SECTION 9
SEWER COLLECTION SYSTEMS

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SECTION 9
SEWER COLLECTION SYSTEMS

9.1 PURPOSE AND DEFINITIONS

9.1.1 Purpose

This Section provides minimum design standards and guidelines for the planning and design of public gravity Sewer System improvements in the City Service Area. This Section generally covers the size, layout, and placement of Mains as well as appurtenant Manholes, temporary storage facilities and Services. Section 10 addresses the design and construction of Sewage pump stations and force Mains. These standards and guidelines may be amended periodically. It is the Designer's responsibility to check the City of Sacramento Department of Utilities (DOU) website or ask DOU representatives for amendments and to use the latest version of this Section. It is expected that all applicable Plates in the Appendix of this and other Sections of this Manual will also be reviewed and utilized as determined to be appropriate by the Project owner and Designer.

Compliance with these standards does not relieve a Designer from the additional responsibility to apply conservative and sound professional judgment when designing public owned and maintained facilities. Designers are expected to consider related issues, such as environmental impacts, maintenance of pedestrian and vehicular traffic patterns, constructability, safety, system maintenance and sustainability principles. Designer shall submit a Variance for all proposed deviations from requirements contained herein. All Variances shall be reviewed and accepted by DOU prior to DOU review of affected portions of Plans or studies (Refer to Section 9.2.4).

9.1.2 DOU Sewer System

The DOU is responsible for operating and maintaining the public Sewer System within the City Service Area (roughly 65 percent of the geographical area of the City), which includes a Combined Sewer System (CSS) in the older central areas of the City and a newer Separated Sewer System in the remaining City Service Area.

The balance of the City residents and businesses are served by the Sacramento Area Sewer District (SASD), which also serves most of Sacramento County (www.sacsewer.com). Flows conveyed by the City Sewer Systems are routed to the Sacramento Regional Wastewater Treatment Plant (SRWTP) for treatment and disposal via an Interceptor system consisting of large diameter pipes and pump stations. The Interceptor system and the SRWTP, located just south of the City limits, are owned and operated by the Sacramento Regional County Sanitation District (SRCSD).

Refer to Plate 9-1 SEWER BASINS for a map showing the City and SASD Service Areas within the City, and boundaries of the Combined and Separated Sewer System Basins.

9.1.3 Definitions

Whenever the following terms or titles are used, the intent and meaning shall be as defined below. Words defined below are shown capitalized throughout this Section. Proper nouns are also capitalized, but not defined below. Refer to Plate 9-2 for utility abbreviations.

10 Year Event: A rainstorm that has a one-in-ten (10%) chance of being equaled or exceeded in any given year, as further defined in Section 11

100 Year Event: A rainstorm that has a one-in-one hundred (1%) chance of being equaled or exceeded in any given year, as further defined in Section 11

As-Builts: Constructed Plans that show documented changes that occurred during construction

Average Dry Weather Flow (**ADWF**): The standard base reference in the design of Sewer System facilities within the City that represents the average daily Sewage flow contribution from Residential, Commercial, and other users plus additional flow from Groundwater Infiltration. Refer to Section 9.3.5

Basin: A geographical area containing the entire network of storm water and/or sewer improvements and associated properties that flow to one of the following:

- A City maintained pump station with an established Sump number,
- A County of Sacramento Interceptor,
- An Outfall to a waterway maintained by others,
- The Combined Sewer System from a Separated Sewer or Drainage System

Build-Out: The completion of all anticipated future development in a given area based on the currently adopted General Plan

Bulb-Out: A type of Round Corner where the curb extends into the road several feet from the Curb Return with the addition of reverse curves and tangents forming a barrier at the end of adjacent parking stalls

City: The city of Sacramento and all departments and representatives therein. Same as defined in *City Code* Chapter 13.08.020

City Code: The latest edition of the Sacramento *City Code* together with all associated addenda

City Service Area: The land containing properties that discharge to the City maintained Sewer and Drainage Systems, or receive potable water from the DOU water system. Refer to Section 9.1.2, 11.1.2 & 13.1.2

Cleanout: The term commonly used for a Service access assembly, conforming to the *Standard*

Specifications. The Cleanout is owned by the Customer and utilized by the City for maintenance purposes. Refer to Section 9.7.6. Same as "'Y' cleanout" in *City Code* Chapter 13.08.020

Collector: A Wastewater pipe designed to carry less than one million gallons of Peak Wet Weather Sewage Flow (PWWF) per day. Subject to calculations, the size of a Collector in the Separated Sewer System is typically no greater than 12-inches in diameter.

Combined Sewer: A combination of Stormwater and Sewage flows

Combined Sewer System (**CSS**): The portion of the Sewer System where Sewage and Stormwater flows are designed to be conveyed by the same piping system (refer to Plate 9-1 SEWER BASINS). Same as defined in *City Code* Chapter 13.08.020. Refer to Section 9.4

Commercial: For the purposes of this manual, all properties that are not Residential; including industrial, manufacturing, and multi-family Residential (greater than two units per parcel)

Common Service: Sewer piping and appurtenances upstream of the Service Cleanout, which is utilized by multiple properties and maintained by a Maintenance Association (refer to Section 9.7.1)

Conditions of Approval: Requirements adopted as part of the acceptance of a tentative map or other entitlement application that must be satisfied prior to acceptance of the corresponding Final Map or granting of other applicable entitlements

Covenants, Conditions, and Restrictions (**CC&Rs**): Written rules established as part of a Subdivision that impose requirements and/or limitations on use of applicable properties

Curb Return: The ends of a Round Corner

Crown: The top inside of a pipe or other type of conduit, or the cross section highpoint of a road, levee, or other surface that acts as a drainage barrier. The Crown is usually near the horizontal longitudinal center of the road or pipe. Refer to Figure 9-2, Section 9.6.

Cubic Feet per Second (**CFS**): A measure of the volume of flow over time

Customer: The owner of a property that discharges to or receives water from DOU facilities. Same as defined in *City Code* Chapter 13

Department of Utilities (**DOU**): City of Sacramento, Department of Utilities

Designer: The engineer of record who is the professional in responsible charge of the design of the Plans, as defined by the California Board for Professional Engineers and Land Surveyors

Director: Director of the Department of Utilities or their designated representative. Same as *City Code* Chapter 13.08.020

Drain Inlet (**DI**): A structure with a steel or iron grate used to collect storm water runoff from a curb and gutter, swale, or ditch. Stormwater collected is directed via pipe (DI lead) to a Manhole or Outfall. Refer to Section 11.

Dual Wye: The piping and appurtenance that joins two Services and routes them to a Main with a single Tap. Dual Wyes are not allowed in new construction and will be separated with a Tap for each Service when encountered.

Easement: A dedicated right to use and/or enter a real property owned by a separate party

Equivalent Single Family Dwelling Unit (**ESD**): A unit by which the average Sewage discharge from properties of different sizes and uses can be standardized and estimated. Same as "ESFD" in *City Code* Chapter 13.08.020. Refer to Section 9.3.4

Feasibility Study: A document that presents preliminary planning data, which may be required at the conceptual stage to assess the impacts of a proposed Project to the existing Sewer System and alternatives for providing such service, if necessary. Refer to Section 9.3.1

Final Map: A map showing a subdivision of land that creates one or more additional parcels. A tentative map and fulfillment of Conditions of Approval are required prior to acceptance of a Final Map in accordance with the Subdivision Map Act and Title 16 of the *City Code*. The Final Map is recorded in the office of the County Recorder after acceptance.

Flexible Pipe: A conduit designed to transmit a portion of the backfill load to the soil at its sides through an allowable amount of deflection. Flexible Pipe must be well supported on both the bottom and sides of the pipe. Common examples include all plastic and most steel pipes.

Flow Factor: Rate used to determine the average dry weather Sewage flow plus Groundwater Infiltration generated per ESD in gallons per day. Refer to Section 9.3.4

Flowing Freely: Assumption that Wastewater is flowing entirely under gravity conditions, without surcharging, and absent of downstream control

Flow Line: The lowest inside elevation of a pipe, swale, pond, Sump, or other structure over which water flows. When referring to a structure that receives water, such as a Manhole with a grated lid or DI, Flow Line can refer to either the surface inlet elevation or the structure/pipe outlet elevation. The terms "Grate", "Rim", and "Invert" can alternatively be used to more specifically reference the applicable Flow Lines for these types of structures. Refer to Figure 9-2, Section 9.6.

Flusher Branch: A Cleanout with a Manhole Head and Cover placed at the upstream terminus of a Main, as further defined in the *Standard Specifications* Dwg. No. S-240. Refer to Section 9.6.8

Grade Change: A point of deflection in vertical alignment, usually associated with a pipe

Grate: The steel lid over a DI with openings to accept drainage or the design elevation of a DI surface Flow Line, where water enters the DI. When referring to a DI that has a defined surface Flow Line depression, the Grate elevation shall be at the projected gutter Flow Line intersection above the DI, not including the depression. For example, the Grate elevation of a Type "B" Drop Inlet is approximately 1.5-inches above the physical Grate surface low point.

Gross Acreage: The entire area of a parcel or tributary sub-Shed, including streets, lots, and other space regardless of use

Gross Floor Area: The entire footprint area of a structure including rooms, walls, entry-ways, and other space whether intended for occupation or not

Groundwater Infiltration: Flows that enter the Sewer or Drainage System through cracks or defective joints in the pipes, Manhole walls and other appurtenances that is not directly attributable to flows collected by Services or Drain Inlets

Hydraulic Grade Line (**HGL**): The elevation to which the free water surface throughout a water system would rise when not constrained by anything other than atmospheric pressure. It will manifest itself as the actual water surface at any facility open to the atmosphere such as a Manhole, DI, pond, or Cleanout.

Interceptor: Large pipelines that gather Trunk and sometimes Collector flows and route them to a different destination. Interceptors generally have a Sewage design capacity greater than 10 mgd and are typically 33-inches in diameter or larger in the Separated Sewer System.

Invert: The bottom inside or Flow Line of a pipe or structure. The Invert in and out elevations noted in Plans and studies for a structure are based on the projection of the incoming and outgoing pipes to the center or defined reference point of the structure, which are not typically the same as the Inverts measured at the structure wall. Refer to Figure 9-2, Section 9.6.

Junction Box: A reinforced rectangular concrete structure as defined by the *Standard Specifications* DWG. No. S-310, with a Manhole Barrel, Cone, Grade Rings, and Head and Cover (Refer to Section 9.6.3)

Main: A pipe of any size owned and maintained by DOU that is intended to serve more than one Customer when constructed or at some time in the future. Mains are usually located in a Right-of-Way. Same as "City sewer main" in Chapter 13.08.020 and "Public water main" in Chapter

13.04.030 of the *City Code*

Maintenance Association: A body established for the purposes of maintaining one or more Services, which is required for Common Services. Same as "Association" that is wholly or partially established for maintenance of a Service in *City Code* Chapter 13.12.010

Manhole: A structure used to access Mains and larger Services. Refer to *Standard Specifications* Dwg. No. S-70 through S-120. Refer to Figure 9-2, Section 9.6. From bottom to top, a Manhole is generally comprised of the following components:

Base: The bottom-most portion of a Manhole that supports the Manhole structure. The Base also provides a smooth transition for flow through the Manhole in the shape of the bottom half of the exiting pipe and other pipes that enter the bottom portion of the Manhole. For No. 3, 3A and 4 Manholes, the Base may be cast-in-place concrete using the through pipe for the channel and a formed bench sloping from the Springline up to the Manhole wall, but are more commonly precast in a similar shape. Saddle Manholes always use the through pipe as the channel Flow Line, and generally do not have benches.

Barrel: A cylinder (typically 4-feet or 5-feet in diameter) that is placed atop the Base as necessary to form the primary riser from the Base toward the surface. The Barrel is composed of precast concrete sections of varying height that are keyed together. All pipes that do not connect to the Base should be connected to the Barrel. Larger Barrels may be specified when necessary to accommodate multiple and/or larger connections at similar elevations, as approved by the DOU.

Cone: A precast concrete conical section that transitions from the Barrel to the Grade Rings. The typical Cone heights are defined in the *Standard Specifications*, but are often altered under special circumstances, as approved by the City. If insufficient depth exists for the Cone, a flat-slab top may be used to connect directly between the Barrel and the Grade Rings.

Grade Rings: A cylinder (typically 2-feet or 3-feet in diameter) that is placed atop the Cone as necessary to make more detailed adjustments to the overall height of the Manhole. The Grade Rings are precast concrete sections of varying height that are keyed together.

Head and Cover: A cylindrical steel frame of the same inside diameter as the Grade Rings, with a steel circular lid that provides access through the top portion of the Manhole. Refer to *Standard Specifications* Dwg. No. S-140, S-150 and S-160

Net Acre(**age**): The developable parcel or tributary sub-Shed areas excluding all non-developable areas that do not contribute Sewage flow (i.e., public streets, parks, cemeteries, etc.). If a parcel is undeveloped and layout for a proposed Project is unknown, assume Net Acreage

equals 80 percent of the Gross Acreage.

On-Site: Property located outside of a public Right-of-Way, typically in reference to the property containing the applicable Project

Outfall: The location at which flows from a specific portion of the Separated Sewer, Drainage, or Combined Sewer System enter a receiving system

Outflows: Any spill, release or discharge of Sewage or Sewage combined with Stormwater from the Separated and Combined Sewer Systems

Peak Dry Weather Flow (**PDWF**): The maximum dry weather flow rate that is likely to be seen at any given point in the Sewer System. Refer to Section 9.3.7

Peaking Factor (**PF**): A variable that is multiplied by the Average Dry Weather Flow (ADWF) to determine the Peak Dry Weather Flow (PDWF). Refer to Section 9.3.7

Peak High Groundwater: The highest historical groundwater elevation applicable to a particular area

Peak Wet Weather Flow (**PWWF**): The maximum flow rate observed or predicted at any given point in the Sewer System during wet weather conditions. Refer to Section 9.3.7

Plans: Contract documents that may include drawings, specifications, and other directions for the construction of facilities described herein. All Plans shall be prepared by a civil engineer registered in the State of California (refer to Designer), or as otherwise required for the specific improvements proposed. All Plans shall be submitted to City for review and shall be accepted by City prior to beginning construction.

