1007	E2103	E2102	45			666.7	0.0024	314.7	14.2	1.00	5.33	118.1
P-1008	E2104	E2103	45			773.1	0.0071	288.5	13.1	1.00	2.82	204.9
P-1021	E2201	E2015		36	60	715.2	0.0159	216.6	16.9	0.85	0.81	266.8
P-537	E2202	E2201		36	96	493.0	0.0057	211.2	11.2	0.78	0.71	296.9
P-536	E2203	E2202		36	96	102.5	0.0020	206.3	8.6	1.00	1.19	174.1
P-535	E2204	E2203		36	96	113.1	0.0088	206.3	13.0	0.66	0.56	370.5
P-534	E2205	E2204		36	96	134.9	0.0074	204.6	12.2	0.70	0.60	339.2
P-533	E2206	E2205		36	96	54.7	0.0183	204.6	16.6	0.51	0.38	532.7
P-532	E2207	E2206		36	96	349.2	0.0029	204.6	8.7	0.98	0.97	210.9
P-531	E2208	E2207		36	96	62.8	0.0080	171.8	11.8	0.60	0.49	351.6
P-530	E2209	E2208		36	96	367.3	0.0082	171.8	12.0	0.60	0.48	356.1
P-529	E2210	E2209		48	60	556.9	0.0081	165.3	12.3	0.67	0.60	274.6
P-528	E2211	E2210	54			146.5	0.0341	143.7	21.5	0.44	0.39	364.2
P-527	E2212	E2211	54			568.6	0.0123	143.7	14.7	0.59	0.66	218.8
P-526	E2213	E2212	42			286.9	0.0017	111.6	11.6	1.00	2.65	42.1
P-525	E2214	E2213	42			463.1	0.0227	92.1	16.5	0.56	0.61	151.9
P-524	E2215	E2214	36			71.7	0.0698	65.0	23.1	0.42	0.37	176.7
P-523	E2216	E2215	36			160.4	0.0015	53.3	7.5	1.00	2.06	25.9
P-522	E2217	E2216	36			348.4	0.0015	53.3	7.5	1.00	2.06	25.8
P-521	E2218	E2217	30			404.9	0.0124	5.8	6.4	0.24	0.13	45.7
P-520	E2219	E2218	30			97.0	0.0103	2.8	4.8	0.18	0.07	41.8
P-538	E2301	E2217	24			65.4	0.0015	47.6	15.2	1.00	5.37	8.9
P-539	E2302	E2301	24			57.2	0.0014	47.6	15.2	1.00	5.61	8.5
P-540	E2303	E2302	24			36.7	0.0016	47.6	15.2	1.00	5.19	9.2
P-541	E2304	E2303	24			303.9	0.0122	45.3	14.4	1.00	1.81	25.1

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P-542	E2305	E2304	24			269.9	0.0552	45.3	19.0	0.71	0.85	53.3
P-543	E2306	E2305	24			223.7	0.0805	39.6	21.5	0.57	0.62	64.3
P-1001	E3001	E1005		36	58	414.8	0.0043	106.7	8.7	0.85	0.81	132.2
P-616	E3002	E3001		36	58	215.5	0.0070	99.9	10.2	0.67	0.59	168.4
P-615	E3003	E3002		36	58	142.5	0.0073	99.9	10.4	0.66	0.58	172.4
P-614	E3004	E3003		36	58	118.2	0.0030	97.1	7.4	0.91	0.88	109.8
P-613	E3005	E3004		36	58	240.5	0.0021	93.8	6.5	1.00	1.01	92.9
P-612	E3006	E3005	33			919.2	0.0039	86.5	14.6	1.00	2.61	33.1
P-611	E3007	E3006	42			134.7	0.0015	86.5	9.0	1.00	2.23	38.9
P-610	E3008	E3007	42			286.2	0.0064	80.7	8.4	1.00	1.00	80.5
P-609	E3009	E3008	42			535.0	0.0015	80.7	8.4	1.00	2.07	39.0
P-608	E3010	E3009	42			141.6	0.0056	71.6	9.0	0.77	0.94	75.8
P-607	E3011	E3010	42			166.8	0.0015	71.6	7.4	1.00	1.83	39.1
P-606	E3012	E3011	36			456.0	0.0015	66.3	9.4	1.00	2.57	25.8
P-605	E3013	E3012	36			408.4	0.0044	62.8	8.9	1.00	1.41	44.5
P-604	E3014	E3013	30			391.1	0.0090	50.9	10.4	1.00	1.30	39.0
P-603	E3015	E3014	30			63.2	0.0022	50.9	10.4	1.00	2.63	19.4
P-602	E3016	E3015	30			378.5	0.0049	44.4	9.0	1.00	1.54	28.8
P-601	E3017	E3016	30			586.5	0.0039	38.2	7.8	1.00	1.48	25.8
P-600	E3018	E3017	30			42.4	0.0118	38.2	10.2	0.71	0.85	44.7
P-997	E4001	E1009	42			124.9	0.0539	168.6	26.5	0.63	0.72	234.2
P-996	E4002	E4001	36			261.2	0.0102	168.6	23.8	1.00	2.49	67.6
P-599	E4003	E4002	36			120.6	0.0065	176.8	25.0	1.00	3.29	53.8
P-598	E4004	E4003	36			469.3	0.0035	171.2	24.2	1.00	4.33	39.5
P-597	E4005	E4004	36			793.9	0.0036	162.6	23.0	1.00	4.07	40.0
P-998	E4006	E4005	4			860.5	0.0009	157.0	1799.2	1.00	2715.80	0.1
P-594	E4007	E4006	42			853.1	0.0030	112.4	11.7	1.00	2.03	55.5
P-593	E4008	E4007	42			283.2	0.0032	112.4	11.7	1.00	1.97	57.2
P-592	E4009	E4008	42			387.5	0.0049	101.1	10.5	1.00	1.43	70.6
P-497	E4010	E4009	42			550.4	0.0129	88.8	13.1	0.66	0.78	114.4
P-496	E4011	E4010	42			606.9	0.0102	74.3	11.5	0.63	0.73	101.7
P-495	E4012	E4011	36			120.3	0.0108	74.3	10.5	1.00	1.07	69.5
P-494	E4013	E4012	30			541.6	0.0109	68.2	13.9	1.00	1.59	43.0
P-493	E4014	E4013	36			265.2	0.0139	61.5	12.3	0.67	0.78	78.8
P-492	E4015	E4014	36			18.2	0.0104	61.5	10.9	0.74	0.90	68.3
P-491	E4016	E4015	36			205.9	0.0138	61.5	12.3	0.67	0.78	78.7
P-490	E4017	E4016	36			105.0	0.0139	61.5	12.3	0.66	0.78	78.9
P-489	E4018	E4017	36			159.6	0.0045	61.5	8.7	1.00	1.37	44.9
P-488	E4019	E4018	36			89.4	0.0047	61.5	8.7	1.00	1.34	45.8
P-487	E4020	E4019	36			464.0	0.0111	61.5	11.2	0.72	0.87	70.5
P-486	E4021	E4020	36			51.9	0.0040	61.5	8.7	1.00	1.45	42.5
P-485	E4022	E4021	24			268.1	0.0124	54.1	17.2	1.00	2.14	25.3
P-484	E4023	E4022	24			272.2	0.0118	51.6	16.4	1.00	2.10	24.6
P-483	E4024	E4023	24			513.0	0.0127	51.6	16.4	1.00	2.02	25.6
P-482	E4025	E4024	24			244.4	0.0088	51.6	16.4	1.00	2.42	21.3
P-481	E4026	E4025	21			673.8	0.0118	38.3	15.9	1.00	2.22	17.2
P-480	E4027	E4026	21			147.8	0.0075	28.2	11.7	1.00	2.05	13.8

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P-479	E4028	E4027	21			175.5	0.0087	28.2	11.7	1.00	1.90	14.8
P-498	E4101	E4010	12			247.5	0.0090	12.8	16.3	1.00	3.79	3.4
P-499	E4102	E4101	12			279.0	0.0096	9.0	11.5	1.00	2.57	3.5
P-500	E4103	E4102	12			57.3	0.0192	9.0	11.5	1.00	1.82	4.9
P-451	E5001	E1018	42			307.1	0.0016	61.2	6.4	1.00	1.52	40.3
P-450	E5002	E5001	42			214.9	0.0020	61.2	6.4	1.00	1.36	45.1
P-449	E5003	E5002	42			66.2	0.0015	61.2	6.4	1.00	1.56	39.2
P-448	E5004	E5003	42			537.2	0.0002	50.0	5.2	1.00	3.64	13.8
P-447	E5005	E5004	36			257.3	0.0015	50.0	7.1	1.00	1.95	25.7
P-446	E5006	E5005	36			273.2	0.0015	50.0	7.1	1.00	1.91	26.2
P-445	E5007	E5006	36			226.9	0.0015	42.5	6.0	1.00	1.62	26.3
P-444	E5008	E5007	30			282.1	0.0015	42.5	8.7	1.00	2.65	16.1
P-443	E5009	E5008	30			242.8	0.0016	32.8	6.7	1.00	2.02	16.3
P-442	E5010	E5009	30			233.0	0.2225	26.8	27.8	0.25	0.14	194.0
P-441	E5011	E5010	21			282.6	0.0041	26.8	11.1	1.00	2.63	10.2
P-440	E5012	E5011	24			177.5	0.0046	14.1	5.6	0.75	0.92	15.4
P-439	E5013	E5012	21			317.9	0.0037	14.1	5.9	1.00	1.46	9.7
P-438	E5014	E5013	21			152.7	0.0131	14.1	8.4	0.66	0.78	18.2
P-472	E6001	E1019	12			291.7	0.0104	43.0	54.7	1.00	11.80	3.6
P-473	E6002	E6001	12			287.8	0.0114	43.0	54.7	1.00	11.28	3.8
P-474	E6003	E6002	12			251.5	0.0130	31.1	39.7	1.00	7.65	4.1
P-475	E6004	E6003	12			226.2	0.0145	31.1	39.7	1.00	7.25	4.3
P-476	E6005	E6004	12			263.0	0.0073	20.5	26.2	1.00	6.75	3.0
P-477	E6006	E6005	12			240.0	0.0132	20.5	26.2	1.00	5.01	4.1
P-478	E6007	E6006	12			292.9	0.0072	9.4	11.9	1.00	3.08	3.0
P-1018	F1001	F-1	18			537.4	0.0279	11.1	10.5	0.58	0.63	17.6
P-502	F1002	F1001	12			57.1	0.0175	11.1	14.1	1.00	2.34	4.7
P-503	F1003	F1002	18			113.2	0.0088	7.3	6.1	0.64	0.74	9.9
P-504	F1004	F1003	12			175.6	0.0057	7.3	9.3	1.00	2.72	2.7
P-505	F1005	F1004	12			101.1	0.0099	3.7	4.7	1.00	1.04	3.6
P-960	I1001	I-1		48	72	333.2	0.0023	286.4	11.9	1.00	1.53	186.9
P-191	I1002	I1001	48			103.7	0.0005	162.4	12.9	1.00	5.13	31.6
P-190	I1003	I1002	48			405.0	0.0015	162.4	12.9	1.00	2.93	55.4
P-189	I1004	I1003	48			441.0	0.0016	162.4	12.9	1.00	2.83	57.4
P-188	I1005	I1004	48			983.2	0.0015	162.4	12.9	1.00	2.89	56.3
P-187	I1006	I1005	36			196.9	0.0015	81.3	11.5	1.00	3.11	26.1
P-186	I1007	I1006	36			51.5	0.0039	81.3	11.5	1.00	1.95	41.7
P-185	I1008	I1007	36			43.2	0.0023	81.3	11.5	1.00	2.53	32.2
P-184	I1009	I1008	36			265.9	0.0016	81.3	11.5	1.00	3.06	26.6
P-183	I1010	I1009	36			69.0	0.0013	72.2	10.2	1.00	2.99	24.1
P-182	I1011	I1010	30			102.5	0.0010	72.2	14.7	1.00	5.62	12.8
P-181	I1012	I1011	21			622.7	0.0041	57.3	23.8	1.00	5.63	10.2
P-180	I1013	I1012	21			569.5	0.0027	57.3	23.8	1.00	6.94	8.3
P-971	I1014	I1013	24			401.2	0.0033	35.6	11.3	1.00	2.72	13.1
P-970	I1015	I1014	24			365.8	0.0034	35.6	11.3	1.00	2.68	13.3
P-106	I1016	I1015	24			352.0	0.0030	25.4	8.1	1.00	2.04	12.4
P-972	I1017	I1016	24			436.6	0.0028	15.6	5.0	1.00	1.29	12.1

Appendix C
City of Richmond - Storm Drain Master Plan
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-974	I1018	I1017	21			277.8	0.0031	10.4	4.3	1.00	1.18	8.8
P-973	I1019	I1018	15			282.1	0.0031	10.4	8.5	1.00	2.89	3.6
P-205	I2001	I1001	30			61.7	0.0015	92.8	18.9	1.00	5.91	15.7
P-204	I2002	I2001	30			409.2	0.0016	92.8	18.9	1.00	5.66	16.4
P-203	I2003	I2002	30			263.6	0.0015	92.8	18.9	1.00	5.79	16.0
P-202	I2004	I2003	30			45.5	0.0015	81.2	16.5	1.00	5.03	16.1
P-201	I2005	I2004	30			473.4	0.0015	81.2	16.5	1.00	5.03	16.1
P-963	I2006	I2005	24			452.0	0.0015	70.7	22.5	1.00	7.92	8.9
P-962	I2007	I2006	24			289.3	0.0016	47.1	15.0	1.00	5.26	8.9
P-199	I2008	I2007	24			248.2	0.0093	47.1	15.0	1.00	2.16	21.8
P-198	I2009	I2008	12			107.0	0.0017	47.1	60.0	1.00	32.14	1.5
P-197	I2010	I2009	12			113.2	0.0177	47.1	60.0	1.00	9.92	4.7
P-196	I2011	I2010	18			56.2	0.0062	47.1	26.7	1.00	5.67	8.3
P-195	I2012	I2011	12			140.9	0.0142	47.1	60.0	1.00	11.07	4.3
P-194	I2013	I2012	18			188.5	0.0212	27.2	15.4	1.00	1.77	15.3
P-193	I2014	I2013	18			311.7	0.0064	27.2	15.4	1.00	3.23	8.4
P-206	I3001	I1001	12			37.3	0.0016	42.6	54.3	1.00	29.74	1.4
P-207	I3002	I3001	12			107.2	0.0213	42.6	54.3	1.00	8.18	5.2
P-208	I3003	I3002	12			442.7	0.0009	42.6	54.3	1.00	39.70	1.1
P-209	I3004	I3003	12			645.3	0.0006	35.7	45.5	1.00	40.18	0.9
P-210	I3005	I3004	12			450.2	0.0004	24.9	31.8	1.00	33.13	0.8
P-965S	I4001	I1005	120			834.0	0.0030	21.8	4.8	0.11	0.02	907.9
P-964	I4002	I4001	24			500.5	0.0015	21.8	7.0	1.00	2.46	8.9
P-967	J1001	J-1	60			163.2	0.0015	65.8	5.5	0.58	0.64	102.2
P-966	J1002	J1001	60			131.4	0.0015	65.8	5.5	0.59	0.65	101.9
P-179	J1003	J1002	54			39.1	0.0026	65.8	6.7	0.59	0.66	99.7
P-178	J1004	J1003	54			145.2	0.0021	65.8	6.2	0.64	0.73	89.6
P-177	J1005	J1004	48			317.8	0.0016	43.0	5.0	0.65	0.75	57.1
P-176	J1006	J1005	48			85.3	0.0018	43.0	5.2	0.62	0.71	60.4
P-175	J1007	J1006	48			489.0	0.0047	43.0	7.6	0.46	0.44	98.8
P-174	J1008	J1007	42			31.9	0.0016	43.0	4.5	1.00	1.08	39.9
P-173	J1009	J1008	42			413.9	0.0019	33.4	5.1	0.65	0.75	44.3
P-172	J1010	J1009	36			27.3	0.0015	33.4	4.7	1.00	1.30	25.6
P-171	J1011	J1010	36			506.9	0.0014	17.6	3.9	0.61	0.69	25.4
P-170	J1012	J1011	36			139.6	0.0015	17.6	3.9	0.60	0.68	25.9
P-169	J1013	J1012	36			53.9	0.0011	17.6	3.5	0.67	0.79	22.3
P-168	J1014	J1013	36			286.2	0.0052	10.8	5.5	0.32	0.22	48.4
P-167	J1015	J1014	30			359.7	0.0050	10.8	5.5	0.42	0.37	29.1
P-166	J1016	J1015	30			52.0	0.0079	10.8	6.5	0.37	0.30	36.5
P-165	J1017	J1016	30			284.5	0.0031	7.9	4.2	0.41	0.35	22.7
P-164	J1018	J1017	18			578.6	0.0061	5.2	4.9	0.57	0.63	8.2
P-1035	K1001	K-1		36	120	104.8	0.0051	264.1	11.2	0.79	0.71	371.8
P-646	K1002	K1001		36	120	166.5	0.0133	217.6	14.5	0.50	0.36	602.4
P-645	K1003	K1002		36	120	194.1	0.0048	217.6	10.4	0.70	0.60	363.8
P-644	K1004	K1003		36	120	100.9	0.0015	217.6	7.3	1.00	1.08	201.6
P-643	K1005	K1004		42	96	248.8	0.0028	154.4	8.0	0.69	0.60	258.1
P-642	K1006	K1005		30	66	675.3	0.0085	137.9	11.9	0.84	0.79	174.4

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P-548	K1007	K1006	36			259.7	0.0191	137.9	19.5	1.00	1.49	92.5
P-547	K1008	K1007	36			254.2	0.0256	137.9	19.5	1.00	1.29	106.9
P-546	K1009	K1008	36			169.0	0.0180	137.9	19.5	1.00	1.53	89.8
P-545	K1010	K1009	30			61.4	0.0139	137.9	28.1	1.00	2.85	48.4
P-544	K1011	K1010	30			145.9	0.0206	79.7	16.2	1.00	1.35	59.1
P-1036	L1001	L-1	48			37.1	0.0269	121.4	14.1	0.28	0.51	709.3
P-660	L1002	L1001	48			206.4	0.0141	110.8	10.9	0.32	0.65	514.0
P-659	L1003	L1002	48			367.1	0.0015	107.2	4.7	0.58	1.92	167.3
P-658	L1004	L1003		36	84	47.3	0.0089	72.6	7.5	0.23	0.23	624.5
P-657	L1005	L1004		36	84	65.4	0.0060	69.7	6.5	0.26	0.27	511.6
P-656	L1006	L1005		36	84	410.4	0.0043	63.6	5.7	0.27	0.29	436.5
P-655	L1007	L1006		36	84	49.0	0.0163	55.1	8.2	0.16	0.13	846.7
P-654	L1008	L1007		36	84	526.3	0.0043	55.1	5.4	0.24	0.25	432.4
P-653	L1009	L1008		36	84	245.9	0.0060	46.4	5.6	0.20	0.18	514.2
P-652	L1010	L1009		36	84	194.8	0.0060	41.1	5.4	0.18	0.16	513.6
P-651	L1011	L1010		36	84	216.9	0.0060	41.1	5.4	0.18	0.16	513.1
P-650	L1012	L1011	7			93.8	0.0134	34.1	127.6	1.00	34.68	1.0
P-649	L1013	L1012	7			408.4	0.0050	28.0	104.7	1.00	46.41	0.6
P-648	L1014	L1013	54			343.5	0.0104	19.4	8.0	0.21	0.10	200.7
P-661	L1101	L1001	18			156.0	0.0006	7.3	4.1	1.00	2.73	2.7
P-662	L1102	L1101	18			45.3	0.0009	7.3	4.1	1.00	2.33	3.1
P-663	L1103	L1102	18			453.4	0.0010	4.5	2.5	1.00	1.36	3.3
P-666	L2001	L1003	12			574.4	0.0042	20.9	26.6	1.00	9.01	2.3
P-665	L2002	L2001	12			604.6	0.0024	13.5	17.2	1.00	7.74	1.7
P-664	L2003	L2002	12			412.5	0.0020	8.9	11.3	1.00	5.52	1.6
P-667	L3001	L1003	30			532.0	0.0015	26.6	5.4	1.00	1.67	15.9
P-668	L3002	L3001	24			369.6	0.0015	26.6	8.5	1.00	3.04	8.7
P-669	L3003	L3002	24			48.8	0.0094	19.4	7.9	0.73	0.88	22.0
P-670	L3004	L3003	24			46.6	0.0129	19.4	9.0	0.65	0.76	25.7
P-671	L3005	L3004	24			155.7	0.0035	19.4	6.2	1.00	1.44	13.5
P-672	L3006	L3005	24			57.0	0.0091	19.4	7.8	0.74	0.90	21.7
P-673	L3007	L3006	24			652.6	0.0039	10.3	4.9	0.63	0.73	14.1
P-674	L3008	L3007	24			562.0	0.0015	4.4	2.8	0.50	0.50	8.7
P-675	L3009	L3008	21			49.2	0.0026	4.4	3.5	0.52	0.54	8.2
P-676	L4001	L1006	15			150.0	0.0015	11.1	9.0	1.00	4.37	2.5
P-1037	L4002	L4001	15			584.8	0.0015	4.2	3.4	1.00	1.69	2.5
P-1041	M1001	M-1		36	72	46.1	0.0097	532.3	14.8	1.00	2.00	532.6
P-692	M1002	M1001		36	72	125.4	0.0441	486.4	24.9	0.54	0.86	1135.5
P-691	M1003	M1002		36	72	285.3	0.0075	486.4	13.5	1.00	2.08	468.1
P-690	M1004	M1003	66			269.7	0.0030	486.4	10.2	1.00	2.64	369.1
P-689	M1005	M1004	66			180.6	0.0030	486.4	10.2	1.00	2.63	369.3
P-688	M1006	M1005	66			585.6	0.0009	482.0	10.1	1.00	4.82	200.1
P-1039	M1007	M1006	66			479.3	0.0046	463.2	9.7	1.00	2.04	455.2
P-685	M1008	M1007	54			849.7	0.0015	463.2	29.1	1.00	6.08	76.2
P-846	M1009	M1008		60	84	123.8	0.0016	288.3	8.2	1.00	1.11	260.9
P-845	M1010	M1009		60	84	73.9	0.0015	288.3	8.2	1.00	1.15	250.5
P-844	M1011	M1010		60	84	126.5	0.0015	288.3	8.2	1.00	1.15	251.6

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P-843	M1012	M1011	42			79.5	0.0063	184.0	19.1	1.00	2.30	80.0
P-842	M1013	M1012	42			686.0	0.0190	174.5	18.1	1.00	1.26	138.9
P-841	M1014	M1013	36			93.9	0.0107	174.5	24.7	1.00	2.53	69.0
P-840	M1015	M1014	36			780.5	0.0192	159.8	22.6	1.00	1.72	92.7
P-839	M1016	M1015	36			43.3	0.0231	159.8	22.6	1.00	1.57	101.6
P-838	M1017	M1016	36			237.5	0.0211	165.6	23.4	1.00	1.71	97.0
P-837	M1018	M1017	36			52.6	0.0190	165.6	23.4	1.00	1.80	92.2
P-836	M1019	M1018	36			762.7	0.0354	158.4	22.4	1.00	1.26	125.8
P-834	M1020	M1019	30			80.4	0.0124	106.9	21.8	1.00	2.33	45.9
P-833	M1021	M1020	30			252.8	0.0752	86.2	25.3	0.66	0.76	112.8
P-832	M1022	M1021	30			269.9	0.0371	86.2	17.6	1.00	1.09	79.2
P-831	M1023	M1022	30			373.8	0.0535	86.2	22.0	0.75	0.91	95.1
P-830	M1024	M1023	24			108.8	0.0920	82.3	26.2	1.00	1.20	68.8
P-1045S	M1025	M1024	120			392.7	0.0652	82.3	21.2	0.10	0.02	4233.6
P-829	M1026	M1025	30			144.0	0.0903	77.1	26.5	0.57	0.62	123.6
P-828	M1027	M1026	30			290.2	0.1378	77.1	31.2	0.50	0.51	152.7
P-827	M1028	M1027	30			597.9	0.0958	65.9	26.2	0.51	0.52	127.3
P-1040	M2001	M-1	12			46.0	0.0096	26.5	33.8	1.00	7.59	3.5
P-684	M2002	M2001	36			337.3	0.0173	26.5	10.9	0.38	0.30	88.1
P-1038	M2003	M2002	36			437.1	0.0015	26.5	3.8	1.00	1.02	26.0
P-682	M2004	M2003	36			206.6	0.0015	26.5	3.8	1.00	1.02	25.9
P-681	M2005	M2004	36			366.4	0.0015	26.5	3.8	1.00	1.02	25.9
P-680	M2006	M2005	24			184.6	0.0056	17.3	5.5	1.00	1.02	17.0
P-693	M3001	M1006	30			315.1	0.0030	44.5	9.1	1.00	1.97	22.6
P-694	M3002	M3001	30			378.6	0.0032	45.5	9.3	1.00	1.96	23.2
P-695	M3003	M3002	30			223.2	0.0493	45.5	18.6	0.50	0.50	91.3
P-1044	M3004	M3003	4			24.5	0.0016	45.5	521.2	1.00	590.20	0.1
P-847	M3005	M3004	30			192.9	0.0052	45.5	9.3	1.00	1.54	29.6
P-961	M3006	M3005	4			469.0	0.0064	0.0	0.0	0.00	0.00	0.2
P-1068	M4001	M1008	42			803.1	0.0015	235.5	24.5	1.00	6.04	39.0
P-1067	M4002	M4001	120			163.3	0.0095	235.5	14.7	0.26	0.15	1615.4
P-1066S	M4003	M4002	120			429.9	0.0028	230.9	9.4	0.35	0.26	879.7
P-1065	M4004	M4003	24			1113.8	0.0151	230.9	36.8	1.00	8.28	55.7
P-1064	M4005	M4004	24			295.1	0.0120	218.0	34.7	1.00	8.78	49.7
P-807	M4006	M4005	30			335.5	0.0258	127.0	25.9	1.00	1.92	66.1
P-806	M4007	M4006	30			595.4	0.0134	127.0	25.9	1.00	2.66	47.7
P-805	M4008	M4007	30			45.8	0.0219	127.0	25.9	1.00	2.09	60.8
P-804	M4009	M4008	30			260.7	0.0230	114.3	23.3	1.00	1.83	62.4
P-803	M4010	M4009	30			166.4	0.0015	114.3	23.3	1.00	7.17	15.9
P-802	M4011	M4010	30			297.9	0.0302	108.6	22.1	1.00	1.52	71.5
P-801	M4012	M4011	30			29.2	0.0343	108.6	22.1	1.00	1.43	76.2
P-800	M4013	M4012	30			400.7	0.0478	104.8	21.4	1.00	1.17	89.9
P-799	M4014	M4013	30			345.7	0.1365	99.9	33.0	0.59	0.66	152.0
P-1063	M4101	M4005	36			1051.2	0.0010	100.1	14.2	1.00	4.85	20.6
P-821	M5001	M1011		48	48	85.9	0.0407	113.1	20.3	0.35	0.25	448.4
P-820	M5002	M5001		48	48	129.1	0.0064	113.1	10.2	0.70	0.64	178.1
P-1043	M5003	M5002		48	48	215.5	0.0015	113.1	7.1	1.00	1.32	85.6

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Gravity Main Output Report: 2-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-818	M5004	M5003		48	72	314.6	0.0033	96.6	7.6	0.53	0.42	227.6
P-817	M5005	M5004		36	60	55.9	0.0089	96.6	11.0	0.58	0.48	199.9
P-816	M5006	M5005		36	60	74.4	0.0040	96.6	8.3	0.78	0.72	134.2
P-815	M5007	M5006		36	60	349.0	0.0143	87.5	12.7	0.46	0.35	253.0
P-814	M5008	M5007		36	36	81.6	0.0012	87.5	9.7	1.00	2.42	36.1
P-813	M5009	M5008		36	36	563.1	0.0114	73.2	11.3	0.72	0.67	110.0
P-812	M5010	M5009	18			56.4	0.0834	44.1	24.9	1.00	1.45	30.4
P-811	M5011	M5010	18			1068.5	0.0372	31.1	17.6	1.00	1.53	20.3
P-810	M5012	M5011	18			49.5	0.0014	31.1	17.6	1.00	7.86	4.0
P-809	M5013	M5012	18			249.9	0.0080	31.1	17.6	1.00	3.30	9.4
P-808	M5014	M5013	18			310.9	0.0050	27.4	15.5	1.00	3.68	7.4
P-1042	M5101	M5003	48			587.0	0.0015	15.4	3.8	0.36	0.28	55.8
P-835	M6001	M1019	30			695.8	0.0431	51.5	18.2	0.56	0.60	85.4
P-1046	N1001	N-1		48	96	920.2	0.0046	411.9	12.9	1.00	1.04	395.7
P-867	N1002	N1001		48	96	554.5	0.0094	360.3	15.6	0.72	0.64	563.8
P-868	N1003	N1002		48	96	408.6	0.0044	360.3	11.9	0.95	0.93	386.4
P-869	N1004	N1003		48	96	330.3	0.0091	360.3	15.5	0.73	0.65	554.9
P-870	N1005	N1004		48	96	255.3	0.0157	350.9	18.7	0.59	0.48	728.7
P-871	N1006	N1005		48	96	311.6	0.0244	346.6	21.7	0.50	0.38	909.3
P-872	N1007	N1006		48	96	31.8	0.0016	346.6	10.8	1.00	1.50	230.8
P-873	N1008	N1007		48	96	269.9	0.0185	343.0	19.6	0.55	0.43	792.4
P-874	N1009	N1008		48	96	214.1	0.0140	343.0	17.8	0.60	0.50	689.2
P-875	N1010	N1009		48	96	64.1	0.0016	338.2	10.6	1.00	1.47	230.0
P-876	N1011	N1010		48	96	571.1	0.0035	332.9	10.7	0.97	0.97	344.5
P-877	N1012	N1011		24	84	243.6	0.0041	330.6	23.6	1.00	2.74	120.7
P-878	N1013	N1012		24	84	280.5	0.0143	326.9	23.4	1.00	1.45	225.0
P-879	N1014	N1013	48			385.8	0.0130	243.5	19.4	1.00	1.49	164.0
P-880	N1015	N1014	48			98.7	0.0304	243.5	22.8	0.79	0.97	251.1
P-881	N1016	N1015	48			183.7	0.0054	214.5	17.1	1.00	2.02	106.3
P-1046S	N1017	N1016	120			541.2	0.0203	214.5	18.7	0.20	0.09	2364.0
P-861	N1018	N1017	30			111.6	0.0099	214.5	43.7	1.00	5.25	40.8
P-860	N1019	N1018	30			128.1	0.0064	214.5	43.7	1.00	6.52	32.9
P-859	N1020	N1019	30			74.5	0.0199	214.5	43.7	1.00	3.70	58.0
P-858	N1021	N1020	30			439.8	0.0321	225.1	45.9	1.00	3.06	73.7
P-857	N1022	N1021	30			52.0	0.0321	225.1	45.9	1.00	3.05	73.7
P-856	N1023	N1022	36			178.0	0.0320	225.1	31.8	1.00	1.88	119.6
P-855	N1024	N1023	36			97.7	0.0320	215.4	30.5	1.00	1.80	119.7
P-854	N1025	N1024	36			322.3	0.0328	253.9	35.9	1.00	2.10	121.1
P-853	N1026	N1025	36			1086.7	0.0320	218.3	30.9	1.00	1.82	119.7
P-852	N1027	N1026	36			240.9	0.0550	222.8	31.5	1.00	1.42	156.9
P-851	N1028	N1027	36			1012.0	0.0175	135.8	19.2	1.00	1.54	88.4
P-1062S	N1029	N1028	120			910.5	0.1856	70.8	29.1	0.07	0.01	7143.8
P-862	N1030	N1029	12			454.5	0.0015	70.8	90.1	1.00	51.21	1.4
P-863	N1031	N1030	12			65.6	0.0091	48.0	61.1	1.00	14.05	3.4
P-882	N2001	N1013	21			615.1	0.0179	114.0	47.4	1.00	5.37	21.2
P-883	N2002	N2001	18			426.3	0.0235	102.7	58.1	1.00	6.37	16.1
P-884	N2003	N2002	21			1177.6	0.0399	73.9	30.7	1.00	2.33	31.7

Appendix C
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-1047	O1001	O-1	36			103.2	0.0097	75.2	10.6	1.00	1.14	65.8
P-895	O1002	O1001	36			52.3	0.0096	57.3	10.4	0.73	0.88	65.4
P-894	O1003	O1002	36			325.0	0.0031	48.2	6.8	1.00	1.30	37.1
P-893	O1004	O1003	30			90.4	0.0310	48.2	15.8	0.60	0.67	72.4
P-1048	O1005	O1004	36			594.5	0.0094	40.9	9.7	0.58	0.63	64.9
P-890	O1006	O1005	36			211.7	0.0099	38.7	9.8	0.55	0.58	66.6
P-889	O1007	O1006	36			269.7	0.0083	31.8	8.7	0.51	0.52	61.0
P-888	O1008	O1007	36			259.3	0.0015	25.0	4.2	0.79	0.96	25.9
P-887	O1009	O1008	21			247.2	0.0015	18.5	7.7	1.00	3.00	6.1
P-886	O1010	O1009	24			223.0	0.0303	18.5	12.4	0.48	0.47	39.5
P-885	O1012	O1010	21			239.3	0.0078	9.6	6.3	0.61	0.69	14.0
39	R1001	R-1	36			1358.3	0.0007	120.6	17.1	1.00	6.65	18.1
P-1086	R1002	R1001	36			1126.5	0.0195	120.6	17.1	1.00	1.29	93.5
P-212	R1003	R1002	30			137.1	0.0219	114.9	23.4	1.00	1.89	60.8
P-211	R1004	R1003	24			390.6	0.0307	29.0	13.8	0.63	0.73	39.8
P-1087	S1001	S-1	42			535.6	0.0034	128.1	13.3	1.00	2.17	59.0
P-300	S1002	S1001	30			172.2	0.0930	128.1	26.1	1.00	1.02	125.4
P-299	S1003	S1002	18			105.2	0.0143	39.4	22.3	1.00	3.13	12.6
P-298	S1004	S1003	18			312.7	0.0607	36.3	20.5	1.00	1.40	25.9
P-297	S1005	S1004	18			122.8	0.0426	36.3	20.5	1.00	1.67	21.7
P-296	S1006	S1005	18			193.1	0.0880	32.8	18.6	1.00	1.05	31.3
P-295	S1007	S1006	18			332.0	0.0633	28.3	16.0	1.00	1.07	26.5
P-303	S2001	S1002	30			234.6	0.0532	84.4	21.9	0.73	0.89	94.9
P-312	S2002	S2001	24			358.1	0.0166	27.1	10.6	0.76	0.93	29.2
P-313	S2003	S2002	24			131.9	0.0735	27.1	19.0	0.46	0.44	61.5
P-314	S2004	S2003	24			119.1	0.0671	20.5	17.0	0.41	0.35	58.8
P-304	S3001	S2001	24			176.6	0.0266	58.9	18.8	1.00	1.59	37.0
P-305	S3002	S3001	24			199.7	0.0432	58.9	18.8	1.00	1.25	47.1
P-306	S3003	S3002	24			376.6	0.1494	42.3	27.7	0.49	0.48	87.7
P-307	S3004	S3003	24			138.1	0.0725	27.8	19.0	0.47	0.46	61.1
P-308	S3005	S3004	18			158.0	0.0739	27.8	18.5	0.79	0.97	28.6
P-309	S3006	S3005	18			131.3	0.0853	19.6	18.4	0.58	0.64	30.8
P-310	S3007	S3006	18			190.1	0.0692	19.6	17.0	0.62	0.71	27.7
P-311	S3008	S3007	18			176.2	0.0719	13.7	15.8	0.49	0.48	28.2
P-1081	T1001	T-1	54			144.5	0.0221	126.7	17.8	0.46	0.43	293.0
P-218	T1002	T1001	54			128.8	0.0220	101.7	16.7	0.41	0.35	292.7
P-219	T1003	T1002	54			104.8	0.0220	101.7	16.7	0.41	0.35	292.7
P-220	T1004	T1003	54			290.8	0.0382	101.7	20.5	0.35	0.26	385.6
P-225	T1005	T1004	54			73.2	0.0015	76.4	5.5	0.82	1.00	76.4
P-226	T1006	T1005	54			114.4	0.0172	76.4	14.2	0.37	0.30	258.8
P-227	T1007	T1006	54			355.0	0.0030	76.4	7.3	0.62	0.71	107.2
P-265	T1008	T1007	54			665.7	0.0142	37.2	10.8	0.27	0.16	234.9
P-266	T1009	T1008	24			366.6	0.0122	37.2	11.8	1.00	1.48	25.0
P-267	T1010	T1009	24			145.2	0.0508	37.2	17.7	0.63	0.73	51.1
P-268	T1011	T1010	24			58.0	0.0722	26.5	18.7	0.46	0.43	60.9
P-269	T1012	T1011	24			343.9	0.0498	18.8	14.9	0.42	0.37	50.6
P-270	T1013	T1012	24			92.7	0.0582	18.8	15.8	0.40	0.34	54.7

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P-217	T2001	T1001	12			83.2	0.0216	23.6	30.0	1.00	4.49	5.3
P-216	T2002	T2001	18			394.7	0.0145	23.6	13.4	1.00	1.86	12.7
P-215	T2003	T2002	15			379.2	0.0390	23.6	19.2	1.00	1.84	12.8
P-224	T3001	T1001	12			244.8	0.0033	0.0	0.0	0.00	0.00	2.0
P-221	T4001	T1004	18			44.4	0.0041	43.1	24.4	1.00	6.43	6.7
P-222	T4002	T4001	15			572.8	0.0190	43.1	35.1	1.00	4.83	8.9
P-223	T4003	T4002	15			415.6	0.0576	24.9	20.3	1.00	1.60	15.5
P-229	T5001	T1007	30			60.4	0.0321	45.1	15.8	0.57	0.61	73.7
P-230	T5002	T5001	30			83.9	0.0393	45.1	17.0	0.53	0.55	81.6
P-231	T5003	T5002	30			60.8	0.0137	45.1	11.1	0.77	0.94	48.1
P-232	T5004	T5003	24			68.8	0.0118	45.1	14.4	1.00	1.83	24.6
P-233	T5005	T5004	24			61.3	0.0130	45.1	14.4	1.00	1.74	25.9
P-234	T5006	T5005	24			65.2	0.0123	23.8	9.1	0.78	0.95	25.1
P-235	T5007	T5006	24			67.3	0.0120	23.8	9.0	0.78	0.96	24.9
P-236	T5008	T5007	24			69.5	0.0116	23.8	8.9	0.79	0.97	24.5
P-237	T5009	T5008	24			72.3	0.0115	20.0	8.6	0.69	0.82	24.3
P-238	T5010	T5009	24			62.2	0.0133	20.0	9.2	0.65	0.76	26.2
P-239	T5011	T5010	24			62.9	0.0135	20.0	9.2	0.65	0.76	26.4
P-240	T5012	T5011	24			203.9	0.0067	14.0	6.5	0.65	0.75	18.6
P-241	T5013	T5012	21			279.5	0.0161	14.0	9.1	0.61	0.70	20.2
P-242	T5014	T5013	21			258.1	0.0030	14.0	5.8	1.00	1.61	8.7
P-1082	U1001	U-1	48			54.0	0.0020	70.4	5.6	1.00	1.08	65.0
P-271	U1002	U1001	48			74.8	0.0021	70.4	5.6	1.00	1.06	66.6
P-272	U1003	U1002	48			60.6	0.0026	60.5	6.6	0.69	0.82	74.0
P-273	U1004	U1003	48			88.8	0.0018	60.5	5.5	0.81	0.99	61.1
P-274	U1005	U1004	48			103.3	0.0072	56.7	9.5	0.48	0.47	121.9
P-275	U1006	U1005	48			61.1	0.0031	56.7	6.9	0.62	0.71	80.3
P-276	U1007	U1006	48			64.1	0.0028	56.7	6.7	0.64	0.74	76.3
P-277	U1008	U1007	48			65.3	0.0029	56.7	6.8	0.63	0.73	77.7
P-278	U1009	U1008	48			54.8	0.0035	56.7	7.2	0.60	0.67	84.8
P-279	U1010	U1009	48			47.7	0.0034	50.8	7.0	0.56	0.61	83.4
P-280	U1011	U1010	48			48.6	0.0033	50.8	6.9	0.57	0.62	82.6
P-281	U1012	U1011	48			47.0	0.0351	50.8	16.5	0.29	0.19	269.9
P-282	U1013	U1012	48			78.5	0.0182	50.8	13.0	0.35	0.26	194.4
P-283	U1014	U1013	36			83.9	0.0380	45.4	16.8	0.41	0.35	130.4
P-284	U1015	U1014	36			265.6	0.0120	45.4	10.9	0.57	0.62	73.4
P-285	U1016	U1015	36			49.7	0.0283	32.7	13.8	0.37	0.29	112.6
P-286	U1017	U1016	18			363.4	0.0818	24.9	19.0	0.69	0.83	30.1
P-1083	V1001	V-1	30			171.7	0.0015	61.3	12.5	1.00	3.83	16.0
P-244	V1002	V1001	12			72.2	0.0222	54.5	69.4	1.00	10.25	5.3
P-245	V1003	V1002	30			200.1	0.0080	54.5	11.1	1.00	1.48	36.8
P-246	V1004	V1003	30			60.0	0.0067	54.5	11.1	1.00	1.62	33.6
P-247	V1005	V1004	42			96.4	0.0078	50.3	9.5	0.54	0.56	89.0
P-248	V1006	V1005	36			441.2	0.0083	37.1	9.0	0.56	0.61	60.7
P-249	V1007	V1006	36			103.9	0.1513	32.6	25.1	0.24	0.13	260.1
P-287	V1008	V1007	36			155.2	0.0015	32.6	4.6	1.00	1.27	25.7
P-288	V1009	V1008	36			101.1	0.0039	32.6	6.5	0.67	0.79	41.5

