PUBLIC STORM DRAIN STANDARDS

Adopted by the Santa Rosa City Council

Resolution No. XXXXX

Date: ~~11/07/2024~~XXXXX

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QUICK REFERENCE SHEETS

DESIGN REQUIREMENTS

Minimum pipe diameter:	15 inches
Pipe materials:	Reinforced concrete pipe (RCP), ~~cast-in-place concrete pipe (CIPP) or,~~ high-density polyethylene (HDPE) pipe, and high--performance polypropylene (HPPP) pipe that conforms to these specifications. HDPE and HPPP shall not be accepted for publicly owned utilities in Wildland-Urban Interface (WUI) Fire Areas as defined by the current City of Santa Rosa (City) WUI map and other restricted use defined herein.
-Horizontal separation from sewer lines:	Five (5) feet clear (outer walls) except at crossings or as required by the current City of Santa Rosa's *Sanitary Sewer System Design and Construction Standards*
Horizontal separation from water lines and other utilities:	Four (4) feet clear (outer walls) minimum except at crossings or as required by the current City of Santa Rosa's *Water Distribution Design and Construction Standards*
Vertical curves:	Not allowed
Horizontal Curves:	RCP ~~and CIPP~~: -300 feet minimum radius (allowed at catch basins and when pipeline is installed under the pavement parallel to the concrete gutter). See detailed design standards. HDPE, HPPP: 3° mitered couplings with no joint or pipe deflection, or as specified in the manufacturer's specifications, and~~.~~ a m~~M~~aximum of one mitered coupling per 10-foot~~'~~ length of pipe. Radius shall not be less than 300 feet. See Design Requirements.~~765 feet minimum radius for 20 foot sections~~
Pipe slope:	≤15%
Minimum cover:	12 inches for class III RCP and HDPE (outside of pipe to road subgrade) and as outlined in Table I-~~1~~1 and Section 6 herein.~~-~~
Maximum distance between structures:	3400 feet

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Minimum pipe velocity and slope:	Minimum three (3.0) feet per second at half--full flow for closed conduit systems as detailed in these s~~pecifications~~tandards Minimum two and a half (2.5) feet per second at the design flow for earth channels, ditches, and hardened or concrete-lined channels for City--owned and operated channels For Sonoma Water--owned and operated channels, refer to the current Sonoma Water's *Flood Management Design Manual.*
Time of Concentration Minimums	5 minutes – Urban commercial, industrial, and residential with more than eight (8)~~8~~ units per acre 10 minutes – Residential 2-8 units per acre 15 minutes – Residential less than two (2) units per acre, undeveloped open space
Rainfall intensities	National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 and NOAA's National Weather ~~Service the~~Service's Atlas 14 Precipitation Frequency Data Server, or current versions

Note: New development, redevelopment, and capital improvement projects may be required to implement stormwater quality source and treatment controls commonly referred to as either post construction Best Management Practices (BMPs) or Low Impact Development (LID) features. Refer to the current regional *Storm Water Low Impact Development Technical Design Manual* to determine if the project requires permanent stormwater BMPs and for design criteria.

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ASTM	American Society of Testing and Materials
BMPs	Best Management Practices
City	City of Santa Rosa
FHWA	U.S Department of Transportation Federal Highway Administration
FMDM	Sonoma Water's *Flood Management Design Manual* dated March 2020, or current version
HDPE	Annular high-density polyethylene
HEC	Hydraulic Engineering Circular
HPPP	high-performance polypropylene
LID	Stormwater Low Impact Development
LID Manual	City of Santa Rosa, et. al. Regional *Storm Water Low Impact Development Technical Design Manual* dated May 2017 (Revised December 2020), or current version
MS4 Permit	Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems, current version or as grandfathered in under previous versions of the MS4 permit as allowed by current MS4 permit conditions
MSMVCD	Marin/Sonoma Mosquito and Vector Control District
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M Plan	Operation and maintenance plan
RCP	Reinforced concrete pipe
SD Standards	City of Santa Rosa's *Public Storm Drain Standards*
SWLIDS	Storm Water Low Impact Development Submittal Report
TPW	Transportation and Public Works Department
WUI	Wildland-Urban Interface

PUBLIC STORM DRAIN DESIGN STANDARDS

PURPOSE:

The purpose of this document is to provide standards for the design of public storm drain system improvements in the City of Santa Rosa (City). All storm drainage systems must be designed ~~in conformance with~~per the standards herein and the most current version of Sonoma Water's *Flood Management Design Manual* (FMDM). These City Public Storm Drain Standards (SD Standards) precede the FDMD ~~Where there are discrepancies between the City's Public Storm Drain Standards (SD Standards) and the FMDM, the City's SD Standards shall govern~~ for City-owned and maintained storm drain infrastructure. ~~These standards consist of:~~

Developers and design engineers should be aware that stormwater treatment, volume capture, and hydromodification requirements, as specified in the City's current National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements for Discharges from the Municipal Separate Storm Sewer Systems permit (MS4 Permit), may apply. Applicability, requirements, and design criteria are governed by the current version of the regional Storm Water Low Impact Development (LID) Technical Design Manual (LID Manual) and other applicable guidance documents.~~(1) hydrologic design criteria,~~

~~(2) hydraulic design criteria, and~~

~~(3) physical design requirements.~~

These standards do not include, ~~(~~but may reference,~~)~~ additional requirements established by other departments of the City and other government agencies. These standards are intended to impose **minimum** acceptable design criteria. The City Engineer may impose ~~M~~more or less stringent requirements ~~may be imposed by the City Engineer~~ based on specific project conditions. Developers and their design engineers are responsible for complying with these standards and all other requirements for the design of storm drain facilities within the City. Design engineers are responsible for initiating written requests for approval (variance request) of any design concept~~(s)~~ that differs from these standards, verifying additional requirements set forth by other departments of the City or other government agencies, performing any necessary calculations or studies, and resolving any problems with the appropriate department or agency. Developers and design engineers should be aware that Section 402(p) of the federal Clean Water Act establishes requirements for National Pollutant Discharge Elimination System permits for industrial and construction-related stormwater discharges.

POLICY:

The City's policy is to safely collect and convey stormwater to the nearest public flood control facility in a storm drain system approved by the City of Santa Rosa's Transportation and Public Works Department (TPW) and Water Department while conforming to water quality and volume

capture (hydromodification) objectives ~~to the maximum extent practicable in the City's creeks as defined in the City's Storm Water Management Plan~~and requirements.

DETENTION BASINS:

The following section on detention basins is not included in ~~the Sonoma County Water's~~the ~~*Agency Flood Control Design Criteria.*~~FMDM. The FMDM outlines two risk-related design criteria for general detention facilities, including emergency outflow structures and high-~~-~~flow conveyance routes, which~~that~~ shall be adhered to. These provisions shall be superseded if, at any point, additional and detailed detention design criteria are added to the FMDM. Design of detention facilities must also meet applicable criteria set forth by Marin/Sonoma Mosquito and Vector Control District requirements (MSMVCD). MSMVCD requirements are based on California *State Health and Safety Code* Division 3, Chapter 1, Article 5, Section 2060 et~~.~~ al. (*State Health and Safety Code*). Therefore, it is not within the City's or City Engineer's purview to grant variances from the MSMVCD requirements.