Point of Connection: The location where a proposed Sewer System connects to an existing or future portion of the Sewer System

Point of Service: A specific location on a Service as defined in Standard Specification DWG. NO. S-260 and S-265. Not the same as “Sewer point of service” in Chapter 13.08.02 of the *City Code*

Pressure Service: A Service under pressure carrying flows from a private Sewage pump. Refer to Section 9.7.11

Project: A proposed improvement including all related phases and elements

Rainfall Dependent Infiltration and Inflow (**RDII**): Water entering the Separated Sewer System that is directly related to precipitation. RDII may enter the Sewer System through Manhole and

pipe defects (infiltration), as well as direct surface drainage connections such as illegally connected roof, pool, and yard drains (inflow). Refer to Section 9.3.6.

Residential: Single family homes, duplexes, and half-plexes. For the purposes of this manual, all other properties are considered Commercial.

Right-of-Way (**ROW**): The property that contains a public road for maintenance by the City or other public jurisdiction. A Right-of-Way may be fee title property owned by the governing body, or an Easement over adjacent properties that is dedicated to the governing body as a Right-of-Way.

Rigid Pipe: Conduit designed to transmit the entire backfill load to the foundation beneath the conduit, with an insignificant amount of conduit deflection. Rigid Pipe predominantly requires support on the bottom portion of the pipe up to the Springline. Common examples include all concrete and clay pipes.

Rim: The elevation of the top center of a Manhole Head and Cover. Refer to Figure 9-2, Section 9.6.

Round Corner: The rounded portions of the curb, gutter, and the adjacent sidewalk and asphalt transitions at points of intersection of intersecting streets. Each of the corners in a street intersection is rounded with a circular curve that is tangent to the boundaries of the intersecting streets at the Curb Return. The curb and gutter portion of the Round Corners allow the smooth flow of runoff from one street to another. Round Corners may also include Bulb-Outs.

Separated Drainage System: A conventional Stormwater collection system utilizing a network of pipes and pumps conveying flows that are segregated from Sewage. Unlike the Combined Sewer and Separated Sewer Systems, the Separated Drainage System does not convey Sewage. Portions of the Separated Drainage System that supply flows to the Combined Sewer System shall comply with requirements of the Combined Sewer System. Same as DOU owned and maintained portions of the “Stormwater conveyance system” in *City Code* Chapter 13.16.030

Separated Sewer System: A collection system utilizing a network of pipes and pumps conveying Sewage flows (refer to Plate 9-1 SEWER BASINS). Unlike the Combined Sewer and Separated Drainage Systems, the Separated Sewer System is not intended to convey Stormwater. Portions of the Separated Sewer System that supply flows to the Combined Sewer System shall comply with the requirements of the Combined Sewer System, except for Basin 48 (refer to Section 9.4.2). Same as “Separate sewer system” in *City Code* Chapter 13.08.020

Service: The piping and appurtenances that includes the Cleanout (usually near the Right-of-Way line), the Tap, and the piping in between. The privately owned and maintained piping and appurtenances that extend from the Cleanout to the Sewage source are not governed by this Section, except for provisions related to Easement and Common Services (Refer to Sections

9.7.1 and 9.7.9). Same as the defined portion of a "Private sewer line" in *City Code* Chapter 13.08.020. Refer to Section 9.7

Sewage: Liquid waste discharged from residences, businesses, and other Customers that is not intended to be combined with Stormwater. Same as "Sanitary sewage" in *City Code* Chapter 13.08.020

Sewer Study: A Feasibility or Plan Study report analyzing Separated Sewer System improvements for proposed Projects, as required by Section 9.3

Sewer System: Unless preceded by the term "Separated" or "Combined", "Sewer System" shall include both the Separated and Combined Sewer Systems, and any other pipes and appurtenances regulated by this Section. Same as DOU maintained portions of the "Public sewer system" in *City Code* Chapter 13.08.020. Refer to Section 9.1.2

Shallow Groundwater: A condition wherein the Peak High Groundwater elevation is above an applicable Invert of a pipe, channel, pond, structure floor, or the surface. Regions in the City known to have Shallow Groundwater conditions include but are not limited to the Pocket, Greenhaven, Little Pocket, Upper Land Park, and Downtown neighborhoods.

Shed: A geographical boundary including the properties that discharge to specific points in the Sewer or Drainage System

Significant Outfall: The downstream terminus of a Sewer Study, which may be any Main that is continuously 10-inches or 18-inches in diameter or larger in the Separated and Combined Sewer Systems, respectively, from the Point(s) of Connection to an Interceptor. If no pipes in the Sewer System meet the noted size criteria, the Significant Outfall shall be the downstream Sump or County Interceptor.

Springline: The sides of a pipe at the elevation halfway between the Invert and Crown. Typically, the Springline is at the widest part of the conduit. Refer to Figure 9-2, Section 9.6.

Standard Specifications: The latest edition of the *City of Sacramento Standard Specifications for Public Construction* together with all associated addenda. All improvements shall conform to the latest edition of the *Standard Specifications*. Refer to http://portal.cityofsacramento.org/Utilities/Resources/Specs-and-Drawings. Same as defined in *City Code* Chapter 13.08.020

Stormwater: Runoff from precipitation that is not yet intended to be combined with Sewage. Same as defined in *City Code* Chapter 13.16.030

Subgrade: The surface of native material below the base rock and/or paving of a structure or pavement section

Subdivision: The division by any sub-divider of any unit or contiguous units of improved or unimproved properties, or any portion thereof for the purpose of sale, lease, or financing, whether immediate or future

Sump: A City maintained pump station with an established number that serves one or more Basins

Tailwater: The existing or future HGL of a system located immediately downstream of a subject pipe, structure, or other Separated Sewer or Drainage or Combined Sewer System appurtenance

Tap: Opening in a Main or structure that receives flow from a Service, and the appurtenance connecting the Service to the Main or structure. Same as “Service connection” in *City Code* Chapters 13.04.030 and 13.08.020

Trunk: A Main that typically carries Sewage flows greater than 1 mgd and less than 10 mgd, and is typically between 15 and 30-inches in diameter in the Separated Sewer System

Wastewater: Sewage, Stormwater, Combined Sewer, and other flows carried by the facilities defined in this Section. Same as defined in *City Code* Chapter 13.08.020

9.2 GENERAL REQUIREMENTS

9.2.1 Authority and Responsibility

The Director is given the authority and responsibility to collect Sewage from the public and convey it to the County of Sacramento for treatment. The Designer is responsible for adherence to the design standards contained herein.

All improvements to the Sewer System shall also be designed to meet the current applicable requirements of the following standards:

1. The *Standard Specifications*,
2. Title Chapter 13.08 of the Sacramento *City Code*,
3. Applicable provisions of the *Uniform Plumbing Code*

In case of a conflict between the various standards, the design criteria presented herein shall govern.

9.2.2 Disclaimer

By use of these DOU Standards and any design aids recommended in these DOU Standards, and in consideration of the City's provision of these products for your use, the user agrees to the following:

The City of Sacramento (City) and the City Department of Utilities (DOU) make no warranty, guarantee, or representation that these DOU Standards or the design aids recommended in these DOU Standards will meet your requirements, will be applicable to all conditions encountered by the Designer, or that the use of these products will be uninterrupted or error free. These products may exhibit nonconformities, defects, bugs, and errors, and are being provided for your use "as is". The DOU and the City disclaim and make no warranties of any kind, either express or implied, including but not limited to, any warranty of merchantability, fitness for a particular purpose, performance levels, course of dealing, or usage in trade. The entire risk as to the quality and performance of these products is assumed by the user, and the DOU and City shall not be liable for any claims, loss, damage, cost, or liability of any kind (hereafter referred to as "Liabilities") arising from the use, quality, or performance of these products.

The user also waives and releases any and all claims for any Liabilities which may arise against the City, its officers, employees, agents, and contractors, including claims arising under Section 1542 of the California Civil Code, which provides that: "A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which if known by him must have materially affected his settlement with the debtor."

Thus, notwithstanding the provisions of Section 1542, and for the purpose of implementing a full and complete release, the user expressly acknowledges that this agreement is intended to release and extinguish, without limitation, all claims for Liabilities that the user presently does not know or suspect to exist.

To the maximum extent permitted by applicable law, the user agrees to defend, hold harmless, and indemnify City, its officers, employees, agents, and contractors from and against any Liabilities arising from the use, quality, or performance of these products.

Preparation of complete and accurate Plans addressing details of structural adequacy, public safety, hydraulic functionality, maintainability, and aesthetics, are the sole responsibility of the Designer.

9.2.3 Acceptance

Acceptance of final studies (as required) and Plans must be obtained prior to construction of any public drainage, sewer or water facilities in the City of Sacramento. Preliminary studies and master plans are conceptual and are reviewed by DOU, but they do not receive a formal acceptance and cannot be used for construction. The acceptance of a study or Plans based on submitted documents and information shall not prevent the DOU from subsequently requiring the correction of errors or removing or conditioning such acceptance due to the discovery of errors or incorrect information or based on DOU's subsequent consideration or receipt of more accurate information. Refer to Plate 9-4 IMPROVEMENT PLAN CHECKLIST and Plate 9-5 SEWER STUDY CHECKLIST.

Plans and studies may be used for a period of one (1) year after the date of acceptance. If substantial construction does not commence within this one-year period, the DOU may require that Plans and studies be updated in accordance with the latest revised standards. Should construction subsequently halt for a period exceeding one continuous year, the DOU may require re-submission of the Plans and studies for re-acceptance as determined by DOU.

9.2.4 Variances

The City recognizes there are occasions when it may be desirable or necessary to vary from the standards and guidelines outlined herein. Designers shall complete and submit a variance request for all proposed deviations from these standards (refer to Plate 9-3 VARIANCE REQUEST FORM).

Acceptance or rejection of a variance is based on the conformance to the City's obligations and authority in *City Code* and City Charter to develop and manage facilities that protect public health, water quality, and the environment. Any proposed variance must also ensure worker safety and health, minimize maintenance and replacement costs, and maintain operational and performance efficiency throughout the system.

9.2.5 Gravity vs. Pumped Systems

All new Wastewater facilities shall operate under gravity flow conditions.

9.2.6 New Sewer Systems

All new improvements that connect to the existing Sewer System shall be Separated Sewer Systems. Plans shall address all requirements of this Manual. Many of these requirements are outlined by Plate 9-4 IMPROVEMENT PLAN CHECKLIST.

9.2.7 Diversion of Flows

Wastewater flows shall not be redirected from one portion of the Sewer System to another without an approved Sewer Study analyzing proposed diversion.

9.2.8 Phasing of Sewer Facilities

If phasing of Wastewater improvements is proposed, an acceptable phasing plan is required prior to acceptance of Plans. Studies shall demonstrate conformance with the requirements of this Manual after the total completion of all phases, as well as after each intermediate phase. The phasing plan shall clearly identify trigger mechanisms and proposed facilities for subsequent phasing, and define operation and maintenance requirements and responsibilities until the complete facilities are in place and functional. All interim facilities shall comply with the requirements of this Manual.

9.2.9 Geotechnical Investigation

A Geotechnical Investigation shall be submitted to DOU prior to Plan approval for all:

1. Improvements where construction excavations may extend within 2-feet of the estimated Peak High Groundwater,
2. Improvements located in areas underlain by uncertain or adverse soil conditions, such as “clean” caving sands, old fill, etc.,
3. Detention/Retention Ponds, Junction Boxes, pump stations, and other large or complex facilities.

All Geotechnical Investigations shall be signed by a Geotechnical Engineer currently registered with the State of California.

9.2.9.1 Field Explorations

When required for pipeline investigations, soil borings or test pits shall be spaced no greater than 500-feet apart with additional borings/test pits spaced closer to better define areas of inconsistent stratigraphy. The soil boring/test pit locations shall be within a horizontal offset distance of no more than 20-feet from the centerline of the Main.

At least two soil borings/test pits shall be performed for pump stations and at least one soil boring/test pit shall be performed for each junction structure or other like facility. At least one soil boring/test pit shall be performed for every acre of detention pond area with a minimum of 4 borings.

For construction excavations 10-feet or less in depth and all entry/exit pits for trenchless construction, soil borings/test pits shall extend to a minimum depth of the excavation plus 5 feet. For deeper construction excavations and detention ponds, soil borings/test pits shall extend to a minimum depth of the excavation plus 10 feet. If the subsurface soils may be susceptible to seismic liquefaction, at least one soil boring shall extend to a depth of 50-feet below proposed excavation.

Where the Peak High Groundwater is above the bottom of a proposed detention pond, at least one pumping test shall be performed within the proposed detention pond area. Observation wells shall be installed to measure groundwater levels during and following the test. Prior to installation of the pumping test and observation wells, a pumping test plan shall be submitted to the DOU for acceptance.

9.2.9.2 Geotechnical Investigation Report

Geotechnical Investigation reports shall include, at a minimum, the following:

1. A description of the Project area topography, landform, and geological formation,
2. A plan showing the proposed Project and locations of soil borings or test pits,
3. A description of the soil conditions and profile encountered. Soil descriptions shall be prepared in accordance with ASTM D2487 and D2488,
4. A description of the groundwater conditions encountered and any anticipated seasonal water table fluctuations,
5. Discussions and recommendations regarding the effect of the soil conditions and Peak High Groundwater elevations may have on the proposed design and construction including shoring, dewatering, excavation bottom stabilization, buoyancy, trench loading, Easement widths, foundation support, settlement, and suitability of the native soil for backfill.