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P-289	V1010	V1009	36			72.7	0.0467	32.6	16.5	0.32	0.23	144.5
P-290	V1011	V1010	36			54.5	0.0670	32.6	18.8	0.29	0.19	173.1
P-291	V1012	V1011	36			55.8	0.0608	26.2	17.1	0.27	0.16	164.9
P-292	V1013	V1012	24			313.9	0.0365	26.2	14.4	0.56	0.61	43.3
P-293	V1014	V1013	24			74.2	0.0539	16.5	14.8	0.38	0.31	52.7
P-294	V1015	V1014	24			127.7	0.0239	16.5	11.0	0.48	0.47	35.1
P-250	V2001	V1005	30			310.3	0.0036	8.6	4.6	0.41	0.35	24.8
P-251	V2002	V2001	24			148.3	0.0047	6.9	4.8	0.47	0.45	15.5
P-252	V2003	V2002	24			112.7	0.0044	5.0	4.3	0.40	0.33	15.1
P-253	V2004	V2003	15			132.4	0.0109	2.5	5.1	0.42	0.37	6.8
P-1084	W1001	W-1	24			197.5	0.0467	36.3	17.1	0.64	0.74	49.0
P-260	W1002	W1001	12			216.2	0.0467	36.3	46.2	1.00	4.70	7.7
P-261	W1003	W1002	12			400.2	0.0467	36.3	46.2	1.00	4.70	7.7
P-262	W1004	W1003	12			427.7	0.0600	15.8	20.1	1.00	1.80	8.8
P-263	W1005	W1004	24			170.0	0.0015	15.8	5.0	1.00	1.82	8.7
P-264	W1006	W1005	15			210.5	0.0015	15.8	12.9	1.00	6.25	2.5
P-1085	W1101	W-1	36			129.9	0.0905	21.1	18.5	0.22	0.11	201.2
P-257	W1102	W1101	12			195.8	0.0930	21.1	26.9	1.00	1.94	10.9
P-256	W1103	W1102	24			214.7	0.0930	21.1	19.3	0.38	0.31	69.2
P-255	W1104	W1103	12			144.5	0.0930	12.3	15.6	1.00	1.12	10.9
P-254	W1105	W1104	24			239.9	0.0930	12.3	16.6	0.28	0.18	69.2
P-1091	X1001	X-1	36			326.1	0.1732	55.2	30.7	0.30	0.20	278.3
P-1090	X1002	X1001	36			209.5	0.1163	50.7	26.0	0.32	0.22	228.1
P-320	X1003	X1002	24			311.5	0.0369	30.1	15.0	0.61	0.69	43.6
P-319	X1004	X1003	24			204.3	0.0441	25.5	15.4	0.52	0.54	47.6
P-318	X1005	X1004	24			587.0	0.0341	15.4	12.3	0.42	0.37	41.9
P-317	X1006	X1005	24			361.9	0.0193	11.5	9.3	0.42	0.37	31.5
P-316	X1007	X1006	24			228.8	0.0044	11.5	5.3	0.66	0.77	15.0
P-315	X1008	X1007	24			235.5	0.0212	6.1	8.0	0.29	0.18	33.1
P-321	X2001	X1002	30			280.5	0.0103	17.1	8.1	0.45	0.41	41.8
P-322	X2002	X2001	30			417.4	0.0073	17.1	7.1	0.49	0.49	35.2
P-323	X2003	X2002	30			290.4	0.1097	17.1	19.0	0.24	0.13	136.2
P-1088	X2004	X2003	30			50.0	0.0150	17.1	9.3	0.40	0.34	50.3
P-1089	X2005	X2004	30			499.5	0.0180	11.5	8.9	0.31	0.21	55.2
P-1092	Y1001	Y-1	36			122.8	0.0105	132.2	18.7	1.00	1.93	68.5
P-330	Y1002	Y1001	36			86.8	0.0518	128.2	24.1	0.70	0.84	152.2
P-329	Y1003	Y1002	36			35.0	0.0017	128.2	18.1	1.00	4.63	27.7
P-326	Y1004	Y1003	30			494.1	0.0334	117.7	24.0	1.00	1.57	75.2
P-327	Y1005	Y1004	30			527.9	0.0227	107.7	21.9	1.00	1.74	62.0
P-328	Y1006	Y1005	30			223.7	0.0134	104.7	21.3	1.00	2.20	47.6
P-1093S	Y1007	Y1006	120			250.4	0.0399	100.6	19.0	0.12	0.03	3313.6
P-331	Y1008	Y1007	36			616.7	0.0859	58.9	24.3	0.38	0.30	196.1
P-332	Y1009	Y1008	30			155.7	0.0128	53.1	10.8	1.00	1.14	46.6
P-333	Y1010	Y1009	30			142.7	0.0140	53.1	10.8	1.00	1.09	48.7
P-334	Y1011	Y1010	30			453.6	0.0088	47.4	9.7	1.00	1.23	38.6
P-335	Y1012	Y1011	30			80.5	0.0124	47.4	9.7	1.00	1.04	45.8
P-336	Y1013	Y1012	12			122.2	0.0082	38.6	49.2	1.00	11.95	3.2

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 2-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-337	Y1014	Y1013	12			104.5	0.0541	38.6	49.2	1.00	4.65	8.3
P-325	Y2001	Y1003	18			147.5	0.0245	11.5	10.1	0.61	0.70	16.5
P-324	Y2002	Y2001	12			109.1	0.0733	7.5	13.6	0.66	0.78	9.7
P-339	Y3001	Y1007	18			237.7	0.1809	34.0	27.9	0.65	0.76	44.8
P-340	Y3002	Y3001	18			230.6	0.0043	29.9	16.9	1.00	4.31	6.9
P-341	Y3003	Y3002	18			463.8	0.0015	29.9	16.9	1.00	7.30	4.1
P-342	Y3004	Y3003	18			162.8	0.0015	20.6	11.7	1.00	5.10	4.0
P-343	Y3005	Y3004	12			137.4	0.0655	20.6	26.3	1.00	2.26	9.1
P-344	Y3006	Y3005	12			69.1	0.0145	20.6	26.3	1.00	4.80	4.3
P-345	Y3101	Y3004	12			223.0	0.0626	0.0	0.0	0.00	0.00	8.9
P-1095	Z1001	Z-1	12			29.7	0.0017	32.8	41.8	1.00	22.39	1.5
P-1094	Z1002	Z1001	12			20.2	0.0020	32.8	41.8	1.00	20.64	1.6
P-351	Z1003	Z1002	21			134.9	0.0148	32.3	13.4	1.00	1.67	19.3
P-349	Z1004	Z1003	18			347.9	0.0015	23.3	13.2	1.00	5.72	4.1
P-348	Z1005	Z1004	15			64.8	0.0617	23.3	19.0	1.00	1.45	16.1
P-347	Z1006	Z1005	15			226.0	0.0015	16.2	13.2	1.00	6.46	2.5
P-346	Z1007	Z1006	12			44.9	0.0045	16.2	20.7	1.00	6.81	2.4
P-1093	Z1101	Z1001	12			22.1	0.0023	0.0	0.0	0.00	0.00	1.7
P-350	Z2001	Z1003	18			176.8	0.0170	7.9	8.0	0.55	0.58	13.7

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
35S	80	B2003	120			1611.4	0.0068	61.3	8.8	0.14	0.04	1370.1
33	82	80	54			604.2	0.0074	61.3	9.8	0.42	0.36	170.2
31	84	82		48	76	167.0	0.0030	61.3	6.4	0.38	0.26	232.3
29	86	84	48			467.6	0.0043	61.3	8.0	0.59	0.65	94.2
P-988	A1001	A-1	78			79.7	0.0015	376.1	11.3	1.00	1.84	204.0
P-16	A1002	A1001	78			984.4	0.0010	376.1	11.3	1.00	2.32	162.4
P-15	A1003	A1002	84			44.5	0.0022	376.1	9.8	1.00	1.24	303.8
P-14	A1004	A1003	84			119.0	0.0015	376.1	9.8	1.00	1.51	249.2
P-13	A1005	A1004	84			426.4	0.0015	358.3	9.3	1.00	1.44	248.2
P-12	A1006	A1005	84			109.7	0.0015	358.3	9.3	1.00	1.46	244.7
P-11	A1007	A1006	84			235.4	0.0015	289.9	7.5	1.00	1.17	247.0
P-21	A1008	A1007	72			953.4	0.0015	230.8	8.2	1.00	1.40	164.5
P-22	A1009	A1008	66			801.7	0.0015	211.8	8.9	1.00	1.60	132.4
P-23	A1010	A1009	60			755.4	0.0015	197.6	10.1	1.00	1.94	101.9
P-987	A1011	A1010	48			745.2	0.0015	173.9	13.8	1.00	3.14	55.3
P-374	A1012	A1011	48			176.6	0.0017	173.9	13.8	1.00	2.93	59.4
P-373	A1013	A1012	48			151.1	0.0015	166.0	13.2	1.00	2.95	56.2
P-372	A1014	A1013	30			714.3	0.0016	166.0	33.8	1.00	10.19	16.3
P-370	A1015	A1014	18			35.7	0.0014	150.2	85.0	1.00	38.10	3.9
P-369S	A1016	A1015	120			204.5	0.0016	150.2	6.8	0.33	0.23	656.0
P-368	A1017	A1016	18			29.7	0.0010	150.2	85.0	1.00	44.90	3.3
P-367	A1018	A1017	36			302.8	0.0015	108.2	15.3	1.00	4.20	25.8
P-366	A1019	A1018	36			219.7	0.0016	108.2	15.3	1.00	4.05	26.7
P-365	A1020	A1019	36			315.9	0.0015	59.7	8.4	1.00	2.29	26.1
P-364	A1021	A1020	36			75.1	0.0016	59.7	8.4	1.00	2.23	26.7
P-363	A1022	A1021	48			676.1	0.0367	11.1	10.7	0.14	0.04	276.0
P-27	A2001	A1006	18			293.5	0.0015	78.7	44.5	1.00	19.09	4.1
P-28	A2002	A2001	18			134.6	0.0015	78.7	44.5	1.00	19.39	4.1
P-29	A2003	A2002	12			703.8	0.0006	78.7	100.2	1.00	92.43	0.9
P-30	A2004	A2003	12			90.7	0.0015	60.5	77.0	1.00	43.10	1.4
P-31	A2005	A2004	12			229.3	0.0015	60.5	77.0	1.00	43.98	1.4
P-32	A2006	A2005	12			189.9	0.0006	0.0	0.0	0.00	0.00	0.9
P-33	A2101	A2005	30			528.7	0.0015	14.9	3.7	0.77	0.94	15.9
P-34	A2201	A2005	21			567.0	0.0057	25.5	10.6	1.00	2.13	12.0
P-35	A2203	A2201	21			377.9	0.0096	25.5	10.6	1.00	1.63	15.6
P-10	A3001	A1007	36			295.9	0.0015	52.9	7.5	1.00	2.03	26.1
P-9	A3002	A3001	36			49.3	0.0016	52.9	7.5	1.00	1.97	26.9
P-8	A3003	A3002	36			254.9	0.0015	51.1	7.2	1.00	1.95	26.2
P-7	A3004	A3003	42			1168.7	0.0016	51.1	5.3	1.00	1.26	40.7
P-990	A3005	A3004	24			485.3	0.0072	51.1	16.3	1.00	2.65	19.3
P-989	A3006	A3005	21			524.4	0.0021	39.6	16.5	1.00	5.45	7.3
P-5	A3007	A3006	18			43.6	0.0115	31.7	18.0	1.00	2.81	11.3
P-4	A3008	A3007	18			238.2	0.0041	31.7	18.0	1.00	4.72	6.7
P-3	A3009	A3008	15			261.5	0.0037	27.3	22.2	1.00	6.91	3.9
P-2	A3010	A3009	15			262.7	0.0027	23.5	19.2	1.00	6.98	3.4
P-1	A3011	A3010	12			274.8	0.0095	18.8	24.0	1.00	5.42	3.5
P-20	A4001	A1008	48			573.5	0.0015	34.7	4.6	0.58	0.63	55.1

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-19	A4002	A4001	48			433.2	0.0015	34.7	4.7	0.57	0.62	55.8
P-18	A4003	A4002	48			405.0	0.0016	34.7	4.8	0.56	0.60	57.7
P-17	A4004	A4003	48			68.8	0.0015	34.7	4.6	0.58	0.63	54.9
P-24	A5001	A1010	48			508.0	0.0015	29.6	4.5	0.52	0.53	55.3
P-25	A5002	A5001	48			423.3	0.0015	29.6	4.5	0.51	0.52	56.4
P-26	A5003	A5002	48			133.4	0.0015	29.6	4.5	0.52	0.53	55.8
P-371	A6001	A1014	18			134.7	0.0015	15.5	8.8	1.00	3.81	4.1
P-1097	AA1001	AA-1	36			106.1	0.0188	90.2	14.8	0.80	0.98	91.8
P-358	AA1002	AA1001	36			49.2	0.0203	84.5	15.2	0.73	0.89	95.3
P-357	AA1003	AA1002	36			418.7	0.0072	78.1	11.1	1.00	1.38	56.6
P-356	AA1004	AA1003	36			429.6	0.0163	53.6	12.8	0.57	0.63	85.4
P-355	AA1005	AA1004	36			463.0	0.0216	43.4	13.5	0.47	0.44	98.3
P-354	AA1006	AA1005	36			134.5	0.0372	39.7	16.1	0.38	0.31	129.0
P-353	AA1007	AA1006	36			482.5	0.1057	28.5	21.3	0.24	0.13	217.4
P-1096	AA1008	AA1007	36			882.3	0.0015	8.4	3.3	0.39	0.32	25.9
P-362	AA2001	AA1003	30			145.9	0.0069	20.0	7.2	0.55	0.59	34.0
P-361	AA2002	AA2001	30			101.0	0.0198	20.0	10.7	0.41	0.35	57.9
P-360	AA2003	AA2002	30			40.3	0.0015	20.0	4.1	1.00	1.26	15.9
P-359	AA2004	AA2003	24			257.0	0.1907	18.1	24.0	0.29	0.18	99.0
P-1098	AB1001	AB-1	72			216.8	0.0015	177.8	6.3	1.00	1.07	165.7
P-1099	AB1002	AB1001	12			29.5	6.2096	161.7	205.8	1.00	1.82	89.0
P-710	AB1003	AB1002	54			258.7	0.0030	147.2	9.3	1.00	1.36	108.3
P-709	AB1004	AB1003	54			553.5	0.0054	147.2	9.3	1.00	1.01	145.2
P-1080	AB1005	AB1004	42			1025.0	0.0480	132.5	24.0	0.56	0.60	221.0
P-716	AB1006	AB1005	12			118.8	0.0619	62.8	80.0	1.00	7.07	8.9
P-717	AB1007	AB1006	15			211.3	0.0015	62.8	51.2	1.00	24.93	2.5
P-718	AB1008	AB1007	21			71.5	0.0014	49.9	20.8	1.00	8.40	5.9
P-719	AB1009	AB1008	21			84.3	0.0015	49.9	20.8	1.00	8.00	6.2
P-720	AB1010	AB1009	24			157.6	0.0263	49.9	15.9	1.00	1.36	36.8
P-721	AB1011	AB1010	21			266.3	0.0909	47.9	19.9	1.00	1.00	47.9
P-722	AB1012	AB1011	21			354.0	0.0455	42.7	17.7	1.00	1.26	33.9
P-723	AB1013	AB1012	21			219.9	0.0200	42.7	17.7	1.00	1.90	22.5
P-724	AB1014	AB1013	21			252.0	0.0198	42.7	17.7	1.00	1.91	22.4
P-725	AB1015	AB1014	18			362.0	0.0989	37.8	21.4	1.00	1.14	33.1
P-726	AB1016	AB1015	12			199.5	0.0689	26.8	34.1	1.00	2.85	9.4
P-705	AB2001	AB1001	18			153.4	0.0015	3.4	2.6	0.70	0.83	4.1
P-704	AB3001	AB1001	36			406.8	0.4664	17.0	30.8	0.13	0.04	456.7
P-703	AB3002	AB3001	36			292.4	0.0246	17.0	10.9	0.27	0.16	104.8
P-702	AB3003	AB3002	36			69.2	0.0040	17.0	5.7	0.44	0.40	42.5
P-701	AB3004	AB3003	30			149.0	0.0074	11.8	6.5	0.40	0.33	35.3
P-700	AB3005	AB3004	30			48.7	0.0637	7.9	12.5	0.19	0.08	103.8
P-699	AB3006	AB3005	24			145.7	0.0184	7.9	8.2	0.35	0.26	30.8
P-698	AB3007	AB3006	24			149.9	0.0133	7.9	7.3	0.38	0.30	26.2
P-697	AB3008	AB3007	24			169.9	0.0164	4.8	6.8	0.28	0.17	29.0
P-711	AB4001	AB1002	15			202.7	0.0120	16.2	13.2	1.00	2.29	7.1
P-712	AB4002	AB4001	12			231.4	0.0107	12.0	15.3	1.00	3.25	3.7
P-713	AB4003	AB4002	15			113.3	0.0100	12.0	9.8	1.00	1.85	6.5

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-715	AB5001	AB1004	21			429.4	0.1108	12.4	17.9	0.33	0.23	52.9
P-714	AB5002	AB5001	21			214.6	0.0614	6.6	12.2	0.28	0.17	39.4
P-707	AB6001	AB1005	42			32.9	0.0015	73.7	7.7	1.00	1.88	39.3
P-706	AB6002	AB6001	42			393.0	0.0015	61.5	6.4	1.00	1.57	39.1
P-1079	AC1001	AC-1	12			101.4	0.0197	52.9	67.3	1.00	10.54	5.0
P-1078	AC1002	AC1001	12			193.7	0.0310	49.4	62.9	1.00	7.85	6.3
P-1077	AC1003	AC1002	12			166.9	0.0360	49.4	62.9	1.00	7.29	6.8
P-727	AC1004	AC1003	18			87.9	0.0455	23.8	13.5	1.00	1.06	22.5
P-728	AC1005	AC1004	18			151.0	0.0993	23.8	20.4	0.63	0.72	33.2
P-729	AC1006	AC1005	18			391.4	0.0869	17.1	18.0	0.53	0.55	31.0
P-730	AC1007	AC1006	15			473.2	0.0845	6.6	14.0	0.41	0.35	18.8
P-731	AC1008	AC1007	15			349.2	0.0143	6.6	7.1	0.71	0.85	7.8
P-732	AC1009	AC1008	15			210.3	0.0571	3.1	9.8	0.30	0.20	15.5
P-1076	AD1001	AD-1	24			113.6	0.0088	106.6	33.9	1.00	5.01	21.3
P-1075	AD1002	AD1001	24			31.0	0.0323	106.6	33.9	1.00	2.61	40.8
P-1074	AD1003	AD1002	24			73.7	0.0136	106.6	33.9	1.00	4.03	26.4
P-741	AD1004	AD1003	24			149.9	0.0133	84.7	27.0	1.00	3.23	26.2
P-740	AD1005	AD1004	24			138.2	0.0217	80.2	25.5	1.00	2.40	33.4
P-739	AD1006	AD1005	24			103.9	0.0193	80.2	25.5	1.00	2.55	31.5
P-738	AD1007	AD1006	21			187.6	0.0267	76.6	31.9	1.00	2.95	25.9
P-737	AD1008	AD1007	15			347.1	0.0922	35.2	28.7	1.00	1.79	19.7
P-736	AD1009	AD1008	15			384.4	0.0885	31.4	25.6	1.00	1.63	19.3
P-735	AD1010	AD1009	15			311.8	0.0866	22.8	18.6	1.00	1.20	19.1
P-734	AD1011	AD1010	15			313.3	0.0032	15.9	13.0	1.00	4.35	3.7
P-733	AD1012	AD1011	12			333.8	0.0210	5.9	7.6	1.00	1.15	5.2
P-745	AD2001	AD1007	21			72.0	0.0417	41.5	17.2	1.00	1.28	32.4
P-746	AD2002	AD2001	21			243.4	0.0698	41.5	19.9	0.81	0.99	42.0
P-747	AD2003	AD2002	21			220.6	0.0227	38.2	15.9	1.00	1.60	23.9
P-748	AD2004	AD2003	18			217.8	0.1194	32.0	23.2	0.73	0.88	36.4
P-749	AD2005	AD2004	18			458.6	0.0850	29.8	19.8	0.79	0.97	30.7
P-750	AD2006	AD2005	18			160.9	0.0015	29.8	16.9	1.00	7.34	4.1
P-751	AD2007	AD2006	18			90.8	0.0441	29.8	16.9	1.00	1.35	22.1
P-752	AD2008	AD2007	18			167.0	0.0479	24.8	14.0	1.00	1.08	23.0
P-753	AD2009	AD2008	18			129.7	0.0015	24.8	14.0	1.00	6.16	4.0
P-754	AD2010	AD2009	18			212.4	0.0141	17.0	9.6	1.00	1.36	12.5
P-742	AD3001	AD1009	12			324.0	0.0185	8.6	11.0	1.00	1.77	4.9
P-743	AD3002	AD3001	12			204.2	0.0196	2.3	6.2	0.48	0.46	5.0
P-744	AD3003	AD3002	12			241.1	0.0871	2.3	10.8	0.32	0.22	10.5
P-1069	AE1001	AE-1	42			129.5	0.0601	145.5	26.7	0.55	0.59	247.3
P-771	AE1002	AE1001	42			352.9	0.0680	138.8	27.7	0.52	0.53	263.1
P-770	AE1003	AE1002	42			197.2	0.0015	138.8	14.4	1.00	3.53	39.3
P-769	AE1004	AE1003	42			386.5	0.0846	103.9	27.9	0.41	0.35	293.4
P-768	AE1005	AE1004	42			783.5	0.0326	97.4	19.2	0.52	0.54	182.0
P-1072	AE1006	AE1005	24			72.6	0.1506	43.8	28.0	0.50	0.50	88.0
P-1071	AE1007	AE1006	24			223.0	0.0245	43.8	13.9	1.00	1.23	35.5
P-765	AE1008	AE1007	24			374.4	0.0929	37.4	22.4	0.52	0.54	69.2
P-764	AE1009	AE1008	24			58.6	0.0568	37.4	18.6	0.61	0.69	54.1

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-763	AE1010	AE1009	24			498.9	0.0511	30.1	17.0	0.55	0.59	51.3
P-762	AE1011	AE1010	18			273.9	0.0045	25.9	14.6	1.00	3.67	7.1
P-777	AE2001	AE1003	24			113.3	0.2223	22.5	27.0	0.31	0.21	107.0
P-776	AE2002	AE2001	24			114.7	0.0628	22.5	17.0	0.44	0.40	56.8
P-775	AE2003	AE2002	24			172.7	0.0949	19.6	19.1	0.36	0.28	69.9
P-774	AE2004	AE2003	24			352.6	0.0724	13.4	15.6	0.32	0.22	61.0
P-773	AE2005	AE2004	24			374.2	0.0199	7.8	8.4	0.34	0.24	32.0
P-767	AE3001	AE1005	36			308.3	0.1377	44.8	26.6	0.29	0.18	248.2
P-1070	AF1001	AF-1	90			440.1	0.0476	202.6	25.7	0.23	0.12	1680.3
P-787	AF1002	AF1001	48			137.2	0.0787	145.9	29.5	0.42	0.36	404.1
P-786	AF1003	AF1002	48			634.4	0.0334	145.9	21.5	0.53	0.55	263.0
P-791	AF1004	AF1003	48			516.8	0.0399	37.4	15.8	0.24	0.13	287.7
P-792	AF1005	AF1004	48			710.2	0.0158	32.6	10.9	0.29	0.18	180.9
P-788	AF2001	AF1001	60			273.0	0.0015	48.0	5.1	0.48	0.47	101.2
P-789	AF2002	AF2001	54			354.0	0.0015	30.0	4.5	0.44	0.39	76.3
P-785	AF3001	AF1003	30			41.5	0.0662	95.9	24.4	0.75	0.91	105.8
P-784	AF3002	AF3001	30			397.8	0.0420	95.9	19.5	1.00	1.14	84.2
P-783	AF3003	AF3002	24			64.8	0.0386	95.9	30.5	1.00	2.15	44.6
P-782	AF3004	AF3003	24			179.5	0.0691	89.9	28.6	1.00	1.51	59.6
P-781	AF3005	AF3004	24			220.8	0.0784	89.9	28.6	1.00	1.42	63.5
P-780	AF3006	AF3005	24			239.2	0.0412	79.4	25.3	1.00	1.73	46.0
P-779	AF3007	AF3006	24			264.7	0.0655	63.4	20.2	1.00	1.09	58.1
P-1073	AG1001	AG-1	21			202.1	0.0148	43.5	18.1	1.00	2.25	19.4
P-760	AG1002	AG1001	18			442.1	0.0204	25.7	14.6	1.00	1.71	15.0
P-758	AG1003	AG1002	12			128.0	0.2579	8.8	22.9	0.49	0.48	18.1
P-757	AG1004	AG1003	12			104.9	0.4288	8.8	27.7	0.42	0.38	23.4
P-756	AG1005	AG1004	12			80.1	0.0624	8.8	13.0	0.80	0.98	8.9
P-755	AG1006	AG1005	12			241.1	0.0166	6.6	8.4	1.00	1.43	4.6
P-761	AG2001	AG1002	12			422.5	0.0544	10.3	13.1	1.00	1.24	8.3
P-1100	AH1001	AH-1	36			96.3	0.0015	12.0	3.6	0.48	0.47	25.5
P-794	AH1002	AH1001	36			133.7	0.0015	11.2	3.5	0.46	0.43	25.9
P-795	AH1003	AH1002	36			350.8	0.0513	11.2	12.5	0.18	0.07	151.5
P-796	AH1004	AH1003	36			189.4	0.1109	6.4	13.9	0.12	0.03	222.7
P-797	AH1005	AH1004	36			370.4	0.1107	6.4	13.9	0.12	0.03	222.5
P-798	AH1006	AH1005	21			248.9	0.1326	2.9	12.6	0.15	0.05	57.9
21	B1009	B-1		66	114	173.7	0.0058	206.3	10.9	0.36	0.24	847.8
P-44	B1010	B1009	72			185.9	0.0054	197.2	11.7	0.58	0.63	311.4
23	B1012	B1010	54			316.5	0.0014	188.5	11.9	1.00	2.54	74.3
P-41	B1013	B1012	54			520.5	0.0011	173.5	10.9	1.00	2.71	64.1
P-40	B1014	B1013	60			465.8	0.0064	166.8	11.8	0.67	0.80	209.6
P-39	B1015	B1014	36			247.9	0.0040	110.3	15.6	1.00	2.60	42.5
P-38	B1016	B1015	36			156.8	0.0089	110.3	15.6	1.00	1.75	63.2
P-985	B1017	B1016	24			282.1	0.0092	94.8	30.2	1.00	4.35	21.8
P-984	B1018	B1017	24			748.0	0.0017	94.8	30.2	1.00	10.03	9.5
P-36	B1019	B1018	24			173.0	0.0015	53.7	17.1	1.00	6.11	8.8
P-986	B2001	B1014	12			209.5	0.0024	106.6	135.7	1.00	61.06	1.7
P-987S	B2002	B2001	120			705.2	0.0015	106.6	6.1	0.28	0.17	642.9

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-53	B2003	B2002	54			257.2	0.0012	106.6	6.7	1.00	1.58	67.3
P-54	B2004	B2003	54			57.7	0.0797	69.9	23.9	0.24	0.13	556.8
P-55	B2005	B2004	24			544.8	0.0079	69.9	22.2	1.00	3.47	20.2
P-56	B2006	B2005	21			281.9	0.0058	52.2	21.7	1.00	4.32	12.1
P-57	B2007	B2006	21			283.4	0.0101	52.2	21.7	1.00	3.26	16.0
P-58	B2008	B2007	12			264.6	0.0125	34.8	44.4	1.00	8.74	4.0
P-52	B3001	B1016	12			264.1	0.0015	0.0	0.0	0.00	0.00	1.4
P-977	C1001	C-1	84			195.7	0.0016	235.3	7.5	0.76	0.92	255.0
P-975	C1002	C1001	36			53.8	0.0015	161.1	22.8	1.00	6.25	25.8
P-72	C1003	C1002	36			79.1	0.0015	161.1	22.8	1.00	6.19	26.0
P-71	C1004	C1003	36			113.3	0.0015	161.1	22.8	1.00	6.22	25.9
P-70	C1005	C1004	36			176.8	0.0015	153.5	21.7	1.00	5.87	26.1
P-69	C1006	C1005	36			274.7	0.0015	142.3	20.1	1.00	5.44	26.2
P-68	C1007	C1006	36			115.6	0.0016	142.3	20.1	1.00	5.39	26.4
P-67	C1008	C1007	36			220.3	0.0016	138.4	19.6	1.00	5.19	26.7
P-66	C1009	C1008	36			262.4	0.0015	138.4	19.6	1.00	5.30	26.1
P-65	C1010	C1009	36			162.2	0.0015	135.4	19.2	1.00	5.16	26.3
P-64	C1011	C1010	36			238.5	0.0015	131.6	18.6	1.00	5.06	26.0
P-63	C1012	C1011	36			249.8	0.0016	131.6	18.6	1.00	4.98	26.4
P-62	C1013	C1012	36			253.1	0.0016	127.2	18.0	1.00	4.79	26.6
P-61	C1014	C1013	36			252.6	0.0016	127.2	18.0	1.00	4.78	26.6
P-60	C1015	C1014	30			265.5	0.0015	127.2	25.9	1.00	7.97	16.0
P-59	C1016	C1015	30			254.7	0.0016	122.6	25.0	1.00	7.52	16.3
P-980	C1017	C1016	30			49.4	0.0016	122.6	25.0	1.00	7.41	16.5
P-979	C1018	C1017	30			231.7	0.0016	122.6	25.0	1.00	7.46	16.4
P-375	C1019	C1018	30			182.9	0.0107	122.6	25.0	1.00	2.88	42.6
P-376	C1020	C1019	30			175.7	0.0114	114.7	23.4	1.00	2.62	43.9
P-377	C1021	C1020	30			95.4	0.0015	114.7	23.4	1.00	7.28	15.8
P-378	C1022	C1021	30			86.1	0.0015	114.7	23.4	1.00	7.18	16.0
P-379	C1023	C1022	30			83.5	0.0016	114.7	23.4	1.00	7.07	16.2
P-380	C1024	C1023	30			70.4	0.0016	114.7	23.4	1.00	7.06	16.3
P-381	C1025	C1024	30			281.1	0.0026	107.0	21.8	1.00	5.14	20.8
P-382	C1026	C1025	21			235.5	0.0078	107.0	44.5	1.00	7.64	14.0
P-383	C1027	C1026	18			259.4	0.0077	48.7	27.6	1.00	5.27	9.2
P-976	C2001	C1001	54			59.9	0.0015	109.8	6.9	1.00	1.44	76.4
P-74	C2002	C2001	54			189.9	0.0015	109.8	6.9	1.00	1.45	75.7
P-75	C2003	C2002	48			268.3	0.0015	77.3	6.2	1.00	1.39	55.6
P-76	C2004	C2003	48			288.2	0.0016	70.6	5.6	1.00	1.24	56.9
17	C2006	C2004	48			368.5	0.0015	64.1	5.1	1.00	1.16	55.1
P-79	C2007	C2006	4			71.7	0.0015	29.1	333.9	1.00	389.82	0.1
P-80	C2008	C2007	4			139.2	0.0014	29.1	333.9	1.00	402.84	0.1
P-81	C2009	C2008	4			242.3	0.0015	23.1	265.1	1.00	310.28	0.1
P-82	C2010	C2009	3			269.5	0.0093	23.1	471.3	1.00	271.14	0.1
P-83	C2011	C2010	3			208.6	0.0024	18.9	385.8	1.00	436.63	0.0
P-84	C2012	C2011	30			281.4	0.0018	12.4	3.8	0.63	0.71	17.3
P-85	C2013	C2012	24			310.6	0.0032	12.4	4.7	0.79	0.96	12.9
P-86	C2014	C2013	21			255.4	0.0055	5.8	4.9	0.49	0.49	11.8

Appendix C
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-87	C2015	C2014	18			283.7	0.0078	3.4	4.8	0.42	0.36	9.3
P-88	C3001	C2002	36			54.2	0.0015	31.7	4.5	1.00	1.23	25.7
P-89	C3002	C3001	36			114.2	0.0015	31.7	4.5	1.00	1.23	25.8
P-90	C3003	C3002	36			318.1	0.0015	31.7	4.5	1.00	1.22	26.0
P-91	C3004	C3003	36			211.2	0.0014	22.8	4.0	0.74	0.90	25.2
P-92	C3005	C3004	30			230.6	0.0014	17.6	3.6	1.00	1.13	15.6
P-93	C3006	C3005	24			281.2	0.0104	17.6	8.1	0.65	0.76	23.1
P-94	C3007	C3006	24			353.1	0.0062	14.2	6.3	0.67	0.79	17.9
P-95	C3008	C3007	24			319.0	0.0056	10.1	5.7	0.55	0.59	17.0
P-96	C3009	C3008	24			186.8	0.0054	4.6	4.5	0.36	0.28	16.6
P-1102S	C4001	C2006	120			613.8	0.0015	29.8	4.2	0.15	0.05	642.0
P-1101	C4002	C4001	27			167.0	0.0015	29.8	7.5	1.00	2.48	12.0
P-97	C4003	C4002	24			265.4	0.0015	20.0	6.4	1.00	2.27	8.8
P-98	C4004	C4003	24			180.3	0.0022	16.4	5.2	1.00	1.53	10.7
P-99	C4005	C4004	24			299.3	0.0015	16.4	5.2	1.00	1.86	8.8
P-100	C4006	C4005	21			194.4	0.0015	14.9	6.2	1.00	2.43	6.1
P-101	C4007	C4006	21			239.5	0.0015	10.9	4.6	1.00	1.78	6.2
P-102	C4008	C4007	18			347.3	0.0015	10.9	6.2	1.00	2.69	4.1
P-103	C4009	C4008	15			301.6	0.0015	3.9	3.2	1.00	1.57	2.5
P-104	C4010	C4009	12			270.1	0.0588	3.9	10.8	0.47	0.45	8.7
11	D1001	D-1		48	72	197.5	0.0015	593.6	12.4	1.00	3.87	307.2
P-135	D1002	D1001		48	84	129.4	0.0074	574.4	13.6	0.75	1.37	838.1
P-134	D1003	D1002		48	84	378.6	0.0015	574.4	10.3	1.00	3.04	377.6
P-133	D1004	D1003		48	84	154.0	0.0015	566.8	10.1	1.00	3.01	376.1
P-132	D1005	D1004		48	84	143.4	0.0016	566.8	10.1	1.00	2.91	389.7
P-131	D1006	D1005		48	84	305.6	0.0014	566.8	10.1	1.00	3.11	365.0
P-130	D1007	D1006		48	84	351.1	0.0032	566.8	10.1	1.00	2.07	547.1
P-129	D1008	D1007		48	72	92.9	0.0027	566.8	11.8	1.00	2.77	408.9
P-128	D1009	D1008		48	72	438.2	0.0069	547.8	13.1	0.87	1.68	653.2
P-127	D1010	D1009		48	72	53.7	0.0016	547.8	11.4	1.00	3.43	319.1
P-126	D1011	D1010		48	72	447.5	0.0014	538.4	11.2	1.00	3.64	296.1
P-125	D1012	D1011		48	72	442.3	0.0017	538.4	11.2	1.00	3.32	324.5
P-124	D1013	D1012		48	72	366.7	0.0016	523.0	10.9	1.00	3.28	318.8
P-123	D1014	D1013		48	72	127.7	0.0015	523.0	10.9	1.00	3.44	303.9
P-122	D1015	D1014		48	72	72.9	0.0015	523.0	10.9	1.00	3.42	306.1
P-143	D1016	D1015	72			71.5	0.0027	414.6	8.8	0.78	1.89	437.9
P-142	D1017	D1016	72			580.8	0.0020	414.6	7.3	1.00	2.19	377.9
P-141	D1018	D1017	72			749.4	0.0160	397.1	17.6	0.42	0.74	1074.7
P-140	D1019	D1018	84			140.9	0.0001	301.0	7.8	1.00	3.94	76.3
P-139	D1020	D1019	84			531.4	0.0013	301.0	7.8	1.00	1.29	234.1
P-138	D1021	D1020	84			622.0	0.0020	286.7	7.5	1.00	1.01	284.8
P-137	D1022	D1021	54			511.6	0.0037	269.2	16.9	1.00	2.23	120.5
P-425	D1023	D1022	48			273.0	0.0036	257.6	20.5	1.00	2.98	86.3
P-424	D1024	D1023	48			287.1	0.0034	257.6	20.5	1.00	3.08	83.7
P-423	D1025	D1024	48			280.6	0.0028	257.6	20.5	1.00	3.37	76.4
P-422	D1026	D1025	42			503.2	0.0040	245.2	25.5	1.00	3.86	63.4
P-421	D1027	D1026	42			343.6	0.0027	241.0	25.1	1.00	4.59	52.5

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P-420	D1028	D1027	42			250.1	0.0073	241.0	25.1	1.00	2.79	86.3
P-419	D1029	D1028	54			354.2	0.0041	239.6	15.1	1.00	1.91	125.7
P-418	D1030	D1029	54			290.4	0.0045	239.6	15.1	1.00	1.82	131.9
P-417	D1031	D1030	54			540.9	0.0027	204.8	12.9	1.00	1.99	103.1
P-416	D1032	D1031	48			786.0	0.0042	185.4	14.8	1.00	1.97	93.9
P-415	D1033	D1032	48			124.8	0.0092	185.4	14.8	1.00	1.34	138.3
P-407	D1034	D1033	48			414.2	0.0022	167.6	13.3	1.00	2.50	67.1
P-406	D1035	D1034	48			269.3	0.0031	167.6	13.3	1.00	2.10	80.0
P-405	D1036	D1035	48			239.6	0.0029	167.6	13.3	1.00	2.15	77.9
P-404	D1037	D1036	48			239.3	0.0030	157.1	12.5	1.00	2.00	78.4
P-403	D1038	D1037	48			225.7	0.0025	157.1	12.5	1.00	2.19	71.8
P-402	D1039	D1038	48			298.1	0.0025	144.3	11.5	1.00	2.01	71.8
P-401	D1040	D1039	48			513.6	0.0020	144.3	11.5	1.00	2.23	64.8
P-400	D1041	D1040	36			526.7	0.0052	118.7	16.8	1.00	2.45	48.4
P-399	D1042	D1041	36			763.9	0.0015	118.7	16.8	1.00	4.62	25.7
P-396	D1043	D1042	36			156.4	0.0114	118.7	16.8	1.00	1.66	71.5
P-395	D1044	D1043	36			277.4	0.0052	118.7	16.8	1.00	2.46	48.3
P-393	D1045	D1044	12			85.4	0.0082	79.5	101.2	1.00	24.57	3.2
P-392	D1046	D1045	12			554.7	0.0079	66.2	84.2	1.00	20.79	3.2
P-391	D1047	D1046	24			614.8	0.0085	66.2	21.1	1.00	3.17	20.9
P-390	D1048	D1047	18			192.3	0.0042	48.9	27.7	1.00	7.21	6.8
P-389	D1049	D1048	18			109.2	0.0038	48.9	27.7	1.00	7.49	6.5
P-388	D1050	D1049	18			203.4	0.0046	48.9	27.7	1.00	6.87	7.1
P-991	D2001	D-2	36			397.0	0.0015	170.4	24.1	1.00	6.55	26.0
P-157	D2002	D2001	42			59.7	0.0017	161.0	16.7	1.00	3.90	41.3
P-156	D2003	D2002	42			552.0	0.0014	161.0	16.7	1.00	4.19	38.4
P-155	D2004	D2003	42			550.8	0.0015	161.0	16.7	1.00	4.06	39.6
P-154	D2005	D2004	42			235.2	0.0015	84.0	8.7	1.00	2.16	38.9
P-153	D2006	D2005	42			1385.7	0.0014	56.8	5.9	1.00	1.48	38.3
P-152	D2007	D2006	42			1128.8	0.0015	56.8	5.9	1.00	1.46	38.8
P-151	D2008	D2007	42			122.9	0.0108	36.4	9.9	0.41	0.35	104.9
P-150	D2009	D2008	42			1407.9	0.0014	36.4	4.5	0.78	0.96	38.0
P-549	D2101	D2004	8			374.0	0.0015	105.6	302.5	1.00	227.29	0.5
P-550	D2102	D2101	8			452.3	0.0015	105.6	302.5	1.00	221.55	0.5
P-551	D2103	D2102	6			265.8	0.0015	105.6	537.8	1.00	483.94	0.2
P-552	D2104	D2103	12			901.1	0.0014	43.0	54.7	1.00	31.69	1.4
P-121	D4001	D1015	42			146.7	0.0061	108.7	11.3	1.00	1.38	79.0
P-120	D4002	D4001	42			392.7	0.0039	108.7	11.3	1.00	1.72	63.2
P-119	D4003	D4002	42			641.8	0.0015	108.7	11.3	1.00	2.80	38.8
P-118	D4004	D4003	36			760.9	0.0015	108.7	15.4	1.00	4.18	26.0
P-117	D4005	D4004	36			251.0	0.0015	74.1	10.5	1.00	2.89	25.7
P-116	D4006	D4005	36			209.3	0.0015	74.1	10.5	1.00	2.83	26.1
P-115	D4007	D4006	36			39.2	0.0015	74.1	10.5	1.00	2.83	26.2
P-114	D4008	D4007	36			105.1	0.0015	74.1	10.5	1.00	2.84	26.1
P-113	D4009	D4008	36			406.3	0.0016	53.4	7.6	1.00	2.01	26.5
P-112	D4010	D4009	36			85.6	0.0015	53.4	7.6	1.00	2.05	26.1
P-111	D4011	D4010	24			527.7	0.0001	0.0	0.0	0.00	0.00	2.6

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-110	D4012	D4010	24			541.5	0.0015	53.4	17.0	1.00	6.05	8.8
P-384	D4013	D4012	24			75.3	0.0016	36.5	11.6	1.00	4.03	9.1
P-385	D4014	D4013	24			278.9	0.0015	36.5	11.6	1.00	4.10	8.9
P-386	D4015	D4014	18			275.9	0.0014	26.0	14.7	1.00	6.49	4.0
P-387	D4016	D4015	15			260.6	0.0014	15.5	12.6	1.00	6.43	2.4
P-148	D4101	D4003	24			276.8	0.0018	0.0	0.0	0.00	0.00	9.7
P-147	D4102	D4101	24			261.5	0.0038	0.0	0.0	0.00	0.00	14.0
P-146	D4103	D4102	21			500.8	0.0058	0.0	0.0	0.00	0.00	12.1
P-145	D4104	D4103	15			348.1	0.0028	0.0	0.0	0.00	0.00	3.4
P-959	D5001	D1018	60			819.1	0.0079	116.1	11.8	0.50	0.50	232.5
P-563	D5002	D5001	48			83.7	0.0016	116.1	9.2	1.00	2.05	56.8
P-562	D5003	D5002	48			94.2	0.0015	116.1	9.2	1.00	2.09	55.5
P-561	D5004	D5003	48			70.1	0.0419	116.1	22.1	0.44	0.39	294.9
P-560	D5005	D5004	48			474.3	0.0015	93.9	7.5	1.00	1.68	55.7
P-559	D5006	D5005	42			570.9	0.0015	75.2	7.8	1.00	1.92	39.2
P-565	D5007	D5006	24			251.9	0.0015	58.7	18.7	1.00	6.66	8.8
P-566	D5008	D5007	24			281.0	0.0070	58.7	18.7	1.00	3.09	19.0
P-567	D5009	D5008	24			280.2	0.0070	52.7	16.8	1.00	2.78	19.0
P-568	D5010	D5009	24			553.1	0.0014	52.7	16.8	1.00	6.15	8.6
P-569	D5011	D5010	24			46.1	0.0109	52.7	16.8	1.00	2.23	23.6
P-570	D5012	D5011	24			178.8	0.0017	29.5	9.4	1.00	3.18	9.3
P-571	D5013	D5012	30			100.6	0.0041	29.5	6.0	1.00	1.12	26.3
P-572	D5014	D5013	24			316.2	0.0041	29.5	9.4	1.00	2.04	14.5
P-573	D5015	D5014	24			54.5	0.0092	29.5	9.4	1.00	1.36	21.7
P-574	D5016	D5015	24			105.2	0.0029	29.5	9.4	1.00	2.44	12.1
P-575	D5017	D5016	24			45.3	0.0037	29.5	9.4	1.00	2.13	13.9
P-576	D5018	D5017	24			1351.8	0.0035	7.5	4.4	0.53	0.56	13.5
P-558	D5101	D5006	30			665.2	0.0015	26.2	5.3	1.00	1.64	15.9
P-557	D5102	D5101	42			396.9	0.0050	26.2	6.8	0.42	0.37	71.3
P-556	D5103	D5102	42			128.1	0.0013	26.2	4.1	0.62	0.71	36.7
P-555	D5104	D5103	42			91.0	0.0016	26.2	4.5	0.58	0.64	41.0
P-554	D5105	D5104	42			438.3	0.0015	2.7	2.3	0.18	0.07	39.4
P-958	D5106	D5105	42			72.5	0.0015	0.0	0.0	0.00	0.00	39.3
P-577	D5201	D5008	12			644.0	0.0066	11.4	14.5	1.00	3.93	2.9
P-144	D6001	D1022	24			499.4	0.0015	17.1	5.4	1.00	1.95	8.8
P-434	D7001	D1030	24			299.1	0.0075	15.7	6.9	0.68	0.80	19.6
P-435	D7002	D7001	24			258.3	0.0081	15.7	7.2	0.66	0.77	20.4
P-436	D7003	D7002	15			323.9	0.0111	15.7	12.8	1.00	2.30	6.8
P-437	D7004	D7003	12			253.5	0.0114	15.7	20.0	1.00	4.12	3.8
P-430	D8001	D1031	24			305.0	0.0059	9.5	5.7	0.53	0.55	17.4
P-431	D8002	D8001	24			293.3	0.0044	9.5	5.1	0.58	0.63	15.1
P-432	D8003	D8002	21			272.7	0.0048	9.5	5.1	0.72	0.87	11.0
P-433	D8004	D8003	15			281.2	0.0076	9.5	7.8	1.00	1.68	5.7
P-414	D9001	D1033	24			199.5	0.0058	24.7	7.9	1.00	1.43	17.3
P-413	D9002	D9001	24			80.5	0.0051	24.7	7.9	1.00	1.53	16.2
P-412	D9003	D9002	24			264.6	0.0056	24.7	7.9	1.00	1.45	17.0
P-411	D9004	D9003	21			275.8	0.0036	24.7	10.3	1.00	2.61	9.5