Detention basins are natural or constructed basins, oversized pipes, or ~~or~~ underground vaults~~,~~ that ~~receive and hold~~attenuate storm-water runoff to reduce downstream peak flows for flood control purposes ~~and/or~~ , to enhance water quality, or to alleviate hydromodification impacts. Detention basins to be owned and maintained by the City as public infrastructure due to existing storm drain infrastructure capacity issues are allowed as an alternative to requiring upsizing of the existing storm drain infrastructure, beginning at the downstream outfall and progressing upstream until current capacity requirements are met, are only ~~with the~~allowed with a variance approval ~~of~~ from the City Engineer.- Without a variance approval, projects connecting to City storm drain infrastructure that do not meet current City design criteria shall be required to upsize the existing storm drain system originating at the outfall progressing upstream as required until the system meets current City standards. Providing a detention basin due to insufficient existing storm drain infrastructure capacities in- lieu of requirements to upsize the existing storm drain system is subject to acceptance and approval of the City Engineer, with agreement from the impacted City department director(s), and shall not be assumed to be an approved path forward.

Publicly maintained storm-water ponds with permanent pools of water are prohibited except where they provide multiple benefits, ~~to~~ include~~e~~ing groundwater recharge, flood mitigation, and recreational opportunities consistent with various City Master Plans, including, but not limited to, the *Citywide Creek Master Plan*, *Storm Drain Master Plan* (in development as of 7/28/2023), and *General Plan*. Projects proposing these facilities shall prepare an operation and maintenance plan (O&M Plan), -including all annual and recurring costs and how vector concerns will be mitigated. The O&M Plan also needs to include the funding source for the operation and maintenance of the facility. If the funding source is to be the responsibility of the City, the City fund to be used to implement the O&M Plan (e.g., General funds, specific enterprise funds, etc.) needs to be expressly stated~~,~~ and agreed to by the impacted department director(s) and the City Engineer. The O&M Plan must receive approval from all departments ~~that will have~~with operation and maintenance responsibilities to the feature, which may include Recreation~~,~~ and ~~and~~ Parks ~~Department~~, ~~Department of Transportation and Public Works~~TPW, and ~~Santa Rosa~~ Water ~~Department~~. Grounds for rejection can consist of ~~include~~ insufficient funds in the funding source or staff to operate and maintain the asset as outlined in the O&M Plan. ~~However, a~~Approval

may be granted provided the applicant/developer executes a binding agreement to provide funding, in perpetuity, for the operation and maintenance costs associated with these facilities, including City staff time.

Detention basins should be designed to be multipurpose wherever possible and designed to enhance storm-water quality. Detention basins whose primary purpose is water quality enhancement will be considered during planning for storm drain system improvements and in -8accordance with the current approved regional ~~Standard Urban Storm Water Mitigation Plan (SUSMP) unless approved otherwise by the City Engineer~~LID Manual. Detention basins solely for the purpose of LID shall be privately owned, operated, and maintained, unless triggered by a capital improvement project, and do not require a variance for approval. Flows ~~in excess of~~exceeding the detention basin design flows ~~will be~~shall be diverted around the detention basin. Overflow routing and design criteria for bypass flows shall be shown on improvement plans including design storm, flow rate, and high-water level.

Publicly maintained detention facilities for flood control purposes may be permitted, with the approval of the City Engineer, when it is more cost-effective than providing storm drain improvements when there are flow capacity issues in the existing storm drain systems~~.~~ -An analysis~~, which~~ that justifies the financial need for the detention basin by presenting both the estimated capital cost and the estimated annual operation and maintenance costs of the basin, as well as comparable costs for an underground closed conduit storm drain system, shall be prepared under the direction of a licensed c~~e~~ivil c~~e~~ngineer and submitted for approval by the City Engineer prior to approval of a tentative map ~~with~~ by the City ~~Community~~ Planning ~~&~~and Economic Development Department.- ~~The aforementioned requirements for p~~Public ~~-owned and maintained detention basins shall apply~~Approvals of designs shall includ~~ing~~e approvals from the d~~D~~epartment d~~D~~irector(s) whose departments will be impacted by acceptance of the feature. The City Engineer may prohibit or restrict the use of detention basins based on specific site conditions such as insufficient depth to bedrock; extreme community disruption; insufficient mitigation of vector concerns; need for extensive relocation of existing improvements and utilities; soils with increased risk of instabilities including the Goulding cobbly loam formations; potential for ~~infiltration~~infiltration to negatively impact structures' soil bearing capacity, design earth pressures, support block envelope, or sphere of influence; existing site or groundwater contamination concerns; or lack of sufficient, available, suitable land. When a project proposes infiltration in Types C and/or D soils and perforated pipe underdrains are not proposed, information must be supplied in the Drainage Reports proving that the design storm will be able to infiltrate into the soils and not create nuisance stagnant water beyond 72 hours after precipitation has ended. When infiltration tests are required, the following American Society for Testing and Materials (ASTM) standards shall be used: D5093 Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring, D3385 Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer, or D8152 Standard Practice for Measuring Field Infiltration Rate and Calculating Field Hydraulic Conductivity Using the Modified Philip Dunne Infiltrometer Test.

The design of detention basins for flood control purposes shall be based on the size of the basin; the maximum allowable depth of temporary ponding; the recurrence interval of the storm being

considered; the peak rate, total volume, and timing of the inflow; the maximum allowable outflow rate; and the length of time water is allowed to remain in the basin. -The design shall be accomplished through the development of three items:- an inflow hydrograph, a depth-storage relationship, and a depth-outflow relationship. -These three items shall be combined in a routing routine to obtain the outflow rate, depth of stored water, and storage volume at any specific time as the design storm flow passes through the detention basin. -The design considerations and procedures are discussed in *Design and Construction of Urban Stormwater Management Systems*, Chapter 6, WEF Manual of Practice FD-20, 1992.- Publicly maintained detention facilities that require pumping are prohibited unless designed to meet multi-benefit objectives outlined in available City Master Planning level documents, be in accordance with City-wide flood ~~control~~mitigation goals, and be approved by the City Engineer. Provisions for draining private underground vaults shall be included on the improvement plans. ~~are prohibited.~~

The design considerations cited above determine the detention basin volume required for flood control purposes only. The design of detention basins should also consider other benefits that can be achieved, such as water quality enhancement, groundwater recharge, recreational opportunities, and open space aesthetic enjoyment. -Public health and safety needs should be considered, such as the need for vector control and fencing in particular applications. -Detention basin designs shall promote personal safety by locating the basin along public streets, parking areas, or paved access roads/trails to ensure visual access to the basin area. Site, street, and basin design sh~~ould~~all be coordinated to orient buildings and streets for good surveillance of the basin area.

The basin's geometry should be designed to reduce underutilized zones and increase detention times. Inlet and outlet structures must be carefully designed to reduce turbulence that could resuspend settled solids.- Consideration should be given to installing energy dissipators, stilling basins, berms, and separation walls.

To prevent erosion during large storm flows, unprotected side slopes should be no steeper than 3 horizontal: 1 vertical.- Steeper banks will only be allowed with the approval of the City Engineer and shall be protected by vegetation and/or planted rock slope protection~~rip rap~~.