Geotechnical Investigation reports for detention ponds shall also include, at a minimum the following additional items:

1. Calculations for seasonal (summer, winter, and maximum) and average inflow estimates. Where variable bottom materials are encountered in the detention pond area, provide expected or estimated inflow rates for each major soil type,
2. The results of the groundwater tests and a groundwater quality characterization. Provide modeling, if necessary, to demonstrate the impact (or lack thereof) of adverse pollutant migration on nearby properties or facilities,
3. Discussions and recommendations regarding the effect of the soil conditions and Peak High Groundwater elevations may have on the proposed design and construction including:
    a. Under-drain systems,
    b. Capacity of required pumping facilities,
    c. Adverse impacts on nearby properties or facilities from construction dewatering and long-term underdrain dewatering,
    d. The need for and construction of a clay and/or geosynthetic liner or other device

for preventing exfiltration/infiltration and embankment stability.

4. Discussions regarding geotechnical conditions that may impact the long-term operation and maintenance of the facility with recommended contingencies.

9.2.9.3 Construction Monitoring

When a Geotechnical Investigation report is required, construction monitoring shall be performed by a licensed geotechnical engineer to observe the soil conditions encountered during construction, evaluate the applicability of the recommendations presented in the Geotechnical Investigation report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions vary from those encountered during the investigation. If construction dewatering is required, the results of the temporary dewatering system selected should be analyzed on an on-going basis and compared to the proposed permanent system. Refer to Section 9.2.10 for groundwater discharge requirements.

A weekly progress report shall be prepared and submitted to the DOU by the geotechnical engineer describing the work progress, geotechnical conditions encountered, the results of testing, conditions that may modify design assumptions, and daily pumping rates and volumes.

If dewatering will be required for detention pond construction, a report shall first be submitted to the DOU for approval that includes the following information: a map showing layout and configuration of dewatering facilities, collection manifolds and discharge points; location of monitoring points and metering devices to estimate flow; listing of well sizes, depth, and pumping capacities; and other pertinent data.

After detention pond construction, the geotechnical engineer shall prepare a final report summarizing the conditions encountered and their professional opinion concerning the suitability of the constructed facilities to function as designed from a geotechnical standpoint.

9.2.9.4 Peak High Groundwater Elevation

The historical Peak High Groundwater elevation shall be determined based on the Groundwater Elevation Contour Map (Spring 1995) developed by the Sacramento County Department of Water Resources and/or nearby well data. When evaluating Peak High Groundwater depths or elevations, the DOU will reference these maps or well data unless the Designer can demonstrate that the Peak High Groundwater depth varies from that shown on the maps.

9.2.9.5 Shallow Groundwater Areas

The Designer shall determine if the proposed improvements are in an area of Shallow Groundwater and shall design the facilities accordingly. There are regions in the City of Sacramento that are known to be subject to Shallow Groundwater conditions such as North and South Natomas, the Pocket Area and the Valley Hi neighborhood.

In areas of Shallow Groundwater, the Geotechnical Investigation shall also address the following:

1. Premature failure of pipe trench sections or other excavations due to saturated soils,
2. Seepage over sidewalks,
3. Seepage through and around building foundations,
4. Infiltration of groundwater into pipelines,
5. Groundwater infiltration into channels or detention ponds resulting in pumping downstream,
6. Exfiltration from Wet Detention Ponds (Refer to Section 11),
7. Slope erosion or failure due to groundwater seepage,
8. Difficulties encountered during construction relative to dewatering and unstable soils.

9.2.10 Groundwater Discharges

Temporary groundwater discharges to the Sewer System shall require approval per City Code Section 13.08.110. Permanent discharges of groundwater to the Sewer System are not allowed. All temporary discharges to the Sewer Systems shall also require approval from SRCSD.

Discharges to the Sewer System shall be limited to dry weather periods only. A shut-off system shall be required for the groundwater discharge, which is capable of automatically terminating the discharge during rain events.

In the Combined Sewer System, the maximum Groundwater discharge flow rate shall be limited to 50-percent of the Main's design capacity unless the discharger demonstrates that additional capacity is available through a minimum of 30 days of continuous 15 minute increment flow metering. In the Separated Sewer System, the maximum discharge flow shall be determined by DOU unless the discharger demonstrates that capacity is available through a minimum of 30 days of continuous 15 minute increment flow metering.

9.3 SEPARATED SEWER SYSTEM

9.3.1 Feasibility Study

A Feasibility Study shall be submitted and accepted prior to approval of Project entitlements if there is a possibility that any of the following apply, as determined by DOU:

1. The hydraulic capacity of the existing Sewer System downstream of the proposed Point of Connection(s) does not meet the surcharge standards of Section 9.5.3,
2. Upstream or adjacent areas may require service through the proposed Project,
3. A gravity Sewer System may not be feasible to serve the proposed Project and/or surrounding areas.

The purpose of the Feasibility Study is to demonstrate that sewer service can be provided to a proposed Project. The study emphasis is on Project topography, phasing, and timing, Trunk or primary "backbone" sewers (and their capacity), sewer Sheds, pump station locations, and anticipated Shed shifts as outlined in the Sewer Study Checklist (Refer to attached Plate 9-5 SEWER STUDY CHECKLIST). The study need not include minor Collector sewers (other than schematic lines), minor Collector Manholes, and Subdivision layout.

The Feasibility Study shall be signed and sealed by a California registered professional civil engineer. The submission of a Feasibility Study is not a substitute for the Plan Study outlined in Section 9.3.2.

9.3.2 Plan Study

Projects that generate 25 or more ESD's shall submit a Plan Study with the initial Plan submittal (or earlier) and shall be approved by the DOU prior to final acceptance of the Plans. As outlined in the Sewer Study Checklist (Refer to attached Plate 9-5 SEWER STUDY CHECKLIST), a Plan Study is the design analysis of the Sewer System for a specific Project, which forms the basis for the Plans. The study focus is on everything required for the Feasibility Study plus minor Collector pipes, pipe depths, Subdivision layout, street layout, manholes, exceptions to policy, and pump station sizing, location and details. The Plan Study shall be signed and sealed by a California registered professional civil engineer. Projects in sewer basin 48 shall mitigate sewage impacts to the Combined Sewer System per Section 9.4.4.

9.3.3 Study Software

The Designer shall use InfoSewer ® developed by Innovyze ® or a spreadsheet software that demonstrates conformance with all criteria listed herein. InfoSewer modeling shall conform to the DOU InfoSewer modeling guide. Upon request, an electronic copy of the modeling guide can be provided by the DOU.

9.3.4 ESD Flow Factor

An ESD Flow Factor of 310 gpd/ESD shall be used for all Projects, unless otherwise directed by DOU. Depending on available information such as flow monitoring data, previous studies,

maintenance records, and complaint records, the DOU may vary the applicable ESD Flow Factor. The ESD Flow Factor includes Groundwater Infiltration when used in the Separated Sewer System. Groundwater Infiltration is accounted for separately in the CSS (Refer to Section 9.4.7).

9.3.5 Average Dry Weather Flow (ADWF)

Off-site ADWF conveyed by the existing Sewer System may be estimated using the following two approaches.

1. Temporary Flow Monitoring: the existing ADWF may be estimated by performing flow monitoring. The requirements for temporary flow monitoring will be determined by the DOU. General guidelines include the following:
    a. The number of temporary flow meters required will be determined by the complexity of the downstream Sewer System. The maximum number shall not exceed five,
    b. The monitoring duration shall be a minimum of 60 days and must include a rain event where at least 1½-inches of rainfall is recorded in a 24-hour period,
    c. A temporary rain gage(s) shall be installed at or near the temporary flow monitoring site(s) during the flow monitoring period unless meters are located within one mile of an operating rain gauge maintained by the City or County of Sacramento,
    d. The flow monitoring data shall include depth/velocity hydrographs, flow hydrographs, scatterplots, and any other data deemed necessary. A paper copy of the data shall be presented along with an electronic copy of the data in Excel® format.
2. Land Use Projections: the DOU has assigned ESDs to each parcel within the Separated Sewer System based on land use, historical water use, flow metering data, and typical published values.
    a. A data sheet and GIS map with the assigned ESDs for each parcel is available upon request,
    b. If a parcel is not included in the data sheet or not assigned ESDs, it shall be added to the study and assigned ESDs based on Plate 9-6 SEWER GENERATION RATES,
    c. The ADWF is equal to the total tributary ESDs multiplied by the ESD Flow Factor.

On-site ADWF conveyed by the Project may be estimated using Plate 9-6 SEWER GENERATION RATES or fixture-unit values included in the adopted Uniform Plumbing Code. One fixture-unit equals 7.5 gallons per minute. Fixtures are rated as multiples of this unit of flow. Additional analysis shall be required to determine ADWF for unusual and/or potentially large water users, such as food processing facilities, heavy industrial facilities, car washes, etc.

The designer shall review the listed data and note/explain any exceptions to flow estimates in the Feasibility and/or Plan Study.

9.3.6 Rainfall Dependent Infiltration and Inflow

For planning studies and design, a peak RDII rate of 1,600 gallons per Net Acre per day (gpad) shall be applied when evaluating Sewer Systems for new Projects and existing Sewer Systems constructed after 1990. A peak RDII rate of 2,500 gpad shall be applied when evaluating all remaining Sewer Systems.

The magnitude of RDII flows are related to the intensity and duration of the rainfall, the relative soil moisture at the time of the rainfall event, the condition of the Sewer System, and other factors. Peak Wastewater flows during rainfall events are typically the highest flow rates that occur in any Separated Sewer System. Depending on available data/information; such as flow monitoring data, previous studies, maintenance records, complaint records, etc., a greater peak RDII rate and RDII evaluations may be required.

9.3.7 Peak Wet Weather Flow (PWWF)

The PWWF is the maximum flow rate observed or predicted at any given point in the Sewer System during wet weather conditions. The Designer shall assume that the peak RDII flow coincides with the Peak Dry Weather Flow (PDWF). The Peak Dry Weather Flow (PDWF) is a product of the Peaking Factor (PF) times the ADWF.

Equation 9-1

$PWWF$ (Separated Sewer System) = $PDWF + RDII$ (Refer to Section 9.3.6 for $RDII$)

Where:

$PDWF$ = $ADWF$ x PF (Refer to Section 9.3.5 for $ADWF$)

PF = $1.7\ ADWF^{-0.056}$ ($ADWF$ in MGD)

9.4 COMBINED SEWER SYSTEM (CSS)

9.4.1 General

Design requirements and procedures not contained below are addressed in other Sections and sub-sections of this Manual.

9.4.2 Separated Systems

Separated Sewer System Basins that discharge to the CSS and separated portions of the CSS shall conform to requirements of the CSS, except for Basin 48. Sewer improvements in Basin 48 shall be designed in accordance with Section 9.3, but are required to mitigate sewer impacts in accordance with Section 9.4.4. Projects in the CSS shall redirect flows to separated systems when practicable, as directed by DOU. Sewer Services shall not be connected to Mains in the CSS that currently only convey Stormwater.

9.4.3 Combined Sewer Development Policy

The CSS Improvement Plan (CSSIP) update began in 2008 and the modeling was based on existing conditions at that time. The CSSIP does not include additional capacity for development. The CSSIP assumes that Development will mitigate all impacts on the CSS. Under no circumstances shall proposed infill drainage systems result in increased flooding, increased Outflows of Combined Sewer or Sewage to the streets, increased volume of Sewage on the streets, or increased overflows to the Sacramento River.

9.4.4 Mitigation of Sewer Impacts

All Projects shall demonstrate that all increases in Sewage flows are mitigated. The City will consider one of the following approaches to mitigate the impact:

1. Pay the established CSS mitigation fee. City Council has adopted a Mitigation Fee (*City Code* Section 13.08.490) that requires development Projects to offset the additional downstream Combined Sewer System Outflows due to the Sewage component of the Project,
2. At the City's discretion, the Project can participate in a City sponsored Project that improves the system in the area that can be upsized to incorporate mitigation of the Project. A separate cost sharing agreement shall be executed for this option.

Projects contributing increased sewer flows of more than 5 ESDs to the CSS shall evaluate the available Sewage only capacity of existing CSS Mains from the Project's Point of Connection to the nearest 18-inch or larger Main including all tributary Sewage flows. If any portion of the Mains to the nearest 18-inch Main is determined to have insufficient capacity to accommodate the increased sewer flow, the development shall also be required to improve the undersized Mains to the nearest 18-inch Main. Refer to Section 9.4.8 item 4 for capacity criteria.

9.4.5 Mitigation of Drainage Impacts

The Designer shall demonstrate that the proposed Project does not impact the CSS by increasing the volume of flooding, Outflows of Combined Sewer to the street, or volume of Sewage on the street. In addition, Designer shall demonstrate the proposed Project does not increase treated and untreated Combined Sewer System overflows to the River.

To address impact from the proposed Project, the City will consider the following approaches:

1. Pay the established Combined Sewer Development Fee (adopted under City resolution 2023-0338, City Code Section 13.08.490),
2. Directly mitigate the impacts utilizing low impact development BMPs per section 9.4.12,
3. Directly mitigate the impacts via public and/or private storage and other measures in accordance with Section 11 and the Onsite Design Manual. The setup of hydraulic models shall be in accordance with the CSS model user guide. Prior to hydraulic modeling, the Designer shall schedule a meeting with the DOU to review the Project, the modeling parameters, and discuss possible drainage solutions,
4. At the City's discretion, the Project can share in a City sponsored Project that improves the system in the area that can be upsized to incorporate mitigation of the Project. A separate cost sharing agreement shall be executed for this option.