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-410	D9005	D9004	21			88.4	0.0032	24.7	10.3	1.00	2.77	8.9
P-409	D9006	D9005	18			314.0	0.0075	24.7	14.0	1.00	2.72	9.1
P-408	D9007	D9006	15			266.5	0.0044	12.6	10.3	1.00	2.96	4.3
P-992	E1001	E-1	60			199.4	0.0032	1118.3	19.0	1.00	7.62	440.4
P-641	E1002	E1001	60			168.5	0.0031	1114.9	18.9	1.00	7.69	435.2
P-993	E1003	E1002	60			287.2	0.0890	1105.4	39.1	0.48	1.42	2336.7
P-591	E1004	E1003	66			677.7	0.0024	711.9	10.0	1.00	4.31	495.4
P-1000	E1005	E1004	66			302.2	0.0024	711.9	10.0	1.00	4.30	496.5
P-999	E1006	E1005	66			547.2	0.0019	593.4	8.3	1.00	4.08	436.1
P-589	E1007	E1006	66			157.8	0.0029	593.4	12.5	1.00	3.30	359.6
P-588	E1008	E1007	66			109.4	0.0030	593.4	12.5	1.00	3.21	369.9
P-587	E1009	E1008	66			1302.1	0.0015	575.5	12.1	1.00	4.42	260.6
P-586	E1010	E1009	60			745.1	0.0023	356.4	9.1	1.00	2.87	248.0
P-585	E1011	E1010	60			492.7	0.0023	348.8	8.9	1.00	2.78	251.2
P-994	E1012	E1011	60			1037.0	0.0028	328.2	8.4	1.00	2.39	274.3
P-579	E1013	E1012	66			852.4	0.0028	309.3	13.0	1.00	1.72	179.4
P-578	E1014	E1013	54			274.1	0.0046	290.3	18.3	1.00	2.16	134.2
P-455	E1015	E1014	48			50.3	0.0034	290.3	23.1	1.00	3.47	83.7
P-454	E1016	E1015	48			390.3	0.0069	284.0	22.6	1.00	2.37	120.0
P-453	E1017	E1016	42			294.1	0.0039	284.0	29.5	1.00	4.48	63.4
P-452	E1018	E1017	42			185.5	0.0067	268.1	27.9	1.00	3.25	82.5
P-995	E1019	E1018	54			35.8	0.0031	198.7	12.5	1.00	1.82	109.3
P-471	E1020	E1019	54			638.4	0.0044	140.1	8.8	1.00	1.07	130.8
P-470	E1021	E1020	48			545.6	0.0046	140.1	11.2	1.00	1.44	97.5
P-469	E1022	E1021	48			94.0	0.0046	140.1	11.2	1.00	1.44	97.4
P-468	E1023	E1022	48			313.3	0.0080	140.1	11.2	1.00	1.09	128.7
P-467	E1024	E1023	48			235.4	0.0203	140.1	17.6	0.61	0.68	205.0
P-466	E1025	E1024	48			389.1	0.0039	140.1	11.2	1.00	1.57	89.4
P-465	E1026	E1025	42			255.7	0.0035	121.0	12.6	1.00	2.03	59.5
P-464	E1027	E1026	42			641.6	0.0041	118.9	12.4	1.00	1.83	64.8
P-463	E1028	E1027	42			275.0	0.0046	118.9	12.4	1.00	1.74	68.3
P-462	E1029	E1028	42			252.5	0.0042	102.4	10.6	1.00	1.57	65.4
P-461	E1030	E1029	42			426.7	0.0038	102.4	10.6	1.00	1.64	62.3
P-460	E1031	E1030	42			210.9	0.0054	102.4	10.6	1.00	1.39	73.8
P-459	E1032	E1031	30			285.5	0.0028	83.6	17.0	1.00	3.82	21.9
P-458	E1033	E1032	30			199.3	0.0157	69.3	14.1	1.00	1.35	51.5
P-457	E1034	E1033	30			526.5	0.0027	69.3	14.1	1.00	3.23	21.4
P-456	E1035	E1034	30			331.3	0.0030	33.1	6.7	1.00	1.47	22.5
P-638	E2001	E1003		60	60	105.4	0.0015	402.9	16.1	1.00	2.57	156.9
P-637	E2002	E2001	5			25.1	0.0016	24.3	178.0	1.00	175.64	0.1
P-636	E2003	E2002	42			327.6	0.0046	24.3	6.5	0.41	0.36	68.3
P-635	E2004	E2003	42			578.5	0.0081	16.2	7.1	0.29	0.18	90.8
P-1009	E2005	E2004	36			757.4	0.0023	6.4	3.5	0.30	0.20	32.0
P-1002	E2006	E2104		48	76	408.7	0.0150	347.9	15.4	0.45	0.67	1039.6
P-1003	E2007	E2006	54			786.0	0.0015	335.3	10.5	1.00	4.39	152.8
P-1004	E2008	E2007	54			777.6	0.0048	319.4	10.0	1.00	2.33	274.6
P-625	E2009	E2008	48			145.7	0.0034	313.5	12.5	1.00	3.72	168.7

Appendix C
City of Richmond - Storm Drain Master Plan
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P-624	E2010	E2009	48			386.7	0.0054	334.8	13.3	1.00	3.15	212.3
P-1010	E2011	E2010		42	144	603.2	0.0073	334.8	13.2	0.60	0.48	697.7
P-1014	E2012	E2011		48	144	136.5	0.0037	326.2	10.4	0.66	0.55	596.9
P-1013	E2013	E2012		48	144	161.3	0.0062	326.2	12.4	0.55	0.42	776.5
P-1012	E2014	E2013		48	144	282.0	0.0035	318.2	10.2	0.65	0.54	587.3
P-1020	E2015	E2014		48	144	334.9	0.0015	309.2	7.5	0.86	0.81	381.1
P-1019	E2016	E2015	12			82.8	0.0014	107.9	137.4	1.00	79.33	1.4
P-618	E2017	E2016		36	60	632.6	0.0130	107.9	13.0	0.55	0.45	240.7
P-519	E2018	E2017	48			432.8	0.0015	97.9	7.8	1.00	1.75	55.8
P-518	E2019	E2018	48			660.1	0.0053	91.7	9.4	0.72	0.87	104.9
P-517	E2020	E2019	48			250.7	0.0020	80.3	6.4	1.00	1.25	64.3
P-516	E2021	E2020		24	96	386.5	0.0091	75.3	9.4	0.50	0.36	211.4
P-515	E2022	E2021	48			462.2	0.0076	68.0	10.2	0.52	0.54	125.3
P-514	E2023	E2022	42			751.8	0.0100	49.7	10.4	0.50	0.49	100.8
P-513	E2024	E2023	21			225.7	0.0266	42.8	17.8	1.00	1.65	25.9
P-512	E2025	E2024	12			410.2	0.0024	32.7	41.6	1.00	18.54	1.8
P-511	E2026	E2025	12			696.4	0.0015	17.0	21.7	1.00	12.34	1.4
P-1017	E2027	E2026	12			540.0	0.0056	5.0	6.4	1.00	1.88	2.7
P-1016	E2028	E2027	12			699.2	0.0014	0.0	0.0	0.00	0.00	1.4
P-1015	E2029	E2028	12			342.0	0.0088	0.0	0.0	0.00	0.00	3.3
P-1005	E2101	E2001	12			25.8	1.0505	387.9	493.9	1.00	10.59	36.6
P-1006	E2102	E2101	42			247.0	0.0249	387.9	20.2	1.00	2.44	318.4
P-1007	E2103	E2102	45			666.7	0.0024	384.6	17.4	1.00	6.52	118.1
P-1008	E2104	E2103	45			773.1	0.0071	352.6	16.0	1.00	3.44	204.9
P-1021	E2201	E2015		36	60	715.2	0.0159	263.6	17.7	0.99	0.99	266.8
P-537	E2202	E2201		36	96	493.0	0.0057	257.0	11.9	0.90	0.87	296.9
P-536	E2203	E2202		36	96	102.5	0.0020	251.1	10.5	1.00	1.44	174.1
P-535	E2204	E2203		36	96	113.1	0.0088	251.1	13.8	0.76	0.68	370.5
P-534	E2205	E2204		36	96	134.9	0.0074	249.0	12.9	0.80	0.73	339.2
P-533	E2206	E2205		36	96	54.7	0.0183	249.0	17.7	0.59	0.47	532.7
P-532	E2207	E2206		36	96	349.2	0.0029	249.0	10.4	1.00	1.18	210.9
P-531	E2208	E2207		36	96	62.8	0.0080	209.1	12.6	0.69	0.59	351.6
P-530	E2209	E2208		36	96	367.3	0.0082	209.1	12.7	0.69	0.59	356.1
P-529	E2210	E2209		48	60	556.9	0.0081	202.7	12.9	0.79	0.74	274.6
P-528	E2211	E2210	54			146.5	0.0341	177.2	22.7	0.49	0.49	364.2
P-527	E2212	E2211	54			568.6	0.0123	177.2	15.3	0.68	0.81	218.8
P-526	E2213	E2212	42			286.9	0.0017	137.6	14.3	1.00	3.27	42.1
P-525	E2214	E2213	42			463.1	0.0227	113.6	17.3	0.64	0.75	151.9
P-524	E2215	E2214	36			71.7	0.0698	80.2	24.4	0.47	0.45	176.7
P-523	E2216	E2215	36			160.4	0.0015	65.7	9.3	1.00	2.54	25.9
P-522	E2217	E2216	36			348.4	0.0015	65.7	9.3	1.00	2.54	25.8
P-521	E2218	E2217	30			404.9	0.0124	7.1	6.8	0.27	0.16	45.7
P-520	E2219	E2218	30			97.0	0.0103	3.5	5.2	0.19	0.08	41.8
P-538	E2301	E2217	24			65.4	0.0015	58.7	18.7	1.00	6.62	8.9
P-539	E2302	E2301	24			57.2	0.0014	58.7	18.7	1.00	6.92	8.5
P-540	E2303	E2302	24			36.7	0.0016	58.7	18.7	1.00	6.41	9.2
P-541	E2304	E2303	24			303.9	0.0122	55.9	17.8	1.00	2.23	25.1

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P-542	E2305	E2304	24			269.9	0.0552	55.9	17.8	1.00	1.05	53.3
P-543	E2306	E2305	24			223.7	0.0805	48.9	22.5	0.65	0.76	64.3
P-1001	E3001	E1005		36	58	414.8	0.0043	132.2	9.1	1.00	1.00	132.2
P-616	E3002	E3001		36	58	215.5	0.0070	123.8	10.8	0.79	0.74	168.4
P-615	E3003	E3002		36	58	142.5	0.0073	123.8	11.0	0.78	0.72	172.4
P-614	E3004	E3003		36	58	118.2	0.0030	120.4	8.3	1.00	1.10	109.8
P-613	E3005	E3004		36	58	240.5	0.0021	116.3	8.0	1.00	1.25	92.9
P-612	E3006	E3005	33			919.2	0.0039	107.2	18.1	1.00	3.24	33.1
P-611	E3007	E3006	42			134.7	0.0015	107.2	11.1	1.00	2.76	38.9
P-610	E3008	E3007	42			286.2	0.0064	100.0	10.4	1.00	1.24	80.5
P-609	E3009	E3008	42			535.0	0.0015	100.0	10.4	1.00	2.56	39.0
P-608	E3010	E3009	42			141.6	0.0056	88.8	9.2	1.00	1.17	75.8
P-607	E3011	E3010	42			166.8	0.0015	88.8	9.2	1.00	2.27	39.1
P-606	E3012	E3011	36			456.0	0.0015	82.2	11.6	1.00	3.18	25.8
P-605	E3013	E3012	36			408.4	0.0044	77.8	11.0	1.00	1.75	44.5
P-604	E3014	E3013	30			391.1	0.0090	63.0	12.8	1.00	1.62	39.0
P-603	E3015	E3014	30			63.2	0.0022	63.0	12.8	1.00	3.26	19.4
P-602	E3016	E3015	30			378.5	0.0049	55.0	11.2	1.00	1.91	28.8
P-601	E3017	E3016	30			586.5	0.0039	47.3	9.6	1.00	1.84	25.8
P-600	E3018	E3017	30			42.4	0.0118	47.3	9.6	1.00	1.06	44.7
P-997	E4001	E1009	42			124.9	0.0539	206.1	27.5	0.73	0.88	234.2
P-996	E4002	E4001	36			261.2	0.0102	206.1	29.2	1.00	3.05	67.6
P-599	E4003	E4002	36			120.6	0.0065	220.2	31.2	1.00	4.09	53.8
P-598	E4004	E4003	36			469.3	0.0035	213.3	30.2	1.00	5.40	39.5
P-597	E4005	E4004	36			793.9	0.0036	202.6	28.7	1.00	5.06	40.0
P-998	E4006	E4005	4			860.5	0.0009	195.6	2241.4	1.00	3383.21	0.1
P-594	E4007	E4006	42			853.1	0.0030	140.0	14.6	1.00	2.52	55.5
P-593	E4008	E4007	42			283.2	0.0032	140.0	14.6	1.00	2.45	57.2
P-592	E4009	E4008	42			387.5	0.0049	125.9	13.1	1.00	1.78	70.6
P-497	E4010	E4009	42			550.4	0.0129	110.6	13.6	0.79	0.97	114.4
P-496	E4011	E4010	42			606.9	0.0102	92.6	12.0	0.75	0.91	101.7
P-495	E4012	E4011	36			120.3	0.0108	92.6	13.1	1.00	1.33	69.5
P-494	E4013	E4012	30			541.6	0.0109	85.0	17.3	1.00	1.98	43.0
P-493	E4014	E4013	36			265.2	0.0139	76.7	12.7	0.80	0.97	78.8
P-492	E4015	E4014	36			18.2	0.0104	76.7	10.8	1.00	1.12	68.3
P-491	E4016	E4015	36			205.9	0.0138	76.7	12.7	0.80	0.97	78.7
P-490	E4017	E4016	36			105.0	0.0139	76.7	12.7	0.79	0.97	78.9
P-489	E4018	E4017	36			159.6	0.0045	76.7	10.8	1.00	1.71	44.9
P-488	E4019	E4018	36			89.4	0.0047	76.7	10.8	1.00	1.67	45.8
P-487	E4020	E4019	36			464.0	0.0111	76.7	10.8	1.00	1.09	70.5
P-486	E4021	E4020	36			51.9	0.0040	76.7	10.8	1.00	1.80	42.5
P-485	E4022	E4021	24			268.1	0.0124	67.3	21.4	1.00	2.66	25.3
P-484	E4023	E4022	24			272.2	0.0118	64.3	20.5	1.00	2.62	24.6
P-483	E4024	E4023	24			513.0	0.0127	64.3	20.5	1.00	2.52	25.6
P-482	E4025	E4024	24			244.4	0.0088	64.3	20.5	1.00	3.02	21.3
P-481	E4026	E4025	21			673.8	0.0118	47.8	19.9	1.00	2.77	17.2
P-480	E4027	E4026	21			147.8	0.0075	35.8	14.9	1.00	2.60	13.8

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-479	E4028	E4027	21			175.5	0.0087	35.8	14.9	1.00	2.42	14.8
P-498	E4101	E4010	12			247.5	0.0090	15.8	20.1	1.00	4.66	3.4
P-499	E4102	E4101	12			279.0	0.0096	11.1	14.1	1.00	3.16	3.5
P-500	E4103	E4102	12			57.3	0.0192	11.1	14.1	1.00	2.24	4.9
P-451	E5001	E1018	42			307.1	0.0016	78.4	8.1	1.00	1.95	40.3
P-450	E5002	E5001	42			214.9	0.0020	78.4	8.1	1.00	1.74	45.1
P-449	E5003	E5002	42			66.2	0.0015	78.4	8.1	1.00	2.00	39.2
P-448	E5004	E5003	42			537.2	0.0002	64.1	6.7	1.00	4.66	13.8
P-447	E5005	E5004	36			257.3	0.0015	64.1	9.1	1.00	2.49	25.7
P-446	E5006	E5005	36			273.2	0.0015	64.1	9.1	1.00	2.44	26.2
P-445	E5007	E5006	36			226.9	0.0015	54.5	7.7	1.00	2.07	26.3
P-444	E5008	E5007	30			282.1	0.0015	54.5	11.1	1.00	3.39	16.1
P-443	E5009	E5008	30			242.8	0.0016	42.1	8.6	1.00	2.59	16.3
P-442	E5010	E5009	30			233.0	0.2225	34.3	29.8	0.28	0.18	194.0
P-441	E5011	E5010	21			282.6	0.0041	34.3	14.3	1.00	3.37	10.2
P-440	E5012	E5011	24			177.5	0.0046	18.1	5.8	1.00	1.17	15.4
P-439	E5013	E5012	21			317.9	0.0037	18.1	7.5	1.00	1.87	9.7
P-438	E5014	E5013	21			152.7	0.0131	18.1	8.6	0.81	1.00	18.2
P-472	E6001	E1019	12			291.7	0.0104	54.7	69.6	1.00	15.02	3.6
P-473	E6002	E6001	12			287.8	0.0114	54.7	69.6	1.00	14.36	3.8
P-474	E6003	E6002	12			251.5	0.0130	39.7	50.5	1.00	9.74	4.1
P-475	E6004	E6003	12			226.2	0.0145	39.7	50.5	1.00	9.23	4.3
P-476	E6005	E6004	12			263.0	0.0073	26.2	33.3	1.00	8.59	3.0
P-477	E6006	E6005	12			240.0	0.0132	26.2	33.3	1.00	6.38	4.1
P-478	E6007	E6006	12			292.9	0.0072	11.9	15.1	1.00	3.91	3.0
P-1018	F1001	F-1	18			537.4	0.0279	13.7	11.0	0.66	0.78	17.6
P-502	F1002	F1001	12			57.1	0.0175	13.7	17.4	1.00	2.89	4.7
P-503	F1003	F1002	18			113.2	0.0088	9.0	6.3	0.75	0.91	9.9
P-504	F1004	F1003	12			175.6	0.0057	9.0	11.5	1.00	3.36	2.7
P-505	F1005	F1004	12			101.1	0.0099	4.6	5.8	1.00	1.29	3.6
P-960	I1001	I-1		48	72	333.2	0.0023	350.7	14.6	1.00	1.88	186.9
P-191	I1002	I1001	48			103.7	0.0005	198.8	15.8	1.00	6.29	31.6
P-190	I1003	I1002	48			405.0	0.0015	198.8	15.8	1.00	3.59	55.4
P-189	I1004	I1003	48			441.0	0.0016	198.8	15.8	1.00	3.47	57.4
P-188	I1005	I1004	48			983.2	0.0015	198.8	15.8	1.00	3.53	56.3
P-187	I1006	I1005	36			196.9	0.0015	103.3	14.6	1.00	3.96	26.1
P-186	I1007	I1006	36			51.5	0.0039	103.3	14.6	1.00	2.48	41.7
P-185	I1008	I1007	36			43.2	0.0023	103.3	14.6	1.00	3.21	32.2
P-184	I1009	I1008	36			265.9	0.0016	103.3	14.6	1.00	3.89	26.6
P-183	I1010	I1009	36			69.0	0.0013	91.8	13.0	1.00	3.80	24.1
P-182	I1011	I1010	30			102.5	0.0010	91.8	18.7	1.00	7.14	12.8
P-181	I1012	I1011	21			622.7	0.0041	72.8	30.3	1.00	7.15	10.2
P-180	I1013	I1012	21			569.5	0.0027	72.8	30.3	1.00	8.82	8.3
P-971	I1014	I1013	24			401.2	0.0033	45.0	14.3	1.00	3.43	13.1
P-970	I1015	I1014	24			365.8	0.0034	45.0	14.3	1.00	3.38	13.3
P-106	I1016	I1015	24			352.0	0.0030	32.0	10.2	1.00	2.58	12.4
P-972	I1017	I1016	24			436.6	0.0028	19.3	6.1	1.00	1.59	12.1

Appendix C
City of Richmond - Storm Drain Master Plan
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-974	I1018	I1017	21			277.8	0.0031	12.9	5.3	1.00	1.45	8.8
P-973	I1019	I1018	15			282.1	0.0031	12.9	10.5	1.00	3.57	3.6
P-205	I2001	I1001	30			61.7	0.0015	119.2	24.3	1.00	7.59	15.7
P-204	I2002	I2001	30			409.2	0.0016	119.2	24.3	1.00	7.28	16.4
P-203	I2003	I2002	30			263.6	0.0015	119.2	24.3	1.00	7.44	16.0
P-202	I2004	I2003	30			45.5	0.0015	104.4	21.3	1.00	6.47	16.1
P-201	I2005	I2004	30			473.4	0.0015	104.4	21.3	1.00	6.46	16.1
P-963	I2006	I2005	24			452.0	0.0015	89.4	28.5	1.00	10.02	8.9
P-962	I2007	I2006	24			289.3	0.0016	59.6	19.0	1.00	6.66	8.9
P-199	I2008	I2007	24			248.2	0.0093	59.6	19.0	1.00	2.73	21.8
P-198	I2009	I2008	12			107.0	0.0017	59.6	75.9	1.00	40.67	1.5
P-197	I2010	I2009	12			113.2	0.0177	59.6	75.9	1.00	12.55	4.7
P-196	I2011	I2010	18			56.2	0.0062	59.6	33.7	1.00	7.17	8.3
P-195	I2012	I2011	12			140.9	0.0142	59.6	75.9	1.00	14.00	4.3
P-194	I2013	I2012	18			188.5	0.0212	33.4	18.9	1.00	2.18	15.3
P-193	I2014	I2013	18			311.7	0.0064	33.4	18.9	1.00	3.96	8.4
P-206	I3001	I1001	12			37.3	0.0016	52.1	66.4	1.00	36.38	1.4
P-207	I3002	I3001	12			107.2	0.0213	52.1	66.4	1.00	10.01	5.2
P-208	I3003	I3002	12			442.7	0.0009	52.1	66.4	1.00	48.55	1.1
P-209	I3004	I3003	12			645.3	0.0006	43.7	55.6	1.00	49.14	0.9
P-210	I3005	I3004	12			450.2	0.0004	30.5	38.8	1.00	40.52	0.8
P-965S	I4001	I1005	120			834.0	0.0030	26.8	5.1	0.12	0.03	907.9
P-964	I4002	I4001	24			500.5	0.0015	26.8	8.5	1.00	3.01	8.9
P-967	J1001	J-1	60			163.2	0.0015	82.4	5.8	0.68	0.81	102.2
P-966	J1002	J1001	60			131.4	0.0015	82.4	5.8	0.68	0.81	101.9
P-179	J1003	J1002	54			39.1	0.0026	82.4	7.0	0.69	0.83	99.7
P-178	J1004	J1003	54			145.2	0.0021	82.4	6.4	0.76	0.92	89.6
P-177	J1005	J1004	48			317.8	0.0016	54.5	5.2	0.78	0.95	57.1
P-176	J1006	J1005	48			85.3	0.0018	54.5	5.4	0.74	0.90	60.4
P-175	J1007	J1006	48			489.0	0.0047	54.5	8.1	0.53	0.55	98.8
P-174	J1008	J1007	42			31.9	0.0016	54.5	5.7	1.00	1.37	39.9
P-173	J1009	J1008	42			413.9	0.0019	42.3	5.2	0.78	0.95	44.3
P-172	J1010	J1009	36			27.3	0.0015	42.3	6.0	1.00	1.65	25.6
P-171	J1011	J1010	36			506.9	0.0014	22.4	4.1	0.73	0.88	25.4
P-170	J1012	J1011	36			139.6	0.0015	22.4	4.1	0.72	0.86	25.9
P-169	J1013	J1012	36			53.9	0.0011	22.4	3.2	1.00	1.00	22.3
P-168	J1014	J1013	36			286.2	0.0052	13.8	5.9	0.36	0.28	48.4
P-167	J1015	J1014	30			359.7	0.0050	13.8	5.8	0.48	0.47	29.1
P-166	J1016	J1015	30			52.0	0.0079	13.8	6.9	0.43	0.38	36.5
P-165	J1017	J1016	30			284.5	0.0031	10.1	4.5	0.47	0.45	22.7
P-164	J1018	J1017	18			578.6	0.0061	6.6	5.2	0.68	0.80	8.2
P-1035	K1001	K-1		36	120	104.8	0.0051	339.0	12.1	0.94	0.91	371.8
P-646	K1002	K1001		36	120	166.5	0.0133	279.3	15.8	0.59	0.46	602.4
P-645	K1003	K1002		36	120	194.1	0.0048	279.3	11.2	0.83	0.77	363.8
P-644	K1004	K1003		36	120	100.9	0.0015	279.3	9.3	1.00	1.39	201.6
P-643	K1005	K1004		42	96	248.8	0.0028	198.2	8.6	0.83	0.77	258.1
P-642	K1006	K1005		30	66	675.3	0.0085	177.0	12.9	1.00	1.02	174.4

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P-548	K1007	K1006	36			259.7	0.0191	177.0	25.0	1.00	1.91	92.5
P-547	K1008	K1007	36			254.2	0.0256	177.0	25.0	1.00	1.66	106.9
P-546	K1009	K1008	36			169.0	0.0180	177.0	25.0	1.00	1.97	89.8
P-545	K1010	K1009	30			61.4	0.0139	177.0	36.1	1.00	3.66	48.4
P-544	K1011	K1010	30			145.9	0.0206	102.3	20.8	1.00	1.73	59.1
P-1036	L1001	L-1	48			37.1	0.0269	155.1	15.1	0.32	0.66	709.3
P-660	L1002	L1001	48			206.4	0.0141	141.4	11.6	0.36	0.83	514.0
P-659	L1003	L1002	48			367.1	0.0015	136.8	5.0	0.69	2.45	167.3
P-658	L1004	L1003		36	84	47.3	0.0089	92.7	8.2	0.27	0.30	624.5
P-657	L1005	L1004		36	84	65.4	0.0060	89.0	7.1	0.30	0.35	511.6
P-656	L1006	L1005		36	84	410.4	0.0043	81.2	6.2	0.31	0.37	436.5
P-655	L1007	L1006		36	84	49.0	0.0163	70.3	9.0	0.19	0.17	846.7
P-654	L1008	L1007		36	84	526.3	0.0043	70.3	5.8	0.29	0.33	432.4
P-653	L1009	L1008		36	84	245.9	0.0060	59.3	6.2	0.23	0.23	514.2
P-652	L1010	L1009		36	84	194.8	0.0060	52.4	5.9	0.21	0.20	513.6
P-651	L1011	L1010		36	84	216.9	0.0060	52.4	5.9	0.21	0.20	513.1
P-650	L1012	L1011	7			93.8	0.0134	41.9	156.9	1.00	42.65	1.0
P-649	L1013	L1012	7			408.4	0.0050	34.4	128.7	1.00	57.08	0.6
P-648	L1014	L1013	54			343.5	0.0104	23.9	8.5	0.23	0.12	200.7
P-661	L1101	L1001	18			156.0	0.0006	9.0	5.1	1.00	3.37	2.7
P-662	L1102	L1101	18			45.3	0.0009	9.0	5.1	1.00	2.88	3.1
P-663	L1103	L1102	18			453.4	0.0010	5.6	3.1	1.00	1.68	3.3
P-666	L2001	L1003	12			574.4	0.0042	25.5	32.5	1.00	11.03	2.3
P-665	L2002	L2001	12			604.6	0.0024	16.5	21.0	1.00	9.48	1.7
P-664	L2003	L2002	12			412.5	0.0020	10.9	13.9	1.00	6.77	1.6
P-667	L3001	L1003	30			532.0	0.0015	32.9	6.7	1.00	2.06	15.9
P-668	L3002	L3001	24			369.6	0.0015	32.9	10.5	1.00	3.76	8.7
P-669	L3003	L3002	24			48.8	0.0094	24.0	7.6	1.00	1.09	22.0
P-670	L3004	L3003	24			46.6	0.0129	24.0	9.3	0.77	0.93	25.7
P-671	L3005	L3004	24			155.7	0.0035	24.0	7.6	1.00	1.78	13.5
P-672	L3006	L3005	24			57.0	0.0091	24.0	7.6	1.00	1.11	21.7
P-673	L3007	L3006	24			652.6	0.0039	12.7	5.1	0.74	0.90	14.1
P-674	L3008	L3007	24			562.0	0.0015	5.4	2.9	0.57	0.62	8.7
P-675	L3009	L3008	21			49.2	0.0026	5.4	3.6	0.60	0.66	8.2
P-676	L4001	L1006	15			150.0	0.0015	13.6	11.1	1.00	5.35	2.5
P-1037	L4002	L4001	15			584.8	0.0015	5.2	4.2	1.00	2.08	2.5
P-1041	M1001	M-1		36	72	46.1	0.0097	681.9	18.9	1.00	2.56	532.6
P-692	M1002	M1001		36	72	125.4	0.0441	623.0	26.8	0.65	1.10	1135.5
P-691	M1003	M1002		36	72	285.3	0.0075	623.0	17.3	1.00	2.66	468.1
P-690	M1004	M1003	66			269.7	0.0030	623.0	13.1	1.00	3.38	369.1
P-689	M1005	M1004	66			180.6	0.0030	623.0	13.1	1.00	3.37	369.3
P-688	M1006	M1005	66			585.6	0.0009	617.4	13.0	1.00	6.17	200.1
P-1039	M1007	M1006	66			479.3	0.0046	589.0	12.4	1.00	2.59	455.2
P-685	M1008	M1007	54			849.7	0.0015	589.0	37.0	1.00	7.73	76.2
P-846	M1009	M1008		60	84	123.8	0.0016	352.6	10.1	1.00	1.35	260.9
P-845	M1010	M1009		60	84	73.9	0.0015	352.6	10.1	1.00	1.41	250.5
P-844	M1011	M1010		60	84	126.5	0.0015	352.6	10.1	1.00	1.40	251.6

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P-843	M1012	M1011	42			79.5	0.0063	225.0	23.4	1.00	2.81	80.0
P-842	M1013	M1012	42			686.0	0.0190	213.5	22.2	1.00	1.54	138.9
P-841	M1014	M1013	36			93.9	0.0107	213.5	30.2	1.00	3.09	69.0
P-840	M1015	M1014	36			780.5	0.0192	196.8	27.8	1.00	2.12	92.7
P-839	M1016	M1015	36			43.3	0.0231	196.8	27.8	1.00	1.94	101.6
P-838	M1017	M1016	36			237.5	0.0211	204.6	28.9	1.00	2.11	97.0
P-837	M1018	M1017	36			52.6	0.0190	204.6	28.9	1.00	2.22	92.2
P-836	M1019	M1018	36			762.7	0.0354	195.6	27.7	1.00	1.55	125.8
P-834	M1020	M1019	30			80.4	0.0124	132.0	26.9	1.00	2.88	45.9
P-833	M1021	M1020	30			252.8	0.0752	106.5	26.1	0.77	0.94	112.8
P-832	M1022	M1021	30			269.9	0.0371	106.5	21.7	1.00	1.35	79.2
P-831	M1023	M1022	30			373.8	0.0535	106.5	21.7	1.00	1.12	95.1
P-830	M1024	M1023	24			108.8	0.0920	101.6	32.4	1.00	1.48	68.8
P-1045S	M1025	M1024	120			392.7	0.0652	101.6	22.5	0.11	0.02	4233.6
P-829	M1026	M1025	30			144.0	0.0903	95.2	27.8	0.66	0.77	123.6
P-828	M1027	M1026	30			290.2	0.1378	95.2	32.8	0.57	0.62	152.7
P-827	M1028	M1027	30			597.9	0.0958	81.4	27.5	0.58	0.64	127.3
P-1040	M2001	M-1	12			46.0	0.0096	32.2	41.0	1.00	9.22	3.5
P-684	M2002	M2001	36			337.3	0.0173	32.2	11.5	0.42	0.37	88.1
P-1038	M2003	M2002	36			437.1	0.0015	32.2	4.6	1.00	1.24	26.0
P-682	M2004	M2003	36			206.6	0.0015	32.2	4.6	1.00	1.24	25.9
P-681	M2005	M2004	36			366.4	0.0015	32.2	4.6	1.00	1.24	25.9
P-680	M2006	M2005	24			184.6	0.0056	21.3	6.8	1.00	1.25	17.0
P-693	M3001	M1006	30			315.1	0.0030	57.0	11.6	1.00	2.52	22.6
P-694	M3002	M3001	30			378.6	0.0032	55.2	11.3	1.00	2.39	23.2
P-695	M3003	M3002	30			223.2	0.0493	55.2	19.5	0.56	0.61	91.3
P-1044	M3004	M3003	4			24.5	0.0016	55.2	633.1	1.00	716.84	0.1
P-847	M3005	M3004	30			192.9	0.0052	55.2	11.3	1.00	1.87	29.6
P-961	M3006	M3005	4			469.0	0.0064	0.0	0.0	0.00	0.00	0.2
P-1068	M4001	M1008	42			803.1	0.0015	299.5	31.1	1.00	7.68	39.0
P-1067	M4002	M4001	120			163.3	0.0095	299.5	15.7	0.29	0.19	1615.4
P-1066S	M4003	M4002	120			429.9	0.0028	293.7	10.1	0.40	0.33	879.7
P-1065	M4004	M4003	24			1113.8	0.0151	293.7	46.7	1.00	10.54	55.7
P-1064	M4005	M4004	24			295.1	0.0120	277.3	44.1	1.00	11.16	49.7
P-807	M4006	M4005	30			335.5	0.0258	161.5	32.9	1.00	2.44	66.1
P-806	M4007	M4006	30			595.4	0.0134	161.5	32.9	1.00	3.39	47.7
P-805	M4008	M4007	30			45.8	0.0219	161.5	32.9	1.00	2.66	60.8
P-804	M4009	M4008	30			260.7	0.0230	145.4	29.6	1.00	2.33	62.4
P-803	M4010	M4009	30			166.4	0.0015	145.4	29.6	1.00	9.12	15.9
P-802	M4011	M4010	30			297.9	0.0302	138.1	28.1	1.00	1.93	71.5
P-801	M4012	M4011	30			29.2	0.0343	138.1	28.1	1.00	1.81	76.2
P-800	M4013	M4012	30			400.7	0.0478	133.3	27.2	1.00	1.48	89.9
P-799	M4014	M4013	30			345.7	0.1365	127.0	34.7	0.70	0.84	152.0
P-1063	M4101	M4005	36			1051.2	0.0010	123.3	17.4	1.00	5.98	20.6
P-821	M5001	M1011		48	48	85.9	0.0407	139.3	21.5	0.41	0.31	448.4
P-820	M5002	M5001		48	48	129.1	0.0064	139.3	10.6	0.82	0.78	178.1
P-1043	M5003	M5002		48	48	215.5	0.0015	139.3	8.7	1.00	1.63	85.6

Appendix C
City of Richmond - Storm Drain Master Plan
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-818	M5004	M5003		48	72	314.6	0.0033	119.4	8.1	0.61	0.52	227.6
P-817	M5005	M5004		36	60	55.9	0.0089	119.4	11.7	0.68	0.60	199.9
P-816	M5006	M5005		36	60	74.4	0.0040	119.4	8.7	0.91	0.89	134.2
P-815	M5007	M5006		36	60	349.0	0.0143	108.1	13.5	0.53	0.43	253.0
P-814	M5008	M5007		36	36	81.6	0.0012	108.1	12.0	1.00	2.99	36.1
P-813	M5009	M5008		36	36	563.1	0.0114	90.4	11.8	0.85	0.82	110.0
P-812	M5010	M5009	18			56.4	0.0834	54.4	30.8	1.00	1.79	30.4
P-811	M5011	M5010	18			1068.5	0.0372	38.4	21.7	1.00	1.89	20.3
P-810	M5012	M5011	18			49.5	0.0014	38.4	21.7	1.00	9.70	4.0
P-809	M5013	M5012	18			249.9	0.0080	38.4	21.7	1.00	4.08	9.4
P-808	M5014	M5013	18			310.9	0.0050	33.8	19.1	1.00	4.55	7.4
P-1042	M5101	M5003	48			587.0	0.0015	18.9	4.0	0.40	0.34	55.8
P-835	M6001	M1019	30			695.8	0.0431	63.6	19.1	0.64	0.74	85.4
P-1046	N1001	N-1		48	96	920.2	0.0046	503.0	15.7	1.00	1.27	395.7
P-867	N1002	N1001		48	96	554.5	0.0094	440.0	16.5	0.83	0.78	563.8
P-868	N1003	N1002		48	96	408.6	0.0044	440.0	13.8	1.00	1.14	386.4
P-869	N1004	N1003		48	96	330.3	0.0091	440.0	16.3	0.84	0.79	554.9
P-870	N1005	N1004		48	96	255.3	0.0157	428.5	19.8	0.68	0.59	728.7
P-871	N1006	N1005		48	96	311.6	0.0244	423.3	23.0	0.57	0.47	909.3
P-872	N1007	N1006		48	96	31.8	0.0016	423.3	13.2	1.00	1.83	230.8
P-873	N1008	N1007		48	96	269.9	0.0185	418.8	20.8	0.63	0.53	792.4
P-874	N1009	N1008		48	96	214.1	0.0140	418.8	18.9	0.69	0.61	689.2
P-875	N1010	N1009		48	96	64.1	0.0016	413.1	12.9	1.00	1.80	230.0
P-876	N1011	N1010		48	96	571.1	0.0035	406.6	12.7	1.00	1.18	344.5
P-877	N1012	N1011		24	84	243.6	0.0041	403.8	28.8	1.00	3.34	120.7
P-878	N1013	N1012		24	84	280.5	0.0143	399.3	28.5	1.00	1.77	225.0
P-879	N1014	N1013	48			385.8	0.0130	297.4	23.7	1.00	1.81	164.0
P-880	N1015	N1014	48			98.7	0.0304	297.4	23.7	1.00	1.18	251.1
P-881	N1016	N1015	48			183.7	0.0054	261.9	20.8	1.00	2.46	106.3
P-1046S	N1017	N1016	120			541.2	0.0203	268.3	20.0	0.23	0.11	2364.0
P-861	N1018	N1017	30			111.6	0.0099	268.3	54.7	1.00	6.57	40.8
P-860	N1019	N1018	30			128.1	0.0064	268.3	54.7	1.00	8.16	32.9
P-859	N1020	N1019	30			74.5	0.0199	268.3	54.7	1.00	4.63	58.0
P-858	N1021	N1020	30			439.8	0.0321	286.5	58.4	1.00	3.89	73.7
P-857	N1022	N1021	30			52.0	0.0321	286.5	58.4	1.00	3.89	73.7
P-856	N1023	N1022	36			178.0	0.0320	286.5	40.5	1.00	2.40	119.6
P-855	N1024	N1023	36			97.7	0.0320	274.2	38.8	1.00	2.29	119.7
P-854	N1025	N1024	36			322.3	0.0328	309.7	43.8	1.00	2.56	121.1
P-853	N1026	N1025	36			1086.7	0.0320	267.8	37.9	1.00	2.24	119.7
P-852	N1027	N1026	36			240.9	0.0550	275.3	38.9	1.00	1.75	156.9
P-851	N1028	N1027	36			1012.0	0.0175	167.8	23.7	1.00	1.90	88.4
P-1062S	N1029	N1028	120			910.5	0.1856	87.4	31.0	0.08	0.01	7143.8
P-862	N1030	N1029	12			454.5	0.0015	87.4	111.3	1.00	63.26	1.4
P-863	N1031	N1030	12			65.6	0.0091	59.3	75.5	1.00	17.36	3.4
P-882	N2001	N1013	21			615.1	0.0179	138.6	57.6	1.00	6.52	21.2
P-883	N2002	N2001	18			426.3	0.0235	124.9	70.7	1.00	7.74	16.1
P-884	N2003	N2002	21			1177.6	0.0399	90.1	37.5	1.00	2.84	31.7

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-1047	O1001	O-1	36			103.2	0.0097	92.4	13.1	1.00	1.40	65.8
P-895	O1002	O1001	36			52.3	0.0096	70.0	9.9	1.00	1.07	65.4
P-894	O1003	O1002	36			325.0	0.0031	58.9	8.3	1.00	1.59	37.1
P-893	O1004	O1003	30			90.4	0.0310	58.9	16.4	0.69	0.81	72.4
P-1048	O1005	O1004	36			594.5	0.0094	49.9	10.1	0.66	0.77	64.9
P-890	O1006	O1005	36			211.7	0.0099	47.7	10.3	0.63	0.72	66.6
P-889	O1007	O1006	36			269.7	0.0083	39.3	9.2	0.58	0.64	61.0
P-888	O1008	O1007	36			259.3	0.0015	30.8	4.4	1.00	1.19	25.9
P-887	O1009	O1008	21			247.2	0.0015	22.8	9.5	1.00	3.71	6.1
P-886	O1010	O1009	24			223.0	0.0303	22.8	13.0	0.54	0.58	39.5
P-885	O1012	O1010	21			239.3	0.0078	11.9	6.6	0.71	0.85	14.0
61	P1002	P1001	48			176.1	0.0870	63.1	24.2	0.26	0.15	424.9
59	P1003	P1002	48			24.8	0.0628	63.1	21.6	0.28	0.17	361.0
87	P1004	P1003	48			91.3	0.0122	45.4	10.9	0.37	0.29	158.8
85	P1005	P1004	48			318.4	0.0213	41.8	13.0	0.30	0.20	210.2
83	P1006	P1005	42			197.7	0.0524	38.1	17.7	0.27	0.16	230.8
81	P1007	P1006	36			225.8	0.0750	38.1	20.5	0.31	0.21	183.2
79	P1008	P1007	24			262.1	0.0230	20.4	11.4	0.55	0.59	34.4
77	P1009	P1008	24			324.3	0.0316	15.4	12.0	0.43	0.38	40.3
75	P1010	P1009	24			184.4	0.0308	15.4	11.9	0.43	0.39	39.8
73	P1011	P1010	18			142.0	0.0318	6.6	9.7	0.41	0.35	18.8
71	P1012	P1011	18			123.5	0.0308	6.6	9.6	0.41	0.36	18.5
69	P1013	P1012	15			223.6	0.0273	4.1	8.1	0.43	0.38	10.7
67	P1014	P1013	15			40.2	0.0239	1.9	6.3	0.29	0.19	10.0
65	P1015	P1014	12			123.5	0.0175	1.9	5.7	0.44	0.40	4.7
63	P1016	P1015	12			65.2	0.0158	0.8	4.3	0.28	0.17	4.5
57	P1101	P1003	18			277.1	0.0252	13.2	10.5	0.67	0.79	16.7
55	P1102	P1101	18			84.1	0.0245	13.2	10.4	0.68	0.80	16.5
53	P1103	P1102	15			205.3	0.0380	8.9	11.1	0.62	0.70	12.6
51	P1104	P1103	15			74.9	0.0342	4.1	8.8	0.40	0.34	12.0
49	P1105	P1104	12			120.1	0.0490	4.1	10.1	0.51	0.52	7.9
47	P1106	P1105	12			133.1	0.0410	4.1	9.5	0.54	0.56	7.2
45	P1107	P1106	12			118.9	0.0328	4.1	8.7	0.58	0.63	6.5
105	P1201	P1010	18			55.4	0.0236	6.4	5.5	0.63	0.72	8.9
103	P1202	P1201	18			328.4	0.0314	6.4	9.6	0.40	0.34	18.7
101	P1203	P1202	18			241.6	0.0046	4.0	4.2	0.54	0.56	7.1
99	P1301	P1007	24			60.6	0.0200	14.6	10.0	0.47	0.46	32.0
97	P1302	P1301	24			43.9	0.0423	12.6	12.6	0.36	0.27	46.7
95	P1303	P1302	18			261.4	0.0096	12.6	7.1	1.00	1.22	10.3
93	P1304	P1303	15			316.8	0.0410	8.9	11.5	0.61	0.68	13.1
91	P1305	P1304	12			451.3	0.0234	3.1	7.2	0.54	0.57	5.5
89	P1306	P1305	12			84.4	0.0319	3.1	8.1	0.49	0.49	6.4
133	P2001	P2	42			132.0	0.0195	114.2	16.3	0.68	0.81	140.8
131	P2002	P2001	42			87.0	0.0193	114.2	16.2	0.69	0.81	140.2
129	P2003	P2002	42			508.3	0.0194	100.1	15.9	0.62	0.71	140.6
127	P2004	P2003	42			154.2	0.0900	100.1	28.2	0.40	0.33	302.6
125	P2005	P2004	42			731.9	0.0120	75.7	12.4	0.61	0.69	110.5