Detention basins shall be designed and constructed to allow for all-weather ~~for~~(paved) ~~easy~~ driven access into the basin itself and to all inlet and outlet structures. Access to the bottom of the basin is necessary. Basins to be maintained by City staff must meet City accessibility criteria discussed below under "Design Requirements."

DESIGN REQUIREMENTS

1. CONNECTION TO THE EXISTING STORM DRAIN SYSTEM

1.1. New storm drain systems must connect to existing City, County of Sonoma, or Sonoma Water storm drain infrastructure, ditch, channel, or creek or an approved natural waterway. Storm drain designs shall incorporate the design of any off-site storm drain improvements required to accommodate flow from the storm drain system for the proposed development. -A structure must be installed at each connection (i.e., no "blind" connections) except as otherwise approved by variance by the City Engineer.

1.2. Where public storm drains must traverse private property, inlets necessary to drain the private property are permitted to connect to the public storm drain. These inlets and connecting pipes shall be delineated as private on the improvement plans.

1.3. Sump pumps to remove rainwater or groundwater from foundations, basements, or crawl spaces shall not ~~for non-residential or mixed land uses shall not~~ discharge to gutters, ~~or~~ sidewalk drains, or storm drain structures unless all feasible alternatives to discharge non-stormwater have been considered and deemed infeasible, which City staff must concur with. If an alternative is not possible:

1.3.1. Sediment and solids shall be removed from the discharge through settling or filtration designs.

1.3.2. To the maximum extent possible, segregate flow to prevent introduction of pollutants. Flows shall be discharged to landscaped areas avoiding directing flows across paved surfaces or gutters where pollutants may be present.

1.3.3. Best Management Practices (such as those outlined in California Stormwater Quality Association manuals), the LID Manual, and vegetation shall be utilized and maintained to prevent erosion and sediment transport.

1.3.4. All sediment removed from non-stormwater discharges shall be collected and disposed of in a timely, legal, and appropriate manner.

1.3.5. When a proposed sump pump site for groundwater, such as from foundations, basements, or crawl spaces, is located within ~~one half~~one-half mile of a source of contaminated groundwater as ~~outline~~identified on the State Water Resources Control Board's GeoTracker website (https://geotracker.waterboards.ca.gov/) and/or identified during the project's Environmental Site Assessments, the sump pumps shall not be permitted to discharge to storm drain infrastructure, ditches, gutters, sidewalk drains, or natural drainage courses without providing treatment prior to discharge and/or the recommended mitigation measures as determined during the Environmental Site Assessments and as approved by the City Engineer. Sump pumps may then discharge by pumping to a jurisdiction structure allowing the water

to gravity flow through pipes into a closed conduit system or open channel, if permitted by the North Coast Regional Water Quality Control Board.

1.3.6. Sump pumps that have potential to discharge liquids other than uncontaminated water (e.g., oil, grease, solvents, etc.) shall discharge to a sanitary sewer, if approved by the City's Water Department. Industrial pretreatment of these discharges may be required.

1.3.7. Sump pumps installed solely for the purpose of transporting water to a LID feature for water quality shall not be permitted as part of a public facility or public storm drain system without an approved variance from the City Engineer. Sump pumps shall only be used to transport water from privately owned and operated storm drain infrastructure to a private LID feature. Pump stations (not sump pumps) might be permitted when serving multi-benefit needs as outlined in the Detention Basin section of these standards and shall adhere to the requirements in that section including obtaining approval from impacted City department director(s).

~~1.2.1. Sump pumps shall discharge into closed conduit systems or open channels, if permitted by the North Coast Regional Water Quality Control Board. Sump pumps for nonresidential land uses shall discharge at a structure (i.e., no blind connections). Sump pumps which may discharge liquids other than uncontaminated water (e.g., oil, grease, solvents, etc.) shall discharge to sanitary sewers, if approved by the City's Utilities Department; industrial pretreatment of these discharges may be required. Sump pumps for single-family residences shall be allowed to discharge to sidewalk drains or gutters by gravity flow only. (For instance, by pumping to a box and then allowing the water to gravity flow through curb into the gutter.)~~

1.4. Concentrated drainage flows in pipe systems from private property shall not flow over public sidewalks. Sidewalk drains, ~~-~~ sidewalk trench drains, or other means of collection and conveyance to a proper discharge location shall be provided. Sidewalk drains shall be privately owned and maintained including the curb face.

~~1.3.~~1.5. Lots shall be drained in a manner so as not to adversely affect adjoining properties. No developed lot to developed lot (cross-lot) concentrated overland drainage is permitted (the exception is for lots draining to a common driveway). When cross-lot drainage, such as ditches or environmentally protected features, is allowed, drainage easements and declarations shall be required. Concentrated overland flows, even if a dissipator design is included, must be directed away from buildings and adjacent properties pursuant to 2022 California Building Code (or most current version), Part 5 California Plumbing Code, Chapter 11 Storm Drainage.

2. MATERIALS

2.1. Storm drain pipes 15 inches in diameter or larger shall be reinforced concrete pipe (RCP), ~~cast-in-place concrete pipe (CIPP) or~~ annular high density polyethylene (HDPE) pipe, or high-performance polypropylene (HPPP) pipe. Cast-in-place pipe is not

permitted. Use of HDPE and HPPP for storm drain, including pipes, flared end sections, and pipe inlets, will not be accepted for p~~P~~ublicly owned and maintained storm drain systems in Wildland-Urban Interface (WUI) Fire Areas as defined by the current City WUI map. For Public storm drain systems outside of WUI Fire Areas, HDPE and HPPP, including pipes, flared end sections, and pipe inlets, shall not be permitted as inlet/outfall structures or between an inlet/outfall that daylights, ~~(~~such as a flared end section or headwall, at a vegetated area, ditch, or creek~~)~~ and the next downstream/upstream storm drain structure in the storm drain system. HDPE and HPPP shall not be accepted where they connect to a structure that is located in an unpaved area, such as ~~a~~ field inlets in ditches or LID features. Changes in pipe material shall only occur at structures. Plastic perforated pipes located in LID features as part of the LID design are exempt from this rule and will continue to be allowed to connect to structures located in unpaved locations. ~~Changes of pipe types must occur at storm drain structures.~~

2.2. RCP shall be Class III, IV, or V as specified in Part ~~3~~III, Public Storm Drain Construction Standard Specifications, of these standards.

Typical total effective loads on buried pipe, expressed in pounds per linear foot of pipe, are shown in Table I-~~3~~1. The design engineer shall determine the D-load for the depth and diameter of pipe from the table and select the class of RCP with a D-load rating equal to or greater than the value in Table I-~~3~~1. The design engineer shall interpolate between the values in Table I-~~3~~ 1 for conditions not presented in the table.

2.3.HDPE and HPPP pipe for publicly owned and maintained infrastructure shall only be used in sizes of 48 inches or smaller diameter pipes with cover of less than 30 feet. The design engineer shall determine flotation restraint per manufacturer's recommendations. Loading on buried pipes shall be able to meet loads as outlined in Table I-1, American Association of State Highway and Transportation Officials (AASHTO) H-25, H-20, and HL-93 loads, and shall have a minimum depth of cover per City Standard details and as determined per the manufacturer's recommended specifications. HDPE and HPPP pipe shall have a 36-inch minimum cover in unimproved areas. The HDPE and HPPP pipe walls must be free of cracks, holes, voids, blisters, foreign inclusions, scratches deeper than 10% of the wall thickness, or other defects visible to the naked eye or affecting the pipe wall integrity. The residue from the ignition of HDPE or HPPP compounds must not exceed 30 percent as determined under ASTM D2584 except the muffle furnace temperature must be 840 ± 45 degrees Fahrenheit.