9.4.6 Combined Sewer Studies

Combined Sewer Studies shall be based on existing conditions, modeled with and without the Project. Storm Drain Master Plans are not required in the CSS.

At a minimum, Combined Sewer Studies shall include:

1. A description of existing and proposed site conditions including a map,
2. Calculation of existing and post Project sewer flows,
3. The study shall describe how the increase in sewer flows will be mitigated,
4. Calculation of existing and post Project drainage flows,
5. The study shall describe how the increase in drainage flows will be mitigated,
6. Demonstrate that the existing flow patterns will be maintained. Provide pre and post Project Shed maps with peak flows,
7. Calculation of the available Sewage only capacity in existing CSS Mains from the Project's Point of Connection to the nearest 18-inch or larger Main and whether any Mains need to be upsized (refer to Section 9.4.4),
8. Include completed check lists (Refer to Plate 9-5 SEWER STUDY CHECKLIST and Plate 11-7 DRAINAGE STUDY CHECKLIST),

Studies that utilize hydraulic modeling software to demonstrate mitigation of impacts shall demonstrate the following:

1. For a 10 Year Event demonstrate no increase in volume of flooding by showing no increase in system wide flood volume and that the flood level has not increased at any node by more than 0.01 feet,
2. For a 10 Year Event mitigate sewer impacts per Section 9.4.4 or demonstrate no increase

in Outflows of Combined Sewer to the street by showing no overall increase in system wide Outflows and that Outflows have not increased at any node in the vicinity of the Project or downstream of the Project,

3. For a 10 Year Event demonstrate no increase in volume of Sewage on the street by showing no increase in system wide Sewage volume on street and that the volume of Sewage on the street has not increased at any node in the vicinity of the Project or downstream of the Project. Sewage volume is calculated by multiplying the concentration of Sewage by the flood volume,
4. For a 10 Year Event and for the average annual storms demonstrate no increase in treated and untreated Combined Sewer System Overflows to the River.

9.4.7 Combined Sewer Flows

Sewer and drainage flows in the CSS shall be calculated in accordance with the criteria presented in Sections 9 and 11, with the following modifications:

1. Calculate ADWF from Plate 9-6 SEWER GENERATION RATES), times the ESD Flow Factor (Section 9.3.4),
2. For ADWF less than 1 MGD, calculate PDWF by multiplying ADWF by the Peaking Factor determined from Plate 9-7 CSS PEAKING FACTOR. Peaking Factor for ADWF greater than or equal to 1MGD shall be 2.3,
3. Add Groundwater Infiltration at a rate of 600 GPAD to determine PWWF sewer flows,
4. Calculate PWWF drainage flows using Infoworks ® or the rational method as described in Section 11.

9.4.8 Combined Sewer Pipe Sizing

All CSS pipes shall be sized in accordance with the criteria presented in Sections 9 and 11, with the following modifications:

1. All new conveyance and replacement pipe carrying Stormwater shall have a minimum inside diameter of 10 inches,
2. Pipe material used for storage shall have an inside diameter equal to or greater than the diameter utilized in the study,
3. The maximum d/D ratio for Combined Sewer flows in all pipes shall be 1 when Flowing Freely during a 10 Year Event,
4. The maximum d/D ratio for Sewage flows in all pipes shall be 0.5 when Flowing Freely during PDWF.

9.4.9 Stormwater Detention Ponds

Stormwater detentions ponds may be constructed in the CSS to mitigate Stormwater impacts in accordance with Section 11, if the pond does not receive upstream Sewage or CSS flows, and an approved backwater valve is placed on the discharge to the CSS.

9.4.10 Underground Storage

All storage of Combined Sewer shall be for a duration of less than one day, placed underground, released at a rate of not more than 0.18 CFS/acre and shall be approved by the DOU. Longer term storage of Sewage is prohibited.

Storage may be provided in underground detention vaults or oversized pipes. Underground storage must include design measures to facilitate operations and maintenance.

9.4.11 On-site Storage

Stormwater may be stored On-Site in accordance with Section 11 and the Onsite Design Manual. A backflow device shall be required when necessary to prevent Outflows from the CSS.

9.4.12 Hydromodification Plan (HMP)

Increased drainage flows to the CSS may be mitigated by implementing Low Impact Development (LID) features. The HMP standards state that HMP is not required in the CSS. However, the increase in drainage flows to the CSS may be mitigated if the Project demonstrates that it does not increase peak flows or duration utilizing the Sacramento Area Hydrology Model (SAHM, refer to Section 11.3.7).

9.4.13 Combined Sewer Credits

The City provides “credit” for flow contributions within the CSS that exist or had existed when the Combined Sewer System Cease and Desist Order was issued (July 1990). For example, if records indicate that a given lot had 10 ESDs and 70 percent imperviousness in July 1990,

1. Was subsequently razed, and is currently proposed for redevelopment of 50 ESDs at 80 percent imperviousness,
2. The Project would mitigate or pay CSS impact fees for the additional 40 ESDs, and
3. Construct On-Site or off-site mitigation for the additional 10 percent imperviousness.

9.5 DESIGN OF PIPELINES

9.5.1 Pipe Sizing

All new and replacement Mains in the Separated Sewer System shall have an inside diameter of at least 8 inches. New conveyance pipe in the Separated Sewer System shall also be sized to accommodate the PWWF subject to the following limitations (excluding backwater conditions):

1. The maximum d/D ratios in the Separated Sewer System shall be 0.7 for Mains less than 12-inches and 1.0 for larger pipes,
2. Designer shall use a Manning coefficient (n) value of 0.013 for all sewer pipes, which accounts for typical minor losses.

Refer to Section 9.4.8 for additional pipe sizing requirements in the CSS.

9.5.2 Slope and Velocity

All Wastewater pipes shall be sloped to achieve a minimum velocity of 2 FPS and a maximum velocity of 10 FPS at its maximum allowable d/D ratio (refer to Section 9.5.1) while Flowing Freely.

The minimum slopes required to achieve a flow velocity of 2 FPS for common pipe sizes are listed in Table 9-1 Minimum Slopes. The minimum slope shall be increased further as necessary to achieve a minimum flow velocity of 1 FPS flow velocity during the ADWF.

Table 9-1 Minimum Slopes

Main Diameter (inch)	Max. d/D	Minimum Slope
8	0.70	0.0027
10	0.70	0.0020
12	1.00	0.0020
15	1.00	0.0015
18	1.00	0.0012
21	1.00	0.0010
24	1.00	0.0008

9.5.3 Surcharge of Pipelines

PWWF flows shall not cause the HGL in an existing Main upstream of the First Significant Outfall to rise:

1. More than 2-feet above the Crown of the existing pipe, or
2. Within 2-feet of the lowest Manhole Rim elevation.

If the existing HGL does not meet this requirement, Project impacts to the HGL shall be mitigated entirely, or as necessary to achieve this requirement. Designer shall contact DOU to determine

the estimated HGL at the First Significant Outfall. If DOU does not have HGL data, Designer shall assume the HGL is at the crown of the existing Main at the connection point.

9.5.4 Horizontal Alignment

Mains shall be laid with straight alignments between Manholes and parallel to the street centerline wherever possible. If curved Mains are justified,

1. The radius shall be at least 1.33 times the manufacturer's minimum,
2. The maximum deflection angle of pipe joints shall be restricted to 67 percent of the pipe manufacturer's recommendations,
3. Sufficient data shall be provided on the Plans to define any proposed pipe curves.

New Mains shall be located in City Right-of-Ways dedicated for public streets and shall be placed south and east of the street centerline where conditions allow. If the Main will serve property on one side of the street only, it may be located on that side of the street if no potential conflict with other utilities exists.

Mains in new streets shall not encroach horizontally (edge to edge) within:

1. 5½-feet of other utilities (except water mains),
2. Four-feet from the lip of gutter, edge of pavement, median curbs, or the face of buildings or other permanent structures for streets with less than 30-feet of asphalt width,
3. Seven feet from the lip of gutter, edge of pavement, median curbs, or the face of buildings or other permanent structures for streets with more than 30-feet of asphalt width.

Mains shall be located in conformance with Water System design standards Section 13.2.5. More rigorous separation requirements may also be required by the City or others for unusual conditions, such as Shallow Groundwater or unstable soils.

Long skew crossings under existing or proposed facilities shall be avoided. Mains shall cross substructures and other pipes as close to perpendicular as possible. Skew angles shall not be less than 75 degrees.

9.5.5 Vertical Alignment

Mains shall provide a constant slope between Manholes. If a Grade Change is necessary, construction of a Manhole shall be required at the Grade Change.

A minimum vertical separation of 1 foot between Mains and crossing utilities shall be maintained. Water mains and other facilities may require additional separation or measures (refer to Water System design standards Section 13.2.5).

9.5.6 Pipe Cover

The minimum cover for new Mains shall be 4-feet measured from the top of bell to the finished surface unless connecting to an existing main with less cover.

New Mains connecting to existing shallow Mains may have less than 4-feet of cover if the Main is sufficiently deep to ensure gravity flow of Service connections and avoid conflicts of Services with water mains and other utilities. Mains shall be installed at the depth required to serve potential future extensions, which may include areas outside the Project. No Mains shall have less than 1-1/2-feet of cover to the finished surface grade and 6-inches to the Subgrade of a road.

Flexible Pipe shall not be installed where cover exceeds 12 feet. Pipe cover shall conform to manufacturer's recommendations and the *Standard Specifications* in addition to requirements noted above.

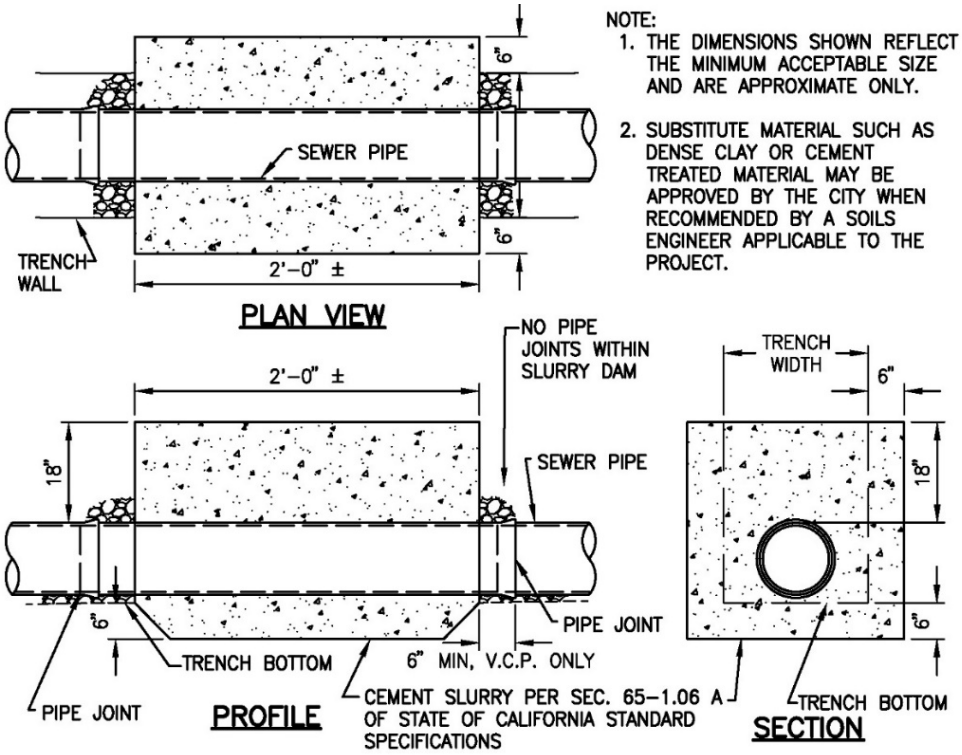
9.5.7 Buoyancy

Buoyancy of improvements shall be considered during design. Flotation of the Main and appurtenances shall be prevented throughout construction, operations, and maintenance.

9.5.8 Trench Dams

Trench dams shall be installed in areas with Shallow Groundwater at a maximum spacing of 400 feet and shall be located near the midpoint of Mains between Manholes. Refer to detail below.

Figure 9-1 Trench Dam



9.5.9 Levee Crossings

Refer to section 11.5 for design of Sewer System improvements crossing levees.

9.5.10 Track, Freeway, and Waterway Crossings

Contact DOU regarding requirements for all Mains that cross railroad tracks, freeways, waterways, or other crossings that will be difficult to access by City maintenance crews.

9.5.11 Inverted Siphons

Inverted siphons are prohibited.

9.5.12 Trenching, Bedding, and Backfill

Trenching, bedding, and backfill shall conform to the *Standard Specifications*.

9.5.13 Pipe Materials

Acceptable pipe types for Wastewater applications are defined by Sections 10 and 26 of the *Standard Specifications*.

9.5.14 Removal or Replacement

When an existing Main will be removed and replaced in an existing Right of Way, the Contractor shall use a ferreting device or equivalent to determine the exact location of the existing Main and mark location on the pavement. The Main location shall be completed prior to any excavation or saw cutting of pavement. A note to this affect shall be included on the Plans.

Mains installed to replace existing facilities shall generally follow existing alignments, but may be realigned as deemed necessary to achieve optimum flow conditions, reasonable access, and separation from existing utility infrastructure. Install the replacement Main to match the Crown of the existing Main, if feasible.