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123	P2006	P2005	42			226.7	0.0120	75.7	12.4	0.61	0.68	110.5
121	P2007	P2006	42			491.5	0.0208	61.3	14.5	0.45	0.42	145.5
119	P2008	P2007	42			147.7	0.0492	61.3	19.8	0.36	0.27	223.7
117	P2009	P2008	42			163.2	0.0820	49.5	22.4	0.28	0.17	288.9
115	P2010	P2009	42			108.2	0.0670	49.5	20.9	0.29	0.19	261.2
113	P2011	P2010	42			626.7	0.0230	43.0	13.7	0.36	0.28	153.0
111	P2012	P2011	42			329.5	0.0200	38.8	12.6	0.36	0.27	142.7
109	P2013	P2012	54			127.3	0.0096	38.8	9.5	0.30	0.20	193.0
107	P2014	P2013	54			156.2	0.0100	38.8	9.6	0.30	0.20	197.1
39	R1001	R-1	36			1358.3	0.0007	146.1	20.7	1.00	8.05	18.1
P-1086	R1002	R1001	36			1126.5	0.0195	146.1	20.7	1.00	1.56	93.5
P-212	R1003	R1002	30			137.1	0.0219	138.9	28.3	1.00	2.28	60.8
P-211	R1004	R1003	24			390.6	0.0307	31.3	14.0	0.67	0.79	39.8
P-1087	S1001	S-1	42			535.6	0.0034	156.3	16.2	1.00	2.65	59.0
P-300	S1002	S1001	30			172.2	0.0930	156.3	31.8	1.00	1.25	125.4
P-299	S1003	S1002	18			105.2	0.0143	48.1	27.2	1.00	3.82	12.6
P-298	S1004	S1003	18			312.7	0.0607	44.3	25.1	1.00	1.71	25.9
P-297	S1005	S1004	18			122.8	0.0426	44.3	25.1	1.00	2.04	21.7
P-296	S1006	S1005	18			193.1	0.0880	40.0	22.6	1.00	1.28	31.3
P-295	S1007	S1006	18			332.0	0.0633	34.6	19.6	1.00	1.30	26.5
P-303	S2001	S1002	30			234.6	0.0532	103.8	21.1	1.00	1.09	94.9
P-312	S2002	S2001	24			358.1	0.0166	33.5	10.7	1.00	1.15	29.2
P-313	S2003	S2002	24			131.9	0.0735	33.5	20.0	0.53	0.54	61.5
P-314	S2004	S2003	24			119.1	0.0671	25.3	18.0	0.46	0.43	58.8
P-304	S3001	S2001	24			176.6	0.0266	72.5	23.1	1.00	1.96	37.0
P-305	S3002	S3001	24			199.7	0.0432	72.5	23.1	1.00	1.54	47.1
P-306	S3003	S3002	24			376.6	0.1494	51.9	29.1	0.55	0.59	87.7
P-307	S3004	S3003	24			138.1	0.0725	34.4	20.0	0.54	0.56	61.1
P-308	S3005	S3004	18			158.0	0.0739	34.4	19.5	1.00	1.20	28.6
P-309	S3006	S3005	18			131.3	0.0853	24.2	19.3	0.67	0.79	30.8
P-310	S3007	S3006	18			190.1	0.0692	24.2	17.7	0.72	0.87	27.7
P-311	S3008	S3007	18			176.2	0.0719	16.9	16.7	0.56	0.60	28.2
P-1081	T1001	T-1	54			144.5	0.0221	161.3	18.9	0.53	0.55	293.0
P-218	T1002	T1001	54			128.8	0.0220	129.4	17.8	0.47	0.44	292.7
P-219	T1003	T1002	54			104.8	0.0220	129.4	17.8	0.47	0.44	292.7
P-220	T1004	T1003	54			290.8	0.0382	129.4	21.8	0.40	0.34	385.6
P-225	T1005	T1004	54			73.2	0.0015	93.0	5.8	1.00	1.22	76.4
P-226	T1006	T1005	54			114.4	0.0172	93.0	14.9	0.41	0.36	258.8
P-227	T1007	T1006	54			355.0	0.0030	93.0	7.6	0.72	0.87	107.2
P-265	T1008	T1007	54			665.7	0.0142	45.3	11.4	0.30	0.19	234.9
P-266	T1009	T1008	24			366.6	0.0122	45.3	14.4	1.00	1.81	25.0
P-267	T1010	T1009	24			145.2	0.0508	45.3	18.4	0.73	0.89	51.1
P-268	T1011	T1010	24			58.0	0.0722	32.2	19.7	0.52	0.53	60.9
P-269	T1012	T1011	24			343.9	0.0498	22.9	15.7	0.47	0.45	50.6
P-270	T1013	T1012	24			92.7	0.0582	22.9	16.6	0.45	0.42	54.7
P-217	T2001	T1001	12			83.2	0.0216	29.2	37.1	1.00	5.55	5.3
P-216	T2002	T2001	18			394.7	0.0145	29.2	16.5	1.00	2.30	12.7

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-215	T2003	T2002	15			379.2	0.0390	29.2	23.8	1.00	2.28	12.8
P-224	T3001	T1001	12			244.8	0.0033	0.0	0.0	0.00	0.00	2.0
P-221	T4001	T1004	18			44.4	0.0041	54.9	31.1	1.00	8.19	6.7
P-222	T4002	T4001	15			572.8	0.0190	54.9	44.7	1.00	6.14	8.9
P-223	T4003	T4002	15			415.6	0.0576	31.9	26.0	1.00	2.05	15.5
P-229	T5001	T1007	30			60.4	0.0321	55.6	16.5	0.65	0.75	73.7
P-230	T5002	T5001	30			83.9	0.0393	55.6	17.9	0.61	0.68	81.6
P-231	T5003	T5002	30			60.8	0.0137	55.6	11.3	1.00	1.16	48.1
P-232	T5004	T5003	24			68.8	0.0118	55.6	17.7	1.00	2.26	24.6
P-233	T5005	T5004	24			61.3	0.0130	55.6	17.7	1.00	2.15	25.9
P-234	T5006	T5005	24			65.2	0.0123	29.4	9.4	1.00	1.17	25.1
P-235	T5007	T5006	24			67.3	0.0120	29.4	9.4	1.00	1.18	24.9
P-236	T5008	T5007	24			69.5	0.0116	29.4	9.4	1.00	1.20	24.5
P-237	T5009	T5008	24			72.3	0.0115	24.7	7.9	1.00	1.02	24.3
P-238	T5010	T5009	24			62.2	0.0133	24.7	9.5	0.77	0.94	26.2
P-239	T5011	T5010	24			62.9	0.0135	24.7	9.5	0.77	0.94	26.4
P-240	T5012	T5011	24			203.9	0.0067	17.3	6.7	0.76	0.93	18.6
P-241	T5013	T5012	21			279.5	0.0161	17.3	9.4	0.71	0.86	20.2
P-242	T5014	T5013	21			258.1	0.0030	17.3	7.2	1.00	1.98	8.7
P-1082	U1001	U-1	48			54.0	0.0020	86.9	6.9	1.00	1.34	65.0
P-271	U1002	U1001	48			74.8	0.0021	86.9	6.9	1.00	1.30	66.6
P-272	U1003	U1002	48			60.6	0.0026	74.7	5.9	1.00	1.01	74.0
P-273	U1004	U1003	48			88.8	0.0018	74.7	5.9	1.00	1.22	61.1
P-274	U1005	U1004	48			103.3	0.0072	70.0	10.0	0.54	0.57	121.9
P-275	U1006	U1005	48			61.1	0.0031	70.0	7.2	0.72	0.87	80.3
P-276	U1007	U1006	48			64.1	0.0028	70.0	6.9	0.75	0.92	76.3
P-277	U1008	U1007	48			65.3	0.0029	70.0	7.0	0.74	0.90	77.7
P-278	U1009	U1008	48			54.8	0.0035	70.0	7.5	0.69	0.83	84.8
P-279	U1010	U1009	48			47.7	0.0034	62.8	7.3	0.65	0.75	83.4
P-280	U1011	U1010	48			48.6	0.0033	62.8	7.2	0.65	0.76	82.6
P-281	U1012	U1011	48			47.0	0.0351	62.8	17.5	0.33	0.23	269.9
P-282	U1013	U1012	48			78.5	0.0182	62.8	13.8	0.39	0.32	194.4
P-283	U1014	U1013	36			83.9	0.0380	56.1	17.8	0.46	0.43	130.4
P-284	U1015	U1014	36			265.6	0.0120	56.1	11.4	0.65	0.76	73.4
P-285	U1016	U1015	36			49.7	0.0283	40.4	14.6	0.41	0.36	112.6
P-286	U1017	U1016	18			363.4	0.0818	30.7	17.4	1.00	1.02	30.1
P-1083	V1001	V-1	30			171.7	0.0015	75.7	15.4	1.00	4.73	16.0
P-244	V1002	V1001	12			72.2	0.0222	67.4	85.8	1.00	12.66	5.3
P-245	V1003	V1002	30			200.1	0.0080	67.4	13.7	1.00	1.83	36.8
P-246	V1004	V1003	30			60.0	0.0067	67.4	13.7	1.00	2.01	33.6
P-247	V1005	V1004	42			96.4	0.0078	62.1	10.0	0.62	0.70	89.0
P-248	V1006	V1005	36			441.2	0.0083	45.8	9.4	0.65	0.75	60.7
P-249	V1007	V1006	36			103.9	0.1513	40.3	26.7	0.27	0.16	260.1
P-287	V1008	V1007	36			155.2	0.0015	40.3	5.7	1.00	1.57	25.7
P-288	V1009	V1008	36			101.1	0.0039	40.3	6.7	0.79	0.97	41.5
P-289	V1010	V1009	36			72.7	0.0467	40.3	17.5	0.36	0.28	144.5
P-290	V1011	V1010	36			54.5	0.0670	40.3	20.0	0.33	0.23	173.1

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 5-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-291	V1012	V1011	36			55.8	0.0608	32.4	18.1	0.30	0.20	164.9
P-292	V1013	V1012	24			313.9	0.0365	32.4	15.1	0.65	0.75	43.3
P-293	V1014	V1013	24			74.2	0.0539	20.4	15.7	0.43	0.39	52.7
P-294	V1015	V1014	24			127.7	0.0239	20.4	11.6	0.55	0.58	35.1
P-250	V2001	V1005	30			310.3	0.0036	10.6	4.9	0.46	0.43	24.8
P-251	V2002	V2001	24			148.3	0.0047	8.6	5.1	0.53	0.55	15.5
P-252	V2003	V2002	24			112.7	0.0044	6.1	4.6	0.44	0.41	15.1
P-253	V2004	V2003	15			132.4	0.0109	3.1	5.4	0.47	0.45	6.8
P-1084	W1001	W-1	24			197.5	0.0467	44.8	17.7	0.75	0.91	49.0
P-260	W1002	W1001	12			216.2	0.0467	44.8	57.0	1.00	5.80	7.7
P-261	W1003	W1002	12			400.2	0.0467	44.8	57.0	1.00	5.80	7.7
P-262	W1004	W1003	12			427.7	0.0600	19.5	24.8	1.00	2.23	8.8
P-263	W1005	W1004	24			170.0	0.0015	19.5	6.2	1.00	2.24	8.7
P-264	W1006	W1005	15			210.5	0.0015	19.5	15.9	1.00	7.73	2.5
P-1085	W1101	W-1	36			129.9	0.0905	26.1	19.6	0.24	0.13	201.2
P-257	W1102	W1101	12			195.8	0.0930	26.1	33.2	1.00	2.40	10.9
P-256	W1103	W1102	24			214.7	0.0930	26.1	20.5	0.43	0.38	69.2
P-255	W1104	W1103	12			144.5	0.0930	15.1	19.3	1.00	1.39	10.9
P-254	W1105	W1104	24			239.9	0.0930	15.1	17.6	0.32	0.22	69.2
P-1091	X1001	X-1	36			326.1	0.1732	67.1	32.4	0.33	0.24	278.3
P-1090	X1002	X1001	36			209.5	0.1163	61.6	27.4	0.36	0.27	228.1
P-320	X1003	X1002	24			311.5	0.0369	36.6	15.5	0.70	0.84	43.6
P-319	X1004	X1003	24			204.3	0.0441	31.0	16.1	0.59	0.65	47.6
P-318	X1005	X1004	24			587.0	0.0341	18.8	13.0	0.47	0.45	41.9
P-317	X1006	X1005	24			361.9	0.0193	14.0	9.7	0.47	0.44	31.5
P-316	X1007	X1006	24			228.8	0.0044	14.0	5.4	0.77	0.94	15.0
P-315	X1008	X1007	24			235.5	0.0212	7.4	8.5	0.32	0.22	33.1
P-321	X2001	X1002	30			280.5	0.0103	21.1	8.5	0.50	0.50	41.8
P-322	X2002	X2001	30			417.4	0.0073	21.1	7.5	0.56	0.60	35.2
P-323	X2003	X2002	30			290.4	0.1097	21.1	20.2	0.27	0.16	136.2
P-1088	X2004	X2003	30			50.0	0.0150	21.1	9.8	0.45	0.42	50.3
P-1089	X2005	X2004	30			499.5	0.0180	14.2	9.4	0.35	0.26	55.2
P-1092	Y1001	Y-1	36			122.8	0.0105	162.2	22.9	1.00	2.37	68.5
P-330	Y1002	Y1001	36			86.8	0.0518	157.2	22.2	1.00	1.03	152.2
P-329	Y1003	Y1002	36			35.0	0.0017	157.2	22.2	1.00	5.68	27.7
P-326	Y1004	Y1003	30			494.1	0.0334	144.4	29.4	1.00	1.92	75.2
P-327	Y1005	Y1004	30			527.9	0.0227	132.1	26.9	1.00	2.13	62.0
P-328	Y1006	Y1005	30			223.7	0.0134	128.4	26.2	1.00	2.70	47.6
P-1093S	Y1007	Y1006	120			250.4	0.0399	123.3	20.1	0.13	0.04	3313.6
P-331	Y1008	Y1007	36			616.7	0.0859	72.2	25.6	0.42	0.37	196.1
P-332	Y1009	Y1008	30			155.7	0.0128	65.1	13.3	1.00	1.40	46.6
P-333	Y1010	Y1009	30			142.7	0.0140	65.1	13.3	1.00	1.34	48.7
P-334	Y1011	Y1010	30			453.6	0.0088	58.2	11.8	1.00	1.51	38.6
P-335	Y1012	Y1011	30			80.5	0.0124	58.2	11.8	1.00	1.27	45.8
P-336	Y1013	Y1012	12			122.2	0.0082	47.4	60.3	1.00	14.66	3.2
P-337	Y1014	Y1013	12			104.5	0.0541	47.4	60.3	1.00	5.70	8.3
P-325	Y2001	Y1003	18			147.5	0.0245	14.2	10.5	0.71	0.86	16.5

Appendix C
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-324	Y2002	Y2001	12			109.1	0.0733	9.3	14.0	0.79	0.96	9.7
P-339	Y3001	Y1007	18			237.7	0.1809	41.7	28.8	0.76	0.93	44.8
P-340	Y3002	Y3001	18			230.6	0.0043	36.7	20.8	1.00	5.29	6.9
P-341	Y3003	Y3002	18			463.8	0.0015	36.7	20.8	1.00	8.97	4.1
P-342	Y3004	Y3003	18			162.8	0.0015	25.3	14.3	1.00	6.26	4.0
P-343	Y3005	Y3004	12			137.4	0.0655	25.3	32.2	1.00	2.77	9.1
P-344	Y3006	Y3005	12			69.1	0.0145	25.3	32.2	1.00	5.89	4.3
P-345	Y3101	Y3004	12			223.0	0.0626	0.0	0.0	0.00	0.00	8.9
P-1095	Z1001	Z-1	12			29.7	0.0017	40.5	51.6	1.00	27.66	1.5
P-1094	Z1002	Z1001	12			20.2	0.0020	40.5	51.6	1.00	25.50	1.6
P-351	Z1003	Z1002	21			134.9	0.0148	39.9	16.6	1.00	2.06	19.3
P-349	Z1004	Z1003	18			347.9	0.0015	28.8	16.3	1.00	7.06	4.1
P-348	Z1005	Z1004	15			64.8	0.0617	28.8	23.4	1.00	1.79	16.1
P-347	Z1006	Z1005	15			226.0	0.0015	20.1	16.3	1.00	7.98	2.5
P-346	Z1007	Z1006	12			44.9	0.0045	20.1	25.5	1.00	8.41	2.4
P-1093	Z1101	Z1001	12			22.1	0.0023	0.0	0.0	0.00	0.00	1.7
P-350	Z2001	Z1003	18			176.8	0.0170	9.8	8.4	0.63	0.71	13.7

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 10-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
35S	80	B2003	120			1611.4	0.0068	71.4	9.2	0.16	0.05	1370.1
33	82	80	54			604.2	0.0074	71.4	10.2	0.45	0.42	170.2
31	84	82		48	76	167.0	0.0030	71.4	6.7	0.42	0.31	232.3
29	86	84	48			467.6	0.0043	71.4	8.2	0.65	0.76	94.2
P-988	A1001	A-1	78			79.7	0.0015	439.9	13.3	1.00	2.16	204.0
P-16	A1002	A1001	78			984.4	0.0010	439.9	13.3	1.00	2.71	162.4
P-15	A1003	A1002	84			44.5	0.0022	439.9	11.4	1.00	1.45	303.8
P-14	A1004	A1003	84			119.0	0.0015	439.9	11.4	1.00	1.77	249.2
P-13	A1005	A1004	84			426.4	0.0015	419.1	10.9	1.00	1.69	248.2
P-12	A1006	A1005	84			109.7	0.0015	419.1	10.9	1.00	1.71	244.7
P-11	A1007	A1006	84			235.4	0.0015	339.1	8.8	1.00	1.37	247.0
P-21	A1008	A1007	72			953.4	0.0015	270.0	9.5	1.00	1.64	164.5
P-22	A1009	A1008	66			801.7	0.0015	247.8	10.4	1.00	1.87	132.4
P-23	A1010	A1009	60			755.4	0.0015	231.2	11.8	1.00	2.27	101.9
P-987	A1011	A1010	48			745.2	0.0015	203.4	16.2	1.00	3.68	55.3
P-374	A1012	A1011	48			176.6	0.0017	203.4	16.2	1.00	3.43	59.4
P-373	A1013	A1012	48			151.1	0.0015	194.2	15.5	1.00	3.46	56.2
P-372	A1014	A1013	30			714.3	0.0016	194.2	39.6	1.00	11.92	16.3
P-370	A1015	A1014	18			35.7	0.0014	175.7	99.4	1.00	44.57	3.9
P-369S	A1016	A1015	120			204.5	0.0016	175.7	7.1	0.35	0.27	656.0
P-368	A1017	A1016	18			29.7	0.0010	175.7	99.4	1.00	52.53	3.3
P-367	A1018	A1017	36			302.8	0.0015	126.6	17.9	1.00	4.91	25.8
P-366	A1019	A1018	36			219.7	0.0016	126.6	17.9	1.00	4.74	26.7
P-365	A1020	A1019	36			315.9	0.0015	69.9	9.9	1.00	2.68	26.1
P-364	A1021	A1020	36			75.1	0.0016	69.9	9.9	1.00	2.61	26.7
P-363	A1022	A1021	48			676.1	0.0367	12.9	11.2	0.15	0.05	276.0
P-27	A2001	A1006	18			293.5	0.0015	92.3	52.2	1.00	22.37	4.1
P-28	A2002	A2001	18			134.6	0.0015	92.3	52.2	1.00	22.72	4.1
P-29	A2003	A2002	12			703.8	0.0006	92.3	117.5	1.00	108.34	0.9
P-30	A2004	A2003	12			90.7	0.0015	70.8	90.1	1.00	50.44	1.4
P-31	A2005	A2004	12			229.3	0.0015	70.8	90.1	1.00	51.47	1.4
P-32	A2006	A2005	12			189.9	0.0006	0.0	0.0	0.00	0.00	0.9
P-33	A2101	A2005	30			528.7	0.0015	17.1	3.5	1.00	1.08	15.9
P-34	A2201	A2005	21			567.0	0.0057	29.8	12.4	1.00	2.49	12.0
P-35	A2203	A2201	21			377.9	0.0096	29.8	12.4	1.00	1.91	15.6
P-10	A3001	A1007	36			295.9	0.0015	62.0	8.8	1.00	2.38	26.1
P-9	A3002	A3001	36			49.3	0.0016	62.0	8.8	1.00	2.30	26.9
P-8	A3003	A3002	36			254.9	0.0015	58.7	8.3	1.00	2.24	26.2
P-7	A3004	A3003	42			1168.7	0.0016	58.7	6.1	1.00	1.44	40.7
P-990	A3005	A3004	24			485.3	0.0072	58.7	18.7	1.00	3.05	19.3
P-989	A3006	A3005	21			524.4	0.0021	45.5	18.9	1.00	6.25	7.3
P-5	A3007	A3006	18			43.6	0.0115	36.4	20.6	1.00	3.23	11.3
P-4	A3008	A3007	18			238.2	0.0041	36.4	20.6	1.00	5.42	6.7
P-3	A3009	A3008	15			261.5	0.0037	31.3	25.5	1.00	7.93	3.9
P-2	A3010	A3009	15			262.7	0.0027	27.0	22.0	1.00	8.01	3.4
P-1	A3011	A3010	12			274.8	0.0095	21.6	27.5	1.00	6.22	3.5
P-20	A4001	A1008	48			573.5	0.0015	39.8	4.8	0.63	0.72	55.1

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Gravity Main Output Report: 10-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-19	A4002	A4001	48			433.2	0.0015	39.8	4.8	0.62	0.71	55.8
P-18	A4003	A4002	48			405.0	0.0016	39.8	5.0	0.61	0.69	57.7
P-17	A4004	A4003	48			68.8	0.0015	39.8	4.8	0.63	0.72	54.9
P-24	A5001	A1010	48			508.0	0.0015	33.8	4.6	0.56	0.61	55.3
P-25	A5002	A5001	48			423.3	0.0015	33.8	4.7	0.56	0.60	56.4
P-26	A5003	A5002	48			133.4	0.0015	33.8	4.7	0.56	0.61	55.8
P-371	A6001	A1014	18			134.7	0.0015	17.7	10.0	1.00	4.36	4.1
P-1097	AA1001	AA-1	36			106.1	0.0188	103.1	14.6	1.00	1.12	91.8
P-358	AA1002	AA1001	36			49.2	0.0203	96.6	13.7	1.00	1.01	95.3
P-357	AA1003	AA1002	36			418.7	0.0072	89.3	12.6	1.00	1.58	56.6
P-356	AA1004	AA1003	36			429.6	0.0163	61.2	13.1	0.63	0.72	85.4
P-355	AA1005	AA1004	36			463.0	0.0216	49.6	13.9	0.50	0.50	98.3
P-354	AA1006	AA1005	36			134.5	0.0372	45.4	16.6	0.41	0.35	129.0
P-353	AA1007	AA1006	36			482.5	0.1057	32.6	22.1	0.26	0.15	217.4
P-1096	AA1008	AA1007	36			882.3	0.0015	9.6	3.4	0.42	0.37	25.9
P-362	AA2001	AA1003	30			145.9	0.0069	22.8	7.4	0.60	0.67	34.0
P-361	AA2002	AA2001	30			101.0	0.0198	22.8	11.1	0.44	0.39	57.9
P-360	AA2003	AA2002	30			40.3	0.0015	22.8	4.6	1.00	1.44	15.9
P-359	AA2004	AA2003	24			257.0	0.1907	20.7	24.9	0.31	0.21	99.0
P-1098	AB1001	AB-1	72			216.8	0.0015	204.0	7.2	1.00	1.23	165.7
P-1099	AB1002	AB1001	12			29.5	6.2096	185.5	236.2	1.00	2.08	89.0
P-710	AB1003	AB1002	54			258.7	0.0030	168.9	10.6	1.00	1.56	108.3
P-709	AB1004	AB1003	54			553.5	0.0054	168.9	10.6	1.00	1.16	145.2
P-1080	AB1005	AB1004	42			1025.0	0.0480	152.0	24.8	0.61	0.69	221.0
P-716	AB1006	AB1005	12			118.8	0.0619	72.1	91.8	1.00	8.11	8.9
P-717	AB1007	AB1006	15			211.3	0.0015	72.1	58.7	1.00	28.61	2.5
P-718	AB1008	AB1007	21			71.5	0.0014	57.3	23.8	1.00	9.64	5.9
P-719	AB1009	AB1008	21			84.3	0.0015	57.3	23.8	1.00	9.18	6.2
P-720	AB1010	AB1009	24			157.6	0.0263	57.3	18.2	1.00	1.56	36.8
P-721	AB1011	AB1010	21			266.3	0.0909	55.0	22.9	1.00	1.15	47.9
P-722	AB1012	AB1011	21			354.0	0.0455	48.9	20.4	1.00	1.44	33.9
P-723	AB1013	AB1012	21			219.9	0.0200	48.9	20.4	1.00	2.18	22.5
P-724	AB1014	AB1013	21			252.0	0.0198	48.9	20.4	1.00	2.19	22.4
P-725	AB1015	AB1014	18			362.0	0.0989	43.3	24.5	1.00	1.31	33.1
P-726	AB1016	AB1015	12			199.5	0.0689	30.7	39.1	1.00	3.28	9.4
P-705	AB2001	AB1001	18			153.4	0.0015	3.9	2.6	0.78	0.95	4.1
P-704	AB3001	AB1001	36			406.8	0.4664	19.4	32.1	0.14	0.04	456.7
P-703	AB3002	AB3001	36			292.4	0.0246	19.4	11.3	0.29	0.19	104.8
P-702	AB3003	AB3002	36			69.2	0.0040	19.4	5.9	0.47	0.46	42.5
P-701	AB3004	AB3003	30			149.0	0.0074	13.5	6.7	0.43	0.38	35.3
P-700	AB3005	AB3004	30			48.7	0.0637	9.0	13.0	0.20	0.09	103.8
P-699	AB3006	AB3005	24			145.7	0.0184	9.0	8.5	0.37	0.29	30.8
P-698	AB3007	AB3006	24			149.9	0.0133	9.0	7.6	0.40	0.34	26.2
P-697	AB3008	AB3007	24			169.9	0.0164	5.5	7.1	0.30	0.19	29.0
P-711	AB4001	AB1002	15			202.7	0.0120	18.6	15.1	1.00	2.61	7.1
P-712	AB4002	AB4001	12			231.4	0.0107	13.7	17.4	1.00	3.71	3.7
P-713	AB4003	AB4002	15			113.3	0.0100	13.7	11.2	1.00	2.12	6.5

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-715	AB5001	AB1004	21			429.4	0.1108	14.1	18.6	0.35	0.27	52.9
P-714	AB5002	AB5001	21			214.6	0.0614	7.6	12.6	0.30	0.19	39.4
P-707	AB6001	AB1005	42			32.9	0.0015	84.2	8.8	1.00	2.14	39.3
P-706	AB6002	AB6001	42			393.0	0.0015	70.3	7.3	1.00	1.80	39.1
P-1079	AC1001	AC-1	12			101.4	0.0197	60.4	76.9	1.00	12.04	5.0
P-1078	AC1002	AC1001	12			193.7	0.0310	56.4	71.9	1.00	8.98	6.3
P-1077	AC1003	AC1002	12			166.9	0.0360	56.4	71.9	1.00	8.33	6.8
P-727	AC1004	AC1003	18			87.9	0.0455	27.2	15.4	1.00	1.21	22.5
P-728	AC1005	AC1004	18			151.0	0.0993	27.2	20.9	0.69	0.82	33.2
P-729	AC1006	AC1005	18			391.4	0.0869	19.6	18.6	0.58	0.63	31.0
P-730	AC1007	AC1006	15			473.2	0.0845	7.5	14.5	0.44	0.40	18.8
P-731	AC1008	AC1007	15			349.2	0.0143	7.5	7.2	0.79	0.97	7.8
P-732	AC1009	AC1008	15			210.3	0.0571	3.5	10.2	0.32	0.23	15.5
P-1076	AD1001	AD-1	24			113.6	0.0088	121.8	38.8	1.00	5.72	21.3
P-1075	AD1002	AD1001	24			31.0	0.0323	121.8	38.8	1.00	2.99	40.8
P-1074	AD1003	AD1002	24			73.7	0.0136	121.8	38.8	1.00	4.61	26.4
P-741	AD1004	AD1003	24			149.9	0.0133	96.8	30.8	1.00	3.70	26.2
P-740	AD1005	AD1004	24			138.2	0.0217	91.6	29.2	1.00	2.74	33.4
P-739	AD1006	AD1005	24			103.9	0.0193	91.6	29.2	1.00	2.91	31.5
P-738	AD1007	AD1006	21			187.6	0.0267	87.6	36.4	1.00	3.38	25.9
P-737	AD1008	AD1007	15			347.1	0.0922	40.2	32.8	1.00	2.04	19.7
P-736	AD1009	AD1008	15			384.4	0.0885	35.9	29.3	1.00	1.86	19.3
P-735	AD1010	AD1009	15			311.8	0.0866	26.1	21.2	1.00	1.37	19.1
P-734	AD1011	AD1010	15			313.3	0.0032	18.2	14.8	1.00	4.97	3.7
P-733	AD1012	AD1011	12			333.8	0.0210	6.8	8.7	1.00	1.31	5.2
P-745	AD2001	AD1007	21			72.0	0.0417	47.4	19.7	1.00	1.46	32.4
P-746	AD2002	AD2001	21			243.4	0.0698	47.4	19.7	1.00	1.13	42.0
P-747	AD2003	AD2002	21			220.6	0.0227	43.7	18.2	1.00	1.83	23.9
P-748	AD2004	AD2003	18			217.8	0.1194	36.5	20.7	1.00	1.00	36.4
P-749	AD2005	AD2004	18			458.6	0.0850	34.1	19.3	1.00	1.11	30.7
P-750	AD2006	AD2005	18			160.9	0.0015	34.1	19.3	1.00	8.38	4.1
P-751	AD2007	AD2006	18			90.8	0.0441	34.1	19.3	1.00	1.54	22.1
P-752	AD2008	AD2007	18			167.0	0.0479	28.4	16.0	1.00	1.23	23.0
P-753	AD2009	AD2008	18			129.7	0.0015	28.4	16.0	1.00	7.04	4.0
P-754	AD2010	AD2009	18			212.4	0.0141	19.5	11.0	1.00	1.56	12.5
P-742	AD3001	AD1009	12			324.0	0.0185	9.8	12.5	1.00	2.02	4.9
P-743	AD3002	AD3001	12			204.2	0.0196	2.6	6.5	0.52	0.53	5.0
P-744	AD3003	AD3002	12			241.1	0.0871	2.6	11.2	0.34	0.25	10.5
P-1069	AE1001	AE-1	42			129.5	0.0601	166.3	27.6	0.60	0.67	247.3
P-771	AE1002	AE1001	42			352.9	0.0680	158.7	28.6	0.56	0.60	263.1
P-770	AE1003	AE1002	42			197.2	0.0015	158.7	16.5	1.00	4.03	39.3
P-769	AE1004	AE1003	42			386.5	0.0846	118.8	28.9	0.44	0.40	293.4
P-768	AE1005	AE1004	42			783.5	0.0326	111.3	19.9	0.56	0.61	182.0
P-1072	AE1006	AE1005	24			72.6	0.1506	50.1	28.9	0.54	0.57	88.0
P-1071	AE1007	AE1006	24			223.0	0.0245	50.1	15.9	1.00	1.41	35.5
P-765	AE1008	AE1007	24			374.4	0.0929	42.7	23.2	0.57	0.62	69.2
P-764	AE1009	AE1008	24			58.6	0.0568	42.7	19.1	0.67	0.79	54.1

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P-763	AE1010	AE1009	24			498.9	0.0511	34.4	17.5	0.60	0.67	51.3
P-762	AE1011	AE1010	18			273.9	0.0045	29.6	16.7	1.00	4.19	7.1
P-777	AE2001	AE1003	24			113.3	0.2223	25.7	28.0	0.33	0.24	107.0
P-776	AE2002	AE2001	24			114.7	0.0628	25.7	17.6	0.47	0.45	56.8
P-775	AE2003	AE2002	24			172.7	0.0949	22.5	19.8	0.39	0.32	69.9
P-774	AE2004	AE2003	24			352.6	0.0724	15.3	16.1	0.34	0.25	61.0
P-773	AE2005	AE2004	24			374.2	0.0199	9.0	8.7	0.36	0.28	32.0
P-767	AE3001	AE1005	36			308.3	0.1377	51.2	27.7	0.31	0.21	248.2
P-1070	AF1001	AF-1	90			440.1	0.0476	231.6	26.7	0.25	0.14	1680.3
P-787	AF1002	AF1001	48			137.2	0.0787	166.8	30.6	0.45	0.41	404.1
P-786	AF1003	AF1002	48			634.4	0.0334	166.8	22.2	0.58	0.63	263.0
P-791	AF1004	AF1003	48			516.8	0.0399	42.7	16.4	0.26	0.15	287.7
P-792	AF1005	AF1004	48			710.2	0.0158	37.3	11.3	0.31	0.21	180.9
P-788	AF2001	AF1001	60			273.0	0.0015	54.9	5.3	0.52	0.54	101.2
P-789	AF2002	AF2001	54			354.0	0.0015	34.3	4.7	0.47	0.45	76.3
P-785	AF3001	AF1003	30			41.5	0.0662	109.6	22.3	1.00	1.04	105.8
P-784	AF3002	AF3001	30			397.8	0.0420	109.6	22.3	1.00	1.30	84.2
P-783	AF3003	AF3002	24			64.8	0.0386	109.6	34.9	1.00	2.46	44.6
P-782	AF3004	AF3003	24			179.5	0.0691	102.7	32.7	1.00	1.72	59.6
P-781	AF3005	AF3004	24			220.8	0.0784	102.7	32.7	1.00	1.62	63.5
P-780	AF3006	AF3005	24			239.2	0.0412	90.8	28.9	1.00	1.97	46.0
P-779	AF3007	AF3006	24			264.7	0.0655	72.5	23.1	1.00	1.25	58.1
P-1073	AG1001	AG-1	21			202.1	0.0148	49.7	20.7	1.00	2.57	19.4
P-760	AG1002	AG1001	18			442.1	0.0204	29.4	16.6	1.00	1.96	15.0
P-758	AG1003	AG1002	12			128.0	0.2579	10.0	23.7	0.53	0.55	18.1
P-757	AG1004	AG1003	12			104.9	0.4288	10.0	28.6	0.46	0.43	23.4
P-756	AG1005	AG1004	12			80.1	0.0624	10.0	12.8	1.00	1.12	8.9
P-755	AG1006	AG1005	12			241.1	0.0166	7.5	9.5	1.00	1.63	4.6
P-761	AG2001	AG1002	12			422.5	0.0544	11.8	15.0	1.00	1.41	8.3
P-1100	AH1001	AH-1	36			96.3	0.0015	13.7	3.7	0.52	0.54	25.5
P-794	AH1002	AH1001	36			133.7	0.0015	12.8	3.7	0.50	0.50	25.9
P-795	AH1003	AH1002	36			350.8	0.0513	12.8	13.1	0.20	0.08	151.5
P-796	AH1004	AH1003	36			189.4	0.1109	7.3	14.5	0.12	0.03	222.7
P-797	AH1005	AH1004	36			370.4	0.1107	7.3	14.5	0.12	0.03	222.5
P-798	AH1006	AH1005	21			248.9	0.1326	3.3	13.1	0.16	0.06	57.9
21	B1009	B-1		66	114	173.7	0.0058	240.3	11.4	0.40	0.28	847.8
P-44	B1010	B1009	72			185.9	0.0054	229.6	12.0	0.64	0.74	311.4
23	B1012	B1010	54			316.5	0.0014	219.5	13.8	1.00	2.95	74.3
P-41	B1013	B1012	54			520.5	0.0011	202.0	12.7	1.00	3.15	64.1
P-40	B1014	B1013	60			465.8	0.0064	194.2	12.1	0.76	0.93	209.6
P-39	B1015	B1014	36			247.9	0.0040	126.7	17.9	1.00	2.98	42.5
P-38	B1016	B1015	36			156.8	0.0089	126.7	17.9	1.00	2.01	63.2
P-985	B1017	B1016	24			282.1	0.0092	108.9	34.7	1.00	5.00	21.8
P-984	B1018	B1017	24			748.0	0.0017	108.9	34.7	1.00	11.52	9.5
P-36	B1019	B1018	24			173.0	0.0015	61.7	19.6	1.00	7.01	8.8
P-986	B2001	B1014	12			209.5	0.0024	124.1	158.0	1.00	71.11	1.7
P-987S	B2002	B2001	120			705.2	0.0015	124.1	6.3	0.30	0.19	642.9

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P-53	B2003	B2002	54			257.2	0.0012	124.1	7.8	1.00	1.84	67.3
P-54	B2004	B2003	54			57.7	0.0797	80.9	24.9	0.26	0.15	556.8
P-55	B2005	B2004	24			544.8	0.0079	80.9	25.7	1.00	4.01	20.2
P-56	B2006	B2005	21			281.9	0.0058	60.4	25.1	1.00	5.00	12.1
P-57	B2007	B2006	21			283.4	0.0101	60.4	25.1	1.00	3.78	16.0
P-58	B2008	B2007	12			264.6	0.0125	40.2	51.2	1.00	10.08	4.0
P-52	B3001	B1016	12			264.1	0.0015	0.0	0.0	0.00	0.00	1.4
P-977	C1001	C-1	84			195.7	0.0016	274.0	7.1	1.00	1.07	255.0
P-975	C1002	C1001	36			53.8	0.0015	187.6	26.5	1.00	7.28	25.8
P-72	C1003	C1002	36			79.1	0.0015	187.6	26.5	1.00	7.20	26.0
P-71	C1004	C1003	36			113.3	0.0015	187.6	26.5	1.00	7.24	25.9
P-70	C1005	C1004	36			176.8	0.0015	178.8	25.3	1.00	6.84	26.1
P-69	C1006	C1005	36			274.7	0.0015	165.7	23.4	1.00	6.33	26.2
P-68	C1007	C1006	36			115.6	0.0016	165.7	23.4	1.00	6.28	26.4
P-67	C1008	C1007	36			220.3	0.0016	161.2	22.8	1.00	6.05	26.7
P-66	C1009	C1008	36			262.4	0.0015	161.2	22.8	1.00	6.17	26.1
P-65	C1010	C1009	36			162.2	0.0015	157.7	22.3	1.00	6.01	26.3
P-64	C1011	C1010	36			238.5	0.0015	153.2	21.7	1.00	5.90	26.0
P-63	C1012	C1011	36			249.8	0.0016	153.2	21.7	1.00	5.80	26.4
P-62	C1013	C1012	36			253.1	0.0016	148.2	21.0	1.00	5.57	26.6
P-61	C1014	C1013	36			252.6	0.0016	148.2	21.0	1.00	5.57	26.6
P-60	C1015	C1014	30			265.5	0.0015	148.2	30.2	1.00	9.28	16.0
P-59	C1016	C1015	30			254.7	0.0016	142.7	29.1	1.00	8.76	16.3
P-980	C1017	C1016	30			49.4	0.0016	142.7	29.1	1.00	8.63	16.5
P-979	C1018	C1017	30			231.7	0.0016	142.7	29.1	1.00	8.68	16.4
P-375	C1019	C1018	30			182.9	0.0107	142.7	29.1	1.00	3.35	42.6
P-376	C1020	C1019	30			175.7	0.0114	133.6	27.2	1.00	3.05	43.9
P-377	C1021	C1020	30			95.4	0.0015	133.6	27.2	1.00	8.48	15.8
P-378	C1022	C1021	30			86.1	0.0015	133.6	27.2	1.00	8.36	16.0
P-379	C1023	C1022	30			83.5	0.0016	133.6	27.2	1.00	8.23	16.2
P-380	C1024	C1023	30			70.4	0.0016	133.6	27.2	1.00	8.22	16.3
P-381	C1025	C1024	30			281.1	0.0026	124.6	25.4	1.00	5.98	20.8
P-382	C1026	C1025	21			235.5	0.0078	124.6	51.8	1.00	8.89	14.0
P-383	C1027	C1026	18			259.4	0.0077	56.7	32.1	1.00	6.13	9.2
P-976	C2001	C1001	54			59.9	0.0015	128.7	8.1	1.00	1.68	76.4
P-74	C2002	C2001	54			189.9	0.0015	128.7	8.1	1.00	1.70	75.7
P-75	C2003	C2002	48			268.3	0.0015	90.4	7.2	1.00	1.63	55.6
P-76	C2004	C2003	48			288.2	0.0016	82.6	6.6	1.00	1.45	56.9
17	C2006	C2004	48			368.5	0.0015	74.9	6.0	1.00	1.36	55.1
P-79	C2007	C2006	4			71.7	0.0015	33.5	383.4	1.00	447.63	0.1
P-80	C2008	C2007	4			139.2	0.0014	33.5	383.4	1.00	462.58	0.1
P-81	C2009	C2008	4			242.3	0.0015	26.6	304.4	1.00	356.29	0.1
P-82	C2010	C2009	3			269.5	0.0093	26.6	541.2	1.00	311.34	0.1
P-83	C2011	C2010	3			208.6	0.0024	21.7	443.0	1.00	501.39	0.0
P-84	C2012	C2011	30			281.4	0.0018	14.2	3.9	0.69	0.82	17.3
P-85	C2013	C2012	24			310.6	0.0032	14.2	4.5	1.00	1.10	12.9
P-86	C2014	C2013	21			255.4	0.0055	6.6	5.0	0.54	0.56	11.8