2.4. HDPE pipe shall be smooth interior, corrugated exterior (Type S) pipe with bell-and-spigot joints per AASHTO Designation M294.

2.5. HPPP pipe shall be smooth interior, corrugated exterior (Type S) pipe meeting or exceeding ASTM F2881 or AASHTO M330 with bell-and-spigot joints meeting ASTM D3212.

~~2.3. Designers see Section 63 Cast-In-Place Concrete Pipe Special Inspections for use with CIPP.~~

~~2.4. HDPE pipe shall be smooth interior, corrugated exterior pipe with bell-and-spigot joints, Type S, per AASHTO Designation M294. HDPE pipe shall only be used in sizes of 36-inch or smaller diameter with cover of less than 30 feet. The design engineer shall determine flotation restraint per manufacturer's recommendations. Minimum cover over pipe shall be 12 inches from the outside top of pipe to subgrade. HDPE pipe shall only be used under pavement areas.~~

2.6. Sidewalk drains shall be per SD Standard 406.

2.7. Sidewalk trench drains shall be per SD Standard ~~XXXX~~406C.

2.8. Wood storm drain structures, covers, or lids shall not be permitted within City jurisdiction under any circumstance. Any existing wooden storm drain component in need of repair or replacement shall be replaced with a concrete City standard structure, metal cover/lid, and/or metal grate. Projects connecting to or fronting wooden storm drain structures shall be required to replace the wooden structure(s) or components with a concrete structure and metal components as part of their required frontage improvements.

3. SIZE

3.1. Storm drain pipe diameters within the public right-of-way, including driveway culverts, shall be 15 inches or larger when self-cleaning velocities can be met, except perforated subdrains, sidewalk drains or sidewalk trench drains, which shall be per SD Standard 406 and 406C, respectively.

3.2. In new portions of the storm drain system, pipe sizes shall not decrease in the downstream direction. This design requirement doesn't apply to hydromodification facilities.

4. ALIGNMENT

4.1. Storm drain pipes shall be located within public streets unless ~~otherwise authorized~~a variance is approved by the City Engineer.

4.1.1. Storm drain mains shall be aligned so that the outside of the pipes are a minimum of one (1) foot from the lip of gutter. An exception shall be allowed where the existing storm drain main does not meet this requirement and is not proposed, or required to, realign the existing main (e.g. a new junction structure is proposed to supply a lateral connection to avoid a blind connection, required current City standard roadway section aligns new gutter over the existing storm drain main, etc.).

~~4.1.1.~~4.1.2. 48-inch manholes shall be centered a minimum of three (3) feet from the lip of gutter. 60-inch manholes shall be centered a minimum of four (4) feet from the lip of gutter.

4.2. Storm drains traversing private property shall be straight between manholes (i.e., no horizontal curves) unless otherwise approved by a variance, in which case the pipe shall be centered within the easement dedication, or~~except~~ when installed in a private street parallel to the centerline of~~-~~ the private street.~~.~~

4.3. In general, storm drains shall be installed parallel to the centerline of the street or right-of-way.

4.4. Horizontal separation of storm drain line from sanitary sewer shall be a minimum of ~~5~~ five (5) feet clear (i.e., outside of pipe to outside of pipe), except at pipe crossings, or as required by the City's *Sanitary Sewer Design Standards*.~~.~~

4.5. Horizontal separation from water mains and other utilities, gas, underground electric, underground television cable, etc., shall be a minimum of four (4) feet clear (outer walls), except at pipe crossings, or as required by the City's *Water Distribution Design and Construction Standards*.

4.6. Vertical curves are not allowed unless a variance is approved~~specifically authorized~~ by the City Engineer.

4.7. Horizontal curves with a minimum radius of 300 feet for RCP ~~and CIPP~~ shall be provided at catch basins installed at curbs and gutters to locate as much of storm drain as possible under asphaltic concrete paving rather than concrete curbs and gutters.

4.8. Horizontal curves concentric with public or private street centerlines may be permitted with RCP provided the radius is 300 feet or greater.- Horizontal curves in HDPE and HPPP pipe may be achieved using 3° mitered couplings with no joint or pipe deflection unless otherwise specified in the manufacturer's specifications. -A minimum of 10 -feet of pipe shall separate mitered couplings.~~The minimum allowable radius used with 20 foot sections of HPDE pipe is 765 feet.~~

4.9. Horizontal curves can be installed in RCP by pulling pipe joints if the resulting deflections are not greater than the pipe manufacturer's recommendations. -The design engineer shall use the following equation in designing horizontal curves for RCP with a diameter over 48 inches:

$$R = \frac{L}{2(Tan\frac{1}{2}\frac{\Delta}{N})}$$

where:

R	=	radius of curvature of the centerline of the pipeline in feet
L	=	laying length of pipe section in feet, measured along centerline
Δ	=	total deflection angle of curve in degrees
N	=	number of pipe sections with pulled joints
Δ/N	=	deflection angle of each pipe in degrees

4.10. An access structure shall be installed when total horizontal deflection exceeds 45 degrees.

5. SLOPE

5.1. Minimum slopes shall achieve a half-full flow velocity of three (3.0) feet per second or greater for the required design storm (excluding 100--year storm) for closed conduit systems. Pump stations may be required where there are no ~~Flatter grades may be approved where no~~ other practical solution ~~is available~~s and self-cleaning velocities cannot be met. Except where located to serve public storm drain main outfalls to open channels, or where public storm drain mains cannot maintain positive drainage, new pump stations serving private developments shall be privately owned and maintained. A variance approved by the City Engineer shall be required for proposed systems not achieving a minimum half-full flow velocity of three (3.0) feet per second. It should not be assumed a variance will be granted. These calculations are required in all drainage

reports. Where proposed pipes are connecting between existing storm drain main inverts controlled by the previously allowed two and a half (2.5) feet per second velocities, an exception can be granted without requiring the need for a variance.

5.2. Minimum slopes for earth channels, ditches, and hardened or concrete-lined channels for City owned and maintained channels shall achieve a velocity of two and a half (2.5) feet per second based on the design flow calculations.

5.3. Minimum slopes for Sonoma Water owned and maintained channels shall meet the current Sonoma Water FMDM design requirements.

5.4. Maximum slope for storm drains shall be 15 percent or 15 feet per 100 feet.

5.5. All City maintained storm drain systems shall drain by gravity achieving the minimum velocities to the receiving waters or existing storm drain systems. Systems where the inverts out are at a higher elevation than inverts in (i.e., "bubble-up") designs on public or private storm drain mains and laterals are prohibited and are not subject to variance approval by the City Engineer as they are a violation of California *State Health and Safety Code* Division 3, Chapter 1, Article 5, Section 2060 et. al. Therefore, it is not within the City's or City Engineer's purview to grant variances from the MSMVCD or *State Health and Safety Code* requirements. Private storm drain systems are allowed to install private pump stations that shall have both low-flow and high-flow needs designed appropriately and pump station design and cycling calculations are required in the project's drainage report. Publicly owned and maintained pump stations shall only be allowed where the existing system does not meet current design standards, the minimum slopes cannot be maintained to the outfall location due to existing grade of channels, or as approved by variance by the City Engineer. All public and private pump stations shall have a trash capture component incorporated into the design and be oriented prior to the pump intake(s). The trash capture component shall comply with current MS4 and California statewide trash capture requirements. Neglecting to perform industry standard due diligence in design, including neglecting to obtain pothole information in design prior to final approved improvement plans, shall not warrant grounds for a variance approval to this clause.