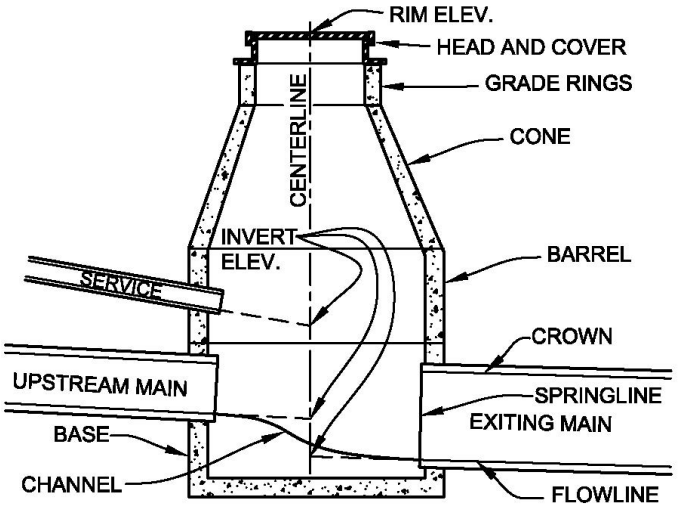
9.6 MANHOLES

9.6.1 Location

Manholes shall be required at the following locations:

1. Grade Changes in Main,
2. Changes in Main size,
3. Changes in Main material,
4. Upstream ends of Mains,
5. Intersection of Mains,
6. Changes in flow direction,
7. Service connections to the Main when the Service is 8-inches in diameter or greater,
8. Service connections to the Main when the Service matches the diameter of the Main,
9. Discharge of a force Main.

Figure 9-2 Typical Manhole Terms



Manholes are prohibited at the following locations:

1. Areas inaccessible to City maintenance vehicles,
2. Sidewalks, crosswalks, pedestrian ramps, gutters & drainage swales,
3. Within 50-feet of fire station, police station, or other emergency facility driveways,
4. Within 15-feet of railroad track beds or in accordance with the jurisdictional railroad authority, whichever setback is greater,
5. Within traffic circle islands, bulb-outs, other traffic calming facilities, or medians,
6. Within intersections and limits of associated Round Corners where no side Mains or other connections enter the Manhole.

9.6.2 Manhole Spacing

Maximum horizontal spacing of Manholes shall be 500 feet for all straight runs of Main. Manhole spacing on pipes placed with a horizontal curve shall be further reduced to the curve radius. For example, Manholes shall be placed every 200 feet or less for Mains constructed with a longitudinal radius of 200 feet.

9.6.3 Manhole Types

Manhole types shall conform to the *Standard Specifications,* as outlined in Table 9-2 Manhole Types.

Table 9-2 Manhole Types

Main Diameter (inch)	Manhole Type	Manhole Barrel Diameter (ft)	Cone Type	*Standard Specifications* Dwg. No.
Less than 21 (and less than 8-feet deep)	3	4	Concentric	S-70
Less than 21 (and more than 8-feet deep)	3A	4	Eccentric	S-80
21 to 42	4	5	Eccentric	S-110
Larger than 42	Saddle	5	Eccentric	S-120
Varies	Junction Box	Varies	Eccentric	S-310

A flat-slab top may be used in lieu of a Cone for Manholes with connecting Mains that have less than 30-inches of cover. Manhole rungs or ladders are prohibited for all manholes. Manholes with force main Outfalls, large drops, turbulent flow, and other excessive exposure to sewer gases shall be lined with epoxy or other approved methods and materials. All lined Manholes shall be labeled as such on Plans.

A Junction Box shall be required where other manhole types listed are not practical. Applicable portions of *Standard Specifications* Sections 10, 25 and 38, and DWG. NO. S-310 shall apply to Junction Boxes. Junction Boxes shall be made of pre-cast reinforced concrete or cast-in-place reinforced concrete, designed by a professional structural or civil engineer registered in the State of California. Design, stamped calculations, drawings and submittals shall be approved by DOU prior to the start of construction. Junction Boxes shall support H20 loading and impact loads, and shall be accessible via one 36-inch manhole head and cover, at a minimum. For Mains greater than 25-feet in depth, Junction Boxes shall be provided with a minimum of two access points.

9.6.4 Venting

Manholes shall be equipped with a gasketed and bolted Head and Cover at force main Outfalls or in areas where the City has identified Sewage odor problems. Manholes with force Main Outfalls shall require an analysis to determine if venting of trapped air is required. If required, the Manhole shall be equipped with approved ventilation piping and a Sewage gas filter, located in an area appropriate for venting of filtered Sewage gases.

9.6.5 Manhole Connections

Pipes shall intersect Manholes maintaining a minimum 90 degrees to the downstream pipe. The upstream Main shall be the same or smaller diameter than the downstream Main and shall not have its Crown lower than the Crown of the downstream Main.

Inverts through Manholes and Junction Boxes shall be designed to maintain the energy gradient across the structure.

Connections shall not be allowed to the Cone or Grade Ring sections of the Manhole. At least 1 foot of Manhole wall shall be provided between connection openings into the Manhole. Refer to Section 9.7.8 for Service connections to a Manhole.

9.6.6 Drop Connections

A drop connection is required for incoming pipes in Manholes or Junction Boxes with benches if the Invert of the incoming sewer pipe is 1 ½-feet (18-inches) or more above the Springline of the outgoing pipe. Drop connections shall not be placed for pipes that only convey Stormwater. The construction of drop connections shall conform to the *Standard Specifications*. Drop connections shall not be greater than 10-feet in height. All 10-inch and larger drop connections shall be outside drop connections. All 8-inch and smaller drop connections shall be inside drop connections.

A maximum of two drop connections may be constructed in a Type 3 or 3A Manhole. A maximum of three drop connections may be constructed in a Type 4 Manhole. At least 1-foot of horizontal clearance shall be provided from the drop structure to any other connections or appurtenances inside the Manhole. The drop connection shall not be in a location that obstructs the flow of any other connection in the Manhole or Manhole access.

Due to the unequal earth pressures that result from the backfilling operation near a Manhole, outside drop connection shall be encased with CDF to at least 1 foot above the drop connection.

9.6.7 Buoyancy

Buoyancy of Manholes shall be addressed, and flotation of the Manhole shall be prevented with appropriate construction where Shallow Groundwater conditions are anticipated.

9.6.8 Flusher Branch

Flusher branches are not allowed.

9.6.9 Pipe Stubs

A minimum 2-foot long stub from the outside of Manholes shall be provided where an anticipated future extension could be made. The *Standard Specifications* requires a flexible joint be located within 2-feet from the outside Manhole wall for pipes less than 21-inches in diameter.

An approved mechanical plug shall be installed at the end of pipe stubs 18-inches in diameter and smaller. For larger diameter Mains, provide a plug constructed with grout and manufactured concrete masonry units of sufficient strength to withstand the potential hydrostatic and soil loads on the plug, as determined by a civil engineer, licensed in the State of California. The plug shall be capable of disassembly in the future without harming the stub.

9.6.10 Cross Connections

There shall be no physical connections between a public or private water supply system and the Sewer System that could permit the passage of Wastewater into the water supply. No water supply pipe shall pass through or come into contact with any part of a Manhole or Main.

9.6.11 Separation and Summit Manholes

Separation and summit Manholes are prohibited.

A separation Manhole permits the crossing of two gravity pipes that would otherwise conflict, without comingling flows (typically storm and sanitary sewer). Typically, separation Manholes are constructed over the deeper pipeline, allowing the intersecting pipe to flow continuously through the Barrel section of the Manhole.

A summit Manhole has two or more exiting pipes with approximately the same Invert elevations, such that normal flows can exit in more than one direction.

9.7 SEWER SERVICES

9.7.1 Service Requirements

Service connections to the Sewer System from the Cleanout to the Main shall conform to the standards presented in this Section and Chapter 13.08 of the *City Code*. The sewer pipe and appurtenances upstream of the Cleanout shall conform to the adopted plumbing code and may require a building permit.

9.7.2 Service Size

The minimum Service diameter shall be 4 inches. Larger diameter Services may be required for developments expected to contribute high Wastewater flows. In this case, the Services shall be sized according to minimum requirements of the adopted plumbing code or larger if determined by the Designer.

9.7.3 Depth and Material

New Services connected to new Mains shall have a minimum depth of 4 feet measured from the top of the pipe to the surface at the Cleanout, and:

1. Four and six-inch diameter Services shall be ABS Schedule 40 pipe per ASTM D2661,
2. Larger diameter Services shall be PVC SDR 35 pipe per ASTM D3034,
3. VCP Services may be required in industrial areas where Sewage contains chemicals detrimental to ABS or PVC.

The depth of cover over Services connecting to existing shallow Mains shall not be less than 2-feet.

In Shallow Groundwater areas, no Services will be connected to a Main with more than 9-feet of cover. No Services shall be connected to a Main with greater than 15-feet of cover in all other areas. In these cases, a shallower Main placed parallel to the deeper Main will be required to connect proposed Services.

9.7.4 Location

All new Services are prohibited within 3-feet of side-yard property lines, water services, street lights, trees, Drain Inlets, other Sewer Services connected to the same Main, and fire hydrants. The location of Services and anticipated driveways or entrances shall be shown on Plans.

Service connections to Mains outside the Right-of-Way are prohibited where connection can be made to a Main in the public Right-of-Way.

9.7.5 Slope

Services shall have a minimum slope of 2 percent or ¼ inch per foot. The maximum slope shall not exceed 100 percent or 1 horizontal to 1 vertical.

9.7.6 Cleanouts

All Services shall have Cleanouts for cleaning in the direction of the Main. The Cleanouts shall be installed per Drawing S-260 and S-265 of the *Standard Specifications*. A cast iron Cleanout assembly shall be installed where located in areas of concrete or asphalt. A Manhole shall be installed in lieu of a Cleanout for 10-inch diameter and larger Services.

9.7.7 Backflow Preventers

When required, private backwater devices shall be installed upstream of the Cleanout outside the public Right-of-Way, and shall be maintained by the property owner.

9.7.8 Main Connections

New Services that do not connect to a Manhole shall be installed perpendicular to the Main. Services less than 8-inches in diameter shall connect to 8-inch diameter and larger Mains using manufactured tees or Insert-a-Tees (or approved equal) per Drawing S-260 of the *Standard Specifications*. Insert-A-Tees are a proprietary product that connects Services to Mains without disrupting flow. Saddle tees are not permitted.

All Service connections to 6-inch diameter and smaller Mains shall be made with cut-in tees. All tees shall be the same material as the Main.

Services 8 inches and larger shall connect to the Main with a Manhole. When connecting a Service to a Manhole, the Invert of the Service shall be at or above the Springline of the Main and a Drop Connection may be required, as defined by Section 9.6.6.

All connections to existing Mains shall be made by the City. Double wyes and other methods of splitting a single Service downstream of the most downstream Cleanout are prohibited.

9.7.9 Easement Services

Services that run parallel to and within a Right-of-Way will only be allowed if the following conditions are met:

1. The lot does not front a public Main,
2. The Service is privately maintained and is labeled as “private” on the Plans,
3. A revocable encroachment permit is obtained,
4. The need for future extension of the Service is not anticipated,
5. The Service does not exceed 300-feet in length.

An Easement Service extends from a public Main through one or more adjacent properties to access the property to be served. Easement Services will be allowed only if all the following conditions are met:

1. The lot(s) being served does not front a public Main,
2. The Service is privately maintained and is labeled as “private” on the Plans,
3. The need for future extension of the Service is not anticipated,
4. The Service does not exceed 300-feet in length,

5. A private Easement or a conveyance of Easement agreement (if the properties have common ownership) shall be dedicated to the lot benefiting from the Service.

Easement Services are privately owned and maintained. Easement Services may be shared by more than one Customer (Common Service). Easements, maintenance agreements, homeowner's associations, CC&R's, and other documents may be required for Easement Services. Refer to City Code Chapter 13.08.190.

9.7.10 Main Replacements

When a Main is being replaced or relocated, live Services shall be replaced from the Main to the edge of Right of Way. Existing Services to vacant lots or Services that are not being used shall not be reconnected, and instead shall be properly abandoned per Section 9.8, unless a permitted building plan for the lot shows a need for the existing Service(s). The abandoned Services shall be shown on the Plans or As-Builts.

If Residential Services with a Dual Wye are encountered during replacement of an existing Main or the Service, separate Services shall be provided to each parcel.

9.7.11 Pressure Services

Pressure Services shall not be less than 2-inches in diameter, shall discharge into a private on-site Manhole or Cleanout and shall flow by gravity prior to reaching the Point of Service. The Pressure Service shall be equipped with a Backflow Preventer upstream of the Point of Service.

Manholes that directly receive pressure service discharges shall be lined with epoxy or other approved methods and materials. All Manholes into which Pressure Services discharge shall be labeled as such on Plans.

9.8 ABANDONMENT OF SEWER FACILITIES

Existing Wastewater facilities within the Project limits that have no current or future anticipated use shall be removed or abandoned per Section 13-3.5 of the *Standard Specifications*.
Any excavation or depression created by the removal shall be backfilled to within 12-inches of the pavement using CDF or Class 2 aggregate base.