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P-87	C2015	C2014	18			283.7	0.0078	3.8	5.0	0.45	0.41	9.3
P-88	C3001	C2002	36			54.2	0.0015	36.5	5.2	1.00	1.42	25.7
P-89	C3002	C3001	36			114.2	0.0015	36.5	5.2	1.00	1.41	25.8
P-90	C3003	C3002	36			318.1	0.0015	36.5	5.2	1.00	1.41	26.0
P-91	C3004	C3003	36			211.2	0.0014	26.2	3.7	1.00	1.04	25.2
P-92	C3005	C3004	30			230.6	0.0014	20.3	4.1	1.00	1.31	15.6
P-93	C3006	C3005	24			281.2	0.0104	20.3	8.3	0.73	0.88	23.1
P-94	C3007	C3006	24			353.1	0.0062	16.3	6.5	0.75	0.91	17.9
P-95	C3008	C3007	24			319.0	0.0056	11.6	5.8	0.61	0.68	17.0
P-96	C3009	C3008	24			186.8	0.0054	5.3	4.7	0.39	0.32	16.6
P-1102S	C4001	C2006	120			613.8	0.0015	34.5	4.3	0.16	0.05	642.0
P-1101	C4002	C4001	27			167.0	0.0015	34.5	8.7	1.00	2.87	12.0
P-97	C4003	C4002	24			265.4	0.0015	23.0	7.3	1.00	2.61	8.8
P-98	C4004	C4003	24			180.3	0.0022	18.8	6.0	1.00	1.76	10.7
P-99	C4005	C4004	24			299.3	0.0015	18.8	6.0	1.00	2.14	8.8
P-100	C4006	C4005	21			194.4	0.0015	17.1	7.1	1.00	2.78	6.1
P-101	C4007	C4006	21			239.5	0.0015	12.5	5.2	1.00	2.04	6.2
P-102	C4008	C4007	18			347.3	0.0015	12.5	7.1	1.00	3.08	4.1
P-103	C4009	C4008	15			301.6	0.0015	4.5	3.7	1.00	1.80	2.5
P-104	C4010	C4009	12			270.1	0.0588	4.5	11.1	0.51	0.52	8.7
11	D1001	D-1		48	72	197.5	0.0015	693.5	14.4	1.00	4.52	307.2
P-135	D1002	D1001		48	84	129.4	0.0074	671.0	14.2	0.85	1.60	838.1
P-134	D1003	D1002		48	84	378.6	0.0015	671.0	12.0	1.00	3.55	377.6
P-133	D1004	D1003		48	84	154.0	0.0015	662.4	11.8	1.00	3.52	376.1
P-132	D1005	D1004		48	84	143.4	0.0016	662.4	11.8	1.00	3.40	389.7
P-131	D1006	D1005		48	84	305.6	0.0014	662.4	11.8	1.00	3.63	365.0
P-130	D1007	D1006		48	84	351.1	0.0032	662.4	11.8	1.00	2.42	547.1
P-129	D1008	D1007		48	72	92.9	0.0027	662.4	13.8	1.00	3.24	408.9
P-128	D1009	D1008		48	72	438.2	0.0069	640.2	13.6	0.98	1.96	653.2
P-127	D1010	D1009		48	72	53.7	0.0016	640.2	13.3	1.00	4.01	319.1
P-126	D1011	D1010		48	72	447.5	0.0014	629.9	13.1	1.00	4.25	296.1
P-125	D1012	D1011		48	72	442.3	0.0017	629.9	13.1	1.00	3.88	324.5
P-124	D1013	D1012		48	72	366.7	0.0016	612.7	12.8	1.00	3.84	318.8
P-123	D1014	D1013		48	72	127.7	0.0015	612.7	12.8	1.00	4.03	303.9
P-122	D1015	D1014		48	72	72.9	0.0015	612.7	12.8	1.00	4.00	306.1
P-143	D1016	D1015	72			71.5	0.0027	485.7	8.6	1.00	2.22	437.9
P-142	D1017	D1016	72			580.8	0.0020	485.7	8.6	1.00	2.57	377.9
P-141	D1018	D1017	72			749.4	0.0160	465.2	18.3	0.46	0.87	1074.7
P-140	D1019	D1018	84			140.9	0.0001	352.4	9.2	1.00	4.62	76.3
P-139	D1020	D1019	84			531.4	0.0013	352.4	9.2	1.00	1.51	234.1
P-138	D1021	D1020	84			622.0	0.0020	335.7	8.7	1.00	1.18	284.8
P-137	D1022	D1021	54			511.6	0.0037	315.2	19.8	1.00	2.62	120.5
P-425	D1023	D1022	48			273.0	0.0036	301.6	24.0	1.00	3.49	86.3
P-424	D1024	D1023	48			287.1	0.0034	301.6	24.0	1.00	3.60	83.7
P-423	D1025	D1024	48			280.6	0.0028	301.6	24.0	1.00	3.95	76.4
P-422	D1026	D1025	42			503.2	0.0040	287.1	29.8	1.00	4.52	63.4
P-421	D1027	D1026	42			343.6	0.0027	282.2	29.3	1.00	5.38	52.5

Appendix C
City of Richmond - Storm Drain Master Plan
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-420	D1028	D1027	42			250.1	0.0073	282.2	29.3	1.00	3.27	86.3
P-419	D1029	D1028	54			354.2	0.0041	280.5	17.6	1.00	2.23	125.7
P-418	D1030	D1029	54			290.4	0.0045	280.5	17.6	1.00	2.13	131.9
P-417	D1031	D1030	54			540.9	0.0027	239.8	15.1	1.00	2.33	103.1
P-416	D1032	D1031	48			786.0	0.0042	217.1	17.3	1.00	2.31	93.9
P-415	D1033	D1032	48			124.8	0.0092	217.1	17.3	1.00	1.57	138.3
P-407	D1034	D1033	48			414.2	0.0022	196.2	15.6	1.00	2.92	67.1
P-406	D1035	D1034	48			269.3	0.0031	196.2	15.6	1.00	2.45	80.0
P-405	D1036	D1035	48			239.6	0.0029	196.2	15.6	1.00	2.52	77.9
P-404	D1037	D1036	48			239.3	0.0030	183.4	14.6	1.00	2.34	78.4
P-403	D1038	D1037	48			225.7	0.0025	183.4	14.6	1.00	2.56	71.8
P-402	D1039	D1038	48			298.1	0.0025	168.5	13.4	1.00	2.35	71.8
P-401	D1040	D1039	48			513.6	0.0020	168.5	13.4	1.00	2.60	64.8
P-400	D1041	D1040	36			526.7	0.0052	138.5	19.6	1.00	2.86	48.4
P-399	D1042	D1041	36			763.9	0.0015	138.5	19.6	1.00	5.39	25.7
P-396	D1043	D1042	36			156.4	0.0114	138.5	19.6	1.00	1.94	71.5
P-395	D1044	D1043	36			277.4	0.0052	138.5	19.6	1.00	2.86	48.3
P-393	D1045	D1044	12			85.4	0.0082	92.7	118.1	1.00	28.67	3.2
P-392	D1046	D1045	12			554.7	0.0079	77.2	98.3	1.00	24.26	3.2
P-391	D1047	D1046	24			614.8	0.0085	77.2	24.6	1.00	3.70	20.9
P-390	D1048	D1047	18			192.3	0.0042	57.1	32.3	1.00	8.40	6.8
P-389	D1049	D1048	18			109.2	0.0038	57.1	32.3	1.00	8.74	6.5
P-388	D1050	D1049	18			203.4	0.0046	57.1	32.3	1.00	8.02	7.1
P-991	D2001	D-2	36			397.0	0.0015	199.0	28.2	1.00	7.65	26.0
P-157	D2002	D2001	42			59.7	0.0017	188.0	19.5	1.00	4.55	41.3
P-156	D2003	D2002	42			552.0	0.0014	188.0	19.5	1.00	4.89	38.4
P-155	D2004	D2003	42			550.8	0.0015	188.0	19.5	1.00	4.74	39.6
P-154	D2005	D2004	42			235.2	0.0015	98.0	10.2	1.00	2.52	38.9
P-153	D2006	D2005	42			1385.7	0.0014	66.3	6.9	1.00	1.73	38.3
P-152	D2007	D2006	42			1128.8	0.0015	66.3	6.9	1.00	1.71	38.8
P-151	D2008	D2007	42			122.9	0.0108	42.5	10.3	0.44	0.40	104.9
P-150	D2009	D2008	42			1407.9	0.0014	42.5	4.4	1.00	1.12	38.0
P-549	D2101	D2004	8			374.0	0.0015	123.0	352.4	1.00	264.75	0.5
P-550	D2102	D2101	8			452.3	0.0015	123.0	352.4	1.00	258.06	0.5
P-551	D2103	D2102	6			265.8	0.0015	123.0	626.5	1.00	563.69	0.2
P-552	D2104	D2103	12			901.1	0.0014	50.1	63.8	1.00	36.91	1.4
P-121	D4001	D1015	42			146.7	0.0061	124.8	13.0	1.00	1.58	79.0
P-120	D4002	D4001	42			392.7	0.0039	124.8	13.0	1.00	1.98	63.2
P-119	D4003	D4002	42			641.8	0.0015	124.8	13.0	1.00	3.22	38.8
P-118	D4004	D4003	36			760.9	0.0015	124.8	17.7	1.00	4.80	26.0
P-117	D4005	D4004	36			251.0	0.0015	85.1	12.0	1.00	3.31	25.7
P-116	D4006	D4005	36			209.3	0.0015	85.1	12.0	1.00	3.25	26.1
P-115	D4007	D4006	36			39.2	0.0015	85.1	12.0	1.00	3.25	26.2
P-114	D4008	D4007	36			105.1	0.0015	85.1	12.0	1.00	3.26	26.1
P-113	D4009	D4008	36			406.3	0.0016	61.3	8.7	1.00	2.31	26.5
P-112	D4010	D4009	36			85.6	0.0015	61.3	8.7	1.00	2.35	26.1
P-111	D4011	D4010	24			527.7	0.0001	0.0	0.0	0.00	0.00	2.6

Appendix C
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-110	D4012	D4010	24			541.5	0.0015	61.3	19.5	1.00	6.95	8.8
P-384	D4013	D4012	24			75.3	0.0016	41.9	13.3	1.00	4.62	9.1
P-385	D4014	D4013	24			278.9	0.0015	41.9	13.3	1.00	4.70	8.9
P-386	D4015	D4014	18			275.9	0.0014	29.9	16.9	1.00	7.45	4.0
P-387	D4016	D4015	15			260.6	0.0014	17.7	14.4	1.00	7.36	2.4
P-148	D4101	D4003	24			276.8	0.0018	0.0	0.0	0.00	0.00	9.7
P-147	D4102	D4101	24			261.5	0.0038	0.0	0.0	0.00	0.00	14.0
P-146	D4103	D4102	21			500.8	0.0058	0.0	0.0	0.00	0.00	12.1
P-145	D4104	D4103	15			348.1	0.0028	0.0	0.0	0.00	0.00	3.4
P-959	D5001	D1018	60			819.1	0.0079	136.1	12.3	0.55	0.59	232.5
P-563	D5002	D5001	48			83.7	0.0016	136.1	10.8	1.00	2.40	56.8
P-562	D5003	D5002	48			94.2	0.0015	136.1	10.8	1.00	2.45	55.5
P-561	D5004	D5003	48			70.1	0.0419	136.1	23.0	0.48	0.46	294.9
P-560	D5005	D5004	48			474.3	0.0015	110.0	8.8	1.00	1.97	55.7
P-559	D5006	D5005	42			570.9	0.0015	88.1	9.2	1.00	2.25	39.2
P-565	D5007	D5006	24			251.9	0.0015	68.8	21.9	1.00	7.80	8.8
P-566	D5008	D5007	24			281.0	0.0070	68.8	21.9	1.00	3.62	19.0
P-567	D5009	D5008	24			280.2	0.0070	61.8	19.7	1.00	3.26	19.0
P-568	D5010	D5009	24			553.1	0.0014	61.8	19.7	1.00	7.21	8.6
P-569	D5011	D5010	24			46.1	0.0109	61.8	19.7	1.00	2.61	23.6
P-570	D5012	D5011	24			178.8	0.0017	34.6	11.0	1.00	3.72	9.3
P-571	D5013	D5012	30			100.6	0.0041	34.6	7.0	1.00	1.32	26.3
P-572	D5014	D5013	24			316.2	0.0041	34.6	11.0	1.00	2.39	14.5
P-573	D5015	D5014	24			54.5	0.0092	34.6	11.0	1.00	1.59	21.7
P-574	D5016	D5015	24			105.2	0.0029	34.6	11.0	1.00	2.85	12.1
P-575	D5017	D5016	24			45.3	0.0037	34.6	11.0	1.00	2.49	13.9
P-576	D5018	D5017	24			1351.8	0.0035	8.7	4.6	0.58	0.64	13.5
P-558	D5101	D5006	30			665.2	0.0015	29.9	6.1	1.00	1.88	15.9
P-557	D5102	D5101	42			396.9	0.0050	29.9	7.1	0.45	0.42	71.3
P-556	D5103	D5102	42			128.1	0.0013	29.9	4.3	0.69	0.81	36.7
P-555	D5104	D5103	42			91.0	0.0016	29.9	4.6	0.63	0.73	41.0
P-554	D5105	D5104	42			438.3	0.0015	3.0	2.4	0.19	0.08	39.4
P-958	D5106	D5105	42			72.5	0.0015	0.0	0.0	0.00	0.00	39.3
P-577	D5201	D5008	12			644.0	0.0066	13.0	16.6	1.00	4.49	2.9
P-144	D6001	D1022	24			499.4	0.0015	19.6	6.2	1.00	2.23	8.8
P-434	D7001	D1030	24			299.1	0.0075	18.0	7.1	0.75	0.92	19.6
P-435	D7002	D7001	24			258.3	0.0081	18.0	7.3	0.73	0.88	20.4
P-436	D7003	D7002	15			323.9	0.0111	18.0	14.6	1.00	2.63	6.8
P-437	D7004	D7003	12			253.5	0.0114	18.0	22.9	1.00	4.70	3.8
P-430	D8001	D1031	24			305.0	0.0059	10.9	5.9	0.57	0.63	17.4
P-431	D8002	D8001	24			293.3	0.0044	10.9	5.2	0.63	0.72	15.1
P-432	D8003	D8002	21			272.7	0.0048	10.9	5.2	0.82	1.00	11.0
P-433	D8004	D8003	15			281.2	0.0076	10.9	8.9	1.00	1.93	5.7
P-414	D9001	D1033	24			199.5	0.0058	28.4	9.0	1.00	1.64	17.3
P-413	D9002	D9001	24			80.5	0.0051	28.4	9.0	1.00	1.75	16.2
P-412	D9003	D9002	24			264.6	0.0056	28.4	9.0	1.00	1.67	17.0
P-411	D9004	D9003	21			275.8	0.0036	28.4	11.8	1.00	3.00	9.5

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P-410	D9005	D9004	21			88.4	0.0032	28.4	11.8	1.00	3.17	8.9
P-409	D9006	D9005	18			314.0	0.0075	28.4	16.1	1.00	3.12	9.1
P-408	D9007	D9006	15			266.5	0.0044	14.5	11.8	1.00	3.39	4.3
P-992	E1001	E-1	60			199.4	0.0032	1310.3	22.2	1.00	8.93	440.4
P-641	E1002	E1001	60			168.5	0.0031	1306.2	22.2	1.00	9.00	435.2
P-993	E1003	E1002	60			287.2	0.0890	1295.1	40.7	0.53	1.66	2336.7
P-591	E1004	E1003	66			677.7	0.0024	834.1	11.7	1.00	5.05	495.4
P-1000	E1005	E1004	66			302.2	0.0024	834.1	11.7	1.00	5.04	496.5
P-999	E1006	E1005	66			547.2	0.0019	695.2	9.8	1.00	4.78	436.1
P-589	E1007	E1006	66			157.8	0.0029	695.2	14.6	1.00	3.87	359.6
P-588	E1008	E1007	66			109.4	0.0030	695.2	14.6	1.00	3.76	369.9
P-587	E1009	E1008	66			1302.1	0.0015	674.3	14.2	1.00	5.17	260.6
P-586	E1010	E1009	60			745.1	0.0023	417.8	10.6	1.00	3.37	248.0
P-585	E1011	E1010	60			492.7	0.0023	408.9	10.4	1.00	3.26	251.2
P-994	E1012	E1011	60			1037.0	0.0028	384.7	9.8	1.00	2.81	274.3
P-579	E1013	E1012	66			852.4	0.0028	359.4	15.1	1.00	2.00	179.4
P-578	E1014	E1013	54			274.1	0.0046	337.4	21.2	1.00	2.51	134.2
P-455	E1015	E1014	48			50.3	0.0034	337.4	26.9	1.00	4.03	83.7
P-454	E1016	E1015	48			390.3	0.0069	330.0	26.3	1.00	2.75	120.0
P-453	E1017	E1016	42			294.1	0.0039	330.0	34.3	1.00	5.21	63.4
P-452	E1018	E1017	42			185.5	0.0067	311.6	32.4	1.00	3.78	82.5
P-995	E1019	E1018	54			35.8	0.0031	230.9	14.5	1.00	2.11	109.3
P-471	E1020	E1019	54			638.4	0.0044	162.8	10.2	1.00	1.24	130.8
P-470	E1021	E1020	48			545.6	0.0046	162.8	13.0	1.00	1.67	97.5
P-469	E1022	E1021	48			94.0	0.0046	162.8	13.0	1.00	1.67	97.4
P-468	E1023	E1022	48			313.3	0.0080	162.8	13.0	1.00	1.27	128.7
P-467	E1024	E1023	48			235.4	0.0203	162.8	18.1	0.67	0.79	205.0
P-466	E1025	E1024	48			389.1	0.0039	162.8	13.0	1.00	1.82	89.4
P-465	E1026	E1025	42			255.7	0.0035	140.7	14.6	1.00	2.36	59.5
P-464	E1027	E1026	42			641.6	0.0041	138.2	14.4	1.00	2.13	64.8
P-463	E1028	E1027	42			275.0	0.0046	138.2	14.4	1.00	2.02	68.3
P-462	E1029	E1028	42			252.5	0.0042	119.0	12.4	1.00	1.82	65.4
P-461	E1030	E1029	42			426.7	0.0038	119.0	12.4	1.00	1.91	62.3
P-460	E1031	E1030	42			210.9	0.0054	119.0	12.4	1.00	1.61	73.8
P-459	E1032	E1031	30			285.5	0.0028	97.1	19.8	1.00	4.43	21.9
P-458	E1033	E1032	30			199.3	0.0157	80.6	16.4	1.00	1.57	51.5
P-457	E1034	E1033	30			526.5	0.0027	80.6	16.4	1.00	3.76	21.4
P-456	E1035	E1034	30			331.3	0.0030	38.5	7.8	1.00	1.71	22.5
P-638	E2001	E1003		60	60	105.4	0.0015	472.3	18.9	1.00	3.01	156.9
P-637	E2002	E2001	5			25.1	0.0016	27.8	203.8	1.00	201.17	0.1
P-636	E2003	E2002	42			327.6	0.0046	27.8	6.7	0.44	0.41	68.3
P-635	E2004	E2003	42			578.5	0.0081	18.6	7.4	0.31	0.20	90.8
P-1009	E2005	E2004	36			757.4	0.0023	7.3	3.7	0.32	0.23	32.0
P-1002	E2006	E2104		48	76	408.7	0.0150	407.8	16.1	0.50	0.78	1039.6
P-1003	E2007	E2006	54			786.0	0.0015	393.1	12.4	1.00	5.15	152.8
P-1004	E2008	E2007	54			777.6	0.0048	374.4	11.8	1.00	2.73	274.6
P-625	E2009	E2008	48			145.7	0.0034	367.5	14.6	1.00	4.36	168.7

Appendix C
City of Richmond - Storm Drain Master Plan
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-624	E2010	E2009	48			386.7	0.0054	388.8	15.5	1.00	3.66	212.3
P-1010	E2011	E2010		42	144	603.2	0.0073	388.8	13.9	0.67	0.56	697.7
P-1014	E2012	E2011		48	144	136.5	0.0037	378.8	10.9	0.73	0.63	596.9
P-1013	E2013	E2012		48	144	161.3	0.0062	378.8	13.0	0.61	0.49	776.5
P-1012	E2014	E2013		48	144	282.0	0.0035	369.6	10.7	0.72	0.63	587.3
P-1020	E2015	E2014		48	144	334.9	0.0015	359.1	7.8	0.96	0.94	381.1
P-1019	E2016	E2015	12			82.8	0.0014	125.3	159.5	1.00	92.13	1.4
P-618	E2017	E2016		36	60	632.6	0.0130	125.3	13.6	0.62	0.52	240.7
P-519	E2018	E2017	48			432.8	0.0015	113.7	9.0	1.00	2.04	55.8
P-518	E2019	E2018	48			660.1	0.0053	106.5	8.5	1.00	1.02	104.9
P-517	E2020	E2019	48			250.7	0.0020	93.2	7.4	1.00	1.45	64.3
P-516	E2021	E2020		24	96	386.5	0.0091	87.5	9.9	0.55	0.41	211.4
P-515	E2022	E2021	48			462.2	0.0076	79.0	10.5	0.58	0.63	125.3
P-514	E2023	E2022	42			751.8	0.0100	57.7	10.8	0.54	0.57	100.8
P-513	E2024	E2023	21			225.7	0.0266	49.7	20.6	1.00	1.92	25.9
P-512	E2025	E2024	12			410.2	0.0024	38.0	48.4	1.00	21.53	1.8
P-511	E2026	E2025	12			696.4	0.0015	19.8	25.2	1.00	14.33	1.4
P-1017	E2027	E2026	12			540.0	0.0056	5.7	7.3	1.00	2.15	2.7
P-1016	E2028	E2027	12			699.2	0.0014	0.0	0.0	0.00	0.00	1.4
P-1015	E2029	E2028	12			342.0	0.0088	0.0	0.0	0.00	0.00	3.3
P-1005	E2101	E2001	12			25.8	1.0505	454.7	578.9	1.00	12.42	36.6
P-1006	E2102	E2101	42			247.0	0.0249	454.7	23.6	1.00	2.86	318.4
P-1007	E2103	E2102	45			666.7	0.0024	450.8	20.4	1.00	7.64	118.1
P-1008	E2104	E2103	45			773.1	0.0071	413.3	18.7	1.00	4.03	204.9
P-1021	E2201	E2015		36	60	715.2	0.0159	302.4	20.2	1.00	1.13	266.8
P-537	E2202	E2201		36	96	493.0	0.0057	294.8	12.4	0.99	0.99	296.9
P-536	E2203	E2202		36	96	102.5	0.0020	288.1	12.0	1.00	1.66	174.1
P-535	E2204	E2203		36	96	113.1	0.0088	288.1	14.4	0.84	0.78	370.5
P-534	E2205	E2204		36	96	134.9	0.0074	285.6	13.5	0.88	0.84	339.2
P-533	E2206	E2205		36	96	54.7	0.0183	285.6	18.5	0.64	0.54	532.7
P-532	E2207	E2206		36	96	349.2	0.0029	285.6	11.9	1.00	1.35	210.9
P-531	E2208	E2207		36	96	62.8	0.0080	239.9	13.1	0.76	0.68	351.6
P-530	E2209	E2208		36	96	367.3	0.0082	239.9	13.2	0.75	0.67	356.1
P-529	E2210	E2209		48	60	556.9	0.0081	232.0	13.3	0.88	0.84	274.6
P-528	E2211	E2210	54			146.5	0.0341	202.6	23.5	0.53	0.56	364.2
P-527	E2212	E2211	54			568.6	0.0123	202.6	15.6	0.76	0.93	218.8
P-526	E2213	E2212	42			286.9	0.0017	157.3	16.3	1.00	3.74	42.1
P-525	E2214	E2213	42			463.1	0.0227	129.9	17.8	0.71	0.85	151.9
P-524	E2215	E2214	36			71.7	0.0698	91.6	25.2	0.51	0.52	176.7
P-523	E2216	E2215	36			160.4	0.0015	75.2	10.6	1.00	2.91	25.9
P-522	E2217	E2216	36			348.4	0.0015	75.2	10.6	1.00	2.91	25.8
P-521	E2218	E2217	30			404.9	0.0124	8.2	7.0	0.29	0.18	45.7
P-520	E2219	E2218	30			97.0	0.0103	4.0	5.4	0.21	0.09	41.8
P-538	E2301	E2217	24			65.4	0.0015	67.1	21.4	1.00	7.57	8.9
P-539	E2302	E2301	24			57.2	0.0014	67.1	21.4	1.00	7.91	8.5
P-540	E2303	E2302	24			36.7	0.0016	67.1	21.4	1.00	7.33	9.2
P-541	E2304	E2303	24			303.9	0.0122	63.9	20.3	1.00	2.55	25.1

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-542	E2305	E2304	24			269.9	0.0552	63.9	20.3	1.00	1.20	53.3
P-543	E2306	E2305	24			223.7	0.0805	55.9	23.1	0.72	0.87	64.3
P-1001	E3001	E1005		36	58	414.8	0.0043	154.1	10.6	1.00	1.17	132.2
P-616	E3002	E3001		36	58	215.5	0.0070	144.3	11.2	0.89	0.86	168.4
P-615	E3003	E3002		36	58	142.5	0.0073	144.3	11.4	0.87	0.84	172.4
P-614	E3004	E3003		36	58	118.2	0.0030	140.3	9.7	1.00	1.28	109.8
P-613	E3005	E3004		36	58	240.5	0.0021	135.5	9.3	1.00	1.46	92.9
P-612	E3006	E3005	33			919.2	0.0039	125.0	21.0	1.00	3.78	33.1
P-611	E3007	E3006	42			134.7	0.0015	125.0	13.0	1.00	3.22	38.9
P-610	E3008	E3007	42			286.2	0.0064	116.6	12.1	1.00	1.45	80.5
P-609	E3009	E3008	42			535.0	0.0015	116.6	12.1	1.00	2.99	39.0
P-608	E3010	E3009	42			141.6	0.0056	103.5	10.8	1.00	1.36	75.8
P-607	E3011	E3010	42			166.8	0.0015	103.5	10.8	1.00	2.65	39.1
P-606	E3012	E3011	36			456.0	0.0015	95.8	13.6	1.00	3.71	25.8
P-605	E3013	E3012	36			408.4	0.0044	90.7	12.8	1.00	2.04	44.5
P-604	E3014	E3013	30			391.1	0.0090	73.5	15.0	1.00	1.88	39.0
P-603	E3015	E3014	30			63.2	0.0022	73.5	15.0	1.00	3.80	19.4
P-602	E3016	E3015	30			378.5	0.0049	64.1	13.1	1.00	2.22	28.8
P-601	E3017	E3016	30			586.5	0.0039	55.1	11.2	1.00	2.14	25.8
P-600	E3018	E3017	30			42.4	0.0118	55.1	11.2	1.00	1.23	44.7
P-997	E4001	E1009	42			124.9	0.0539	241.6	25.1	1.00	1.03	234.2
P-996	E4002	E4001	36			261.2	0.0102	241.6	34.2	1.00	3.57	67.6
P-599	E4003	E4002	36			120.6	0.0065	256.2	36.2	1.00	4.76	53.8
P-598	E4004	E4003	36			469.3	0.0035	248.1	35.1	1.00	6.28	39.5
P-597	E4005	E4004	36			793.9	0.0036	235.6	33.3	1.00	5.89	40.0
P-998	E4006	E4005	4			860.5	0.0009	227.5	2607.2	1.00	3935.40	0.1
P-594	E4007	E4006	42			853.1	0.0030	162.9	16.9	1.00	2.94	55.5
P-593	E4008	E4007	42			283.2	0.0032	162.9	16.9	1.00	2.85	57.2
P-592	E4009	E4008	42			387.5	0.0049	146.5	15.2	1.00	2.07	70.6
P-497	E4010	E4009	42			550.4	0.0129	128.7	13.4	1.00	1.12	114.4
P-496	E4011	E4010	42			606.9	0.0102	107.7	11.2	1.00	1.06	101.7
P-495	E4012	E4011	36			120.3	0.0108	107.7	15.2	1.00	1.55	69.5
P-494	E4013	E4012	30			541.6	0.0109	98.9	20.1	1.00	2.30	43.0
P-493	E4014	E4013	36			265.2	0.0139	89.2	12.6	1.00	1.13	78.8
P-492	E4015	E4014	36			18.2	0.0104	89.2	12.6	1.00	1.31	68.3
P-491	E4016	E4015	36			205.9	0.0138	89.2	12.6	1.00	1.13	78.7
P-490	E4017	E4016	36			105.0	0.0139	89.2	12.6	1.00	1.13	78.9
P-489	E4018	E4017	36			159.6	0.0045	89.2	12.6	1.00	1.99	44.9
P-488	E4019	E4018	36			89.4	0.0047	89.2	12.6	1.00	1.94	45.8
P-487	E4020	E4019	36			464.0	0.0111	89.2	12.6	1.00	1.26	70.5
P-486	E4021	E4020	36			51.9	0.0040	89.2	12.6	1.00	2.10	42.5
P-485	E4022	E4021	24			268.1	0.0124	78.3	24.9	1.00	3.10	25.3
P-484	E4023	E4022	24			272.2	0.0118	74.8	23.8	1.00	3.04	24.6
P-483	E4024	E4023	24			513.0	0.0127	74.8	23.8	1.00	2.93	25.6
P-482	E4025	E4024	24			244.4	0.0088	74.8	23.8	1.00	3.51	21.3
P-481	E4026	E4025	21			673.8	0.0118	55.6	23.1	1.00	3.22	17.2
P-480	E4027	E4026	21			147.8	0.0075	41.3	17.2	1.00	3.00	13.8

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P-479	E4028	E4027	21			175.5	0.0087	41.3	17.2	1.00	2.79	14.8
P-498	E4101	E4010	12			247.5	0.0090	18.0	23.0	1.00	5.33	3.4
P-499	E4102	E4101	12			279.0	0.0096	12.7	16.1	1.00	3.61	3.5
P-500	E4103	E4102	12			57.3	0.0192	12.7	16.1	1.00	2.56	4.9
P-451	E5001	E1018	42			307.1	0.0016	90.2	9.4	1.00	2.24	40.3
P-450	E5002	E5001	42			214.9	0.0020	90.2	9.4	1.00	2.00	45.1
P-449	E5003	E5002	42			66.2	0.0015	90.2	9.4	1.00	2.30	39.2
P-448	E5004	E5003	42			537.2	0.0002	73.7	7.7	1.00	5.36	13.8
P-447	E5005	E5004	36			257.3	0.0015	73.7	10.4	1.00	2.87	25.7
P-446	E5006	E5005	36			273.2	0.0015	73.7	10.4	1.00	2.81	26.2
P-445	E5007	E5006	36			226.9	0.0015	62.7	8.9	1.00	2.39	26.3
P-444	E5008	E5007	30			282.1	0.0015	62.7	12.8	1.00	3.90	16.1
P-443	E5009	E5008	30			242.8	0.0016	48.4	9.9	1.00	2.97	16.3
P-442	E5010	E5009	30			233.0	0.2225	39.5	31.0	0.31	0.20	194.0
P-441	E5011	E5010	21			282.6	0.0041	39.5	16.4	1.00	3.88	10.2
P-440	E5012	E5011	24			177.5	0.0046	20.8	6.6	1.00	1.35	15.4
P-439	E5013	E5012	21			317.9	0.0037	20.8	8.7	1.00	2.15	9.7
P-438	E5014	E5013	21			152.7	0.0131	20.8	8.7	1.00	1.15	18.2
P-472	E6001	E1019	12			291.7	0.0104	62.8	80.0	1.00	17.25	3.6
P-473	E6002	E6001	12			287.8	0.0114	62.8	80.0	1.00	16.50	3.8
P-474	E6003	E6002	12			251.5	0.0130	45.5	58.0	1.00	11.18	4.1
P-475	E6004	E6003	12			226.2	0.0145	45.5	58.0	1.00	10.60	4.3
P-476	E6005	E6004	12			263.0	0.0073	30.0	38.3	1.00	9.87	3.0
P-477	E6006	E6005	12			240.0	0.0132	30.0	38.3	1.00	7.33	4.1
P-478	E6007	E6006	12			292.9	0.0072	13.6	17.4	1.00	4.49	3.0
P-1018	F1001	F-1	18			537.4	0.0279	15.6	11.2	0.73	0.89	17.6
P-502	F1002	F1001	12			57.1	0.0175	15.6	19.9	1.00	3.31	4.7
P-503	F1003	F1002	18			113.2	0.0088	10.3	5.9	1.00	1.04	9.9
P-504	F1004	F1003	12			175.6	0.0057	10.3	13.2	1.00	3.84	2.7
P-505	F1005	F1004	12			101.1	0.0099	5.2	6.7	1.00	1.47	3.6
P-960	I1001	I-1		48	72	333.2	0.0023	410.9	17.1	1.00	2.20	186.9
P-191	I1002	I1001	48			103.7	0.0005	232.9	18.5	1.00	7.37	31.6
P-190	I1003	I1002	48			405.0	0.0015	232.9	18.5	1.00	4.20	55.4
P-189	I1004	I1003	48			441.0	0.0016	232.9	18.5	1.00	4.06	57.4
P-188	I1005	I1004	48			983.2	0.0015	232.9	18.5	1.00	4.14	56.3
P-187	I1006	I1005	36			196.9	0.0015	119.2	16.9	1.00	4.57	26.1
P-186	I1007	I1006	36			51.5	0.0039	119.2	16.9	1.00	2.86	41.7
P-185	I1008	I1007	36			43.2	0.0023	119.2	16.9	1.00	3.71	32.2
P-184	I1009	I1008	36			265.9	0.0016	119.2	16.9	1.00	4.49	26.6
P-183	I1010	I1009	36			69.0	0.0013	105.9	15.0	1.00	4.39	24.1
P-182	I1011	I1010	30			102.5	0.0010	105.9	21.6	1.00	8.24	12.8
P-181	I1012	I1011	21			622.7	0.0041	84.1	35.0	1.00	8.25	10.2
P-180	I1013	I1012	21			569.5	0.0027	84.1	35.0	1.00	10.18	8.3
P-971	I1014	I1013	24			401.2	0.0033	51.7	16.4	1.00	3.94	13.1
P-970	I1015	I1014	24			365.8	0.0034	51.7	16.4	1.00	3.88	13.3
P-106	I1016	I1015	24			352.0	0.0030	36.8	11.7	1.00	2.96	12.4
P-972	I1017	I1016	24			436.6	0.0028	22.1	7.0	1.00	1.82	12.1

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P-974	I1018	I1017	21			277.8	0.0031	14.7	6.1	1.00	1.66	8.8
P-973	I1019	I1018	15			282.1	0.0031	14.7	12.0	1.00	4.09	3.6
P-205	I2001	I1001	30			61.7	0.0015	137.0	27.9	1.00	8.72	15.7
P-204	I2002	I2001	30			409.2	0.0016	137.0	27.9	1.00	8.36	16.4
P-203	I2003	I2002	30			263.6	0.0015	137.0	27.9	1.00	8.55	16.0
P-202	I2004	I2003	30			45.5	0.0015	119.9	24.4	1.00	7.43	16.1
P-201	I2005	I2004	30			473.4	0.0015	119.9	24.4	1.00	7.42	16.1
P-963	I2006	I2005	24			452.0	0.0015	102.7	32.7	1.00	11.50	8.9
P-962	I2007	I2006	24			289.3	0.0016	68.4	21.8	1.00	7.65	8.9
P-199	I2008	I2007	24			248.2	0.0093	68.4	21.8	1.00	3.13	21.8
P-198	I2009	I2008	12			107.0	0.0017	68.4	87.1	1.00	46.69	1.5
P-197	I2010	I2009	12			113.2	0.0177	68.4	87.1	1.00	14.41	4.7
P-196	I2011	I2010	18			56.2	0.0062	68.4	38.7	1.00	8.23	8.3
P-195	I2012	I2011	12			140.9	0.0142	68.4	87.1	1.00	16.08	4.3
P-194	I2013	I2012	18			188.5	0.0212	38.2	21.6	1.00	2.49	15.3
P-193	I2014	I2013	18			311.7	0.0064	38.2	21.6	1.00	4.53	8.4
P-206	I3001	I1001	12			37.3	0.0016	61.1	77.8	1.00	42.64	1.4
P-207	I3002	I3001	12			107.2	0.0213	61.1	77.8	1.00	11.73	5.2
P-208	I3003	I3002	12			442.7	0.0009	61.1	77.8	1.00	56.90	1.1
P-209	I3004	I3003	12			645.3	0.0006	51.2	65.2	1.00	57.59	0.9
P-210	I3005	I3004	12			450.2	0.0004	35.8	45.5	1.00	47.48	0.8
P-965S	I4001	I1005	120			834.0	0.0030	30.7	5.4	0.13	0.03	907.9
P-964	I4002	I4001	24			500.5	0.0015	30.7	9.8	1.00	3.45	8.9
P-967	J1001	J-1	60			163.2	0.0015	95.7	5.9	0.77	0.94	102.2
P-966	J1002	J1001	60			131.4	0.0015	95.7	5.9	0.77	0.94	101.9
P-179	J1003	J1002	54			39.1	0.0026	95.7	7.1	0.79	0.96	99.7
P-178	J1004	J1003	54			145.2	0.0021	95.7	6.0	1.00	1.07	89.6
P-177	J1005	J1004	48			317.8	0.0016	63.0	5.0	1.00	1.10	57.1
P-176	J1006	J1005	48			85.3	0.0018	63.0	5.0	1.00	1.04	60.4
P-175	J1007	J1006	48			489.0	0.0047	63.0	8.3	0.58	0.64	98.8
P-174	J1008	J1007	42			31.9	0.0016	63.0	6.5	1.00	1.58	39.9
P-173	J1009	J1008	42			413.9	0.0019	48.9	5.1	1.00	1.10	44.3
P-172	J1010	J1009	36			27.3	0.0015	48.9	6.9	1.00	1.91	25.6
P-171	J1011	J1010	36			506.9	0.0014	25.8	3.7	1.00	1.02	25.4
P-170	J1012	J1011	36			139.6	0.0015	25.8	4.2	0.82	1.00	25.9
P-169	J1013	J1012	36			53.9	0.0011	25.8	3.7	1.00	1.16	22.3
P-168	J1014	J1013	36			286.2	0.0052	15.9	6.1	0.39	0.33	48.4
P-167	J1015	J1014	30			359.7	0.0050	15.9	6.1	0.53	0.55	29.1
P-166	J1016	J1015	30			52.0	0.0079	15.9	7.2	0.46	0.43	36.5
P-165	J1017	J1016	30			284.5	0.0031	11.7	4.7	0.51	0.51	22.7
P-164	J1018	J1017	18			578.6	0.0061	7.6	5.3	0.76	0.92	8.2
P-1035	K1001	K-1		36	120	104.8	0.0051	389.4	13.0	1.00	1.05	371.8
P-646	K1002	K1001		36	120	166.5	0.0133	320.8	16.5	0.65	0.53	602.4
P-645	K1003	K1002		36	120	194.1	0.0048	320.8	11.7	0.92	0.88	363.8
P-644	K1004	K1003		36	120	100.9	0.0015	320.8	10.7	1.00	1.59	201.6
P-643	K1005	K1004		42	96	248.8	0.0028	227.7	8.9	0.91	0.88	258.1
P-642	K1006	K1005		30	66	675.3	0.0085	203.3	14.8	1.00	1.17	174.4

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P-548	K1007	K1006	36			259.7	0.0191	203.3	28.8	1.00	2.20	92.5
P-547	K1008	K1007	36			254.2	0.0256	203.3	28.8	1.00	1.90	106.9
P-546	K1009	K1008	36			169.0	0.0180	203.3	28.8	1.00	2.26	89.8
P-545	K1010	K1009	30			61.4	0.0139	203.3	41.4	1.00	4.20	48.4
P-544	K1011	K1010	30			145.9	0.0206	117.5	23.9	1.00	1.99	59.1
P-1036	L1001	L-1	48			37.1	0.0269	178.1	15.7	0.34	0.75	709.3
P-660	L1002	L1001	48			206.4	0.0141	162.4	12.1	0.39	0.95	514.0
P-659	L1003	L1002	48			367.1	0.0015	157.2	5.0	0.77	2.82	167.3
P-658	L1004	L1003		36	84	47.3	0.0089	106.4	8.6	0.30	0.34	624.5
P-657	L1005	L1004		36	84	65.4	0.0060	102.2	7.4	0.33	0.40	511.6
P-656	L1006	L1005		36	84	410.4	0.0043	93.3	6.5	0.34	0.43	436.5
P-655	L1007	L1006		36	84	49.0	0.0163	80.7	9.5	0.20	0.19	846.7
P-654	L1008	L1007		36	84	526.3	0.0043	80.7	6.1	0.31	0.37	432.4
P-653	L1009	L1008		36	84	245.9	0.0060	68.1	6.5	0.25	0.26	514.2
P-652	L1010	L1009		36	84	194.8	0.0060	60.2	6.2	0.23	0.23	513.6
P-651	L1011	L1010		36	84	216.9	0.0060	60.2	6.2	0.23	0.23	513.1
P-650	L1012	L1011	7			93.8	0.0134	48.0	179.5	1.00	48.78	1.0
P-649	L1013	L1012	7			408.4	0.0050	39.4	147.2	1.00	65.30	0.6
P-648	L1014	L1013	54			343.5	0.0104	27.3	8.8	0.25	0.14	200.7
P-661	L1101	L1001	18			156.0	0.0006	10.3	5.8	1.00	3.86	2.7
P-662	L1102	L1101	18			45.3	0.0009	10.3	5.8	1.00	3.29	3.1
P-663	L1103	L1102	18			453.4	0.0010	6.4	3.6	1.00	1.92	3.3
P-666	L2001	L1003	12			574.4	0.0042	29.2	37.2	1.00	12.63	2.3
P-665	L2002	L2001	12			604.6	0.0024	18.9	24.1	1.00	10.85	1.7
P-664	L2003	L2002	12			412.5	0.0020	12.5	15.9	1.00	7.75	1.6
P-667	L3001	L1003	30			532.0	0.0015	37.6	7.7	1.00	2.35	15.9
P-668	L3002	L3001	24			369.6	0.0015	37.6	12.0	1.00	4.29	8.7
P-669	L3003	L3002	24			48.8	0.0094	27.4	8.7	1.00	1.25	22.0
P-670	L3004	L3003	24			46.6	0.0129	27.4	8.7	1.00	1.07	25.7
P-671	L3005	L3004	24			155.7	0.0035	27.4	8.7	1.00	2.04	13.5
P-672	L3006	L3005	24			57.0	0.0091	27.4	8.7	1.00	1.27	21.7
P-673	L3007	L3006	24			652.6	0.0039	14.5	4.6	1.00	1.03	14.1
P-674	L3008	L3007	24			562.0	0.0015	6.2	3.0	0.62	0.71	8.7
P-675	L3009	L3008	21			49.2	0.0026	6.2	3.7	0.65	0.76	8.2
P-676	L4001	L1006	15			150.0	0.0015	15.5	12.7	1.00	6.12	2.5
P-1037	L4002	L4001	15			584.8	0.0015	5.9	4.8	1.00	2.38	2.5
P-1041	M1001	M-1		36	72	46.1	0.0097	784.7	21.8	1.00	2.95	532.6
P-692	M1002	M1001		36	72	125.4	0.0441	716.9	27.9	0.71	1.26	1135.5
P-691	M1003	M1002		36	72	285.3	0.0075	716.9	19.9	1.00	3.06	468.1
P-690	M1004	M1003	66			269.7	0.0030	716.9	15.1	1.00	3.89	369.1
P-689	M1005	M1004	66			180.6	0.0030	716.9	15.1	1.00	3.88	369.3
P-688	M1006	M1005	66			585.6	0.0009	710.5	15.0	1.00	7.10	200.1
P-1039	M1007	M1006	66			479.3	0.0046	676.4	14.2	1.00	2.97	455.2
P-685	M1008	M1007	54			849.7	0.0015	676.4	42.5	1.00	8.87	76.2
P-846	M1009	M1008		60	84	123.8	0.0016	403.9	11.5	1.00	1.55	260.9
P-845	M1010	M1009		60	84	73.9	0.0015	403.9	11.5	1.00	1.61	250.5
P-844	M1011	M1010		60	84	126.5	0.0015	403.9	11.5	1.00	1.61	251.6