~~5.1.1.~~5.5.1. Bubble-ups are still permitted for individual lot back of lot drains and some applications for LID designs including pipes less than six-inch diameter. These systems by design shall have no ponded water remaining beyond 72 hours due to vector breeding concerns. This can be achieved through infiltration (e.g., one or more sticks of plastic perforated pipe with gravel trench similar to French drain designs) or by other design features including mesh covers at inlet with debris control and pop-up emitters. Neither public nor private site storm drain lines greater than six inches that cannot eliminate ponded water within 72 hours shall be allowed and variances will not be granted as it is not within the purview of City authority.

6. COVER

6.1. Minimum cover over storm drains shall be 12 inches (Class III RCP, HDPE and HPPP ~~CIPP~~) below bottom of a roadway structural section and three (~~three (~~3~~))~~ feet below finish grade, whichever is greater.~~-~~ Refer to ~~Cover is defined as the distance from the outside top of the pipe to the final subgrade (bottom of the structural section) in paved areas or finished grade in unpaved areas. See~~ Table I-~~3~~-1 for RCP. Loading on HDPE and HPPP buried pipes shall be able to meet loads as outlined in Table I-1, American Association of State Highway and Transportation Officials (AASHTO) H-25, H-20, and HL-93 loads, and shall have a minimum depth of cover per City Standard details and as determined per the manufacturer's recommended specifications. HDPE and HPPP pipes shall have a 36-inch minimum cover in unimproved areas. When cover does not meet these standards, a concrete backfill with steel reinforcement shall be required per SD Standard ~~XXXX~~412.

7. MANHOLES AND OTHER STRUCTURES

7.1. A manhole or accessible structure shall be installed at every change in pipe size.

7.2. The maximum distance between manholes and/or accessible structures shall be ~~400~~ 300 feet.

~~7.2.~~7.3. Manholes shall be placed on horizontal curves once the curve has reached 45 degree of total deflection and for each segment of the curb that reach a 45 degree of total deflection.

~~7.3.~~7.4. A manhole or accessible structure shall be installed at every horizontal angle point or vertical change in alignment.

~~Sufficient drop shall be provided through manholes and accessible structures to compensate for energy loss caused by change of alignment.~~

~~7.4.~~7.5. Standard drop between inverts in and inverts out shall be 0.10 feet whenever possible and when not limited by existing storm drain infrastructure elevations.

7.6. Manholes shall be 48 inches in diameter with storm drain pipes of 36 inches diameter or less, and shall be 60 inches in diameter with storm drain pipes larger than 36 inches in diameter. Manholes shall be designed to be large enough to accommodate all pipes connected to manhole with a minimum of 3 inches of manhole wall on both sides of all pipes. Reducer slabs may be provided as shown on SD Standard 401 in Section A-A~~2~~.

~~7.5.~~7.7. Manholes shall be provided at both ends of storm drain infrastructure needing to be maintained or serviced, especially underground detention systems, including public and privately owned and maintained systems.

~~7.6.~~7.8. An accessible structure shall be provided to connect private storm drains to the public storm drains (i.e., no blind connections) except as otherwise approved by the City

Engineer. Structures shall be installed on the private side of the property line to distinguish the public system from the private system. Public and private storm drain facilities shall be clearly identified on the improvement plans. For residential land uses only, no structure is necessary for sump pump connections to public storm drain systems. Accessible structures are required for sump pump connections from non-residential land uses.

7.9. Headwalls, wing walls, flared end sections, or structures shall be provided where open ditches, channels, and creeks discharge into closed ~~pipe~~ conduits or where closed conduits discharge to ditches, channels, and creeks. Refer to Caltrans' *Highway Design Manual* and *Standard Plans*.

7.10. Flared end sections shall be metal. Plastic flared end sections are not permitted as part of publicly owned and maintained infrastructure as they interface with vegetated areas.

~~7.7.~~7.11. Rock slope protection is required where open ditches, channels, or creeks enter a closed conduit or where a closed conduit discharges to an open ditch, channel, or creek. Rock slope protection shall be sized to the controlling flow velocity. Where a closed conduit discharges to a hardened channel, such as a concrete lined channel, or a hardened channel transitions to a closed conduit, rock slope protection shall not be required. For example, where a relatively small, closed conduit (e.g., 15-inch culvert) discharges to an established creek, the creek velocities must be calculated, and the creek velocities would be the controlling factor in sizing the rock slope protection for the closed conduit outfall. Rock slope protection shall be sized following SD Standard 407.

8. ~~CATCH BASINS~~STORM DRAIN INLETS

8.1. Catch basins shall be Type II (SD Standard 402) except as listed below or as otherwise approved by the City Engineer. Galleries per SD Standard 404 may be used on the upstream side of a Type II catch basin to increase inlet interception capacity or if their use reduces the number of catch basins requiring maintenance.

8.2. Flow in gutters must be accounted for in the determination of the design and layout of storm drain inlets. Design depth of flow in gutters should not exceed 0.4 feet for the 10-year flow and calculations to be consistent with Sonoma Water's FMDM guidelines. Storm drain inlets must be sized and located to limit the flooded width from entering the traveled lanes for the design storm (refer to U.S Department of Transportation Federal Highway Administration's (FHWA) *Hydraulic Engineering Circular* (HEC) No. 22, 3rd Edition dated September 2009 revised August 2013, or most current version, for further technical guidance). Gutter flooded width calculations must be supplied with the supporting drainage calculations for Projects. When storm drain inlets are to be replaced, flooded width must be calculated and improved to meet this requirement with larger grates, combination inlets, and/or use of a SD Standard 404 storm drain gallery.

~~8.1.~~8.3. Standard drop between inverts in and inverts out shall be 0.10 feet whenever possible and when not limited by existing storm drain infrastructure elevations.

~~8.2.~~8.4. Catch basins shall be installed at the following locations:

~~8.2.1.~~8.4.1. Such that gutter flows do not cross intersections except where valley gutters are allowed.

~~8.2.2.~~8.4.2. Immediately u~~U~~pstream of bridge abutments.

~~8.2.3.~~8.4.3. The beginning of every roadway superelevation that reverses the cross-slope of the pavement.

8.4.4. The sags (i.e., bottoms) of vertical curves. Catch basins on sags shall have either a curb opening component, gallery per SD Standards 404, or two flanking inlets at all sags.

~~8.2.4.~~8.4.5. For projects ~~triggering~~subject to the City's Hillside Development Ordinances, when the longitudinal roadway slope is 10% or greater and the roadway makes a perpendicular direction change or a knuckle is proposed, a catch basin shall be located at the upstream beginning of the outer radius alignment.