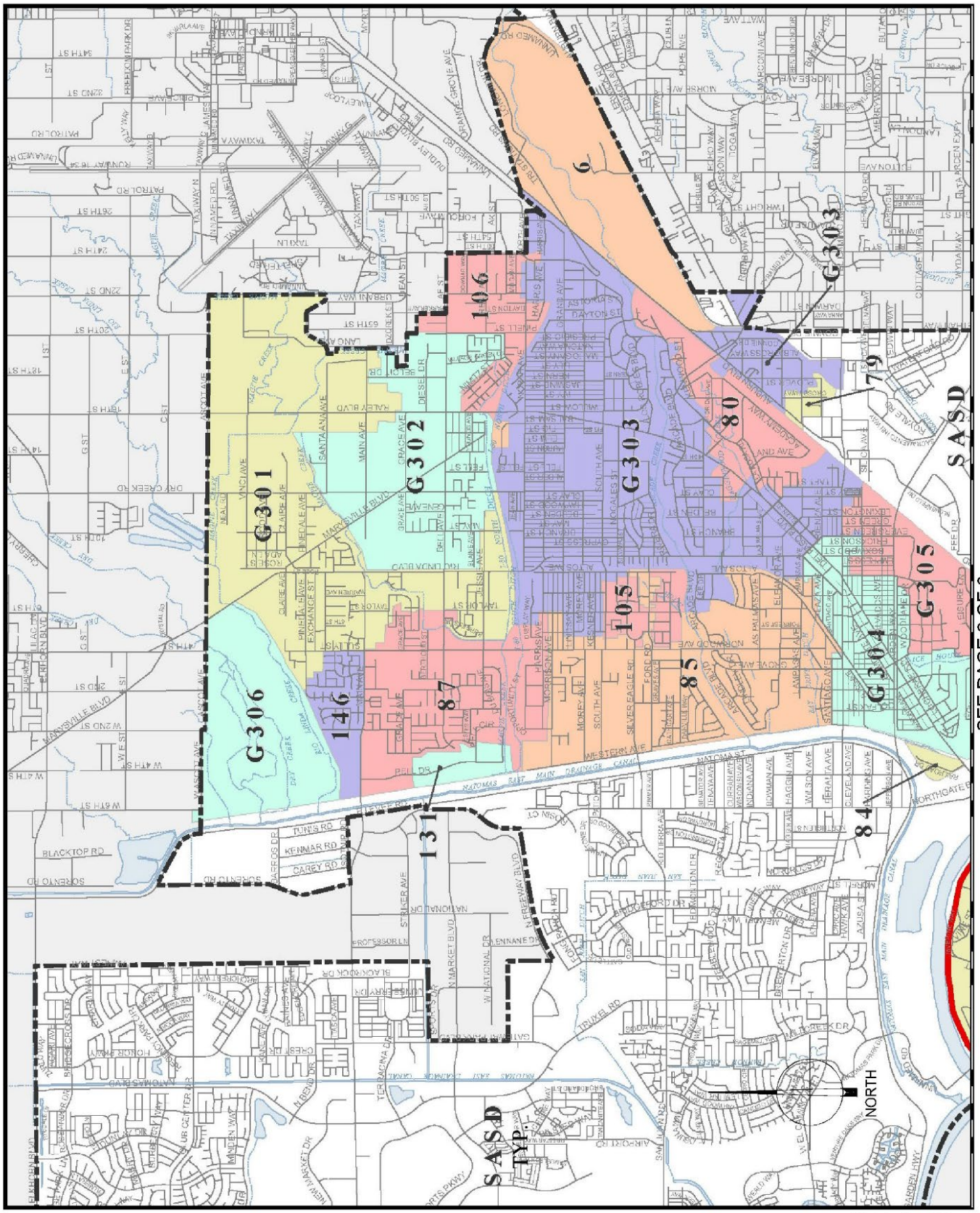
All Wastewater facilities to be abandoned shall be abandoned in accordance with the *Standard Specifications* and the following minimum requirements:

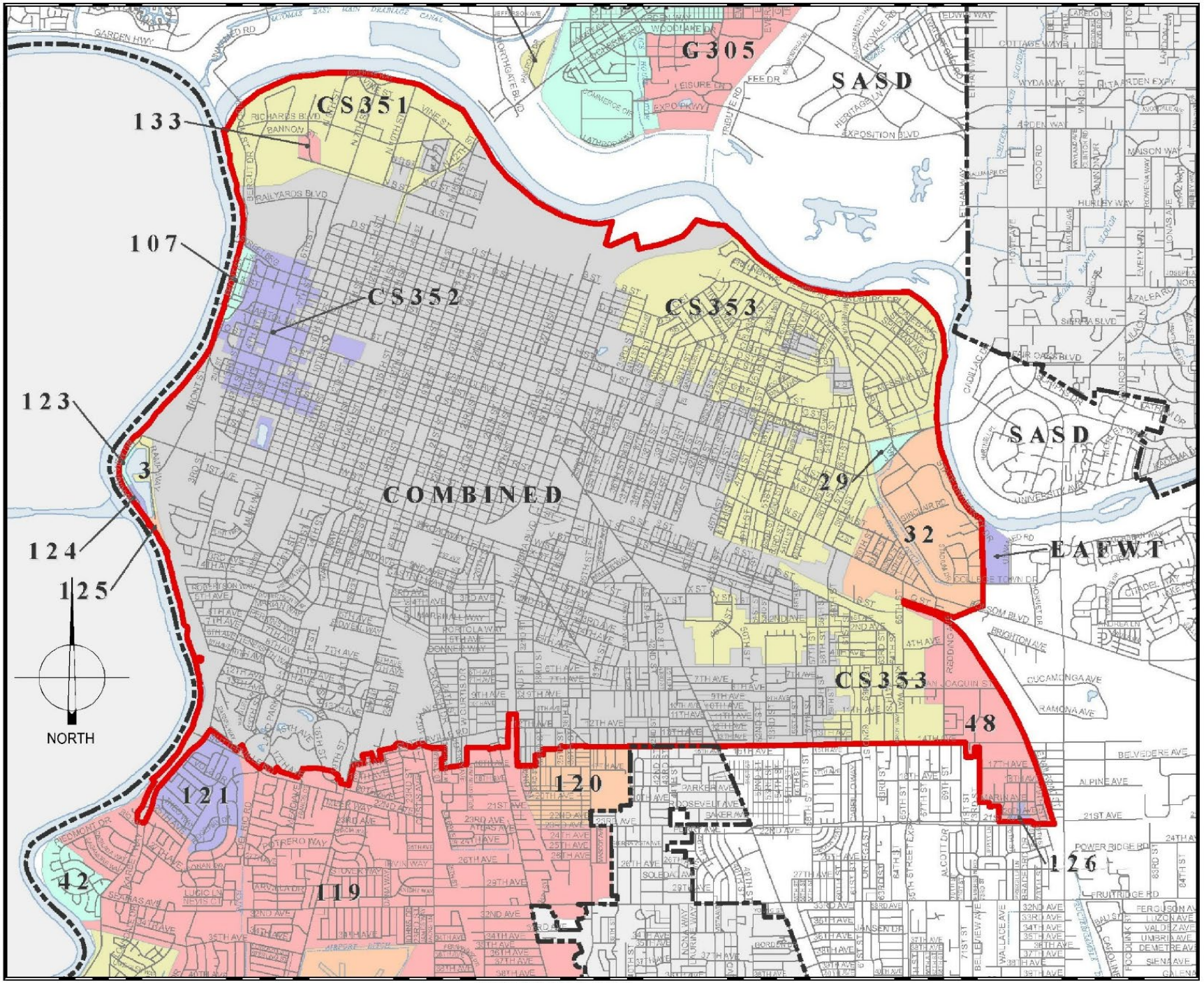
1. Pipe ends shall be plugged with a minimum of 2-longitudinal-feet of concrete,
2. Pipes larger than 8-inches in diameter shall be filled with controlled density fill. A plan for filling pipes shall be submitted for approval. The plan shall provide details regarding the proposed method, sequencing, and materials to be used during the filling operations,
3. Manholes shall be abandoned by removing the Grade Rings and Cone, crushing the concrete Base to allow free movement of groundwater, and backfilling with compacted Class 2 aggregate base. As an alternative, the Grade Rings and Cone can be removed to at least 4-feet below Subgrade and the remaining portion of the Manhole backfilled with CDF. Compacted Class 2 aggregate base shall be placed above the CDF to finish grade.

The removed and/or abandoned facilities shall be shown on the approved Plans and/or As-Builts. The removed Manhole Head and Cover shall be delivered to DOU.

APPENDIX

Plate 9-1 SEWER BASINS




G305
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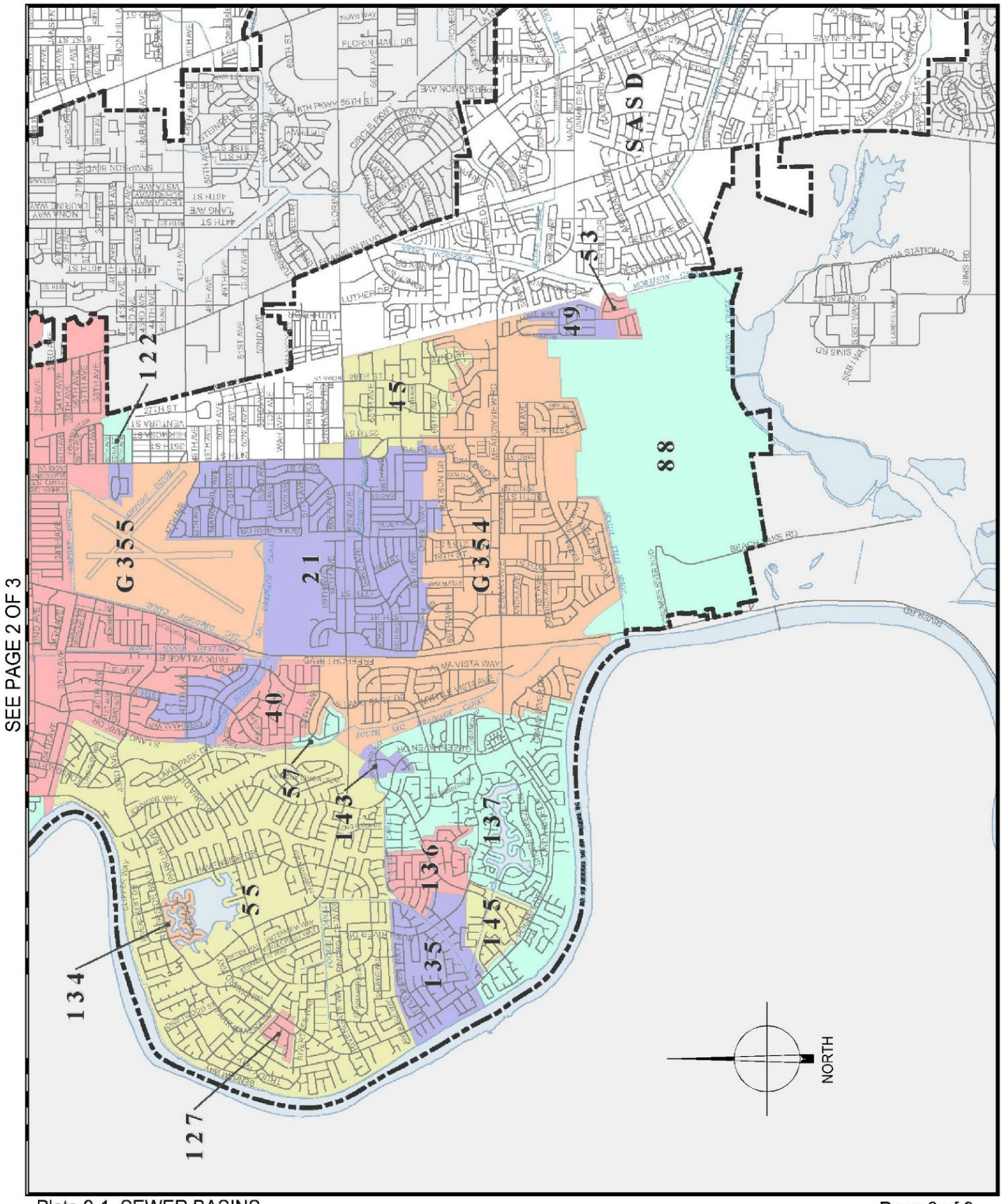

Plate 9-1 SEWER BASINS

Plate 9-2
UTILITY ABBREVIATIONS

The abbreviations used in Section 9 thru 13 shall be as shown in the following table:

ABS:	acrylonitrile butadiene styrene
AC:	asphaltic concrete
ADWF:	average dry weather flow
ASTM:	American Society for Testing and Materials
BMP:	best management practice
CAL/OSHA:	California Division of Occupational Safety and Health
CC&Rs:	covenants, conditions, and restrictions
CFS:	Cubic Feet per Second
CIPP:	cured-in-place pipe
CLSM:	controlled low-strength material
CSS:	Combined Sewer System
d/D:	ratio of flow depth to inside pipe diameter
DI:	Drain Inlet
DIP:	ductile iron pipe
DOU:	City of Sacramento Department of Utilities
Dwg.:	City of Sacramento Standard Specification drawing
DWR:	Department of Water Resources
ESD:	Equivalent Single Family Dwelling Unit
FPS:	feet per second
GFRTR:	glass-fiber-reinforced thermosetting-resin
GPAD:	gallons per acre per day
GPD:	gallons per day
HDPE:	high-density polyethylene
HGL:	Hydraulic Grade Line
HMP:	Hydro Modification Plan
ID:	inside diameter
LID:	low impact development
MGD:	million gallons per day
OD:	outside diameter
OSHA:	Occupational Safety and Health Administration
PDWF:	peak dry weather flow
PF:	Peaking Factor
PVC:	polyvinyl chloride
PWWF:	Peak Wet Weather Flow
RDII:	Rainfall Dependent Infiltration and Inflow
RFF:	ready-mixed flowable fill
ROW:	Right-of-Way
SASD:	Sacramento Area Sewer District
SDR:	standard dimension ratio
SRCSD:	Sacramento Regional County Sanitation District
UPC:	Uniform Plumbing Code
VCP:	vitrified clay pipe

Plate 9-3
VARIANCE REQUEST FORM

City of SACRAMENTO Department of Utilities

A variance may be considered for any design standard that is not applicable or feasible given the proposed physical and operational characteristics of the site or DOU infrastructure. Applicants seeking a variance for these design standards must submit a thoroughly detailed request using this form.

The applicant must clearly demonstrate the variance request meets minimum acceptable engineering, operation, health, welfare and safety standards.

INSTRUCTIONS: Complete all fields below and submit to DOU.