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P-843	M1012	M1011	42			79.5	0.0063	257.7	26.8	1.00	3.22	80.0
P-842	M1013	M1012	42			686.0	0.0190	244.5	25.4	1.00	1.76	138.9
P-841	M1014	M1013	36			93.9	0.0107	244.5	34.6	1.00	3.54	69.0
P-840	M1015	M1014	36			780.5	0.0192	225.1	31.8	1.00	2.43	92.7
P-839	M1016	M1015	36			43.3	0.0231	225.1	31.8	1.00	2.22	101.6
P-838	M1017	M1016	36			237.5	0.0211	233.8	33.1	1.00	2.41	97.0
P-837	M1018	M1017	36			52.6	0.0190	233.8	33.1	1.00	2.54	92.2
P-836	M1019	M1018	36			762.7	0.0354	223.6	31.6	1.00	1.78	125.8
P-834	M1020	M1019	30			80.4	0.0124	150.9	30.7	1.00	3.29	45.9
P-833	M1021	M1020	30			252.8	0.0752	121.7	24.8	1.00	1.08	112.8
P-832	M1022	M1021	30			269.9	0.0371	121.7	24.8	1.00	1.54	79.2
P-831	M1023	M1022	30			373.8	0.0535	121.7	24.8	1.00	1.28	95.1
P-830	M1024	M1023	24			108.8	0.0920	116.2	37.0	1.00	1.69	68.8
P-1045S	M1025	M1024	120			392.7	0.0652	116.2	23.5	0.11	0.03	4233.6
P-829	M1026	M1025	30			144.0	0.0903	108.8	28.4	0.73	0.88	123.6
P-828	M1027	M1026	30			290.2	0.1378	108.8	33.8	0.62	0.71	152.7
P-827	M1028	M1027	30			597.9	0.0958	93.0	28.3	0.63	0.73	127.3
P-1040	M2001	M-1	12			46.0	0.0096	37.0	47.1	1.00	10.58	3.5
P-684	M2002	M2001	36			337.3	0.0173	37.0	11.9	0.45	0.42	88.1
P-1038	M2003	M2002	36			437.1	0.0015	37.0	5.2	1.00	1.42	26.0
P-682	M2004	M2003	36			206.6	0.0015	37.0	5.2	1.00	1.43	25.9
P-681	M2005	M2004	36			366.4	0.0015	37.0	5.2	1.00	1.43	25.9
P-680	M2006	M2005	24			184.6	0.0056	24.4	7.8	1.00	1.43	17.0
P-693	M3001	M1006	30			315.1	0.0030	65.6	13.4	1.00	2.91	22.6
P-694	M3002	M3001	30			378.6	0.0032	63.4	12.9	1.00	2.74	23.2
P-695	M3003	M3002	30			223.2	0.0493	63.4	20.1	0.61	0.69	91.3
P-1044	M3004	M3003	4			24.5	0.0016	63.4	726.2	1.00	822.26	0.1
P-847	M3005	M3004	30			192.9	0.0052	63.4	12.9	1.00	2.14	29.6
P-961	M3006	M3005	4			469.0	0.0064	0.0	0.0	0.00	0.00	0.2
P-1068	M4001	M1008	42			803.1	0.0015	343.9	35.7	1.00	8.82	39.0
P-1067	M4002	M4001	120			163.3	0.0095	343.9	16.3	0.31	0.21	1615.4
P-1066S	M4003	M4002	120			429.9	0.0028	337.2	10.5	0.43	0.38	879.7
P-1065	M4004	M4003	24			1113.8	0.0151	337.2	53.7	1.00	12.10	55.7
P-1064	M4005	M4004	24			295.1	0.0120	318.4	50.7	1.00	12.82	49.7
P-807	M4006	M4005	30			335.5	0.0258	185.5	37.8	1.00	2.81	66.1
P-806	M4007	M4006	30			595.4	0.0134	185.5	37.8	1.00	3.89	47.7
P-805	M4008	M4007	30			45.8	0.0219	185.5	37.8	1.00	3.05	60.8
P-804	M4009	M4008	30			260.7	0.0230	166.9	34.0	1.00	2.68	62.4
P-803	M4010	M4009	30			166.4	0.0015	166.9	34.0	1.00	10.47	15.9
P-802	M4011	M4010	30			297.9	0.0302	158.6	32.3	1.00	2.22	71.5
P-801	M4012	M4011	30			29.2	0.0343	158.6	32.3	1.00	2.08	76.2
P-800	M4013	M4012	30			400.7	0.0478	153.1	31.2	1.00	1.70	89.9
P-799	M4014	M4013	30			345.7	0.1365	145.9	35.3	0.79	0.96	152.0
P-1063	M4101	M4005	36			1051.2	0.0010	141.0	20.0	1.00	6.84	20.6
P-821	M5001	M1011		48	48	85.9	0.0407	159.3	22.3	0.45	0.36	448.4
P-820	M5002	M5001		48	48	129.1	0.0064	159.3	10.9	0.91	0.89	178.1
P-1043	M5003	M5002		48	48	215.5	0.0015	159.3	10.0	1.00	1.86	85.6

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P-818	M5004	M5003		48	72	314.6	0.0033	136.4	8.4	0.68	0.60	227.6
P-817	M5005	M5004		36	60	55.9	0.0089	136.4	12.1	0.75	0.68	199.9
P-816	M5006	M5005		36	60	74.4	0.0040	136.4	9.1	1.00	1.02	134.2
P-815	M5007	M5006		36	60	349.0	0.0143	123.6	14.0	0.59	0.49	253.0
P-814	M5008	M5007		36	36	81.6	0.0012	123.6	13.7	1.00	3.42	36.1
P-813	M5009	M5008		36	36	563.1	0.0114	103.3	12.1	0.95	0.94	110.0
P-812	M5010	M5009	18			56.4	0.0834	62.2	35.2	1.00	2.05	30.4
P-811	M5011	M5010	18			1068.5	0.0372	43.9	24.9	1.00	2.16	20.3
P-810	M5012	M5011	18			49.5	0.0014	43.9	24.9	1.00	11.09	4.0
P-809	M5013	M5012	18			249.9	0.0080	43.9	24.9	1.00	4.66	9.4
P-808	M5014	M5013	18			310.9	0.0050	38.7	21.9	1.00	5.20	7.4
P-1042	M5101	M5003	48			587.0	0.0015	21.7	4.2	0.43	0.39	55.8
P-835	M6001	M1019	30			695.8	0.0431	72.7	19.5	0.71	0.85	85.4
P-1046	N1001	N-1		48	96	920.2	0.0046	589.7	18.4	1.00	1.49	395.7
P-867	N1002	N1001		48	96	554.5	0.0094	515.9	17.2	0.94	0.92	563.8
P-868	N1003	N1002		48	96	408.6	0.0044	515.9	16.1	1.00	1.33	386.4
P-869	N1004	N1003		48	96	330.3	0.0091	515.9	17.0	0.95	0.93	554.9
P-870	N1005	N1004		48	96	255.3	0.0157	502.4	20.7	0.76	0.69	728.7
P-871	N1006	N1005		48	96	311.6	0.0244	496.2	24.1	0.64	0.55	909.3
P-872	N1007	N1006		48	96	31.8	0.0016	496.2	15.5	1.00	2.15	230.8
P-873	N1008	N1007		48	96	269.9	0.0185	491.0	21.8	0.70	0.62	792.4
P-874	N1009	N1008		48	96	214.1	0.0140	491.0	19.7	0.78	0.71	689.2
P-875	N1010	N1009		48	96	64.1	0.0016	484.2	15.1	1.00	2.11	230.0
P-876	N1011	N1010		48	96	571.1	0.0035	476.6	14.9	1.00	1.38	344.5
P-877	N1012	N1011		24	84	243.6	0.0041	473.4	33.8	1.00	3.92	120.7
P-878	N1013	N1012		24	84	280.5	0.0143	468.1	33.4	1.00	2.08	225.0
P-879	N1014	N1013	48			385.8	0.0130	348.7	27.7	1.00	2.13	164.0
P-880	N1015	N1014	48			98.7	0.0304	348.7	27.7	1.00	1.39	251.1
P-881	N1016	N1015	48			183.7	0.0054	307.1	24.4	1.00	2.89	106.3
P-1046S	N1017	N1016	120			541.2	0.0203	311.6	20.9	0.25	0.13	2364.0
P-861	N1018	N1017	30			111.6	0.0099	311.6	63.5	1.00	7.63	40.8
P-860	N1019	N1018	30			128.1	0.0064	311.6	63.5	1.00	9.47	32.9
P-859	N1020	N1019	30			74.5	0.0199	311.6	63.5	1.00	5.37	58.0
P-858	N1021	N1020	30			439.8	0.0321	329.0	67.0	1.00	4.47	73.7
P-857	N1022	N1021	30			52.0	0.0321	329.0	67.0	1.00	4.46	73.7
P-856	N1023	N1022	36			178.0	0.0320	329.0	46.5	1.00	2.75	119.6
P-855	N1024	N1023	36			97.7	0.0320	314.8	44.5	1.00	2.63	119.7
P-854	N1025	N1024	36			322.3	0.0328	354.8	50.2	1.00	2.93	121.1
P-853	N1026	N1025	36			1086.7	0.0320	306.5	43.4	1.00	2.56	119.7
P-852	N1027	N1026	36			240.9	0.0550	314.6	44.5	1.00	2.01	156.9
P-851	N1028	N1027	36			1012.0	0.0175	191.7	27.1	1.00	2.17	88.4
P-1062S	N1029	N1028	120			910.5	0.1856	99.9	32.3	0.08	0.01	7143.8
P-862	N1030	N1029	12			454.5	0.0015	99.9	127.2	1.00	72.29	1.4
P-863	N1031	N1030	12			65.6	0.0091	67.8	86.3	1.00	19.84	3.4
P-882	N2001	N1013	21			615.1	0.0179	158.9	66.1	1.00	7.48	21.2
P-883	N2002	N2001	18			426.3	0.0235	143.2	81.0	1.00	8.88	16.1
P-884	N2003	N2002	21			1177.6	0.0399	103.3	42.9	1.00	3.25	31.7

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P-1047	O1001	O-1	36			103.2	0.0097	106.0	15.0	1.00	1.61	65.8
P-895	O1002	O1001	36			52.3	0.0096	80.2	11.3	1.00	1.23	65.4
P-894	O1003	O1002	36			325.0	0.0031	67.5	9.5	1.00	1.82	37.1
P-893	O1004	O1003	30			90.4	0.0310	67.5	16.8	0.76	0.93	72.4
P-1048	O1005	O1004	36			594.5	0.0094	57.2	10.4	0.73	0.88	64.9
P-890	O1006	O1005	36			211.7	0.0099	54.6	10.5	0.69	0.82	66.6
P-889	O1007	O1006	36			269.7	0.0083	44.9	9.4	0.64	0.74	61.0
P-888	O1008	O1007	36			259.3	0.0015	35.2	5.0	1.00	1.36	25.9
P-887	O1009	O1008	21			247.2	0.0015	26.1	10.8	1.00	4.24	6.1
P-886	O1010	O1009	24			223.0	0.0303	26.1	13.4	0.59	0.66	39.5
P-885	O1012	O1010	21			239.3	0.0078	13.6	6.6	0.79	0.97	14.0
61	P1002	P1001	48			176.1	0.0870	72.1	25.2	0.28	0.17	424.9
59	P1003	P1002	48			24.8	0.0628	72.1	22.4	0.30	0.20	361.0
87	P1004	P1003	48			91.3	0.0122	51.9	11.3	0.39	0.33	158.8
85	P1005	P1004	48			318.4	0.0213	47.8	13.5	0.32	0.23	210.2
83	P1006	P1005	42			197.7	0.0524	43.5	18.4	0.29	0.19	230.8
81	P1007	P1006	36			225.8	0.0750	43.5	21.2	0.33	0.24	183.2
79	P1008	P1007	24			262.1	0.0230	23.3	11.8	0.60	0.68	34.4
77	P1009	P1008	24			324.3	0.0316	17.6	12.4	0.46	0.44	40.3
75	P1010	P1009	24			184.4	0.0308	17.6	12.3	0.47	0.44	39.8
73	P1011	P1010	18			142.0	0.0318	7.5	10.0	0.44	0.40	18.8
71	P1012	P1011	18			123.5	0.0308	7.5	9.9	0.44	0.41	18.5
69	P1013	P1012	15			223.6	0.0273	4.7	8.4	0.46	0.44	10.7
67	P1014	P1013	15			40.2	0.0239	2.2	6.5	0.32	0.22	10.0
65	P1015	P1014	12			123.5	0.0175	2.2	5.9	0.47	0.46	4.7
63	P1016	P1015	12			65.2	0.0158	0.9	4.5	0.30	0.20	4.5
57	P1101	P1003	18			277.1	0.0252	15.1	10.7	0.74	0.90	16.7
55	P1102	P1101	18			84.1	0.0245	15.1	10.6	0.75	0.91	16.5
53	P1103	P1102	15			205.3	0.0380	10.1	11.4	0.68	0.80	12.6
51	P1104	P1103	15			74.9	0.0342	4.7	9.1	0.43	0.39	12.0
49	P1105	P1104	12			120.1	0.0490	4.7	10.5	0.55	0.59	7.9
47	P1106	P1105	12			133.1	0.0410	4.7	9.8	0.58	0.64	7.2
45	P1107	P1106	12			118.9	0.0328	4.7	9.0	0.63	0.72	6.5
105	P1201	P1010	18			55.4	0.0236	7.3	5.6	0.69	0.82	8.9
103	P1202	P1201	18			328.4	0.0314	7.3	9.9	0.43	0.39	18.7
101	P1203	P1202	18			241.6	0.0046	4.6	4.3	0.58	0.64	7.1
99	P1301	P1007	24			60.6	0.0200	16.7	10.3	0.51	0.52	32.0
97	P1302	P1301	24			43.9	0.0423	14.4	13.1	0.38	0.31	46.7
95	P1303	P1302	18			261.4	0.0096	14.4	8.1	1.00	1.40	10.3
93	P1304	P1303	15			316.8	0.0410	10.2	11.8	0.66	0.78	13.1
91	P1305	P1304	12			451.3	0.0234	3.6	7.4	0.59	0.65	5.5
89	P1306	P1305	12			84.4	0.0319	3.6	8.3	0.53	0.56	6.4
133	P2001	P2	42			132.0	0.0195	130.6	16.6	0.76	0.93	140.8
131	P2002	P2001	42			87.0	0.0193	130.6	16.6	0.76	0.93	140.2
129	P2003	P2002	42			508.3	0.0194	114.5	16.3	0.69	0.81	140.6
127	P2004	P2003	42			154.2	0.0900	114.5	29.3	0.43	0.38	302.6
125	P2005	P2004	42			731.9	0.0120	86.5	12.7	0.67	0.78	110.5

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
123	P2006	P2005	42			226.7	0.0120	86.5	12.7	0.67	0.78	110.5
121	P2007	P2006	42			491.5	0.0208	70.1	15.0	0.49	0.48	145.5
119	P2008	P2007	42			147.7	0.0492	70.1	20.6	0.38	0.31	223.7
117	P2009	P2008	42			163.2	0.0820	56.6	23.3	0.30	0.20	288.9
115	P2010	P2009	42			108.2	0.0670	56.6	21.7	0.32	0.22	261.2
113	P2011	P2010	42			626.7	0.0230	49.2	14.2	0.39	0.32	153.0
111	P2012	P2011	42			329.5	0.0200	44.3	13.1	0.38	0.31	142.7
109	P2013	P2012	54			127.3	0.0096	44.3	9.9	0.33	0.23	193.0
107	P2014	P2013	54			156.2	0.0100	44.3	10.0	0.32	0.23	197.1
39	R1001	R-1	36			1358.3	0.0007	170.2	24.1	1.00	9.38	18.1
P-1086	R1002	R1001	36			1126.5	0.0195	170.2	24.1	1.00	1.82	93.5
P-212	R1003	R1002	30			137.1	0.0219	161.8	33.0	1.00	2.66	60.8
P-211	R1004	R1003	24			390.6	0.0307	36.4	14.4	0.75	0.92	39.8
P-1087	S1001	S-1	42			535.6	0.0034	179.1	18.6	1.00	3.04	59.0
P-300	S1002	S1001	30			172.2	0.0930	179.1	36.5	1.00	1.43	125.4
P-299	S1003	S1002	18			105.2	0.0143	55.1	31.2	1.00	4.38	12.6
P-298	S1004	S1003	18			312.7	0.0607	50.8	28.7	1.00	1.96	25.9
P-297	S1005	S1004	18			122.8	0.0426	50.8	28.7	1.00	2.33	21.7
P-296	S1006	S1005	18			193.1	0.0880	45.8	25.9	1.00	1.47	31.3
P-295	S1007	S1006	18			332.0	0.0633	39.6	22.4	1.00	1.50	26.5
P-303	S2001	S1002	30			234.6	0.0532	118.7	24.2	1.00	1.25	94.9
P-312	S2002	S2001	24			358.1	0.0166	38.2	12.2	1.00	1.31	29.2
P-313	S2003	S2002	24			131.9	0.0735	38.2	20.6	0.57	0.62	61.5
P-314	S2004	S2003	24			119.1	0.0671	28.9	18.6	0.50	0.49	58.8
P-304	S3001	S2001	24			176.6	0.0266	82.9	26.4	1.00	2.24	37.0
P-305	S3002	S3001	24			199.7	0.0432	82.9	26.4	1.00	1.76	47.1
P-306	S3003	S3002	24			376.6	0.1494	59.4	30.0	0.60	0.68	87.7
P-307	S3004	S3003	24			138.1	0.0725	39.3	20.6	0.58	0.64	61.1
P-308	S3005	S3004	18			158.0	0.0739	39.3	22.2	1.00	1.37	28.6
P-309	S3006	S3005	18			131.3	0.0853	27.7	19.7	0.74	0.90	30.8
P-310	S3007	S3006	18			190.1	0.0692	27.7	17.9	0.82	1.00	27.7
P-311	S3008	S3007	18			176.2	0.0719	19.3	17.2	0.61	0.68	28.2
P-1081	T1001	T-1	54			144.5	0.0221	186.0	19.5	0.58	0.63	293.0
P-218	T1002	T1001	54			128.8	0.0220	149.3	18.5	0.51	0.51	292.7
P-219	T1003	T1002	54			104.8	0.0220	149.3	18.5	0.51	0.51	292.7
P-220	T1004	T1003	54			290.8	0.0382	149.3	22.7	0.43	0.39	385.6
P-225	T1005	T1004	54			73.2	0.0015	106.6	6.7	1.00	1.40	76.4
P-226	T1006	T1005	54			114.4	0.0172	106.6	15.5	0.45	0.41	258.8
P-227	T1007	T1006	54			355.0	0.0030	106.6	7.7	0.81	0.99	107.2
P-265	T1008	T1007	54			665.7	0.0142	51.9	11.9	0.32	0.22	234.9
P-266	T1009	T1008	24			366.6	0.0122	51.9	16.5	1.00	2.07	25.0
P-267	T1010	T1009	24			145.2	0.0508	51.9	16.5	1.00	1.01	51.1
P-268	T1011	T1010	24			58.0	0.0722	36.9	20.3	0.56	0.61	60.9
P-269	T1012	T1011	24			343.9	0.0498	26.3	16.3	0.51	0.52	50.6
P-270	T1013	T1012	24			92.7	0.0582	26.3	17.2	0.49	0.48	54.7
P-217	T2001	T1001	12			83.2	0.0216	33.3	42.4	1.00	6.34	5.3
P-216	T2002	T2001	18			394.7	0.0145	33.3	18.9	1.00	2.63	12.7

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P-215	T2003	T2002	15			379.2	0.0390	33.3	27.2	1.00	2.60	12.8
P-224	T3001	T1001	12			244.8	0.0033	0.0	0.0	0.00	0.00	2.0
P-221	T4001	T1004	18			44.4	0.0041	63.3	35.8	1.00	9.45	6.7
P-222	T4002	T4001	15			572.8	0.0190	63.3	51.6	1.00	7.09	8.9
P-223	T4003	T4002	15			415.6	0.0576	36.7	29.9	1.00	2.36	15.5
P-229	T5001	T1007	30			60.4	0.0321	63.6	16.9	0.72	0.86	73.7
P-230	T5002	T5001	30			83.9	0.0393	63.6	18.4	0.66	0.78	81.6
P-231	T5003	T5002	30			60.8	0.0137	63.6	13.0	1.00	1.32	48.1
P-232	T5004	T5003	24			68.8	0.0118	63.6	20.2	1.00	2.58	24.6
P-233	T5005	T5004	24			61.3	0.0130	63.6	20.2	1.00	2.45	25.9
P-234	T5006	T5005	24			65.2	0.0123	33.6	10.7	1.00	1.34	25.1
P-235	T5007	T5006	24			67.3	0.0120	33.6	10.7	1.00	1.35	24.9
P-236	T5008	T5007	24			69.5	0.0116	33.6	10.7	1.00	1.37	24.5
P-237	T5009	T5008	24			72.3	0.0115	28.3	9.0	1.00	1.16	24.3
P-238	T5010	T5009	24			62.2	0.0133	28.3	9.0	1.00	1.08	26.2
P-239	T5011	T5010	24			62.9	0.0135	28.3	9.0	1.00	1.07	26.4
P-240	T5012	T5011	24			203.9	0.0067	19.8	6.3	1.00	1.07	18.6
P-241	T5013	T5012	21			279.5	0.0161	19.8	9.5	0.80	0.98	20.2
P-242	T5014	T5013	21			258.1	0.0030	19.8	8.2	1.00	2.27	8.7
P-1082	U1001	U-1	48			54.0	0.0020	99.3	7.9	1.00	1.53	65.0
P-271	U1002	U1001	48			74.8	0.0021	99.3	7.9	1.00	1.49	66.6
P-272	U1003	U1002	48			60.6	0.0026	85.4	6.8	1.00	1.15	74.0
P-273	U1004	U1003	48			88.8	0.0018	85.4	6.8	1.00	1.40	61.1
P-274	U1005	U1004	48			103.3	0.0072	80.0	10.4	0.59	0.66	121.9
P-275	U1006	U1005	48			61.1	0.0031	80.0	7.3	0.82	1.00	80.3
P-276	U1007	U1006	48			64.1	0.0028	80.0	6.4	1.00	1.05	76.3
P-277	U1008	U1007	48			65.3	0.0029	80.0	6.4	1.00	1.03	77.7
P-278	U1009	U1008	48			54.8	0.0035	80.0	7.7	0.77	0.94	84.8
P-279	U1010	U1009	48			47.7	0.0034	71.8	7.5	0.71	0.86	83.4
P-280	U1011	U1010	48			48.6	0.0033	71.8	7.4	0.72	0.87	82.6
P-281	U1012	U1011	48			47.0	0.0351	71.8	18.2	0.35	0.27	269.9
P-282	U1013	U1012	48			78.5	0.0182	71.8	14.3	0.42	0.37	194.4
P-283	U1014	U1013	36			83.9	0.0380	64.1	18.4	0.50	0.49	130.4
P-284	U1015	U1014	36			265.6	0.0120	64.1	11.7	0.72	0.87	73.4
P-285	U1016	U1015	36			49.7	0.0283	46.1	15.1	0.45	0.41	112.6
P-286	U1017	U1016	18			363.4	0.0818	35.1	19.9	1.00	1.17	30.1
P-1083	V1001	V-1	30			171.7	0.0015	86.5	17.6	1.00	5.40	16.0
P-244	V1002	V1001	12			72.2	0.0222	77.0	98.0	1.00	14.47	5.3
P-245	V1003	V1002	30			200.1	0.0080	77.0	15.7	1.00	2.09	36.8
P-246	V1004	V1003	30			60.0	0.0067	77.0	15.7	1.00	2.29	33.6
P-247	V1005	V1004	42			96.4	0.0078	71.0	10.3	0.67	0.80	89.0
P-248	V1006	V1005	36			441.2	0.0083	52.4	9.7	0.72	0.86	60.7
P-249	V1007	V1006	36			103.9	0.1513	46.1	27.8	0.28	0.18	260.1
P-287	V1008	V1007	36			155.2	0.0015	46.1	6.5	1.00	1.79	25.7
P-288	V1009	V1008	36			101.1	0.0039	46.1	6.5	1.00	1.11	41.5
P-289	V1010	V1009	36			72.7	0.0467	46.1	18.2	0.39	0.32	144.5
P-290	V1011	V1010	36			54.5	0.0670	46.1	20.7	0.35	0.27	173.1

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P-291	V1012	V1011	36			55.8	0.0608	37.0	18.8	0.32	0.22	164.9
P-292	V1013	V1012	24			313.9	0.0365	37.0	15.5	0.71	0.85	43.3
P-293	V1014	V1013	24			74.2	0.0539	23.3	16.3	0.47	0.44	52.7
P-294	V1015	V1014	24			127.7	0.0239	23.3	11.9	0.60	0.66	35.1
P-250	V2001	V1005	30			310.3	0.0036	12.1	5.0	0.49	0.49	24.8
P-251	V2002	V2001	24			148.3	0.0047	9.8	5.2	0.58	0.63	15.5
P-252	V2003	V2002	24			112.7	0.0044	7.0	4.7	0.48	0.46	15.1
P-253	V2004	V2003	15			132.4	0.0109	3.5	5.5	0.51	0.52	6.8
P-1084	W1001	W-1	24			197.5	0.0467	51.2	16.3	1.00	1.04	49.0
P-260	W1002	W1001	12			216.2	0.0467	51.2	65.2	1.00	6.63	7.7
P-261	W1003	W1002	12			400.2	0.0467	51.2	65.2	1.00	6.63	7.7
P-262	W1004	W1003	12			427.7	0.0600	22.3	28.4	1.00	2.55	8.8
P-263	W1005	W1004	24			170.0	0.0015	22.3	7.1	1.00	2.56	8.7
P-264	W1006	W1005	15			210.5	0.0015	22.3	18.2	1.00	8.83	2.5
P-1085	W1101	W-1	36			129.9	0.0905	29.8	20.4	0.26	0.15	201.2
P-257	W1102	W1101	12			195.8	0.0930	29.8	38.0	1.00	2.74	10.9
P-256	W1103	W1102	24			214.7	0.0930	29.8	21.2	0.46	0.43	69.2
P-255	W1104	W1103	12			144.5	0.0930	17.3	22.0	1.00	1.59	10.9
P-254	W1105	W1104	24			239.9	0.0930	17.3	18.3	0.34	0.25	69.2
P-1091	X1001	X-1	36			326.1	0.1732	77.0	33.7	0.36	0.28	278.3
P-1090	X1002	X1001	36			209.5	0.1163	70.7	28.4	0.38	0.31	228.1
P-320	X1003	X1002	24			311.5	0.0369	42.0	15.8	0.79	0.96	43.6
P-319	X1004	X1003	24			204.3	0.0441	35.6	16.6	0.64	0.75	47.6
P-318	X1005	X1004	24			587.0	0.0341	21.5	13.4	0.51	0.51	41.9
P-317	X1006	X1005	24			361.9	0.0193	16.1	10.1	0.51	0.51	31.5
P-316	X1007	X1006	24			228.8	0.0044	16.1	5.1	1.00	1.07	15.0
P-315	X1008	X1007	24			235.5	0.0212	8.5	8.8	0.35	0.26	33.1
P-321	X2001	X1002	30			280.5	0.0103	24.1	8.8	0.54	0.58	41.8
P-322	X2002	X2001	30			417.4	0.0073	24.1	7.7	0.61	0.69	35.2
P-323	X2003	X2002	30			290.4	0.1097	24.1	20.9	0.28	0.18	136.2
P-1088	X2004	X2003	30			50.0	0.0150	24.1	10.1	0.49	0.48	50.3
P-1089	X2005	X2004	30			499.5	0.0180	16.2	9.8	0.37	0.29	55.2
P-1092	Y1001	Y-1	36			122.8	0.0105	185.6	26.3	1.00	2.71	68.5
P-330	Y1002	Y1001	36			86.8	0.0518	180.0	25.5	1.00	1.18	152.2
P-329	Y1003	Y1002	36			35.0	0.0017	180.0	25.5	1.00	6.50	27.7
P-326	Y1004	Y1003	30			494.1	0.0334	165.2	33.7	1.00	2.20	75.2
P-327	Y1005	Y1004	30			527.9	0.0227	151.2	30.8	1.00	2.44	62.0
P-328	Y1006	Y1005	30			223.7	0.0134	146.9	29.9	1.00	3.09	47.6
P-1093S	Y1007	Y1006	120			250.4	0.0399	141.2	21.0	0.14	0.04	3313.6
P-331	Y1008	Y1007	36			616.7	0.0859	82.6	26.5	0.45	0.42	196.1
P-332	Y1009	Y1008	30			155.7	0.0128	74.5	15.2	1.00	1.60	46.6
P-333	Y1010	Y1009	30			142.7	0.0140	74.5	15.2	1.00	1.53	48.7
P-334	Y1011	Y1010	30			453.6	0.0088	66.6	13.6	1.00	1.72	38.6
P-335	Y1012	Y1011	30			80.5	0.0124	66.6	13.6	1.00	1.45	45.8
P-336	Y1013	Y1012	12			122.2	0.0082	54.2	69.0	1.00	16.78	3.2
P-337	Y1014	Y1013	12			104.5	0.0541	54.2	69.0	1.00	6.53	8.3
P-325	Y2001	Y1003	18			147.5	0.0245	16.2	10.6	0.80	0.98	16.5

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 10-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-324	Y2002	Y2001	12			109.1	0.0733	10.6	13.5	1.00	1.10	9.7
P-339	Y3001	Y1007	18			237.7	0.1809	47.8	27.0	1.00	1.07	44.8
P-340	Y3002	Y3001	18			230.6	0.0043	42.0	23.8	1.00	6.05	6.9
P-341	Y3003	Y3002	18			463.8	0.0015	42.0	23.8	1.00	10.26	4.1
P-342	Y3004	Y3003	18			162.8	0.0015	29.0	16.4	1.00	7.16	4.0
P-343	Y3005	Y3004	12			137.4	0.0655	29.0	36.9	1.00	3.17	9.1
P-344	Y3006	Y3005	12			69.1	0.0145	29.0	36.9	1.00	6.74	4.3
P-345	Y3101	Y3004	12			223.0	0.0626	0.0	0.0	0.00	0.00	8.9
P-1095	Z1001	Z-1	12			29.7	0.0017	46.3	59.0	1.00	31.61	1.5
P-1094	Z1002	Z1001	12			20.2	0.0020	46.3	59.0	1.00	29.14	1.6
P-351	Z1003	Z1002	21			134.9	0.0148	45.6	19.0	1.00	2.36	19.3
P-349	Z1004	Z1003	18			347.9	0.0015	32.9	18.6	1.00	8.07	4.1
P-348	Z1005	Z1004	15			64.8	0.0617	32.9	26.8	1.00	2.04	16.1
P-347	Z1006	Z1005	15			226.0	0.0015	22.9	18.7	1.00	9.12	2.5
P-346	Z1007	Z1006	12			44.9	0.0045	22.9	29.2	1.00	9.61	2.4
P-1093	Z1101	Z1001	12			22.1	0.0023	0.0	0.0	0.00	0.00	1.7
P-350	Z2001	Z1003	18			176.8	0.0170	11.2	8.7	0.69	0.82	13.7

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 100-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
35S	80	B2003	120			1611.4	0.0068	101.0	10.2	0.18	0.07	1370.1
33	82	80	54			604.2	0.0074	101.0	11.1	0.55	0.59	170.2
31	84	82		48	76	167.0	0.0030	101.0	7.4	0.54	0.43	232.3
29	86	84	48			467.6	0.0043	101.0	8.0	1.00	1.07	94.2
P-988	A1001	A-1	78			79.7	0.0015	627.5	18.9	1.00	3.08	204.0
P-16	A1002	A1001	78			984.4	0.0010	627.5	18.9	1.00	3.86	162.4
P-15	A1003	A1002	84			44.5	0.0022	627.5	16.3	1.00	2.07	303.8
P-14	A1004	A1003	84			119.0	0.0015	627.5	16.3	1.00	2.52	249.2
P-13	A1005	A1004	84			426.4	0.0015	597.8	15.5	1.00	2.41	248.2
P-12	A1006	A1005	84			109.7	0.0015	597.8	15.5	1.00	2.44	244.7
P-11	A1007	A1006	84			235.4	0.0015	483.7	12.6	1.00	1.96	247.0
P-21	A1008	A1007	72			953.4	0.0015	385.3	13.6	1.00	2.34	164.5
P-22	A1009	A1008	66			801.7	0.0015	353.6	14.9	1.00	2.67	132.4
P-23	A1010	A1009	60			755.4	0.0015	330.0	16.8	1.00	3.24	101.9
P-987	A1011	A1010	48			745.2	0.0015	290.4	23.1	1.00	5.25	55.3
P-374	A1012	A1011	48			176.6	0.0017	290.4	23.1	1.00	4.89	59.4
P-373	A1013	A1012	48			151.1	0.0015	277.1	22.1	1.00	4.93	56.2
P-372	A1014	A1013	30			714.3	0.0016	277.1	56.5	1.00	17.02	16.3
P-370	A1015	A1014	18			35.7	0.0014	250.8	141.9	1.00	63.61	3.9
P-369S	A1016	A1015	120			204.5	0.0016	250.8	7.8	0.43	0.38	656.0
P-368	A1017	A1016	18			29.7	0.0010	250.8	141.9	1.00	74.97	3.3
P-367	A1018	A1017	36			302.8	0.0015	180.8	25.6	1.00	7.01	25.8
P-366	A1019	A1018	36			219.7	0.0016	180.8	25.6	1.00	6.77	26.7
P-365	A1020	A1019	36			315.9	0.0015	99.8	14.1	1.00	3.83	26.1
P-364	A1021	A1020	36			75.1	0.0016	99.8	14.1	1.00	3.73	26.7
P-363	A1022	A1021	48			676.1	0.0367	18.4	12.5	0.18	0.07	276.0
P-27	A2001	A1006	18			293.5	0.0015	132.2	74.8	1.00	32.07	4.1
P-28	A2002	A2001	18			134.6	0.0015	132.2	74.8	1.00	32.57	4.1
P-29	A2003	A2002	12			703.8	0.0006	132.2	168.4	1.00	155.27	0.9
P-30	A2004	A2003	12			90.7	0.0015	101.5	129.2	1.00	72.29	1.4
P-31	A2005	A2004	12			229.3	0.0015	101.5	129.2	1.00	73.76	1.4
P-32	A2006	A2005	12			189.9	0.0006	0.0	0.0	0.00	0.00	0.9
P-33	A2101	A2005	30			528.7	0.0015	24.7	5.0	1.00	1.56	15.9
P-34	A2201	A2005	21			567.0	0.0057	42.7	17.7	1.00	3.57	12.0
P-35	A2203	A2201	21			377.9	0.0096	42.7	17.7	1.00	2.74	15.6
P-10	A3001	A1007	36			295.9	0.0015	88.9	12.6	1.00	3.41	26.1
P-9	A3002	A3001	36			49.3	0.0016	88.9	12.6	1.00	3.30	26.9
P-8	A3003	A3002	36			254.9	0.0015	83.8	11.9	1.00	3.20	26.2
P-7	A3004	A3003	42			1168.7	0.0016	83.8	8.7	1.00	2.06	40.7
P-990	A3005	A3004	24			485.3	0.0072	83.8	26.7	1.00	4.35	19.3
P-989	A3006	A3005	21			524.4	0.0021	65.0	27.0	1.00	8.93	7.3
P-5	A3007	A3006	18			43.6	0.0115	52.0	29.4	1.00	4.61	11.3
P-4	A3008	A3007	18			238.2	0.0041	52.0	29.4	1.00	7.74	6.7
P-3	A3009	A3008	15			261.5	0.0037	44.7	36.4	1.00	11.32	3.9
P-2	A3010	A3009	15			262.7	0.0027	38.5	31.4	1.00	11.44	3.4
P-1	A3011	A3010	12			274.8	0.0095	30.9	39.3	1.00	8.88	3.5
P-20	A4001	A1008	48			573.5	0.0015	57.5	4.6	1.00	1.04	55.1

Appendix C
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Gravity Main Output Report: 100-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-19	A4002	A4001	48			433.2	0.0015	57.5	4.6	1.00	1.03	55.8
P-18	A4003	A4002	48			405.0	0.0016	57.5	5.2	0.82	1.00	57.7
P-17	A4004	A4003	48			68.8	0.0015	57.5	4.6	1.00	1.05	54.9
P-24	A5001	A1010	48			508.0	0.0015	49.1	5.0	0.73	0.89	55.3
P-25	A5002	A5001	48			423.3	0.0015	49.1	5.1	0.72	0.87	56.4
P-26	A5003	A5002	48			133.4	0.0015	49.1	5.0	0.73	0.88	55.8
P-371	A6001	A1014	18			134.7	0.0015	25.7	14.6	1.00	6.34	4.1
P-1097	AA1001	AA-1	36			106.1	0.0188	150.3	21.3	1.00	1.64	91.8
P-358	AA1002	AA1001	36			49.2	0.0203	140.8	19.9	1.00	1.48	95.3
P-357	AA1003	AA1002	36			418.7	0.0072	130.2	18.4	1.00	2.30	56.6
P-356	AA1004	AA1003	36			429.6	0.0163	89.3	12.6	1.00	1.05	85.4
P-355	AA1005	AA1004	36			463.0	0.0216	72.3	15.2	0.64	0.74	98.3
P-354	AA1006	AA1005	36			134.5	0.0372	66.2	18.4	0.51	0.51	129.0
P-353	AA1007	AA1006	36			482.5	0.1057	47.6	24.6	0.32	0.22	217.4
P-1096	AA1008	AA1007	36			882.3	0.0015	13.9	3.7	0.52	0.54	25.9
P-362	AA2001	AA1003	30			145.9	0.0069	33.3	7.9	0.80	0.98	34.0
P-361	AA2002	AA2001	30			101.0	0.0198	33.3	12.2	0.54	0.58	57.9
P-360	AA2003	AA2002	30			40.3	0.0015	33.3	6.8	1.00	2.10	15.9
P-359	AA2004	AA2003	24			257.0	0.1907	30.1	27.7	0.38	0.30	99.0
P-1098	AB1001	AB-1	72			216.8	0.0015	292.5	10.3	1.00	1.77	165.7
P-1099	AB1002	AB1001	12			29.5	6.2096	265.9	338.6	1.00	2.99	89.0
P-710	AB1003	AB1002	54			258.7	0.0030	242.1	15.2	1.00	2.24	108.3
P-709	AB1004	AB1003	54			553.5	0.0054	242.1	15.2	1.00	1.67	145.2
P-1080	AB1005	AB1004	42			1025.0	0.0480	217.9	26.2	0.81	0.99	221.0
P-716	AB1006	AB1005	12			118.8	0.0619	103.4	131.6	1.00	11.63	8.9
P-717	AB1007	AB1006	15			211.3	0.0015	103.4	84.2	1.00	41.01	2.5
P-718	AB1008	AB1007	21			71.5	0.0014	82.1	34.1	1.00	13.82	5.9
P-719	AB1009	AB1008	21			84.3	0.0015	82.1	34.1	1.00	13.16	6.2
P-720	AB1010	AB1009	24			157.6	0.0263	82.1	26.1	1.00	2.23	36.8
P-721	AB1011	AB1010	21			266.3	0.0909	78.8	32.8	1.00	1.65	47.9
P-722	AB1012	AB1011	21			354.0	0.0455	70.2	29.2	1.00	2.07	33.9
P-723	AB1013	AB1012	21			219.9	0.0200	70.2	29.2	1.00	3.12	22.5
P-724	AB1014	AB1013	21			252.0	0.0198	70.2	29.2	1.00	3.14	22.4
P-725	AB1015	AB1014	18			362.0	0.0989	62.1	35.1	1.00	1.88	33.1
P-726	AB1016	AB1015	12			199.5	0.0689	44.0	56.0	1.00	4.70	9.4
P-705	AB2001	AB1001	18			153.4	0.0015	5.7	3.2	1.00	1.39	4.1
P-704	AB3001	AB1001	36			406.8	0.4664	28.3	35.9	0.17	0.06	456.7
P-703	AB3002	AB3001	36			292.4	0.0246	28.3	12.6	0.36	0.27	104.8
P-702	AB3003	AB3002	36			69.2	0.0040	28.3	6.4	0.60	0.67	42.5
P-701	AB3004	AB3003	30			149.0	0.0074	19.6	7.4	0.53	0.56	35.3
P-700	AB3005	AB3004	30			48.7	0.0637	13.1	14.5	0.24	0.13	103.8
P-699	AB3006	AB3005	24			145.7	0.0184	13.1	9.4	0.46	0.43	30.8
P-698	AB3007	AB3006	24			149.9	0.0133	13.1	8.3	0.50	0.50	26.2
P-697	AB3008	AB3007	24			169.9	0.0164	8.1	7.9	0.36	0.28	29.0
P-711	AB4001	AB1002	15			202.7	0.0120	27.1	22.1	1.00	3.81	7.1
P-712	AB4002	AB4001	12			231.4	0.0107	20.0	25.4	1.00	5.41	3.7
P-713	AB4003	AB4002	15			113.3	0.0100	20.0	16.3	1.00	3.09	6.5

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P-715	AB5001	AB1004	21			429.4	0.1108	20.6	20.6	0.43	0.39	52.9
P-714	AB5002	AB5001	21			214.6	0.0614	11.0	14.0	0.36	0.28	39.4
P-707	AB6001	AB1005	42			32.9	0.0015	122.9	12.8	1.00	3.13	39.3
P-706	AB6002	AB6001	42			393.0	0.0015	102.6	10.7	1.00	2.62	39.1
P-1079	AC1001	AC-1	12			101.4	0.0197	88.1	112.2	1.00	17.56	5.0
P-1078	AC1002	AC1001	12			193.7	0.0310	82.3	104.8	1.00	13.09	6.3
P-1077	AC1003	AC1002	12			166.9	0.0360	82.3	104.8	1.00	12.15	6.8
P-727	AC1004	AC1003	18			87.9	0.0455	39.6	22.4	1.00	1.76	22.5
P-728	AC1005	AC1004	18			151.0	0.0993	39.6	22.4	1.00	1.19	33.2
P-729	AC1006	AC1005	18			391.4	0.0869	28.6	19.9	0.76	0.92	31.0
P-730	AC1007	AC1006	15			473.2	0.0845	11.0	15.9	0.55	0.58	18.8
P-731	AC1008	AC1007	15			349.2	0.0143	11.0	8.9	1.00	1.41	7.8
P-732	AC1009	AC1008	15			210.3	0.0571	5.1	11.3	0.40	0.33	15.5
P-1076	AD1001	AD-1	24			113.6	0.0088	177.6	56.5	1.00	8.34	21.3
P-1075	AD1002	AD1001	24			31.0	0.0323	177.6	56.5	1.00	4.36	40.8
P-1074	AD1003	AD1002	24			73.7	0.0136	177.6	56.5	1.00	6.72	26.4
P-741	AD1004	AD1003	24			149.9	0.0133	141.2	45.0	1.00	5.39	26.2
P-740	AD1005	AD1004	24			138.2	0.0217	133.6	42.5	1.00	4.00	33.4
P-739	AD1006	AD1005	24			103.9	0.0193	133.6	42.5	1.00	4.24	31.5
P-738	AD1007	AD1006	21			187.6	0.0267	127.7	53.1	1.00	4.92	25.9
P-737	AD1008	AD1007	15			347.1	0.0922	58.6	47.8	1.00	2.98	19.7
P-736	AD1009	AD1008	15			384.4	0.0885	52.3	42.7	1.00	2.72	19.3
P-735	AD1010	AD1009	15			311.8	0.0866	38.0	31.0	1.00	1.99	19.1
P-734	AD1011	AD1010	15			313.3	0.0032	26.5	21.6	1.00	7.25	3.7
P-733	AD1012	AD1011	12			333.8	0.0210	9.9	12.6	1.00	1.92	5.2
P-745	AD2001	AD1007	21			72.0	0.0417	69.1	28.7	1.00	2.13	32.4
P-746	AD2002	AD2001	21			243.4	0.0698	69.1	28.7	1.00	1.65	42.0
P-747	AD2003	AD2002	21			220.6	0.0227	63.7	26.5	1.00	2.66	23.9
P-748	AD2004	AD2003	18			217.8	0.1194	53.3	30.1	1.00	1.46	36.4
P-749	AD2005	AD2004	18			458.6	0.0850	49.7	28.1	1.00	1.62	30.7
P-750	AD2006	AD2005	18			160.9	0.0015	49.7	28.1	1.00	12.23	4.1
P-751	AD2007	AD2006	18			90.8	0.0441	49.7	28.1	1.00	2.25	22.1
P-752	AD2008	AD2007	18			167.0	0.0479	41.4	23.4	1.00	1.79	23.0
P-753	AD2009	AD2008	18			129.7	0.0015	41.4	23.4	1.00	10.26	4.0
P-754	AD2010	AD2009	18			212.4	0.0141	28.4	16.1	1.00	2.27	12.5
P-742	AD3001	AD1009	12			324.0	0.0185	14.4	18.3	1.00	2.95	4.9
P-743	AD3002	AD3001	12			204.2	0.0196	3.9	7.0	0.66	0.77	5.0
P-744	AD3003	AD3002	12			241.1	0.0871	3.9	12.4	0.42	0.37	10.5
P-1069	AE1001	AE-1	42			129.5	0.0601	242.5	29.3	0.80	0.98	247.3
P-771	AE1002	AE1001	42			352.9	0.0680	231.4	30.9	0.73	0.88	263.1
P-770	AE1003	AE1002	42			197.2	0.0015	231.4	24.1	1.00	5.88	39.3
P-769	AE1004	AE1003	42			386.5	0.0846	173.2	31.7	0.55	0.59	293.4
P-768	AE1005	AE1004	42			783.5	0.0326	162.3	21.4	0.74	0.89	182.0
P-1072	AE1006	AE1005	24			72.6	0.1506	73.0	31.3	0.70	0.83	88.0
P-1071	AE1007	AE1006	24			223.0	0.0245	73.0	23.2	1.00	2.06	35.5
P-765	AE1008	AE1007	24			374.4	0.0929	62.3	24.9	0.74	0.90	69.2
P-764	AE1009	AE1008	24			58.6	0.0568	62.3	19.8	1.00	1.15	54.1