8.4.6. The low points of downhill cul-de-sacs

8.4.6.1. For projects ~~triggering~~subject to the City's Hillside Development Ordinances and requirements, roadways shall be crowned to the center point of the bulb radius at a minimum slope of 2%. Due to hydraulics of roadways, variances from this are strongly discouraged. Should a variance be approved by the City Engineer, calculations and potentially modeling will be required to be submitted with the Drainage Report. The calculations must show there are sufficient catch basins upstream of the low point to contain the design flows in the gutter pan. Ponded width shall not be permitted to extend into the pavement section from the gutter pan. Calculations and modeling will need to show that given the velocities and flows, the design flows~~, including 100-year flow requirements.~~ will not encroach over any downstream driveway approaches at the back of sidewalk catch point.

~~8.2.4.1.~~

~~8.2.5.~~8.4.7. As required so that water depth in gutter does not exceed 0.4 feet during the design storm event.

~~8.2.6.~~8.4.8. As required to maintain the following number of 8-foot-wide traffic lanes unimpeded by flowing or standing water during a design storm:

~~8.2.6.1.~~8.4.8.1. Two lanes for all regional streets.

~~8.2.6.2.~~8.4.8.2. One lane for transitional and industrial streets. ~~-~~This lane may be in the middle of the road, spanning the crown. This requirement does not apply to local streets.

~~8.2.6.3.~~8.4.8.3. One lane in each direction for transitional streets that are divided roads or roads with a median strip.

~~8.2.7.~~8.4.9. As required so that carry~~-~~over flows (bypassing catch basins) for a 10 year shall not exceed 2 cubic feet per second.

~~8.2.8.~~8.4.10. At a maximum spacing of ~~400~~ 300 feet from another catch basin or manhole (i.e., maximum length of storm drain pipe without a structure is 300 feet).

~~8.3.~~8.5. Catch basin size and spacing shall be computed by the methods in FHWA HEC-22.~~Drainage of Highway Pavements, Federal Highway Administration, Hydraulic Engineering Circular No. 12, March 1984.~~

9. STUB CAPS

9.1. ~~To plug a pipe for~~Upstream terminations of new storm drain systems where a single stub pipe segment has been provided for future ~~future~~ expansion, a ~~always install a~~ minimum of six (6) feet~~6'~~ of pipe from a structure shall be provided. Cap or seal the last section of pipe by one of the following methods:

9.1.1. For HDPE or HPPP pipe, use a manufacturer approved cap.

9.1.2. For RCP, install an additional section of pipe and fill with concrete or install a plywood seal to the end of pipe not to exceed the outer diameter of the pipe. Install concrete stub cap per SD Standard ~~XXXX~~411.

10. VIDEO INSPECTION

10.1. All new and modified storm drain pipes shall be inspected per Section 79 of the City of Santa Rosa Storm Drain Standard Specifications.

11. ABANDONMENT OF STORM DRAIN PIPES

11.1. Any existing storm drain pipe that will not be used and is to be abandoned, the following shall be noted on the Improvement Plans:

11.1.1. All storm drain pipes to be abandoned shall be done per City Standard 507.

~~9.~~12. EASEMENTS

~~9.1.~~12.1. An easement ~~must~~shall be provided over any public storm drain when it is installed outside a public right-of-way.

~~9.2.~~12.2. The easement shall~~must~~ be a minimum of 15 feet wide if it only contains a publicly maintained storm drain or 20 feet wide (or wider) if it contains another facility, such as water, sewer, or other utility. -The easement will be dedicated as a "public drainage easement" if it contains storm drain only.- It will be dedicated as a "public utilities easement" if it contains other facilities as well. If an existing easement is less than the specified widths above, the existing easement will be required to be expanded to the current 15-foot minimum width. A variance will be considered if expanding the easement to 15 feet wide will impact existing buildings.

12.3. Easements ~~must~~shall be configured to encompass all publicly maintained appurtenances and will be generally centered over the facility. Separate access easements may be required depending on site conditions. -When storm drains are to be installed along a property line the easement will be wholly contained on one parcel.

~~9.3.~~12.4. Clear access shall be provided and maintained to all public infrastructure of the public storm drain system. Where fences are proposed that span a public drainage or utility easement on any development, including subdivisions, the improvement plans shall show that movable gates spanning the width of the entire easement must be provided.

~~9.4.~~12.5. All property restrictions placed as a result of dedication of easements will be so noted on the supplemental sheet of the Subdivision Map, or on the Easement Deed if the easement is not dedicated as part of a subdivision. Typical required notes as applicable are:

12.5.1. No structures shall~~may~~ encroach on, above, or below the surface of the ground in any public easement. -This includes footings of foundations, eaves from the roof of any adjacent structure, pools, ponds, MS4 permit required LID features, fences without a movable gate across the entire width of the public easement, or outbuildings on slabs or foundations. Any structure on, above, or below the ground surface in a public easement damaged as part of maintenance activities for the storm drain will be the responsibility of the property owner at no fault to the City.

12.5.2. Fences shall not be installed along the longitudinal alignment over the storm drain pipes and structures. Any fences installed crossing a storm drain easement must provide vehicle access through the fence within the storm drain easement.

~~9.4.1.~~

~~9.4.2.~~12.5.3. Trees shall not ~~No trees may~~ be planted in ~~a public storm drain~~ easements with public storm drain including “public drainage easements” and “public utility easements”~~ without first obtaining approval of the Director of Public Works. Trees may be allowed to the extent that damage to the drainage system does not occur from root intrusion and adequate access can be provided for maintenance and repair vehicles.~~ .

~~9.4.3.~~12.5.4. The ~~Public Works Department~~ City will take due caution when performing maintenance or repair of drainage systems in easements, but will not be responsible for repairs or replacement of trees, landscaping, fences where gates spanning the width of the easement haven't been provided, or structures not specifically approved in recorded writing by the Director of Transportation and Public Works or by approved variance from the City Engineer. Variances approved to legalize existing structures may be granted, but shall include clauses noting that it is a one-time variance and that the City retains the right to fully use the entire width of the easement without being liable for impacts to the encroaching structure or feature should it be needed to operate or maintain the public infrastructure.

13. ACCESS ROADS

~~9.5.~~13.1. Access shall be provided and kept clear to accommodate maintenance of all public storm drain system facilities within public drainage easements and public utility easements.

~~9.6.Clear access must be provided and maintained to all pubic structures on the drainage system.~~ Formatted

~~9.7.~~13.2. All-weather vehicle access roads are required to access every structure on the storm drain system within the public drainage or utility easement. ~~-~~Access roads must be a minimum ~~of 12' in~~ width of 12 feet and must be provided with turnarounds per City Standard 206 when the back-up distance for any maintenance vehicle exceeds 100 feet.

~~9.8.~~13.3. The design of access roads must be included with the drainage system design plans. ~~-~~At a minimum, the design will conform to the requirements of City Standard 216. Include adequate drainage measures in the design to prevent damage to the access roads from stormwater.

~~9.9.~~13.4. Gates must be provided for access through any fence crossing a public ~~storm drain~~ drainage or utility easement~~s~~ the width of the easement to a maximum required gate width of ~~XXXX~~12 feet. Gates installed across public easements are the responsibility of the property. ~~Where vehicular access is required for maintenance, minimum 14' wide gates must be provided with sliding gates preferred. Where vehicular access is not required, 4' wide gates for pedestrian access must be provided and will be located to permit visual access between storm drain structures.~~

~~9.10.~~13.5. The maximum grade allowed at any point on an access road is 15%. ~~-~~The maximum cross-slope for any access is 5%.