APPLICANT INFORMATION	SITE INFORMATION
Name:	Street Address:
Mailing Address:	City, State, Zip:
City, State, Zip:	APN:
Email:	Planning #:
Phone:	Affected DOU Utility:

VARIANCE OVERVIEW

List the document and Section numbers applicable to the Variance, the requested variation, an overview of the alternatives considered, and justification for proposed solution (attach additional sheets as necessary):

DESIGNER CERTIFICATION AND ACKNOWLEDGEMENT

The applicant declares under the penalty of perjury, and any other applicable state or federal law, that all information provided on this form and submitted attachments are true, factual, and accurate. The applicant also hereby acknowledges any false or misleading information contained herein is grounds for variance denial and/or acceptance revocation.

Designer Name (Printed)	Signature	Date Signed	PE Number	Expiration Date

SECTION REVIEW

List key points of Variance evaluation and explanation for recommended acceptance or denial:

Printed Name	Signature	Date Signed	Accepted or Denied

DIVISION/DEPARTMENT REVIEW

List key points of Variance evaluation and explanation for acceptance or denial:

Printed Name	Signature	Date Signed	Accepted or Denied

Plate 9-4
IMPROVEMENT PLAN CHECKLIST

The following checklist is provided to assist Designers with the development of Plans for DOU infrastructure improvements.

General:

_____ 1. Review map conditions in order to evaluate conformance of Improvement Plans.
_____ 2. Confirm that a Waste Discharge Identification Number (WDID) number was issued to the Project by the Regional Water Board for Projects that disturb one or more acres, including all phases. If project drains to the CSS it is exempt from this requirement.
_____ 3. Review and accept Drainage Study (see separate checklist if applicable).
_____ 4. Review and accept Water Study (if applicable).
_____ 5. Review and accept Sewer Study (see separate checklist if applicable).
_____ 6. Plan and Profile Sheets - Recommended maximum scales: H:1"=40' and V:1"=4'.

Cover Sheet:

_____ 1. Plans on City of Sacramento Standard sheet with title block.
_____ 2. Title Block (bottom right) – CPC/RPC No., Entitlement No. (P, Z, or X) and ECAPS job number shown (all sheets).
_____ 3. Site plan (center of sheet) shown - Subdivision layout with street names, and proposed drain and sewer mains (add title to site plan as follows: “Site Plan”).
_____ 4. Vicinity Map with north arrow (upper right hand corner of sheet)
_____ 5. Sheet Index (in following order: Cover sheet, General Notes, Street Sections/Details, Plan and Profile Sheets, Grading Details and Notes, Grading Plan, Erosion and Sediment Control Details/Notes, Erosion and Sediment Control Plan, Water Plan, Water Details/Notes, Striping Plans, Lighting Plans, and Landscaped Plans (if applicable)).
_____ 6. Name, address, and phone number of Developer and Engineer.
_____ 7. Engineer’s Stamp.
_____ 8. Signature Block of Engineer submitting plans. Include signature space for Development Engineering and Department of Utilities - include County Sanitation SASD (if applicable).
_____ 9. Utility Representatives List - Includes contact names, organizations & telephone numbers.
_____ 10. City Bench Mark with references to number, description, elevation, and datum.
_____ 11. WDID No. (if applicable)

General Notes:

_____ 1. City of Sacramento General Notes.
_____ 2. General Water Note (if no stand-alone water plan)
_____ 3. General Sewer Notes (City or SASD - whichever is applicable).
_____ 4. Abbreviation Table - Show complete list of abbreviations used in plans.
_____ 5. Legend Table - Legend shall be consistent with plans (use symbols per City Standards).
_____ 6. Estimate of Quantities (Public Drainage and Sewer Infrastructure)

Details/Street Sections:

_____ 7. Typical street sections (looking upstation) with street names and station limits-include AC/AB thickness, and street dimensions.
_____ 8. Streets privately maintained, labeled as “Private Streets”.
_____ 9. Right of way and street widths with cross-slopes shown
_____ 10. Curb & gutter type (type 1-rolled curb or type 2-vertical curb) specified or modified (if applicable).
_____ 11. Gutter depth shown. Typical gutter depth (lip to GFL elevation) is 0.17' for type 1 and 0.21' for type 2.
_____ 12. Concrete Sidewalks - Width and thickness shown, including AB. If separated sidewalk, irrigation sleeves are shown with construction note.
_____ 13. Check any special items that may be required, such as structural details (retaining walls, concrete structures).

Plan and Profile Sheets:

Plan View:

_____ 1. Proposed and existing utilities (drain and sewer mains) are clearly plotted and labeled. Check placement of drain and sewer lines.
_____ 2. Proposed drain and sewer mains are placed at correct locations. Per new City criteria, drain lines shall be place in roadway centerline, water main to the north or west of roadway centerline and sewer line south or east of centerline.
_____ 3. Water main, appurtenances and construction notes are shown on water plan. However, water main can be shown on plan and profile (screened) for information purposes only.

_____ 4. Show stations at begin and end of improvements. Add grade elevations to match existing or proposed future improvements.

_____ 5. Station centerline and label street names (cross reference street names and station limits with sheet index on cover sheet).

_____ 6. If more than one sheet, show match-lines with station and reference sheet.

_____ 7. Clearly plot and label existing improvements (screened or dashed). Show existing adjacent buildings and improvements across perimeter streets.

_____ 8. Streets privately maintained shall be labeled as “Private Streets”.

_____ 9. Any shared private utilities (drain, sewer, or water lines) shall be labeled as “Private Mains”.

_____ 10. GFL grades shall be consistent with gutter drop (centerline to GFL) calculated for each typical street section.

_____ 11. Show GFL grades (LT & RT) at all grade breaks (HP’s & LP’s), CR’s, and at DI locations (identify locations with cross-hair symbol “+”). Enclose existing GFL’s in parenthesis.

_____ 12. Grades at round corners (CR’s) shall have a 0.5% min. gutter slope.

_____ 13. Show lot numbers, lot driveway locations, and station lot lines.

_____ 14. Show north arrow.

_____ 15. Separated sidewalk locations - Plot and label 2" irrigation sleeves and provide construction note as necessary (plot irrigation sleeves 5' min. away from sewer service).

_____ 16. Center of DI’s shall be installed at lot lines or 3' min. away from CR at intersections.

_____ 17. Check gutter drainage to flow to proposed DI locations.

_____ 18. Connections at manholes must have a minimum of 1' of MH wall between MH openings.

_____ 19. Pipe abandonment - Pipe beyond ROW shall be removed. Fill pipes 8” and larger with concrete slurry and plug both ends of pipe.

_____ 20. Check length of gutter tributary to a DI (400’ in a single direction, and 600' in both directions).

_____ 21. Pass over DI’s - Per the Design & Procedures Manual, maximum distance between pass-over DI’s is 300'.

_____ 22. Check conflicts of proposed drain and sewer alignment with existing utilities and proposed street medians.

_____ 23. Hatch existing utilities (drain, sewer, and water lines) to be abandoned.

_____ 24. DI leads shall not be installed under the gutter pan for more than 10'.

_____ 25. Check if drainage inlet is required at end of future drain stubs within proposed streets to pick up off-site drainage.

_____ 26. Main sizes and slopes conform to studies.

_____ 27. Sewer main shall be placed to provide a 10' min. separation from parallel existing or proposed water main, or per Requirements of the California Environmental Protection Agency, State Water Resources Control Board, Division of Drinking Water (DDW) relating to domestic water supply, particularly the applicable

provisions of California Statutes Related to Drinking Water contained in Title 17 and 22, California Code of Regulations, and Guidance Memo 2003-02

_____ 28. Station sewer services per detail W-401. Lot driveways must be shown on plans to verify sewer service locations.

_____ 29. Sewer services which serve single family residences shall be 4" min. diameter.

_____ 30. Check if parallel sewer lines are needed. No sewer services shall be connected to a sewer main greater than 9-feet in depth, where there is a problem with ground water, or when the sewer main is deeper than 15 feet in all other cases.

_____ 31. Clean-outs or manholes are required at the Point of Service for private storm drain system.

Profile View:

_____ 1. Top Axis - Show and check proposed centerline grade elevations at 50' stations, at grade breaks (HP's & LP's),DI's, and at CR's. Show existing centerline grades in parenthesis.

_____ 2. Plot and label (add leader w/construction note) existing and proposed centerline, and GFL profiles. Show existing street profile and centerline grades beyond project limits (approx. 100 ft) to justify grades.

_____ 3. Bottom Axis - Station CL Intx., MH's, DI's, CR's, and grade breaks (HP's and LP's).

_____ 4. Drop Inlet (DI) stations shall match with plan view.

_____ 5. Plot DI lead profiles as required.

_____ 6. Plot and label sizes of existing Utilities (drain and sewer lines).

_____ 7. Check manhole stationing - 500 ft max. intervals for straight runs, and intervals less than Radius for lines that curve continuously with a min. radius not less than the manufacturer's recommendations.

_____ 8. Check manhole types per City of Sacramento Design and Procedure Manual 11.6.2

_____ 9. Check sewer manhole types (only when sewer is not in County) per City of Sacramento Design and Procedure Manual and Standard Improvements-Section 9.6.3

_____ 10. Check proposed drainage system per drainage study (Model, pipe sizes, pipe material, slopes and pipe flowlines).

_____ 11. Show the 100-year and 10-year HGL's at each manhole (at nodes) per drainage study (the 10-year HGL shall be no less than 6" min. from GFL at DI's for any new road [Greenfield]). See separate criteria for "infill" developments.

_____ 12. Show public drain pipes in street right-of-way and DI leads. Pipe material per Standard Specs.

_____ 13. Check conflicts with Utilities-crossing (DI leads, drain, sewer, and water lines).

_____ 14. Sewer mains (in City) shall be 8" min. diameter with materials per Standard Specs and min slope per DPM.

_____ 15. Sewer mains shall pass beneath water mains at all transverse locations and shall be placed to provide a 1' min. vertical clearance between outside pipe diameters.

_____ 16. Show existing manholes, water valves, and other facilities to be adjusted to grade.
_____ 17. Show construction notes at connections to existing improvements (show existing elevations in parenthesis).
_____ 18. Minimum cover for sewer or drain line is 4’ unless restricted by existing system, in which case it is18"min. (top of bell to top of finished surface and no less than 6” below AB). DI leads require 18” minimum cover, or 12” with special materials.
_____ 19. Add “Construction Information” block for drainage and sewer pipe material.

Construction Notes:

_____ 1. Construction Notes shall be consistent with plans and design information.
_____ 2. Check GFL grades at DI’s versus that calculated from centerline and street section.
_____ 3. Maximum vertical drop allowed (GFL to INV @DI) is 4'.
_____ 4. Specify drop inlets as “Type ‘B’ DI per S-10”. In the combined system specify “Modified Type ‘B’ DI per detail S-20”.
_____ 5. Typical DI construction note: “Construct Type ‘B’ DI per S-10 and connect to MH(D) w/xx LF of 12" drain line @ S=0.0000, INV@DI=____, INV@MH(D)=_____ and GFL=_____.”
_____ 6. Typical Ditch Box construction note: “Construct Ditch Box per S-30 and connect to MH(D) w/xx LF 12" drain pipe @S=0.0000, FL@ditch box=xx.xx, FL @ MH(D)=xx.xx, FL @ side opening=xx.xx and Grate FL=xx.xx.”
_____ 7. Future Drain Stubs - Provide “Tributary Area=_____acres”.
_____ 8. DI inlet lead pipe material shall be per Note 19 of the General Notes. Prefer 12” PVC C900 or SDR-35.

Subdivision Grading Notes and Details:

_____ 1. Grading Notes.
_____ 2. Typical Section Cut Details as necessary.
_____ 3. Sound wall and retaining wall details. Check conflicts with utilities in P.U.E. Call out concise wall elevations (BW, TW) and changes in elevations
_____ 4. Legend and Abbreviation Table
_____ 5. Typical Lot Grading Detail (if necessary)
_____ 6. Legend Table

Subdivision Grading Plan:

_____ 1. Show site plan at a legible scale (prefer 1"=40' max.).

_____ 2. Show contours and spot elevations (within 100' of project boundaries) to the extent necessary to determine impacts to existing surface drainage paths.

_____ 3. New drainage across property lines is not allowed without drainage easement. The proposed project elevations shall not block existing drainage paths. Add drainage facilities and swales (if necessary), and direct flows to drainage system.

_____ 4. Show proposed drain system layout (drain pipe sizes, manholes, and drop inlets).

_____ 5. Check pad grades based on overland release and 100-year HGL criteria.

_____ 6. Show lot numbers with proposed pad grades.

_____ 7. Show centerline grades at HP's, LP's, and back of walk elevations at property lines and at CR's.

_____ 8. Show and reference "section-cuts" at property boundaries adjacent to existing parcels (as necessary).

_____ 9. Lots shall drain from rear to front (street) when feasible. Pad is usually designed to accommodate rear and side yard swales to be graded to front at a minimum of 1%. Refer to "Typical Lot 'A' Grading Detail".

_____ 10. Provide "Certification of Finished Lot Grades - I hereby certify that the as built finished lot pad elevations, surveyed on (date), do not deviate more than ±0.2-feet from the design lot pad elevations shown on this plan."

_____ 11. Check if retaining walls are needed at project boundaries, slope easements, or right of entry for construction. Retaining walls shall be constructed inside project property line. Type of retaining walls depend on new pads vertical offset as follows:

a. Offset: 0" - 8" - No retaining wall required.
b. Offset: 8"- 24" - Wood retaining walls-Grade No. 2 or better redwood with no open grain material or as noted on plans. Refer to "Wood Retaining Wall Detail".
c. Offset: 2' - 4' - Concrete retaining wall. No calcs. required, however detail with dimensions and reinforcement (rebar) is required.
d. Offset: 4'+ - Concrete retaining wall structural detail with calculations must be submitted to Public Works for review and approval.