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P-763	AE1010	AE1009	24			498.9	0.0511	50.2	18.6	0.80	0.98	51.3
P-762	AE1011	AE1010	18			273.9	0.0045	43.1	24.4	1.00	6.11	7.1
P-777	AE2001	AE1003	24			113.3	0.2223	37.5	31.0	0.41	0.35	107.0
P-776	AE2002	AE2001	24			114.7	0.0628	37.5	19.3	0.59	0.66	56.8
P-775	AE2003	AE2002	24			172.7	0.0949	32.7	21.9	0.48	0.47	69.9
P-774	AE2004	AE2003	24			352.6	0.0724	22.3	17.9	0.42	0.36	61.0
P-773	AE2005	AE2004	24			374.2	0.0199	13.1	9.7	0.44	0.41	32.0
P-767	AE3001	AE1005	36			308.3	0.1377	74.7	30.7	0.38	0.30	248.2
P-1070	AF1001	AF-1	90			440.1	0.0476	337.6	29.7	0.30	0.20	1680.3
P-787	AF1002	AF1001	48			137.2	0.0787	243.1	33.6	0.56	0.60	404.1
P-786	AF1003	AF1002	48			634.4	0.0334	243.1	23.8	0.76	0.92	263.0
P-791	AF1004	AF1003	48			516.8	0.0399	62.3	18.3	0.32	0.22	287.7
P-792	AF1005	AF1004	48			710.2	0.0158	54.4	12.6	0.38	0.30	180.9
P-788	AF2001	AF1001	60			273.0	0.0015	80.1	5.7	0.67	0.79	101.2
P-789	AF2002	AF2001	54			354.0	0.0015	50.0	5.1	0.59	0.65	76.3
P-785	AF3001	AF1003	30			41.5	0.0662	159.8	32.6	1.00	1.51	105.8
P-784	AF3002	AF3001	30			397.8	0.0420	159.8	32.6	1.00	1.90	84.2
P-783	AF3003	AF3002	24			64.8	0.0386	159.8	50.9	1.00	3.59	44.6
P-782	AF3004	AF3003	24			179.5	0.0691	149.8	47.7	1.00	2.51	59.6
P-781	AF3005	AF3004	24			220.8	0.0784	149.8	47.7	1.00	2.36	63.5
P-780	AF3006	AF3005	24			239.2	0.0412	132.3	42.1	1.00	2.87	46.0
P-779	AF3007	AF3006	24			264.7	0.0655	105.6	33.6	1.00	1.82	58.1
P-1073	AG1001	AG-1	21			202.1	0.0148	72.5	30.2	1.00	3.75	19.4
P-760	AG1002	AG1001	18			442.1	0.0204	42.9	24.3	1.00	2.85	15.0
P-758	AG1003	AG1002	12			128.0	0.2579	14.6	25.7	0.68	0.81	18.1
P-757	AG1004	AG1003	12			104.9	0.4288	14.6	31.4	0.57	0.63	23.4
P-756	AG1005	AG1004	12			80.1	0.0624	14.6	18.6	1.00	1.64	8.9
P-755	AG1006	AG1005	12			241.1	0.0166	10.9	13.9	1.00	2.38	4.6
P-761	AG2001	AG1002	12			422.5	0.0544	17.2	21.9	1.00	2.06	8.3
P-1100	AH1001	AH-1	36			96.3	0.0015	20.0	4.0	0.67	0.78	25.5
P-794	AH1002	AH1001	36			133.7	0.0015	18.7	4.0	0.63	0.72	25.9
P-795	AH1003	AH1002	36			350.8	0.0513	18.7	14.6	0.24	0.12	151.5
P-796	AH1004	AH1003	36			189.4	0.1109	10.6	16.2	0.15	0.05	222.7
P-797	AH1005	AH1004	36			370.4	0.1107	10.6	16.2	0.15	0.05	222.5
P-798	AH1006	AH1005	21			248.9	0.1326	4.9	14.6	0.20	0.08	57.9
21	B1009	B-1		66	114	173.7	0.0058	339.6	12.7	0.51	0.40	847.8
P-44	B1010	B1009	72			185.9	0.0054	324.5	11.5	1.00	1.04	311.4
23	B1012	B1010	54			316.5	0.0014	310.2	19.5	1.00	4.17	74.3
P-41	B1013	B1012	54			520.5	0.0011	285.6	18.0	1.00	4.46	64.1
P-40	B1014	B1013	60			465.8	0.0064	274.5	14.0	1.00	1.31	209.6
P-39	B1015	B1014	36			247.9	0.0040	180.5	25.5	1.00	4.25	42.5
P-38	B1016	B1015	36			156.8	0.0089	180.5	25.5	1.00	2.86	63.2
P-985	B1017	B1016	24			282.1	0.0092	155.2	49.4	1.00	7.13	21.8
P-984	B1018	B1017	24			748.0	0.0017	155.2	49.4	1.00	16.41	9.5
P-36	B1019	B1018	24			173.0	0.0015	87.9	28.0	1.00	9.99	8.8
P-986	B2001	B1014	12			209.5	0.0024	175.4	223.3	1.00	100.50	1.7
P-987S	B2002	B2001	120			705.2	0.0015	175.4	7.0	0.36	0.27	642.9

Appendix C
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-53	B2003	B2002	54			257.2	0.0012	175.4	11.0	1.00	2.60	67.3
P-54	B2004	B2003	54			57.7	0.0797	115.5	27.6	0.31	0.21	556.8
P-55	B2005	B2004	24			544.8	0.0079	115.5	36.8	1.00	5.73	20.2
P-56	B2006	B2005	21			281.9	0.0058	86.3	35.9	1.00	7.14	12.1
P-57	B2007	B2006	21			283.4	0.0101	86.3	35.9	1.00	5.40	16.0
P-58	B2008	B2007	12			264.6	0.0125	57.4	73.0	1.00	14.38	4.0
P-52	B3001	B1016	12			264.1	0.0015	0.0	0.0	0.00	0.00	1.4
P-977	C1001	C-1	84			195.7	0.0016	387.3	10.1	1.00	1.52	255.0
P-975	C1002	C1001	36			53.8	0.0015	265.1	37.5	1.00	10.28	25.8
P-72	C1003	C1002	36			79.1	0.0015	265.1	37.5	1.00	10.18	26.0
P-71	C1004	C1003	36			113.3	0.0015	265.1	37.5	1.00	10.24	25.9
P-70	C1005	C1004	36			176.8	0.0015	252.7	35.7	1.00	9.67	26.1
P-69	C1006	C1005	36			274.7	0.0015	234.1	33.1	1.00	8.95	26.2
P-68	C1007	C1006	36			115.6	0.0016	234.1	33.1	1.00	8.87	26.4
P-67	C1008	C1007	36			220.3	0.0016	227.8	32.2	1.00	8.55	26.7
P-66	C1009	C1008	36			262.4	0.0015	227.8	32.2	1.00	8.73	26.1
P-65	C1010	C1009	36			162.2	0.0015	222.8	31.5	1.00	8.49	26.3
P-64	C1011	C1010	36			238.5	0.0015	216.5	30.6	1.00	8.33	26.0
P-63	C1012	C1011	36			249.8	0.0016	216.5	30.6	1.00	8.19	26.4
P-62	C1013	C1012	36			253.1	0.0016	209.4	29.6	1.00	7.88	26.6
P-61	C1014	C1013	36			252.6	0.0016	209.4	29.6	1.00	7.87	26.6
P-60	C1015	C1014	30			265.5	0.0015	209.4	42.7	1.00	13.12	16.0
P-59	C1016	C1015	30			254.7	0.0016	201.7	41.1	1.00	12.38	16.3
P-980	C1017	C1016	30			49.4	0.0016	201.7	41.1	1.00	12.19	16.5
P-979	C1018	C1017	30			231.7	0.0016	201.7	41.1	1.00	12.27	16.4
P-375	C1019	C1018	30			182.9	0.0107	201.7	41.1	1.00	4.74	42.6
P-376	C1020	C1019	30			175.7	0.0114	188.8	38.5	1.00	4.30	43.9
P-377	C1021	C1020	30			95.4	0.0015	188.8	38.5	1.00	11.99	15.8
P-378	C1022	C1021	30			86.1	0.0015	188.8	38.5	1.00	11.82	16.0
P-379	C1023	C1022	30			83.5	0.0016	188.8	38.5	1.00	11.64	16.2
P-380	C1024	C1023	30			70.4	0.0016	188.8	38.5	1.00	11.61	16.3
P-381	C1025	C1024	30			281.1	0.0026	176.0	35.9	1.00	8.46	20.8
P-382	C1026	C1025	21			235.5	0.0078	176.0	73.2	1.00	12.57	14.0
P-383	C1027	C1026	18			259.4	0.0077	80.1	45.3	1.00	8.66	9.2
P-976	C2001	C1001	54			59.9	0.0015	184.4	11.6	1.00	2.41	76.4
P-74	C2002	C2001	54			189.9	0.0015	184.4	11.6	1.00	2.44	75.7
P-75	C2003	C2002	48			268.3	0.0015	129.5	10.3	1.00	2.33	55.6
P-76	C2004	C2003	48			288.2	0.0016	118.3	9.4	1.00	2.08	56.9
17	C2006	C2004	48			368.5	0.0015	107.3	8.5	1.00	1.95	55.1
P-79	C2007	C2006	4			71.7	0.0015	47.7	546.9	1.00	638.43	0.1
P-80	C2008	C2007	4			139.2	0.0014	47.7	546.9	1.00	659.75	0.1
P-81	C2009	C2008	4			242.3	0.0015	37.9	434.2	1.00	508.16	0.1
P-82	C2010	C2009	3			269.5	0.0093	37.9	771.9	1.00	444.05	0.1
P-83	C2011	C2010	3			208.6	0.0024	31.0	631.9	1.00	715.10	0.0
P-84	C2012	C2011	30			281.4	0.0018	20.3	4.1	1.00	1.17	17.3
P-85	C2013	C2012	24			310.6	0.0032	20.3	6.5	1.00	1.58	12.9
P-86	C2014	C2013	21			255.4	0.0055	9.4	5.4	0.68	0.80	11.8

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P-87	C2015	C2014	18			283.7	0.0078	5.6	5.5	0.56	0.60	9.3
P-88	C3001	C2002	36			54.2	0.0015	52.0	7.4	1.00	2.03	25.7
P-89	C3002	C3001	36			114.2	0.0015	52.0	7.4	1.00	2.02	25.8
P-90	C3003	C3002	36			318.1	0.0015	52.0	7.4	1.00	2.00	26.0
P-91	C3004	C3003	36			211.2	0.0014	37.4	5.3	1.00	1.48	25.2
P-92	C3005	C3004	30			230.6	0.0014	29.0	5.9	1.00	1.86	15.6
P-93	C3006	C3005	24			281.2	0.0104	29.0	9.2	1.00	1.25	23.1
P-94	C3007	C3006	24			353.1	0.0062	23.3	7.4	1.00	1.30	17.9
P-95	C3008	C3007	24			319.0	0.0056	16.5	6.2	0.79	0.97	17.0
P-96	C3009	C3008	24			186.8	0.0054	7.6	5.2	0.48	0.46	16.6
P-1102S	C4001	C2006	120			613.8	0.0015	49.2	4.8	0.19	0.08	642.0
P-1101	C4002	C4001	27			167.0	0.0015	49.2	12.4	1.00	4.09	12.0
P-97	C4003	C4002	24			265.4	0.0015	32.9	10.5	1.00	3.74	8.8
P-98	C4004	C4003	24			180.3	0.0022	27.0	8.6	1.00	2.52	10.7
P-99	C4005	C4004	24			299.3	0.0015	27.0	8.6	1.00	3.07	8.8
P-100	C4006	C4005	21			194.4	0.0015	24.6	10.2	1.00	4.01	6.1
P-101	C4007	C4006	21			239.5	0.0015	18.1	7.5	1.00	2.94	6.2
P-102	C4008	C4007	18			347.3	0.0015	18.1	10.2	1.00	4.44	4.1
P-103	C4009	C4008	15			301.6	0.0015	6.5	5.3	1.00	2.60	2.5
P-104	C4010	C4009	12			270.1	0.0588	6.5	12.1	0.65	0.75	8.7
11	D1001	D-1		48	72	197.5	0.0015	986.7	20.6	1.00	6.42	307.2
P-135	D1002	D1001		48	84	129.4	0.0074	954.7	17.0	1.00	2.28	838.1
P-134	D1003	D1002		48	84	378.6	0.0015	954.7	17.0	1.00	5.06	377.6
P-133	D1004	D1003		48	84	154.0	0.0015	943.3	16.8	1.00	5.02	376.1
P-132	D1005	D1004		48	84	143.4	0.0016	943.3	16.8	1.00	4.84	389.7
P-131	D1006	D1005		48	84	305.6	0.0014	943.3	16.8	1.00	5.17	365.0
P-130	D1007	D1006		48	84	351.1	0.0032	943.3	16.8	1.00	3.45	547.1
P-129	D1008	D1007		48	72	92.9	0.0027	943.3	19.7	1.00	4.61	408.9
P-128	D1009	D1008		48	72	438.2	0.0069	911.8	19.0	1.00	2.79	653.2
P-127	D1010	D1009		48	72	53.7	0.0016	911.8	19.0	1.00	5.72	319.1
P-126	D1011	D1010		48	72	447.5	0.0014	899.1	18.7	1.00	6.07	296.1
P-125	D1012	D1011		48	72	442.3	0.0017	899.1	18.7	1.00	5.54	324.5
P-124	D1013	D1012		48	72	366.7	0.0016	877.0	18.3	1.00	5.50	318.8
P-123	D1014	D1013		48	72	127.7	0.0015	877.0	18.3	1.00	5.77	303.9
P-122	D1015	D1014		48	72	72.9	0.0015	877.0	18.3	1.00	5.73	306.1
P-143	D1016	D1015	72			71.5	0.0027	695.2	12.3	1.00	3.17	437.9
P-142	D1017	D1016	72			580.8	0.0020	695.2	12.3	1.00	3.68	377.9
P-141	D1018	D1017	72			749.4	0.0160	665.9	20.0	0.57	1.24	1074.7
P-140	D1019	D1018	84			140.9	0.0001	505.1	13.1	1.00	6.62	76.3
P-139	D1020	D1019	84			531.4	0.0013	505.1	13.1	1.00	2.16	234.1
P-138	D1021	D1020	84			622.0	0.0020	481.2	12.5	1.00	1.69	284.8
P-137	D1022	D1021	54			511.6	0.0037	451.8	28.4	1.00	3.75	120.5
P-425	D1023	D1022	48			273.0	0.0036	432.2	34.4	1.00	5.01	86.3
P-424	D1024	D1023	48			287.1	0.0034	432.2	34.4	1.00	5.16	83.7
P-423	D1025	D1024	48			280.6	0.0028	432.2	34.4	1.00	5.66	76.4
P-422	D1026	D1025	42			503.2	0.0040	411.4	42.8	1.00	6.48	63.4
P-421	D1027	D1026	42			343.6	0.0027	404.5	42.0	1.00	7.71	52.5

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P-420	D1028	D1027	42			250.1	0.0073	404.5	42.0	1.00	4.69	86.3
P-419	D1029	D1028	54			354.2	0.0041	402.0	25.3	1.00	3.20	125.7
P-418	D1030	D1029	54			290.4	0.0045	402.0	25.3	1.00	3.05	131.9
P-417	D1031	D1030	54			540.9	0.0027	343.7	21.6	1.00	3.33	103.1
P-416	D1032	D1031	48			786.0	0.0042	311.1	24.8	1.00	3.31	93.9
P-415	D1033	D1032	48			124.8	0.0092	311.1	24.8	1.00	2.25	138.3
P-407	D1034	D1033	48			414.2	0.0022	281.2	22.4	1.00	4.19	67.1
P-406	D1035	D1034	48			269.3	0.0031	281.2	22.4	1.00	3.52	80.0
P-405	D1036	D1035	48			239.6	0.0029	281.2	22.4	1.00	3.61	77.9
P-404	D1037	D1036	48			239.3	0.0030	262.7	20.9	1.00	3.35	78.4
P-403	D1038	D1037	48			225.7	0.0025	262.7	20.9	1.00	3.66	71.8
P-402	D1039	D1038	48			298.1	0.0025	241.2	19.2	1.00	3.36	71.8
P-401	D1040	D1039	48			513.6	0.0020	241.2	19.2	1.00	3.72	64.8
P-400	D1041	D1040	36			526.7	0.0052	198.3	28.0	1.00	4.10	48.4
P-399	D1042	D1041	36			763.9	0.0015	198.3	28.0	1.00	7.71	25.7
P-396	D1043	D1042	36			156.4	0.0114	198.3	28.0	1.00	2.77	71.5
P-395	D1044	D1043	36			277.4	0.0052	198.3	28.0	1.00	4.10	48.3
P-393	D1045	D1044	12			85.4	0.0082	132.7	169.0	1.00	41.03	3.2
P-392	D1046	D1045	12			554.7	0.0079	110.5	140.6	1.00	34.72	3.2
P-391	D1047	D1046	24			614.8	0.0085	110.5	35.2	1.00	5.29	20.9
P-390	D1048	D1047	18			192.3	0.0042	81.7	46.2	1.00	12.03	6.8
P-389	D1049	D1048	18			109.2	0.0038	81.7	46.2	1.00	12.51	6.5
P-388	D1050	D1049	18			203.4	0.0046	81.7	46.2	1.00	11.48	7.1
P-991	D2001	D-2	36			397.0	0.0015	282.9	40.0	1.00	10.88	26.0
P-157	D2002	D2001	42			59.7	0.0017	267.2	27.8	1.00	6.47	41.3
P-156	D2003	D2002	42			552.0	0.0014	267.2	27.8	1.00	6.96	38.4
P-155	D2004	D2003	42			550.8	0.0015	267.2	27.8	1.00	6.74	39.6
P-154	D2005	D2004	42			235.2	0.0015	139.4	14.5	1.00	3.58	38.9
P-153	D2006	D2005	42			1385.7	0.0014	94.3	9.8	1.00	2.46	38.3
P-152	D2007	D2006	42			1128.8	0.0015	94.3	9.8	1.00	2.43	38.8
P-151	D2008	D2007	42			122.9	0.0108	60.4	11.3	0.54	0.58	104.9
P-150	D2009	D2008	42			1407.9	0.0014	60.4	6.3	1.00	1.59	38.0
P-549	D2101	D2004	8			374.0	0.0015	176.0	504.1	1.00	378.74	0.5
P-550	D2102	D2101	8			452.3	0.0015	176.0	504.1	1.00	369.18	0.5
P-551	D2103	D2102	6			265.8	0.0015	176.0	896.2	1.00	806.41	0.2
P-552	D2104	D2103	12			901.1	0.0014	71.6	91.2	1.00	52.80	1.4
P-121	D4001	D1015	42			146.7	0.0061	177.8	18.5	1.00	2.25	79.0
P-120	D4002	D4001	42			392.7	0.0039	177.8	18.5	1.00	2.81	63.2
P-119	D4003	D4002	42			641.8	0.0015	177.8	18.5	1.00	4.58	38.8
P-118	D4004	D4003	36			760.9	0.0015	177.8	25.2	1.00	6.84	26.0
P-117	D4005	D4004	36			251.0	0.0015	121.3	17.2	1.00	4.72	25.7
P-116	D4006	D4005	36			209.3	0.0015	121.3	17.2	1.00	4.64	26.1
P-115	D4007	D4006	36			39.2	0.0015	121.3	17.2	1.00	4.64	26.2
P-114	D4008	D4007	36			105.1	0.0015	121.3	17.2	1.00	4.65	26.1
P-113	D4009	D4008	36			406.3	0.0016	87.6	12.4	1.00	3.30	26.5
P-112	D4010	D4009	36			85.6	0.0015	87.6	12.4	1.00	3.36	26.1
P-111	D4011	D4010	24			527.7	0.0001	0.0	0.0	0.00	0.00	2.6

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P-110	D4012	D4010	24			541.5	0.0015	87.6	27.9	1.00	9.93	8.8
P-384	D4013	D4012	24			75.3	0.0016	59.8	19.1	1.00	6.61	9.1
P-385	D4014	D4013	24			278.9	0.0015	59.8	19.1	1.00	6.72	8.9
P-386	D4015	D4014	18			275.9	0.0014	42.8	24.2	1.00	10.68	4.0
P-387	D4016	D4015	15			260.6	0.0014	25.6	20.9	1.00	10.65	2.4
P-148	D4101	D4003	24			276.8	0.0018	0.0	0.0	0.00	0.00	9.7
P-147	D4102	D4101	24			261.5	0.0038	0.0	0.0	0.00	0.00	14.0
P-146	D4103	D4102	21			500.8	0.0058	0.0	0.0	0.00	0.00	12.1
P-145	D4104	D4103	15			348.1	0.0028	0.0	0.0	0.00	0.00	3.4
P-959	D5001	D1018	60			819.1	0.0079	194.8	13.3	0.70	0.84	232.5
P-563	D5002	D5001	48			83.7	0.0016	194.8	15.5	1.00	3.43	56.8
P-562	D5003	D5002	48			94.2	0.0015	194.8	15.5	1.00	3.51	55.5
P-561	D5004	D5003	48			70.1	0.0419	194.8	25.1	0.59	0.66	294.9
P-560	D5005	D5004	48			474.3	0.0015	157.4	12.5	1.00	2.82	55.7
P-559	D5006	D5005	42			570.9	0.0015	126.1	13.1	1.00	3.22	39.2
P-565	D5007	D5006	24			251.9	0.0015	98.4	31.3	1.00	11.17	8.8
P-566	D5008	D5007	24			281.0	0.0070	98.4	31.3	1.00	5.18	19.0
P-567	D5009	D5008	24			280.2	0.0070	88.4	28.1	1.00	4.66	19.0
P-568	D5010	D5009	24			553.1	0.0014	88.4	28.1	1.00	10.32	8.6
P-569	D5011	D5010	24			46.1	0.0109	88.4	28.1	1.00	3.74	23.6
P-570	D5012	D5011	24			178.8	0.0017	49.5	15.8	1.00	5.33	9.3
P-571	D5013	D5012	30			100.6	0.0041	49.5	10.1	1.00	1.89	26.3
P-572	D5014	D5013	24			316.2	0.0041	49.5	15.8	1.00	3.42	14.5
P-573	D5015	D5014	24			54.5	0.0092	49.5	15.8	1.00	2.28	21.7
P-574	D5016	D5015	24			105.2	0.0029	49.5	15.8	1.00	4.09	12.1
P-575	D5017	D5016	24			45.3	0.0037	49.5	15.8	1.00	3.56	13.9
P-576	D5018	D5017	24			1351.8	0.0035	12.4	4.9	0.75	0.91	13.5
P-558	D5101	D5006	30			665.2	0.0015	43.6	8.9	1.00	2.74	15.9
P-557	D5102	D5101	42			396.9	0.0050	43.6	7.8	0.57	0.61	71.3
P-556	D5103	D5102	42			128.1	0.0013	43.6	4.5	1.00	1.19	36.7
P-555	D5104	D5103	42			91.0	0.0016	43.6	4.5	1.00	1.07	41.0
P-554	D5105	D5104	42			438.3	0.0015	4.4	2.7	0.23	0.11	39.4
P-958	D5106	D5105	42			72.5	0.0015	0.0	0.0	0.00	0.00	39.3
P-577	D5201	D5008	12			644.0	0.0066	19.0	24.2	1.00	6.55	2.9
P-144	D6001	D1022	24			499.4	0.0015	28.2	9.0	1.00	3.21	8.8
P-434	D7001	D1030	24			299.1	0.0075	26.2	8.3	1.00	1.34	19.6
P-435	D7002	D7001	24			258.3	0.0081	26.2	8.3	1.00	1.29	20.4
P-436	D7003	D7002	15			323.9	0.0111	26.2	21.4	1.00	3.84	6.8
P-437	D7004	D7003	12			253.5	0.0114	26.2	33.4	1.00	6.86	3.8
P-430	D8001	D1031	24			305.0	0.0059	15.8	6.3	0.75	0.91	17.4
P-431	D8002	D8001	24			293.3	0.0044	15.8	5.0	1.00	1.05	15.1
P-432	D8003	D8002	21			272.7	0.0048	15.8	6.6	1.00	1.44	11.0
P-433	D8004	D8003	15			281.2	0.0076	15.8	12.9	1.00	2.80	5.7
P-414	D9001	D1033	24			199.5	0.0058	40.6	12.9	1.00	2.35	17.3
P-413	D9002	D9001	24			80.5	0.0051	40.6	12.9	1.00	2.51	16.2
P-412	D9003	D9002	24			264.6	0.0056	40.6	12.9	1.00	2.39	17.0
P-411	D9004	D9003	21			275.8	0.0036	40.6	16.9	1.00	4.29	9.5

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 100-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-410	D9005	D9004	21			88.4	0.0032	40.6	16.9	1.00	4.55	8.9
P-409	D9006	D9005	18			314.0	0.0075	40.6	23.0	1.00	4.47	9.1
P-408	D9007	D9006	15			266.5	0.0044	20.8	16.9	1.00	4.86	4.3
P-992	E1001	E-1	60			199.4	0.0032	1876.0	31.8	1.00	12.78	440.4
P-641	E1002	E1001	60			168.5	0.0031	1870.2	31.7	1.00	12.89	435.2
P-993	E1003	E1002	60			287.2	0.0890	1854.3	44.0	0.67	2.38	2336.7
P-591	E1004	E1003	66			677.7	0.0024	1194.2	16.8	1.00	7.23	495.4
P-1000	E1005	E1004	66			302.2	0.0024	1194.2	16.8	1.00	7.22	496.5
P-999	E1006	E1005	66			547.2	0.0019	995.4	14.0	1.00	6.85	436.1
P-589	E1007	E1006	66			157.8	0.0029	995.4	20.9	1.00	5.54	359.6
P-588	E1008	E1007	66			109.4	0.0030	995.4	20.9	1.00	5.38	369.9
P-587	E1009	E1008	66			1302.1	0.0015	965.4	20.3	1.00	7.41	260.6
P-586	E1010	E1009	60			745.1	0.0023	598.7	15.2	1.00	4.83	248.0
P-585	E1011	E1010	60			492.7	0.0023	586.0	14.9	1.00	4.67	251.2
P-994	E1012	E1011	60			1037.0	0.0028	551.4	14.0	1.00	4.02	274.3
P-579	E1013	E1012	66			852.4	0.0028	513.8	21.6	1.00	2.86	179.4
P-578	E1014	E1013	54			274.1	0.0046	482.3	30.3	1.00	3.59	134.2
P-455	E1015	E1014	48			50.3	0.0034	482.3	38.4	1.00	5.76	83.7
P-454	E1016	E1015	48			390.3	0.0069	471.7	37.5	1.00	3.93	120.0
P-453	E1017	E1016	42			294.1	0.0039	471.7	49.0	1.00	7.45	63.4
P-452	E1018	E1017	42			185.5	0.0067	445.4	46.3	1.00	5.40	82.5
P-995	E1019	E1018	54			35.8	0.0031	330.1	20.8	1.00	3.02	109.3
P-471	E1020	E1019	54			638.4	0.0044	232.8	14.6	1.00	1.78	130.8
P-470	E1021	E1020	48			545.6	0.0046	232.8	18.5	1.00	2.39	97.5
P-469	E1022	E1021	48			94.0	0.0046	232.8	18.5	1.00	2.39	97.4
P-468	E1023	E1022	48			313.3	0.0080	232.8	18.5	1.00	1.81	128.7
P-467	E1024	E1023	48			235.4	0.0203	232.8	18.5	1.00	1.14	205.0
P-466	E1025	E1024	48			389.1	0.0039	232.8	18.5	1.00	2.60	89.4
P-465	E1026	E1025	42			255.7	0.0035	201.1	20.9	1.00	3.38	59.5
P-464	E1027	E1026	42			641.6	0.0041	197.5	20.5	1.00	3.05	64.8
P-463	E1028	E1027	42			275.0	0.0046	197.5	20.5	1.00	2.89	68.3
P-462	E1029	E1028	42			252.5	0.0042	170.1	17.7	1.00	2.60	65.4
P-461	E1030	E1029	42			426.7	0.0038	170.1	17.7	1.00	2.73	62.3
P-460	E1031	E1030	42			210.9	0.0054	170.1	17.7	1.00	2.30	73.8
P-459	E1032	E1031	30			285.5	0.0028	138.8	28.3	1.00	6.34	21.9
P-458	E1033	E1032	30			199.3	0.0157	115.2	23.5	1.00	2.24	51.5
P-457	E1034	E1033	30			526.5	0.0027	115.2	23.5	1.00	5.37	21.4
P-456	E1035	E1034	30			331.3	0.0030	55.0	11.2	1.00	2.45	22.5
P-638	E2001	E1003		60	60	105.4	0.0015	676.9	27.1	1.00	4.31	156.9
P-637	E2002	E2001	5			25.1	0.0016	40.2	294.6	1.00	290.72	0.1
P-636	E2003	E2002	42			327.6	0.0046	40.2	7.4	0.55	0.59	68.3
P-635	E2004	E2003	42			578.5	0.0081	26.9	8.2	0.37	0.30	90.8
P-1009	E2005	E2004	36			757.4	0.0023	10.5	4.1	0.40	0.33	32.0
P-1002	E2006	E2104		48	76	408.7	0.0150	584.5	17.8	0.65	1.12	1039.6
P-1003	E2007	E2006	54			786.0	0.0015	563.4	17.7	1.00	7.37	152.8
P-1004	E2008	E2007	54			777.6	0.0048	536.6	16.9	1.00	3.91	274.6
P-625	E2009	E2008	48			145.7	0.0034	526.7	21.0	1.00	6.24	168.7

Appendix C
City of Richmond - Storm Drain Master Plan
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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-624	E2010	E2009	48			386.7	0.0054	555.7	22.1	1.00	5.24	212.3
P-1010	E2011	E2010		42	144	603.2	0.0073	555.7	15.5	0.85	0.80	697.7
P-1014	E2012	E2011		48	144	136.5	0.0037	541.3	12.1	0.93	0.91	596.9
P-1013	E2013	E2012		48	144	161.3	0.0062	541.3	14.5	0.78	0.70	776.5
P-1012	E2014	E2013		48	144	282.0	0.0035	528.1	11.9	0.93	0.90	587.3
P-1020	E2015	E2014		48	144	334.9	0.0015	513.1	10.7	1.00	1.35	381.1
P-1019	E2016	E2015	12			82.8	0.0014	179.1	228.0	1.00	131.66	1.4
P-618	E2017	E2016		36	60	632.6	0.0130	179.1	14.9	0.80	0.74	240.7
P-519	E2018	E2017	48			432.8	0.0015	162.5	12.9	1.00	2.91	55.8
P-518	E2019	E2018	48			660.1	0.0053	152.2	12.1	1.00	1.45	104.9
P-517	E2020	E2019	48			250.7	0.0020	133.2	10.6	1.00	2.07	64.3
P-516	E2021	E2020		24	96	386.5	0.0091	125.0	11.2	0.70	0.59	211.4
P-515	E2022	E2021	48			462.2	0.0076	112.9	11.3	0.74	0.90	125.3
P-514	E2023	E2022	42			751.8	0.0100	82.5	11.7	0.69	0.82	100.8
P-513	E2024	E2023	21			225.7	0.0266	71.0	29.5	1.00	2.74	25.9
P-512	E2025	E2024	12			410.2	0.0024	54.3	69.1	1.00	30.77	1.8
P-511	E2026	E2025	12			696.4	0.0015	28.3	36.0	1.00	20.48	1.4
P-1017	E2027	E2026	12			540.0	0.0056	8.3	10.6	1.00	3.11	2.7
P-1016	E2028	E2027	12			699.2	0.0014	0.0	0.0	0.00	0.00	1.4
P-1015	E2029	E2028	12			342.0	0.0088	0.0	0.0	0.00	0.00	3.3
P-1005	E2101	E2001	12			25.8	1.0505	651.6	829.7	1.00	17.80	36.6
P-1006	E2102	E2101	42			247.0	0.0249	651.6	33.9	1.00	4.09	318.4
P-1007	E2103	E2102	45			666.7	0.0024	646.1	29.3	1.00	10.95	118.1
P-1008	E2104	E2103	45			773.1	0.0071	592.3	26.8	1.00	5.78	204.9
P-1021	E2201	E2015		36	60	715.2	0.0159	434.1	28.9	1.00	1.63	266.8
P-537	E2202	E2201		36	96	493.0	0.0057	423.2	17.6	1.00	1.43	296.9
P-536	E2203	E2202		36	96	102.5	0.0020	413.5	17.2	1.00	2.38	174.1
P-535	E2204	E2203		36	96	113.1	0.0088	413.5	17.2	1.00	1.12	370.5
P-534	E2205	E2204		36	96	134.9	0.0074	410.0	17.1	1.00	1.21	339.2
P-533	E2206	E2205		36	96	54.7	0.0183	410.0	20.6	0.83	0.77	532.7
P-532	E2207	E2206		36	96	349.2	0.0029	410.0	17.1	1.00	1.94	210.9
P-531	E2208	E2207		36	96	62.8	0.0080	344.4	14.6	0.99	0.98	351.6
P-530	E2209	E2208		36	96	367.3	0.0082	344.4	14.7	0.98	0.97	356.1
P-529	E2210	E2209		48	60	556.9	0.0081	336.1	16.8	1.00	1.22	274.6
P-528	E2211	E2210	54			146.5	0.0341	295.0	25.5	0.68	0.81	364.2
P-527	E2212	E2211	54			568.6	0.0123	295.0	18.6	1.00	1.35	218.8
P-526	E2213	E2212	42			286.9	0.0017	229.1	23.8	1.00	5.44	42.1
P-525	E2214	E2213	42			463.1	0.0227	189.1	19.7	1.00	1.25	151.9
P-524	E2215	E2214	36			71.7	0.0698	133.5	27.5	0.65	0.76	176.7
P-523	E2216	E2215	36			160.4	0.0015	109.5	15.5	1.00	4.23	25.9
P-522	E2217	E2216	36			348.4	0.0015	109.5	15.5	1.00	4.24	25.8
P-521	E2218	E2217	30			404.9	0.0124	11.9	7.8	0.35	0.26	45.7
P-520	E2219	E2218	30			97.0	0.0103	5.8	6.0	0.25	0.14	41.8
P-538	E2301	E2217	24			65.4	0.0015	97.8	31.1	1.00	11.03	8.9
P-539	E2302	E2301	24			57.2	0.0014	97.8	31.1	1.00	11.53	8.5
P-540	E2303	E2302	24			36.7	0.0016	97.8	31.1	1.00	10.67	9.2
P-541	E2304	E2303	24			303.9	0.0122	93.1	29.6	1.00	3.71	25.1

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-542	E2305	E2304	24			269.9	0.0552	93.1	29.6	1.00	1.75	53.3
P-543	E2306	E2305	24			223.7	0.0805	81.4	25.9	1.00	1.26	64.3
P-1001	E3001	E1005		36	58	414.8	0.0043	220.5	15.2	1.00	1.67	132.2
P-616	E3002	E3001		36	58	215.5	0.0070	206.4	14.2	1.00	1.23	168.4
P-615	E3003	E3002		36	58	142.5	0.0073	206.4	14.2	1.00	1.20	172.4
P-614	E3004	E3003		36	58	118.2	0.0030	200.8	13.8	1.00	1.83	109.8
P-613	E3005	E3004		36	58	240.5	0.0021	193.9	13.4	1.00	2.09	92.9
P-612	E3006	E3005	33			919.2	0.0039	178.8	30.1	1.00	5.40	33.1
P-611	E3007	E3006	42			134.7	0.0015	178.8	18.6	1.00	4.60	38.9
P-610	E3008	E3007	42			286.2	0.0064	166.9	17.3	1.00	2.07	80.5
P-609	E3009	E3008	42			535.0	0.0015	166.9	17.3	1.00	4.28	39.0
P-608	E3010	E3009	42			141.6	0.0056	148.0	15.4	1.00	1.95	75.8
P-607	E3011	E3010	42			166.8	0.0015	148.0	15.4	1.00	3.79	39.1
P-606	E3012	E3011	36			456.0	0.0015	137.1	19.4	1.00	5.31	25.8
P-605	E3013	E3012	36			408.4	0.0044	129.8	18.4	1.00	2.91	44.5
P-604	E3014	E3013	30			391.1	0.0090	105.2	21.4	1.00	2.69	39.0
P-603	E3015	E3014	30			63.2	0.0022	105.2	21.4	1.00	5.43	19.4
P-602	E3016	E3015	30			378.5	0.0049	91.8	18.7	1.00	3.18	28.8
P-601	E3017	E3016	30			586.5	0.0039	78.9	16.1	1.00	3.06	25.8
P-600	E3018	E3017	30			42.4	0.0118	78.9	16.1	1.00	1.77	44.7
P-997	E4001	E1009	42			124.9	0.0539	346.1	36.0	1.00	1.48	234.2
P-996	E4002	E4001	36			261.2	0.0102	346.1	49.0	1.00	5.12	67.6
P-599	E4003	E4002	36			120.6	0.0065	366.3	51.8	1.00	6.81	53.8
P-598	E4004	E4003	36			469.3	0.0035	354.8	50.2	1.00	8.97	39.5
P-597	E4005	E4004	36			793.9	0.0036	336.9	47.7	1.00	8.42	40.0
P-998	E4006	E4005	4			860.5	0.0009	325.3	3728.1	1.00	5627.18	0.1
P-594	E4007	E4006	42			853.1	0.0030	232.9	24.2	1.00	4.20	55.5
P-593	E4008	E4007	42			283.2	0.0032	232.9	24.2	1.00	4.07	57.2
P-592	E4009	E4008	42			387.5	0.0049	209.4	21.8	1.00	2.96	70.6
P-497	E4010	E4009	42			550.4	0.0129	184.0	19.1	1.00	1.61	114.4
P-496	E4011	E4010	42			606.9	0.0102	154.0	16.0	1.00	1.51	101.7
P-495	E4012	E4011	36			120.3	0.0108	154.0	21.8	1.00	2.22	69.5
P-494	E4013	E4012	30			541.6	0.0109	141.4	28.8	1.00	3.28	43.0
P-493	E4014	E4013	36			265.2	0.0139	127.5	18.0	1.00	1.62	78.8
P-492	E4015	E4014	36			18.2	0.0104	127.5	18.0	1.00	1.87	68.3
P-491	E4016	E4015	36			205.9	0.0138	127.5	18.0	1.00	1.62	78.7
P-490	E4017	E4016	36			105.0	0.0139	127.5	18.0	1.00	1.62	78.9
P-489	E4018	E4017	36			159.6	0.0045	127.5	18.0	1.00	2.84	44.9
P-488	E4019	E4018	36			89.4	0.0047	127.5	18.0	1.00	2.78	45.8
P-487	E4020	E4019	36			464.0	0.0111	127.5	18.0	1.00	1.81	70.5
P-486	E4021	E4020	36			51.9	0.0040	127.5	18.0	1.00	3.00	42.5
P-485	E4022	E4021	24			268.1	0.0124	112.0	35.7	1.00	4.43	25.3
P-484	E4023	E4022	24			272.2	0.0118	107.0	34.0	1.00	4.35	24.6
P-483	E4024	E4023	24			513.0	0.0127	107.0	34.0	1.00	4.19	25.6
P-482	E4025	E4024	24			244.4	0.0088	107.0	34.0	1.00	5.02	21.3
P-481	E4026	E4025	21			673.8	0.0118	79.5	33.0	1.00	4.61	17.2
P-480	E4027	E4026	21			147.8	0.0075	58.9	24.5	1.00	4.28	13.8