~~10.~~14. .MAINTENANCE

~~10.1.~~14.1. Storm drains that convey public water, ~~are~~ designed and constructed to City standards~~,~~ and ~~are~~ in a dedicated public easement or right-of-way accepted by the City shall be maintained for hydraulic capacity by the City.~~-~~ All other storm drains, including driveway culverts, shall be privately maintained.

~~10.2.~~14.2. Sidewalk drains shall be privately maintained by the owners of the ~~frontage~~ fronting property.

~~11.~~15. WATER QUALITY ~~TREATMENT~~

15.1. Source controls designed or constructed to reduce the discharge of pollutants from the storm-water conveyance system, otherwise known as LID, shall be designed and maintained ~~in accordance with~~per the current version of the ~~Santa Rosa Area~~Regional LID Manual ~~Standard Urban Storm Water Mitigation Plan (SUSMP)~~. ~~13.~~

15.2. Tire-~~-~~derived aggregate and reclaimed processed asphalt concrete grindings shall be ~~strictly~~ prohibited for use within the City's jurisdiction. The allowable exception to this clause is when reclaimed processed asphalt concrete grindings are used and bonded as part of full-depth reclamation construction practices where the grindings are thereby encapsulated as the new, sealed pavement section.

~~11.1.~~15.3. The City Engineer may prohibit or restrict design of infiltration features, including LID features, based on specific site conditions such as insufficient mitigation of vector concerns; need for extensive relocation of existing improvements and utilities and/or justified rejection of relocation by the utility owner; soils with increased risk of instabilities including the Goulding cobbly loam formations; potential for infiltration to negatively impact structures' soil bearing capacity, design earth pressures, support block envelope, or sphere of influence; or existing site or groundwater contamination concerns.

When infiltration tests are required, the following ASTM standards shall be used: D5093 Standard Test Method for Field Measurement of Infiltration Rate Using a Double-Ring Infiltrometer with a Sealed-Inner Ring, D3385 Standard Test Method for Infiltration Rate of Soils in Field Using Double-Ring Infiltrometer, or D8152 Standard Practice for Measuring Field Infiltration Rate and Calculating Field Hydraulic Conductivity Using the Modified Philip Dunne Infiltrometer Test.

~~12.~~16. OTHER REQUIREMENTS

16.1. The National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 and NOAA's National Weather Service the Atlas 14 Precipitation Frequency Data Server, or current versions, online tool shall be used to determine design storm intensities and intensity-duration-frequency curves.

16.2. For any hydrology or hydraulics design criteria not expressly stated in these SD Standards, including the quick reference sheet, the following references, listed in order of hierarchy, shall be complied to for design and calculation criteria:

16.2.1. Current version of Sonoma Water's *Flood Management Design Manual*

16.2.2. Current versions of Caltrans *Highway Design Manual*, *Standard Plans, and Standard Specifications*

16.2.3. Current versions of FHWA's HECs including, but not limited to, HEC-14 and HEC-22.

~~12.1.~~16.3. Sanitary sewer laterals and industrial process or waste pipelines shall not be connected to storm drains or allowed to discharge to waterways. ~~-~~Sanitary sewer laterals and industrial waste pipelines shall be connected to sanitary sewers in conformance with the latest edition of the City's Sewer Standards; pretreatment of industrial wastes may be required.

16.4. Driveway culverts shall be designed under the direction of a licensed civil engineer to convey anticipated flow from future development and ensure hydraulic adequacy. Corrugated metal pipe compliant with Sonoma County Standards STD-820 Driveway Drainage Culverts, or the current version, can be used for driveway culverts.

16.5. Field verification of utility locations during design (including potholing where necessary) is the full responsibility of the design engineer. Utility conflicts discovered during construction due to inadequate field verification of utility locations during design does not constitute grounds for a variance approval. Design engineers shall not assume public or private utility owners will allow partial or full relocation of existing utilities that conflict with the design.~~Variance requests that are requested due to utility conflicts discovered after Final Improvement Plans have been approved by the City Engineer shall be required to submit their in-design potholing data to be eligible for a variance approval. Design engineers shall not assume public or private utility owner's, including storm drain infrastructure, will be willing or able to allow partial or full relocation of their facilities. Utility conflicts discovered during construction due to a failure to perform adequate potholing and clearing of utility conflicts during design before approval of the Final Improvement Plans by the City Engineer does not constitute grounds for a variance approval. Ramifications of failure to perform in-design pothole~~

~~utility location at proposed utility crossings is regarded as a design engineer choosing to operate at their own risk, which often results in significant time delays and/or cost implications, thereby the responsibility of the design engineer~~.

TABLE I-1 LOADS ON BURIED PIPES
POUNDS PER LINEAR FOOT

THIS CHART IS TO BE USED IF EQUIPMENT OR VEHICLES WILL BE DRIVEN ON SUBGRADE. IF PIPES ARE TO BE INSTALLED IN EXISTING ROADWAY OR PAVED AREAS, MINIMUM COVER SHALL BE CALCULATED USING THE EXISTING STRUCTURAL SECTION.

Cover to Subgrade Pipe Diameter In Inches

in feet	15	18	21	24	27	30	36	42	48	54	60	66	72	78	84	90	96	102	108
1	*	*	*	*	*	*	*	*	*	2919	2310	2475	2310	2169	2048	1944	1852	1778	1705
2	1632	1592	1549	1516	1491	1471	1474	1289	1148	1039	952	881	822	772	729	692	659	633	607
3	931	893	859	834	814	798	827	814	797	784	731	688	652	622	596	573	553	540	524
4	857	816	780	753	733	716	760	742	723	709	699	691	685	658	636	616	599	589	576
5	878	832	794	766	744	726	784	763	742	726	715	706	699	693	687	683	667	660	647
6	921	874	833	803	780	762	835	812	789	771	759	749	741	735	729	724	719	727	720
7	974	924	883	852	828	809	897	872	848	829	816	806	798	790	784	779	775	782	778
8	1029	978	935	904	880	861	964	939	913	893	880	869	861	853	847	842	837	846	842
9	1087	1036	993	961	937	918	1037	1011	985	964	951	940	932	924	918	913	908	918	914
10	1141	1090	1047	1015	992	973	1108	1082	1055	1034	1021	1011	1002	995	989	984	979	991	987
11	1191	1141	1098	1067	1043	1026	1177	1151	1123	1103	1090	1080	1072	1065	1059	1054	1050	1063	1059
12	1236	1187	1145	1115	1092	1075	1242	1217	1190	1170	1157	1148	1140	1134	1128	1124	1120	1135	1131
14	1315	1269	1229	1201	1181	1166	1365	1343	1317	1297	1287	1279	1272	1267	1263	1260	1257	1275	1272
16	1380	1338	1301	1276	1259	1247	1477	1458	1434	1417	1409	1403	1398	1395	1393	1391	1389	1411	1409
18	1433	1396	1363	1341	1327	1318	1578	1564	1543	1528	1523	1519	1517	1516	1516	1516	1516	1542	1542
20	1477	1445	1415	1397	1386	1380	1670	1661	1643	1631	1629	1629	1630	1631	1633	1635	1637	1668	1669
24	1542	1519	1496	1485	1482	1483	1828	1830	1820	1816	1821	1828	1835	1842	1850	1857	1863	1903	1908
28	1585	1570	1554	1550	1553	1560	1955	1969	1969	1973	1987	2002	2016	2030	2043	2056	2068	2118	2126
32	1613	1605	1595	1597	1606	1619	2058	2085	2094	2107	2130	2153	2175	2196	2216	2235	2253	2313	2326
36	1632	1629	1624	1631	1646	1664	2141	2180	2198	2220	2253	2285	2315	2343	2371	2396	2420	2490	2509
40	1644	1645	1644	1656	1675	1698	2208	2258	2286	2317	2359	2399	2437	2474	2508	2540	2571	2651	2675