_____ 12. Show and dimension drainage easements (if any).

_____ 13. Show flow arrows indicating direction of overland release.

Erosion and Sediment Control Notes and Details:

_____ 1. Erosion and Sediment Control Notes.

_____ 2. Best Management Practice (BMP's).

_____ 3. National Pollution Discharge Elimination System (NPDES)- If project larger than 1 acre.

_____ 4. Storm Drain Message Layout (per City Detail Q-70).

_____ 5. Stabilized Construction Entrance Detail (per City Detail Q-10).

_____ 6. Fiber Roll (Wattle) Detail (per City Detail Q-40, Q-50, or Q-60).

_____ 7. Storm Drain Inlet Filter Bag (per City Detail Q-30).

_____ 8. Gravel Bag Inlet Detail (per City Detail Q-20).

_____ 9. Inlet Filter-Fiber Roll w/Gravel Bed (for ditch box locations).

Erosion and Sediment Control Plans:

_____ 1. Show site plan with all grade breaks, drainage flow lines, drain inlets, post construction BMPs (i.e. Bio swales, storm vaults, planters, etc.), adjacent roadside drainage diches, adjacent waterways (creeks, rivers, etc.)
_____ 2. Perimeter controls (fiber-wattle rolls, silt fences, etc.) shall be properly placed along areas that will intersect run-off flows coming from the construction site, disturbed areas, and non-vegetated areas.
_____ 3. All designated entrances to the construction site, storage site, or disturbed areas shall have the proper construction entrance BMP.
_____ 4. All existing and proposed drain inlets shall be protected with appropriate BMP measures.
_____ 5. Post construction BMPs (i.e. swales, planters, etc.) shall be properly protected during construction, thus a note or necessary BMP measures shall be placed on the plans.
_____ 6. Stock piles and construction debris shall be located in specific areas (whenever possible) and away from curb and gutters (minimum 3-feet away from curb and gutters)
_____ 7. Whenever possible, preserve existing vegetated areas to prevent sediment run-off and the discharge of other pollutants associated with construction activities.
_____ 8. Concrete wash out areas shall be designated away from existing and/or proposed drain inlets, roadside ditches, etc.
_____ 9. Portable toilets shall be located away from drain inlets, curb and gutters, roadside ditches.

Water Plan:

_____ 1. Use City of Sacramento Standard Water Sheet with title block and Department of Utilities signature block (only applies for construction of new water mains only).
_____ 2. Assign water plan drawing number and GIS grid numbers.
_____ 3. Check Water Construction Notes for conformance with Standards.
_____ 4. Check Legend Table for conformance with Standards.
_____ 5. Check water main layout (See Plates 13-1 & 13-2).
_____ 6. Check drawing for completeness (scale, north arrow, site plan, and vicinity map)., existing and proposed utilities, lot lines, lot driveway locations, street light locations, street names, and plan notation).
_____ 7. Existing and proposed water lines are clearly shown and labeled.

_____ 8. Provide water construction notes for placement of water appurtenances (tees, crosses, fittings, gate valves, blow-offs, FH's, and water services).

_____ 9. Check drawing for placement and spacing of fire hydrants (300' max. for commercial and 500' max. for residential).

_____ 10. Plot and station water services per detail W-401 (on corner lots water services to be north or west of sewer service and near CR. If a DI is at the CR water service can be moved to side street.

_____ 11. Future water services - No future water services are allowed unless plans for that particular lot are being checked concurrently and if there is an approved tentative map for the future subdivision.

_____ 12. Landscape lots or Parks (if any) - Plot and station water service point of connection. Show water services type and sizes (domestic or irrigation) and provide construction notes as necessary. Check for meter and development fees (if applicable).

_____ 13. Site Plan shall include note as follows: "Note: Water meters shall be placed per detail W-401."

_____ 14. Check water points of connection to existing water system (prefer looped system).

_____ 15. Water main shall not be curved. Use fittings, 45º, 22.5º, or 11.25º or (whichever applies).

_____ 16. Avoid 90º bends of proposed water main, instead use 45º bends (fittings).

_____ 17. If streets have concrete medians, dual water mains may be required.

_____ 18. Water service taps to existing water mains shall be done by City Crews for a fee (Refer to current water service fee schedule).

_____ 19. Add "Construction Information" block for water infrastructure.

_____ 20. Check fire hydrant locations. Fire hydrants shall be placed (in order of preference) as follows:

a. Curb returns (preferred).
b. Lot line or within park sites.
c. Lot lines away from driveways.

Water Notes and Detail Sheet:

_____ 1. Check General Water Notes for conformance with Standards.

_____ 2. Include water details as necessary (i.e. W-106, W-201, W-400, W-401, W-402 & W-403.)

Landscape Plans:

_____ 1. The irrigation meters and/or Development Fees shall be purchased prior to signing of these plans (check w/Customer Services).

_____ 2. Include signature block for Landscape Architect and appropriate Departments.

_____ 3. Irrigation Sheets

a. Plot and clearly label Irrigation Services point of connection (locations shall match with off-site plans).
b. Plot and label irrigation sleeves at street crossings.

_____ 4. Planting Sheets

a. Remove trees within 10' of existing drain, sewer, and water lines.
b. Remove trees within 5' of meters, RP's, and fire hydrants.

_____ 5. Provide Erosion and Sediment Control Plan, if not included in civil Plans - Add BMP's.

a. Add Typical Erosion and Sediment Control Notes and Details.
b. Protect existing DI's (place storm drain inlet filter bag w/gravel bag).
c. Protect back of curb and/or back of walk with Fiber Roll.

Plate 9-5 SEWER STUDY CHECKLIST

The following are the minimum requirements for approval of Separated Sewer System studies by the City of Sacramento, Department of Utilities (DOU). See Section 9 of the City of Sacramento Design and Procedures Manual (DPM) for additional information.

The DOU may require additional information in order to address special circumstances or to make an informed decision on the adequacy of existing and proposed facilities. Please check the appropriate box to the left when completed. Check-boxes are omitted on left edge of page for tasks not required as part of Feasibility Studies.

Feasibility ← Study	Plan ← Study		Accepted by ← DOU

1. PROJECT DESCRIPTION

☐	☐	Vicinity Map – Include a vicinity map showing the boundary of the project site, relationship to major arterial streets, the boundary of the upstream shed and sewer system tributary to the point(s) of connection, and the boundary of the downstream shed and sewer system from the point(s) of connection to the first significant outfall.	☐
☐	☐	On-Site – Describe existing on-site features (streets, creeks, topography, direction drainage, etc.). Include previous/historical and existing zoning designations, landuse(s) as specified in the General Plan, and proposed project zoning. Include site features that may influence sewer service. Incorporate and reference exhibits as necessary.	☐
☐	☐	Off-Site – Describe the existing off-site features adjacent to the project site and within the tributary sheds upstream and downstream of the point(s) of connection. Include a description of the landuse designations within the sheds as specified in the General Plan and the existing sewer system. Include known future development or redevelopment or other features in the sheds that may influence sewer service. Incorporate and reference exhibits as necessary.	☐
☐	☐	Sewer System – Describe the proposed sewer system, including pump stations, force mains or other system features.	☐
	☐	Sewer Study Map – Provide a scaled map showing: 1. lot lines 2. Existing and proposed contours as needed to define terrain 3. Existing and proposed sewer mains in study 4. Street names, easements and right-of-ways 5. Pump station(s) (if warranted) 6. Proposed point(s) of connection or outfall(s) 7. Sub-shed boundaries for each point of connection to proposed trunks and interceptors, and to the existing sewer system. Additional sub-shed divisions shall be required to distinguish different land uses or other flow generation variations. 8. Node information, such as node number, total net and gross acreage tributary to node 9. North arrow, scale, legend, notes, map title, and design firm name and address	☐
	☐	Geotechnical Conditions – Describe the geotechnical conditions within the proposed project area; including the estimated high groundwater elevation(s). Attach the geotechnical design report prepared for the proposed project.	☐

2. PROJECT DESIGN

☐	☐	Assumptions – State assumptions made used in the design and the basis for these assumptions.	☐

☐ ☐ On-Site Flows – Provide the estimated ADWF and PWWF for each node within the proposed wastewater collection system based on zoning, sewer generation rates and/or fixture units. Incorporate and reference exhibits as necessary to demonstrate the approach used to determine flows. With the exception of open space, parcels with land use not specifically addressed in Section 9.3 shall be assigned a unit load factor of not less than 6 ESD's per Net Acre. ☐

☐ ☐ Phasing Data – Provide development phasing flow data, if any. Note changes in flows acreage and ESD's at specific times and projected phases of the development. ☐

☐ ☐ Off-Site Flows – Provide an estimate of wastewater flows upstream and downstream of the proposed point(s) of connection using DOU flow data (if available). If DOU flow data is not available, estimate existing flows using the current zoning, sewer generation rates and/or temporary flow monitoring. Downstream flows shall be estimated to the first significant outfall. Incorporate and reference spread sheets and exhibits as necessary to demonstrate the approach used to determine flows. ☐

☐ ☐ Spreadsheet Analysis – A spreadsheet may be utilized for gravity wastewater systems in lieu of a Model (presented below). An Excel template is available from DOU, or the Designer may elect to use a different spreadsheet. Spreadsheet provided shall include input data and formulas and shall illustrate conformance with all DPM criteria including: ☐

1. Node designations
2. Net acreage, ESDs per acre and total ESDs for each land use entering each node
3. I/I rates and estimated ADWF and PWWF at each node
4. Velocities during ADWF and maximum allowed depth for each pipe absent downstream control
5. Slope, diameter, and cover for each pipe analyzed
6. PWWF hydraulic grade-line at each node

☐ ☐ Model Analysis – A dynamic model analysis shall be performed for wastewater systems that require a pump station. The model shall be setup, calibrated and performed per the DOU's Modeling Standards and Guidelines for either InfoSewer™ (separated sewer system) or InfoWorks™ (combined sewer system). A complete electronic copy of each model shall be provided to the DOU. ☐

☐ Pump Station – Include calculations and details pertaining to pump stations and force mains, if any, per criteria discussed in Section 10 of DPM. Incorporate and reference exhibits as necessary to demonstrate the design approach and basis of design. ☐

☐ ☐ Other Facilities – Include calculations and details pertaining to interim facilities or other special facilities. Incorporate and reference exhibits as necessary to demonstrate the design approach and basis of design. ☐

3. CONCLUSIONS

☐ ☐ Provide conclusions regarding the ability of the Sewer System to meet all DPM requirements. If adequate capacity is not available, discuss proposed mitigation alternatives and available options. Incorporate and reference exhibits as necessary. ☐

☐ ☐ As required, the study should address the selection and evaluation of alternatives, as well as phasing and interim versus ultimate solutions. ☐

4. SUBMITTAL REQUIREMENTS

Submit one hardcopy and one digital copy of Study on the first submittal.

Once approved, a signed and stamped hardcopy and a digital copy of the final study shall be submitted. All large maps shall be folded and placed in pockets bound into the report. Digital files shall be submitted on a thumb drive placed in pockets bound into the report. Drawing files shall be provided in PDF format.

Plate 9-6
SEWER GENERATION RATES

Facility Description		ESD	Unit
Residential	Single Family Residential	1	Per residence
	Apartments	0.66	Per residence
	Duplex	0.83	Per residence
	Triplex	0.6	Per residence
	Fourplex	0.6	Per residence
	Mobile Home	0.67	Per residence
	Hotel and Motel	0.43	Per room
	College Dorm/Boarding House	0.4	Per bed or resident
	Residential Care/Skilled Nursing Facility	0.49	Per residence
Retail	Single Retail	0.53	per 1,000 sq. ft.
	Community Shopping Center	0.85	per 1,000 sq. ft.
	Market	0.59	per 1,000 sq. ft.
	Dine-In Restaurant	1.77	per 1,000 sq. ft.
	Drive-In or Fast Food Restaurant	2.48	per 1,000 sq. ft.
	Cocktail Lounge/Bar	1.58	per 1,000 sq. ft.
	Coffee Shop	0.93	per 1,000 sq. ft.
	Services Station	1.25	per 1,000 sq. ft.
	Theatre	0.43	per 1,000 sq. ft.
Commercial	Car Wash	3.64	per 0.1 acre of property
	Clinic: Medical, Dental, Veterinarian	0.32	per 1,000 sq. ft.
	Food Processing	3.02	per 1,000 sq. ft.
	Store/Office Combo	0.43	per 1,000 sq. ft.
	Auto Repair	0.18	per 1,000 sq. ft.
	Auto Sales	0.7	per 1,000 sq. ft.
	Unclassified Commercial	0.33	per 1,000 sq. ft.

Industrial and Warehouse	Light Industrial	0.27	per 1,000 sq. ft.
	Heavy Industrial	0.3	per 1,000 sq. ft.
	Office Warehouse (>30% Office)	0.67	per 1,000 sq. ft.
	Distribution Warehouse (15%-30% Office)	0.13	per 1,000 sq. ft.
	Storage Warehouse (3%-14% Office)	0.08	per 1,000 sq. ft.
	Mini-Storage	0.05	per 1,000 sq. ft.
	Unclassified Warehouse	0.15	per 1,000 sq. ft.
Office	Single Story	0.33	per 1,000 sq. ft.
	Two Story	0.18	per 1,000 sq. ft.
	Multi-Story	0.11	per 1,000 sq. ft.
Schools and Hospitals	Hospital	1.62	per bed
	Public Elementary, Middle, or Highschool	3.96	per 100 students
	Public or Private Colleges	3.84	per acre of property
	Private School	3.48	per acre of property
	Church	0.22	per 1,000 sq. ft.

For facility types not listed in the table, please contact the DOU Development Review Section: 916-808-7890 or email DOUDevelopmentReview@cityofsacramento.org

Plate 9-7 CSS PEAKING FACTOR