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 100-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-479	E4028	E4027	21			175.5	0.0087	58.9	24.5	1.00	3.98	14.8
P-498	E4101	E4010	12			247.5	0.0090	26.2	33.3	1.00	7.73	3.4
P-499	E4102	E4101	12			279.0	0.0096	18.4	23.4	1.00	5.24	3.5
P-500	E4103	E4102	12			57.3	0.0192	18.4	23.4	1.00	3.71	4.9
P-451	E5001	E1018	42			307.1	0.0016	128.5	13.4	1.00	3.19	40.3
P-450	E5002	E5001	42			214.9	0.0020	128.5	13.4	1.00	2.85	45.1
P-449	E5003	E5002	42			66.2	0.0015	128.5	13.4	1.00	3.28	39.2
P-448	E5004	E5003	42			537.2	0.0002	105.1	10.9	1.00	7.63	13.8
P-447	E5005	E5004	36			257.3	0.0015	105.1	14.9	1.00	4.09	25.7
P-446	E5006	E5005	36			273.2	0.0015	105.1	14.9	1.00	4.01	26.2
P-445	E5007	E5006	36			226.9	0.0015	89.3	12.6	1.00	3.40	26.3
P-444	E5008	E5007	30			282.1	0.0015	89.3	18.2	1.00	5.56	16.1
P-443	E5009	E5008	30			242.8	0.0016	69.0	14.0	1.00	4.24	16.3
P-442	E5010	E5009	30			233.0	0.2225	56.2	34.2	0.37	0.29	194.0
P-441	E5011	E5010	21			282.6	0.0041	56.2	23.4	1.00	5.52	10.2
P-440	E5012	E5011	24			177.5	0.0046	29.7	9.4	1.00	1.92	15.4
P-439	E5013	E5012	21			317.9	0.0037	29.7	12.3	1.00	3.06	9.7
P-438	E5014	E5013	21			152.7	0.0131	29.7	12.3	1.00	1.63	18.2
P-472	E6001	E1019	12			291.7	0.0104	89.6	114.0	1.00	24.60	3.6
P-473	E6002	E6001	12			287.8	0.0114	89.6	114.0	1.00	23.52	3.8
P-474	E6003	E6002	12			251.5	0.0130	64.9	82.7	1.00	15.94	4.1
P-475	E6004	E6003	12			226.2	0.0145	64.9	82.7	1.00	15.12	4.3
P-476	E6005	E6004	12			263.0	0.0073	42.8	54.5	1.00	14.07	3.0
P-477	E6006	E6005	12			240.0	0.0132	42.8	54.5	1.00	10.45	4.1
P-478	E6007	E6006	12			292.9	0.0072	19.4	24.8	1.00	6.40	3.0
P-1018	F1001	F-1	18			537.4	0.0279	22.8	12.9	1.00	1.30	17.6
P-502	F1002	F1001	12			57.1	0.0175	22.8	29.0	1.00	4.82	4.7
P-503	F1003	F1002	18			113.2	0.0088	15.1	8.5	1.00	1.52	9.9
P-504	F1004	F1003	12			175.6	0.0057	15.1	19.2	1.00	5.59	2.7
P-505	F1005	F1004	12			101.1	0.0099	7.6	9.7	1.00	2.14	3.6
P-960	I1001	I-1		48	72	333.2	0.0023	588.2	24.5	1.00	3.15	186.9
P-191	I1002	I1001	48			103.7	0.0005	333.5	26.5	1.00	10.54	31.6
P-190	I1003	I1002	48			405.0	0.0015	333.5	26.5	1.00	6.02	55.4
P-189	I1004	I1003	48			441.0	0.0016	333.5	26.5	1.00	5.81	57.4
P-188	I1005	I1004	48			983.2	0.0015	333.5	26.5	1.00	5.93	56.3
P-187	I1006	I1005	36			196.9	0.0015	170.0	24.0	1.00	6.51	26.1
P-186	I1007	I1006	36			51.5	0.0039	170.0	24.0	1.00	4.08	41.7
P-185	I1008	I1007	36			43.2	0.0023	170.0	24.0	1.00	5.29	32.2
P-184	I1009	I1008	36			265.9	0.0016	170.0	24.0	1.00	6.40	26.6
P-183	I1010	I1009	36			69.0	0.0013	151.0	21.4	1.00	6.25	24.1
P-182	I1011	I1010	30			102.5	0.0010	151.0	30.8	1.00	11.75	12.8
P-181	I1012	I1011	21			622.7	0.0041	119.9	49.8	1.00	11.77	10.2
P-180	I1013	I1012	21			569.5	0.0027	119.9	49.8	1.00	14.51	8.3
P-971	I1014	I1013	24			401.2	0.0033	73.7	23.5	1.00	5.63	13.1
P-970	I1015	I1014	24			365.8	0.0034	73.7	23.5	1.00	5.54	13.3
P-106	I1016	I1015	24			352.0	0.0030	52.5	16.7	1.00	4.23	12.4
P-972	I1017	I1016	24			436.6	0.0028	32.2	10.2	1.00	2.66	12.1

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 100-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-974	I1018	I1017	21			277.8	0.0031	21.4	8.9	1.00	2.42	8.8
P-973	I1019	I1018	15			282.1	0.0031	21.4	17.5	1.00	5.96	3.6
P-205	I2001	I1001	30			61.7	0.0015	195.0	39.7	1.00	12.42	15.7
P-204	I2002	I2001	30			409.2	0.0016	195.0	39.7	1.00	11.90	16.4
P-203	I2003	I2002	30			263.6	0.0015	195.0	39.7	1.00	12.17	16.0
P-202	I2004	I2003	30			45.5	0.0015	170.7	34.8	1.00	10.58	16.1
P-201	I2005	I2004	30			473.4	0.0015	170.7	34.8	1.00	10.57	16.1
P-963	I2006	I2005	24			452.0	0.0015	146.5	46.6	1.00	16.42	8.9
P-962	I2007	I2006	24			289.3	0.0016	97.6	31.1	1.00	10.91	8.9
P-199	I2008	I2007	24			248.2	0.0093	97.6	31.1	1.00	4.47	21.8
P-198	I2009	I2008	12			107.0	0.0017	97.6	124.3	1.00	66.63	1.5
P-197	I2010	I2009	12			113.2	0.0177	97.6	124.3	1.00	20.56	4.7
P-196	I2011	I2010	18			56.2	0.0062	97.6	55.2	1.00	11.74	8.3
P-195	I2012	I2011	12			140.9	0.0142	97.6	124.3	1.00	22.94	4.3
P-194	I2013	I2012	18			188.5	0.0212	55.4	31.4	1.00	3.61	15.3
P-193	I2014	I2013	18			311.7	0.0064	55.4	31.4	1.00	6.57	8.4
P-206	I3001	I1001	12			37.3	0.0016	87.5	111.4	1.00	61.08	1.4
P-207	I3002	I3001	12			107.2	0.0213	87.5	111.4	1.00	16.80	5.2
P-208	I3003	I3002	12			442.7	0.0009	87.5	111.4	1.00	81.51	1.1
P-209	I3004	I3003	12			645.3	0.0006	73.4	93.4	1.00	82.49	0.9
P-210	I3005	I3004	12			450.2	0.0004	51.2	65.2	1.00	68.02	0.8
P-965S	I4001	I1005	120			834.0	0.0030	44.5	6.0	0.15	0.05	907.9
P-964	I4002	I4001	24			500.5	0.0015	44.5	14.2	1.00	5.00	8.9
P-967	J1001	J-1	60			163.2	0.0015	136.7	7.0	1.00	1.34	102.2
P-966	J1002	J1001	60			131.4	0.0015	136.7	7.0	1.00	1.34	101.9
P-179	J1003	J1002	54			39.1	0.0026	136.7	8.6	1.00	1.37	99.7
P-178	J1004	J1003	54			145.2	0.0021	136.7	8.6	1.00	1.53	89.6
P-177	J1005	J1004	48			317.8	0.0016	89.9	7.2	1.00	1.57	57.1
P-176	J1006	J1005	48			85.3	0.0018	89.9	7.2	1.00	1.49	60.4
P-175	J1007	J1006	48			489.0	0.0047	89.9	8.9	0.75	0.91	98.8
P-174	J1008	J1007	42			31.9	0.0016	89.9	9.3	1.00	2.25	39.9
P-173	J1009	J1008	42			413.9	0.0019	69.7	7.2	1.00	1.57	44.3
P-172	J1010	J1009	36			27.3	0.0015	69.7	9.9	1.00	2.73	25.6
P-171	J1011	J1010	36			506.9	0.0014	36.8	5.2	1.00	1.45	25.4
P-170	J1012	J1011	36			139.6	0.0015	36.8	5.2	1.00	1.42	25.9
P-169	J1013	J1012	36			53.9	0.0011	36.8	5.2	1.00	1.65	22.3
P-168	J1014	J1013	36			286.2	0.0052	22.6	6.7	0.48	0.47	48.4
P-167	J1015	J1014	30			359.7	0.0050	22.6	6.5	0.66	0.78	29.1
P-166	J1016	J1015	30			52.0	0.0079	22.6	7.8	0.57	0.62	36.5
P-165	J1017	J1016	30			284.5	0.0031	16.6	5.1	0.63	0.73	22.7
P-164	J1018	J1017	18			578.6	0.0061	10.8	6.1	1.00	1.31	8.2
P-1035	K1001	K-1		36	120	104.8	0.0051	554.5	18.5	1.00	1.49	371.8
P-646	K1002	K1001		36	120	166.5	0.0133	456.9	18.5	0.82	0.76	602.4
P-645	K1003	K1002		36	120	194.1	0.0048	456.9	15.2	1.00	1.26	363.8
P-644	K1004	K1003		36	120	100.9	0.0015	456.9	15.2	1.00	2.27	201.6
P-643	K1005	K1004		42	96	248.8	0.0028	324.2	11.6	1.00	1.26	258.1
P-642	K1006	K1005		30	66	675.3	0.0085	289.5	21.1	1.00	1.66	174.4

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P-548	K1007	K1006	36			259.7	0.0191	289.5	41.0	1.00	3.13	92.5
P-547	K1008	K1007	36			254.2	0.0256	289.5	41.0	1.00	2.71	106.9
P-546	K1009	K1008	36			169.0	0.0180	289.5	41.0	1.00	3.22	89.8
P-545	K1010	K1009	30			61.4	0.0139	289.5	59.0	1.00	5.98	48.4
P-544	K1011	K1010	30			145.9	0.0206	167.4	34.1	1.00	2.83	59.1
P-1036	L1001	L-1	48			37.1	0.0269	253.8	17.2	0.41	1.07	709.3
P-660	L1002	L1001	48			206.4	0.0141	231.5	13.3	0.47	1.35	514.0
P-659	L1003	L1002	48			367.1	0.0015	224.0	5.9	1.00	4.02	167.3
P-658	L1004	L1003		36	84	47.3	0.0089	151.7	9.7	0.37	0.49	624.5
P-657	L1005	L1004		36	84	65.4	0.0060	145.7	8.4	0.42	0.57	511.6
P-656	L1006	L1005		36	84	410.4	0.0043	132.9	7.3	0.43	0.61	436.5
P-655	L1007	L1006		36	84	49.0	0.0163	115.1	10.7	0.26	0.27	846.7
P-654	L1008	L1007		36	84	526.3	0.0043	115.1	6.9	0.40	0.53	432.4
P-653	L1009	L1008		36	84	245.9	0.0060	97.0	7.3	0.32	0.38	514.2
P-652	L1010	L1009		36	84	194.8	0.0060	85.8	7.0	0.29	0.33	513.6
P-651	L1011	L1010		36	84	216.9	0.0060	85.8	7.0	0.29	0.33	513.1
P-650	L1012	L1011	7			93.8	0.0134	69.7	260.7	1.00	70.86	1.0
P-649	L1013	L1012	7			408.4	0.0050	57.2	213.9	1.00	94.85	0.6
P-648	L1014	L1013	54			343.5	0.0104	39.7	9.8	0.30	0.20	200.7
P-661	L1101	L1001	18			156.0	0.0006	15.0	8.5	1.00	5.62	2.7
P-662	L1102	L1101	18			45.3	0.0009	15.0	8.5	1.00	4.79	3.1
P-663	L1103	L1102	18			453.4	0.0010	9.3	5.2	1.00	2.80	3.3
P-666	L2001	L1003	12			574.4	0.0042	42.3	53.8	1.00	18.27	2.3
P-665	L2002	L2001	12			604.6	0.0024	27.4	34.8	1.00	15.70	1.7
P-664	L2003	L2002	12			412.5	0.0020	18.1	23.0	1.00	11.22	1.6
P-667	L3001	L1003	30			532.0	0.0015	54.8	11.2	1.00	3.43	15.9
P-668	L3002	L3001	24			369.6	0.0015	54.8	17.4	1.00	6.26	8.7
P-669	L3003	L3002	24			48.8	0.0094	40.0	12.7	1.00	1.82	22.0
P-670	L3004	L3003	24			46.6	0.0129	40.0	12.7	1.00	1.56	25.7
P-671	L3005	L3004	24			155.7	0.0035	40.0	12.7	1.00	2.97	13.5
P-672	L3006	L3005	24			57.0	0.0091	40.0	12.7	1.00	1.85	21.7
P-673	L3007	L3006	24			652.6	0.0039	21.1	6.7	1.00	1.50	14.1
P-674	L3008	L3007	24			562.0	0.0015	9.0	2.9	1.00	1.04	8.7
P-675	L3009	L3008	21			49.2	0.0026	9.0	3.8	1.00	1.11	8.2
P-676	L4001	L1006	15			150.0	0.0015	22.5	18.3	1.00	8.86	2.5
P-1037	L4002	L4001	15			584.8	0.0015	8.7	7.1	1.00	3.47	2.5
P-1041	M1001	M-1		36	72	46.1	0.0097	1117.8	31.0	1.00	4.20	532.6
P-692	M1002	M1001		36	72	125.4	0.0441	1021.2	30.7	0.92	1.80	1135.5
P-691	M1003	M1002		36	72	285.3	0.0075	1021.2	28.4	1.00	4.36	468.1
P-690	M1004	M1003	66			269.7	0.0030	1021.2	21.5	1.00	5.53	369.1
P-689	M1005	M1004	66			180.6	0.0030	1021.2	21.5	1.00	5.53	369.3
P-688	M1006	M1005	66			585.6	0.0009	1012.0	21.3	1.00	10.12	200.1
P-1039	M1007	M1006	66			479.3	0.0046	964.5	20.3	1.00	4.24	455.2
P-685	M1008	M1007	54			849.7	0.0015	964.5	60.6	1.00	12.65	76.2
P-846	M1009	M1008		60	84	123.8	0.0016	583.8	16.7	1.00	2.24	260.9
P-845	M1010	M1009		60	84	73.9	0.0015	583.8	16.7	1.00	2.33	250.5
P-844	M1011	M1010		60	84	126.5	0.0015	583.8	16.7	1.00	2.32	251.6

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P-843	M1012	M1011	42			79.5	0.0063	372.6	38.7	1.00	4.66	80.0
P-842	M1013	M1012	42			686.0	0.0190	353.4	36.7	1.00	2.54	138.9
P-841	M1014	M1013	36			93.9	0.0107	353.4	50.0	1.00	5.12	69.0
P-840	M1015	M1014	36			780.5	0.0192	327.4	46.3	1.00	3.53	92.7
P-839	M1016	M1015	36			43.3	0.0231	327.4	46.3	1.00	3.22	101.6
P-838	M1017	M1016	36			237.5	0.0211	341.0	48.2	1.00	3.51	97.0
P-837	M1018	M1017	36			52.6	0.0190	341.0	48.2	1.00	3.70	92.2
P-836	M1019	M1018	36			762.7	0.0354	326.0	46.1	1.00	2.59	125.8
P-834	M1020	M1019	30			80.4	0.0124	220.0	44.8	1.00	4.80	45.9
P-833	M1021	M1020	30			252.8	0.0752	177.6	36.2	1.00	1.57	112.8
P-832	M1022	M1021	30			269.9	0.0371	177.6	36.2	1.00	2.24	79.2
P-831	M1023	M1022	30			373.8	0.0535	177.6	36.2	1.00	1.87	95.1
P-830	M1024	M1023	24			108.8	0.0920	169.4	53.9	1.00	2.46	68.8
P-1045S	M1025	M1024	120			392.7	0.0652	169.4	26.3	0.14	0.04	4233.6
P-829	M1026	M1025	30			144.0	0.0903	158.7	32.3	1.00	1.28	123.6
P-828	M1027	M1026	30			290.2	0.1378	158.7	32.3	1.00	1.04	152.7
P-827	M1028	M1027	30			597.9	0.0958	135.7	27.6	1.00	1.07	127.3
P-1040	M2001	M-1	12			46.0	0.0096	53.1	67.6	1.00	15.19	3.5
P-684	M2002	M2001	36			337.3	0.0173	53.1	13.0	0.56	0.60	88.1
P-1038	M2003	M2002	36			437.1	0.0015	53.1	7.5	1.00	2.04	26.0
P-682	M2004	M2003	36			206.6	0.0015	53.1	7.5	1.00	2.05	25.9
P-681	M2005	M2004	36			366.4	0.0015	53.1	7.5	1.00	2.05	25.9
P-680	M2006	M2005	24			184.6	0.0056	35.4	11.3	1.00	2.08	17.0
P-693	M3001	M1006	30			315.1	0.0030	93.5	19.0	1.00	4.14	22.6
P-694	M3002	M3001	30			378.6	0.0032	91.0	18.5	1.00	3.93	23.2
P-695	M3003	M3002	30			223.2	0.0493	91.0	21.2	0.82	1.00	91.3
P-1044	M3004	M3003	4			24.5	0.0016	91.0	1042.7	1.00	1180.64	0.1
P-847	M3005	M3004	30			192.9	0.0052	91.0	18.5	1.00	3.07	29.6
P-961	M3006	M3005	4			469.0	0.0064	0.0	0.0	0.00	0.00	0.2
P-1068	M4001	M1008	42			803.1	0.0015	490.4	51.0	1.00	12.58	39.0
P-1067	M4002	M4001	120			163.3	0.0095	490.4	18.0	0.38	0.30	1615.4
P-1066S	M4003	M4002	120			429.9	0.0028	480.9	11.4	0.53	0.55	879.7
P-1065	M4004	M4003	24			1113.8	0.0151	480.9	76.5	1.00	17.25	55.7
P-1064	M4005	M4004	24			295.1	0.0120	454.0	72.3	1.00	18.28	49.7
P-807	M4006	M4005	30			335.5	0.0258	264.5	53.9	1.00	4.00	66.1
P-806	M4007	M4006	30			595.4	0.0134	264.5	53.9	1.00	5.55	47.7
P-805	M4008	M4007	30			45.8	0.0219	264.5	53.9	1.00	4.35	60.8
P-804	M4009	M4008	30			260.7	0.0230	238.0	48.5	1.00	3.82	62.4
P-803	M4010	M4009	30			166.4	0.0015	238.0	48.5	1.00	14.93	15.9
P-802	M4011	M4010	30			297.9	0.0302	226.1	46.1	1.00	3.16	71.5
P-801	M4012	M4011	30			29.2	0.0343	226.1	46.1	1.00	2.97	76.2
P-800	M4013	M4012	30			400.7	0.0478	218.3	44.5	1.00	2.43	89.9
P-799	M4014	M4013	30			345.7	0.1365	208.0	42.4	1.00	1.37	152.0
P-1063	M4101	M4005	36			1051.2	0.0010	205.2	29.0	1.00	9.95	20.6
P-821	M5001	M1011		48	48	85.9	0.0407	231.7	24.4	0.59	0.52	448.4
P-820	M5002	M5001		48	48	129.1	0.0064	231.7	14.5	1.00	1.30	178.1
P-1043	M5003	M5002		48	48	215.5	0.0015	231.7	14.5	1.00	2.71	85.6

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-818	M5004	M5003		48	72	314.6	0.0033	198.9	9.2	0.90	0.87	227.6
P-817	M5005	M5004		36	60	55.9	0.0089	198.9	13.3	1.00	1.00	199.9
P-816	M5006	M5005		36	60	74.4	0.0040	198.9	13.3	1.00	1.48	134.2
P-815	M5007	M5006		36	60	349.0	0.0143	180.2	15.5	0.77	0.71	253.0
P-814	M5008	M5007		36	36	81.6	0.0012	180.2	20.0	1.00	4.99	36.1
P-813	M5009	M5008		36	36	563.1	0.0114	150.7	16.7	1.00	1.37	110.0
P-812	M5010	M5009	18			56.4	0.0834	90.7	51.3	1.00	2.98	30.4
P-811	M5011	M5010	18			1068.5	0.0372	64.0	36.2	1.00	3.15	20.3
P-810	M5012	M5011	18			49.5	0.0014	64.0	36.2	1.00	16.17	4.0
P-809	M5013	M5012	18			249.9	0.0080	64.0	36.2	1.00	6.80	9.4
P-808	M5014	M5013	18			310.9	0.0050	56.4	31.9	1.00	7.58	7.4
P-1042	M5101	M5003	48			587.0	0.0015	31.5	4.6	0.54	0.56	55.8
P-835	M6001	M1019	30			695.8	0.0431	106.0	21.6	1.00	1.24	85.4
P-1046	N1001	N-1		48	96	920.2	0.0046	845.5	26.4	1.00	2.14	395.7
P-867	N1002	N1001		48	96	554.5	0.0094	739.6	23.1	1.00	1.31	563.8
P-868	N1003	N1002		48	96	408.6	0.0044	739.6	23.1	1.00	1.91	386.4
P-869	N1004	N1003		48	96	330.3	0.0091	739.6	23.1	1.00	1.33	554.9
P-870	N1005	N1004		48	96	255.3	0.0157	720.2	22.7	0.99	0.99	728.7
P-871	N1006	N1005		48	96	311.6	0.0244	711.4	26.7	0.83	0.78	909.3
P-872	N1007	N1006		48	96	31.8	0.0016	711.4	22.2	1.00	3.08	230.8
P-873	N1008	N1007		48	96	269.9	0.0185	704.0	24.0	0.92	0.89	792.4
P-874	N1009	N1008		48	96	214.1	0.0140	704.0	22.0	1.00	1.02	689.2
P-875	N1010	N1009		48	96	64.1	0.0016	694.3	21.7	1.00	3.02	230.0
P-876	N1011	N1010		48	96	571.1	0.0035	683.3	21.4	1.00	1.98	344.5
P-877	N1012	N1011		24	84	243.6	0.0041	678.7	48.5	1.00	5.62	120.7
P-878	N1013	N1012		24	84	280.5	0.0143	671.1	47.9	1.00	2.98	225.0
P-879	N1014	N1013	48			385.8	0.0130	499.9	39.8	1.00	3.05	164.0
P-880	N1015	N1014	48			98.7	0.0304	499.9	39.8	1.00	1.99	251.1
P-881	N1016	N1015	48			183.7	0.0054	440.2	35.0	1.00	4.14	106.3
P-1046S	N1017	N1016	120			541.2	0.0203	445.4	23.1	0.29	0.19	2364.0
P-861	N1018	N1017	30			111.6	0.0099	445.4	90.7	1.00	10.91	40.8
P-860	N1019	N1018	30			128.1	0.0064	445.4	90.7	1.00	13.54	32.9
P-859	N1020	N1019	30			74.5	0.0199	445.4	90.7	1.00	7.68	58.0
P-858	N1021	N1020	30			439.8	0.0321	469.1	95.6	1.00	6.37	73.7
P-857	N1022	N1021	30			52.0	0.0321	469.1	95.6	1.00	6.36	73.7
P-856	N1023	N1022	36			178.0	0.0320	469.1	66.4	1.00	3.92	119.6
P-855	N1024	N1023	36			97.7	0.0320	448.9	63.5	1.00	3.75	119.7
P-854	N1025	N1024	36			322.3	0.0328	511.6	72.4	1.00	4.22	121.1
P-853	N1026	N1025	36			1086.7	0.0320	444.1	62.8	1.00	3.71	119.7
P-852	N1027	N1026	36			240.9	0.0550	458.8	64.9	1.00	2.92	156.9
P-851	N1028	N1027	36			1012.0	0.0175	279.6	39.6	1.00	3.16	88.4
P-1062S	N1029	N1028	120			910.5	0.1856	145.7	36.2	0.10	0.02	7143.8
P-862	N1030	N1029	12			454.5	0.0015	145.7	185.5	1.00	105.43	1.4
P-863	N1031	N1030	12			65.6	0.0091	98.8	125.8	1.00	28.93	3.4
P-882	N2001	N1013	21			615.1	0.0179	228.5	95.0	1.00	10.75	21.2
P-883	N2002	N2001	18			426.3	0.0235	205.9	116.5	1.00	12.76	16.1
P-884	N2003	N2002	21			1177.6	0.0399	148.9	61.9	1.00	4.69	31.7

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P-1047	O1001	O-1	36			103.2	0.0097	152.0	21.5	1.00	2.31	65.8
P-895	O1002	O1001	36			52.3	0.0096	115.9	16.4	1.00	1.77	65.4
P-894	O1003	O1002	36			325.0	0.0031	97.5	13.8	1.00	2.63	37.1
P-893	O1004	O1003	30			90.4	0.0310	97.5	19.9	1.00	1.35	72.4
P-1048	O1005	O1004	36			594.5	0.0094	82.6	11.7	1.00	1.27	64.9
P-890	O1006	O1005	36			211.7	0.0099	79.6	11.3	1.00	1.19	66.6
P-889	O1007	O1006	36			269.7	0.0083	65.4	9.3	1.00	1.07	61.0
P-888	O1008	O1007	36			259.3	0.0015	51.4	7.3	1.00	1.98	25.9
P-887	O1009	O1008	21			247.2	0.0015	38.0	15.8	1.00	6.18	6.1
P-886	O1010	O1009	24			223.0	0.0303	38.0	14.3	0.79	0.96	39.5
P-885	O1012	O1010	21			239.3	0.0078	19.8	8.2	1.00	1.41	14.0
61	P1002	P1001	48			176.1	0.0870	105.2	28.0	0.34	0.25	424.9
59	P1003	P1002	48			24.8	0.0628	105.2	24.9	0.37	0.29	361.0
87	P1004	P1003	48			91.3	0.0122	75.6	12.5	0.49	0.48	158.8
85	P1005	P1004	48			318.4	0.0213	69.7	15.0	0.40	0.33	210.2
83	P1006	P1005	42			197.7	0.0524	63.4	20.5	0.36	0.27	230.8
81	P1007	P1006	36			225.8	0.0750	63.4	23.6	0.41	0.35	183.2
79	P1008	P1007	24			262.1	0.0230	34.0	12.5	0.81	0.99	34.4
77	P1009	P1008	24			324.3	0.0316	25.7	13.6	0.58	0.64	40.3
75	P1010	P1009	24			184.4	0.0308	25.7	13.5	0.59	0.65	39.8
73	P1011	P1010	18			142.0	0.0318	11.0	11.0	0.55	0.58	18.8
71	P1012	P1011	18			123.5	0.0308	11.0	10.9	0.55	0.59	18.5
69	P1013	P1012	15			223.6	0.0273	6.8	9.2	0.58	0.64	10.7
67	P1014	P1013	15			40.2	0.0239	3.1	7.2	0.39	0.31	10.0
65	P1015	P1014	12			123.5	0.0175	3.1	6.4	0.60	0.67	4.7
63	P1016	P1015	12			65.2	0.0158	1.3	4.9	0.37	0.29	4.5
57	P1101	P1003	18			277.1	0.0252	22.0	12.4	1.00	1.31	16.7
55	P1102	P1101	18			84.1	0.0245	22.0	12.4	1.00	1.33	16.5
53	P1103	P1102	15			205.3	0.0380	14.8	12.0	1.00	1.17	12.6
51	P1104	P1103	15			74.9	0.0342	6.8	10.1	0.54	0.57	12.0
49	P1105	P1104	12			120.1	0.0490	6.8	11.3	0.71	0.86	7.9
47	P1106	P1105	12			133.1	0.0410	6.8	10.5	0.77	0.94	7.2
45	P1107	P1106	12			118.9	0.0328	6.8	8.6	1.00	1.05	6.5
105	P1201	P1010	18			55.4	0.0236	10.7	6.0	1.00	1.19	8.9
103	P1202	P1201	18			328.4	0.0314	10.7	10.9	0.54	0.57	18.7
101	P1203	P1202	18			241.6	0.0046	6.7	4.6	0.77	0.94	7.1
99	P1301	P1007	24			60.6	0.0200	24.4	11.2	0.65	0.76	32.0
97	P1302	P1301	24			43.9	0.0423	21.0	14.5	0.47	0.45	46.7
95	P1303	P1302	18			261.4	0.0096	21.0	11.9	1.00	2.04	10.3
93	P1304	P1303	15			316.8	0.0410	14.9	12.1	1.00	1.14	13.1
91	P1305	P1304	12			451.3	0.0234	5.2	7.9	0.78	0.95	5.5
89	P1306	P1305	12			84.4	0.0319	5.2	9.0	0.68	0.81	6.4
133	P2001	P2	42			132.0	0.0195	190.0	19.8	1.00	1.35	140.8
131	P2002	P2001	42			87.0	0.0193	190.0	19.8	1.00	1.36	140.2
129	P2003	P2002	42			508.3	0.0194	166.6	17.3	1.00	1.18	140.6
127	P2004	P2003	42			154.2	0.0900	166.6	32.2	0.53	0.55	302.6
125	P2005	P2004	42			731.9	0.0120	125.9	13.1	1.00	1.14	110.5

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123	P2006	P2005	42			226.7	0.0120	125.9	13.1	1.00	1.14	110.5
121	P2007	P2006	42			491.5	0.0208	102.0	16.4	0.62	0.70	145.5
119	P2008	P2007	42			147.7	0.0492	102.0	22.7	0.47	0.46	223.7
117	P2009	P2008	42			163.2	0.0820	82.3	25.9	0.37	0.28	288.9
115	P2010	P2009	42			108.2	0.0670	82.3	24.0	0.39	0.32	261.2
113	P2011	P2010	42			626.7	0.0230	71.6	15.6	0.48	0.47	153.0
111	P2012	P2011	42			329.5	0.0200	64.5	14.5	0.47	0.45	142.7
109	P2013	P2012	54			127.3	0.0096	64.5	10.9	0.40	0.33	193.0
107	P2014	P2013	54			156.2	0.0100	64.5	11.1	0.39	0.33	197.1
39	R1001	R-1	36			1358.3	0.0007	240.5	34.0	1.00	13.25	18.1
P-1086	R1002	R1001	36			1126.5	0.0195	240.5	34.0	1.00	2.57	93.5
P-212	R1003	R1002	30			137.1	0.0219	228.6	46.6	1.00	3.76	60.8
P-211	R1004	R1003	24			390.6	0.0307	51.4	16.4	1.00	1.29	39.8
P-1087	S1001	S-1	42			535.6	0.0034	258.2	26.8	1.00	4.38	59.0
P-300	S1002	S1001	30			172.2	0.0930	258.2	52.6	1.00	2.06	125.4
P-299	S1003	S1002	18			105.2	0.0143	79.4	45.0	1.00	6.32	12.6
P-298	S1004	S1003	18			312.7	0.0607	73.2	41.4	1.00	2.82	25.9
P-297	S1005	S1004	18			122.8	0.0426	73.2	41.4	1.00	3.37	21.7
P-296	S1006	S1005	18			193.1	0.0880	66.1	37.4	1.00	2.11	31.3
P-295	S1007	S1006	18			332.0	0.0633	57.1	32.3	1.00	2.16	26.5
P-303	S2001	S1002	30			234.6	0.0532	172.4	35.1	1.00	1.82	94.9
P-312	S2002	S2001	24			358.1	0.0166	55.8	17.8	1.00	1.91	29.2
P-313	S2003	S2002	24			131.9	0.0735	55.8	22.2	0.75	0.91	61.5
P-314	S2004	S2003	24			119.1	0.0671	42.1	20.3	0.63	0.72	58.8
P-304	S3001	S2001	24			176.6	0.0266	120.3	38.3	1.00	3.26	37.0
P-305	S3002	S3001	24			199.7	0.0432	120.3	38.3	1.00	2.55	47.1
P-306	S3003	S3002	24			376.6	0.1494	86.3	31.8	0.80	0.98	87.7
P-307	S3004	S3003	24			138.1	0.0725	57.3	22.1	0.77	0.94	61.1
P-308	S3005	S3004	18			158.0	0.0739	57.3	32.4	1.00	2.00	28.6
P-309	S3006	S3005	18			131.3	0.0853	40.3	22.8	1.00	1.31	30.8
P-310	S3007	S3006	18			190.1	0.0692	40.3	22.8	1.00	1.46	27.7
P-311	S3008	S3007	18			176.2	0.0719	28.1	18.2	0.81	1.00	28.2
P-1081	T1001	T-1	54			144.5	0.0221	265.2	20.9	0.75	0.91	293.0
P-218	T1002	T1001	54			128.8	0.0220	212.9	20.1	0.63	0.73	292.7
P-219	T1003	T1002	54			104.8	0.0220	212.9	20.1	0.63	0.73	292.7
P-220	T1004	T1003	54			290.8	0.0382	212.9	24.9	0.53	0.55	385.6
P-225	T1005	T1004	54			73.2	0.0015	153.4	9.6	1.00	2.01	76.4
P-226	T1006	T1005	54			114.4	0.0172	153.4	17.0	0.55	0.59	258.8
P-227	T1007	T1006	54			355.0	0.0030	153.4	9.6	1.00	1.43	107.2
P-265	T1008	T1007	54			665.7	0.0142	74.7	13.1	0.39	0.32	234.9
P-266	T1009	T1008	24			366.6	0.0122	74.7	23.8	1.00	2.98	25.0
P-267	T1010	T1009	24			145.2	0.0508	74.7	23.8	1.00	1.46	51.1
P-268	T1011	T1010	24			58.0	0.0722	53.2	21.9	0.72	0.87	60.9
P-269	T1012	T1011	24			343.9	0.0498	37.8	17.7	0.64	0.75	50.6
P-270	T1013	T1012	24			92.7	0.0582	37.8	18.8	0.61	0.69	54.7
P-217	T2001	T1001	12			83.2	0.0216	48.6	61.9	1.00	9.25	5.3
P-216	T2002	T2001	18			394.7	0.0145	48.6	27.5	1.00	3.83	12.7

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P-215	T2003	T2002	15			379.2	0.0390	48.6	39.6	1.00	3.80	12.8
P-224	T3001	T1001	12			244.8	0.0033	0.0	0.0	0.00	0.00	2.0
P-221	T4001	T1004	18			44.4	0.0041	90.3	51.1	1.00	13.47	6.7
P-222	T4002	T4001	15			572.8	0.0190	90.3	73.6	1.00	10.11	8.9
P-223	T4003	T4002	15			415.6	0.0576	52.2	42.6	1.00	3.36	15.5
P-229	T5001	T1007	30			60.4	0.0321	92.6	18.9	1.00	1.26	73.7
P-230	T5002	T5001	30			83.9	0.0393	92.6	18.9	1.00	1.13	81.6
P-231	T5003	T5002	30			60.8	0.0137	92.6	18.9	1.00	1.93	48.1
P-232	T5004	T5003	24			68.8	0.0118	92.6	29.5	1.00	3.76	24.6
P-233	T5005	T5004	24			61.3	0.0130	92.6	29.5	1.00	3.57	25.9
P-234	T5006	T5005	24			65.2	0.0123	49.0	15.6	1.00	1.95	25.1
P-235	T5007	T5006	24			67.3	0.0120	49.0	15.6	1.00	1.97	24.9
P-236	T5008	T5007	24			69.5	0.0116	49.0	15.6	1.00	2.00	24.5
P-237	T5009	T5008	24			72.3	0.0115	41.2	13.1	1.00	1.70	24.3
P-238	T5010	T5009	24			62.2	0.0133	41.2	13.1	1.00	1.57	26.2
P-239	T5011	T5010	24			62.9	0.0135	41.2	13.1	1.00	1.56	26.4
P-240	T5012	T5011	24			203.9	0.0067	28.9	9.2	1.00	1.55	18.6
P-241	T5013	T5012	21			279.5	0.0161	28.9	12.0	1.00	1.43	20.2
P-242	T5014	T5013	21			258.1	0.0030	28.9	12.0	1.00	3.31	8.7
P-1082	U1001	U-1	48			54.0	0.0020	144.7	11.5	1.00	2.23	65.0
P-271	U1002	U1001	48			74.8	0.0021	144.7	11.5	1.00	2.17	66.6
P-272	U1003	U1002	48			60.6	0.0026	124.4	9.9	1.00	1.68	74.0
P-273	U1004	U1003	48			88.8	0.0018	124.4	9.9	1.00	2.03	61.1
P-274	U1005	U1004	48			103.3	0.0072	116.6	11.0	0.78	0.96	121.9
P-275	U1006	U1005	48			61.1	0.0031	116.6	9.3	1.00	1.45	80.3
P-276	U1007	U1006	48			64.1	0.0028	116.6	9.3	1.00	1.53	76.3
P-277	U1008	U1007	48			65.3	0.0029	116.6	9.3	1.00	1.50	77.7
P-278	U1009	U1008	48			54.8	0.0035	116.6	9.3	1.00	1.37	84.8
P-279	U1010	U1009	48			47.7	0.0034	104.6	8.3	1.00	1.25	83.4
P-280	U1011	U1010	48			48.6	0.0033	104.6	8.3	1.00	1.27	82.6
P-281	U1012	U1011	48			47.0	0.0351	104.6	20.1	0.43	0.39	269.9
P-282	U1013	U1012	48			78.5	0.0182	104.6	15.7	0.52	0.54	194.4
P-283	U1014	U1013	36			83.9	0.0380	93.4	20.1	0.63	0.72	130.4
P-284	U1015	U1014	36			265.6	0.0120	93.4	13.2	1.00	1.27	73.4
P-285	U1016	U1015	36			49.7	0.0283	67.2	16.6	0.56	0.60	112.6
P-286	U1017	U1016	18			363.4	0.0818	51.2	29.0	1.00	1.70	30.1
P-1083	V1001	V-1	30			171.7	0.0015	126.1	25.7	1.00	7.88	16.0
P-244	V1002	V1001	12			72.2	0.0222	112.3	142.9	1.00	21.10	5.3
P-245	V1003	V1002	30			200.1	0.0080	112.3	22.9	1.00	3.05	36.8
P-246	V1004	V1003	30			60.0	0.0067	112.3	22.9	1.00	3.34	33.6
P-247	V1005	V1004	42			96.4	0.0078	103.5	10.8	1.00	1.16	89.0
P-248	V1006	V1005	36			441.2	0.0083	76.4	10.8	1.00	1.26	60.7
P-249	V1007	V1006	36			103.9	0.1513	67.2	30.9	0.35	0.26	260.1
P-287	V1008	V1007	36			155.2	0.0015	67.2	9.5	1.00	2.61	25.7
P-288	V1009	V1008	36			101.1	0.0039	67.2	9.5	1.00	1.62	41.5
P-289	V1010	V1009	36			72.7	0.0467	67.2	20.1	0.48	0.47	144.5
P-290	V1011	V1010	36			54.5	0.0670	67.2	22.9	0.43	0.39	173.1

Appendix C
City of Richmond - Storm Drain Master Plan
Gravity Main Output Report: 100-Year Storm

ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-291	V1012	V1011	36			55.8	0.0608	54.0	20.9	0.39	0.33	164.9
P-292	V1013	V1012	24			313.9	0.0365	54.0	17.2	1.00	1.25	43.3
P-293	V1014	V1013	24			74.2	0.0539	34.0	17.8	0.58	0.64	52.7
P-294	V1015	V1014	24			127.7	0.0239	34.0	12.7	0.79	0.97	35.1
P-250	V2001	V1005	30			310.3	0.0036	17.7	5.5	0.62	0.71	24.8
P-251	V2002	V2001	24			148.3	0.0047	14.3	5.6	0.76	0.92	15.5
P-252	V2003	V2002	24			112.7	0.0044	10.2	5.2	0.60	0.68	15.1
P-253	V2004	V2003	15			132.4	0.0109	5.1	6.0	0.65	0.76	6.8
P-1084	W1001	W-1	24			197.5	0.0467	74.7	23.8	1.00	1.52	49.0
P-260	W1002	W1001	12			216.2	0.0467	74.7	95.1	1.00	9.67	7.7
P-261	W1003	W1002	12			400.2	0.0467	74.7	95.1	1.00	9.67	7.7
P-262	W1004	W1003	12			427.7	0.0600	32.5	41.4	1.00	3.72	8.8
P-263	W1005	W1004	24			170.0	0.0015	32.5	10.4	1.00	3.74	8.7
P-264	W1006	W1005	15			210.5	0.0015	32.5	26.5	1.00	12.88	2.5
P-1085	W1101	W-1	36			129.9	0.0905	43.5	22.7	0.32	0.22	201.2
P-257	W1102	W1101	12			195.8	0.0930	43.5	55.4	1.00	3.99	10.9
P-256	W1103	W1102	24			214.7	0.0930	43.5	23.3	0.58	0.63	69.2
P-255	W1104	W1103	12			144.5	0.0930	25.2	32.1	1.00	2.32	10.9
P-254	W1105	W1104	24			239.9	0.0930	25.2	20.3	0.42	0.36	69.2
P-1091	X1001	X-1	36			326.1	0.1732	110.5	37.1	0.44	0.40	278.3
P-1090	X1002	X1001	36			209.5	0.1163	101.5	31.3	0.47	0.44	228.1
P-320	X1003	X1002	24			311.5	0.0369	60.2	19.2	1.00	1.38	43.6
P-319	X1004	X1003	24			204.3	0.0441	51.1	16.2	1.00	1.07	47.6
P-318	X1005	X1004	24			587.0	0.0341	30.9	14.6	0.64	0.74	41.9
P-317	X1006	X1005	24			361.9	0.0193	23.1	11.0	0.64	0.73	31.5
P-316	X1007	X1006	24			228.8	0.0044	23.1	7.3	1.00	1.54	15.0
P-315	X1008	X1007	24			235.5	0.0212	12.2	9.7	0.42	0.37	33.1
P-321	X2001	X1002	30			280.5	0.0103	35.2	9.5	0.70	0.84	41.8
P-322	X2002	X2001	30			417.4	0.0073	35.2	7.2	1.00	1.00	35.2
P-323	X2003	X2002	30			290.4	0.1097	35.2	23.3	0.35	0.26	136.2
P-1088	X2004	X2003	30			50.0	0.0150	35.2	11.1	0.62	0.70	50.3
P-1089	X2005	X2004	30			499.5	0.0180	23.7	10.8	0.46	0.43	55.2
P-1092	Y1001	Y-1	36			122.8	0.0105	269.0	38.0	1.00	3.92	68.5
P-330	Y1002	Y1001	36			86.8	0.0518	260.8	36.9	1.00	1.71	152.2
P-329	Y1003	Y1002	36			35.0	0.0017	260.8	36.9	1.00	9.41	27.7
P-326	Y1004	Y1003	30			494.1	0.0334	239.4	48.8	1.00	3.19	75.2
P-327	Y1005	Y1004	30			527.9	0.0227	219.0	44.6	1.00	3.53	62.0
P-328	Y1006	Y1005	30			223.7	0.0134	212.9	43.4	1.00	4.47	47.6
P-1093S	Y1007	Y1006	120			250.4	0.0399	204.5	23.4	0.17	0.06	3313.6
P-331	Y1008	Y1007	36			616.7	0.0859	119.7	29.1	0.56	0.61	196.1
P-332	Y1009	Y1008	30			155.7	0.0128	107.9	22.0	1.00	2.31	46.6
P-333	Y1010	Y1009	30			142.7	0.0140	107.9	22.0	1.00	2.22	48.7
P-334	Y1011	Y1010	30			453.6	0.0088	96.5	19.7	1.00	2.50	38.6
P-335	Y1012	Y1011	30			80.5	0.0124	96.5	19.7	1.00	2.10	45.8
P-336	Y1013	Y1012	12			122.2	0.0082	78.5	100.0	1.00	24.31	3.2
P-337	Y1014	Y1013	12			104.5	0.0541	78.5	100.0	1.00	9.45	8.3
P-325	Y2001	Y1003	18			147.5	0.0245	23.6	13.4	1.00	1.43	16.5

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ID	From ID	To ID	Dia. (in)	Channel Depth (in)	Channel Width (in)	Length (ft)	Slope	Storm Flow (cfs)	Velocity (ft/s)	d/D	q/Q	Pipe Capacity (cfs)
P-324	Y2002	Y2001	12			109.1	0.0733	15.5	19.7	1.00	1.60	9.7
P-339	Y3001	Y1007	18			237.7	0.1809	69.2	39.2	1.00	1.55	44.8
P-340	Y3002	Y3001	18			230.6	0.0043	60.9	34.4	1.00	8.77	6.9
P-341	Y3003	Y3002	18			463.8	0.0015	60.9	34.4	1.00	14.88	4.1
P-342	Y3004	Y3003	18			162.8	0.0015	42.0	23.8	1.00	10.39	4.0
P-343	Y3005	Y3004	12			137.4	0.0655	42.0	53.5	1.00	4.59	9.1
P-344	Y3006	Y3005	12			69.1	0.0145	42.0	53.5	1.00	9.77	4.3
P-345	Y3101	Y3004	12			223.0	0.0626	0.0	0.0	0.00	0.00	8.9
P-1095	Z1001	Z-1	12			29.7	0.0017	67.6	86.0	1.00	46.10	1.5
P-1094	Z1002	Z1001	12			20.2	0.0020	67.6	86.0	1.00	42.49	1.6
P-351	Z1003	Z1002	21			134.9	0.0148	66.5	27.6	1.00	3.44	19.3
P-349	Z1004	Z1003	18			347.9	0.0015	47.9	27.1	1.00	11.77	4.1
P-348	Z1005	Z1004	15			64.8	0.0617	47.9	39.1	1.00	2.98	16.1
P-347	Z1006	Z1005	15			226.0	0.0015	33.4	27.2	1.00	13.30	2.5
P-346	Z1007	Z1006	12			44.9	0.0045	33.4	42.6	1.00	14.02	2.4
P-1093	Z1101	Z1001	12			22.1	0.0023	0.0	0.0	0.00	0.00	1.7
P-350	Z2001	Z1003	18			176.8	0.0170	16.3	9.2	1.00	1.19	13.7