Allowable Loads:
Class III 1,350 pounds/linear foot
Class IV 2,000 pounds/linear foot
Class V 3,000 pounds/linear foot

The area within the heavy black line indicates situation where Class III RCP is acceptable.
* Exceeds the capacity of Class V RCP. Special design required to be submitted to City Engineer.
Reference: Ameron Reinforced Concrete Pressure Pipe, 1971, for covers of 2 feet or greater. Loads are interpolated for cover of 1 foot.

TABLE I-1 LOADS ON BURIED PIPES
POUNDS PER LINEAR FOOT

II. PUBLIC STORM DRAIN STANDARD DETAILS

Std.	Title	Approved
400	Standard Precast Concrete Storm Drain Manhole	[Date]
401	Precast Concrete Storm Drain Manhole Reducer Slabs	[Date]
402	Type II Catch Basin	[Date]
403	Type I Catch Basin	[Date]
404	Storm Drain Gallery	[Date]
405	Precast Catch Basin Cover	[Date]
406A	3" Sidewalk Drain	[Date]
406B	3" x 12-1/2" Cast Iron Sidewalk Drain	[Date]
406C	Trench Drain and Grate	[Date]
407	~~Loose~~ Rock ~~Rip-Rap~~Slope Protection Storm Drain Outlet/Inlet	[Date]~~January 2014~~
408	Precast Side Opening Field Drain	[Date]
409	Storm Drain Labels	[Date]
410	Reinforced Concrete Pipe Collar	[Date]
411	Reinforced Concrete Stub Cap	[Date]
412	Concrete Bedding Cap	[Date]
413	Street Bioretention Bulb-Out, Mid-Block, Corner Crossing	[Date]
414	Curb Cut Inlet/Outlet For Planters	[Date]
415	Storm Drain Under Curb or Planter	[Date]

III. PUBLIC STORM DRAIN CONSTRUCTION STANDARD SPECIFICATIONS

CONTENTS

SECTION 64. PLASTIC PIPE

64-1.01 Description

Plastic pipe for use in public storm drain systems shall be 15" through 48" diameter Type S, smooth interior wall, corrugated exterior wall, high density polyethylene pipe (HDPE) as specified in AASHTO designation M294 or high-performance polypropylene (HPPP) as specified in ASTM F2881 or AASHTO M330. HDPE and HPPP compounds used in the manufacture of plastic pipe shall be per the Standard Specifications. The HDPE and HPPP pipe walls must be free of cracks, holes, voids, blisters, foreign inclusions, scratches deeper than 10% of the wall thickness, or other defects visible to the naked eye or affecting the pipe wall integrity. The residue from the ignition of HDPE or HPPP compounds must not exceed 30 percent as determined under ASTM D2584 except the muffle furnace temperature must be 840 ± 45 degrees Fahrenheit.

64-1.02 General

See Section 64-1.02A of the Standard Specifications
4

64-1.02E Couplings and Fittings

Pipe and fittings shall be joined with a bell-and-spigot joint meeting AASHTO M252, AASHTO M294, or MP7. The joint shall be soil tight elastomeric o-ring gaskets meeting the requirements of ASTM F477. HPPP shall have bell-and spigot joints per ASTM D3212. Gaskets shall be supplied by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. A joint lubricant supplied by the manufacturer shall be used on gasket and bell during assembly. The spigot shall be pushed into the bell to the "home line" on the pipe. The method of joining pipes and fittings shall be as recommended by the pipe manufacturer.

64-1.03B Excavation and Backfill

Excavation and backfill shall be as shown on City Standard 215 and the following provisions.

The space between the pipe and trench wall shall be wider than the compaction equipment used in the pipe zone, regardless of the dimensions shown on the City Standard 215 unless self-compacting backfill material is used.

Pipe bedding will be placed in 6" (maximum) lifts to 6" above the top of pipe with each lift hand or mechanically tamped. The final lift may be compacted with a plate type vibrating compactor.

During construction, heavy equipment vehicle loads over the pipe shall be avoided or additional cover shall be placed at vehicle crossings.

64-1.07 Laying Pipe

Plastic storm drain pipe shall be installed in accordance with the Standard Specifications, generally accepted practice and on the alignment and grade as shown on the plans. When long radius curves are permitted, adjustments in horizontal alignment will be achieved by using 3° mitered couplings with a minimum of 10 feet between each mitered coupling and not by bending of the pipe or deflecting joints.

Pipe shall be centered in the trench.

Unless otherwise specifically permitted by the Engineer, all pipe shall be laid upgrade.

Where ground water or surface drainage occurs, pumping shall continue until backfilling has progressed to a sufficient height to prevent flotation of the pipe.

64-1.08 Video Inspection of Plastic Storm Drain Pipe

Video inspection of plastic storm drain pipe shall be in accordance with City Standard 79.

64-1.10 Mandrel Testing

If the video inspection of the pipe indicates the probability of deflection or obstruction in the pipe, mandrel testing shall be required by the engineer. The mandrel shall be able to detect a deflection of 7.6% or greater of the inside diameter of the pipe. All defects indicated in the video shall be corrected; the pipe shall pass a mandrel test and an additional video inspection before acceptance.

SECTION 65. REINFORCED CONCRETE PIPE

65-1.01 Description

Reinforced concrete pipe shall be installed on the alignment and grade as shown on the plans and in accordance with Section 65 of the City of Santa Rosa Construction Specifications and as directed by the Engineer. Reinforced concrete pipe to be installed shall be the size and class as shown on the plans, and shall conform to the provisions of ASTM C76.

65-1.02 Materials

All concrete pipe shall conform to the provisions of Section 65-21.02 of the Standard Specifications prior to shipment from the manufacturer.

65-1.03 Earthwork

Excavation and backfill shall conform to the City of Santa Rosa Construction Specifications. Backfill shall be in accordance with City Std. 215 and as shown on the plans.

If, during excavation for any culvert or structure, material is encountered which is unsuitable as a foundation for such culvert or structure, such unsuitable material shall be removed to a depth as required by the Engineer and the resulting space shall be refilled with approved material.

Trenching operations shall be conducted in such a manner as not to disturb the existing curb and gutter and existing utilities.

Trenching operations for pipelines and structures shall be conducted in such a manner to minimize damage to existing tree roots. Hand digging shall be used where necessary to protect tree roots. Where tree roots are encountered, root pruning shall be accomplished by use of sharp tools appropriate for the size of root to be cut. Each cut shall be clean with no torn bark or splintered wood remaining on the tree. All tree work shall be performed by a certified arborist from the list approved by the City.

All raised pavement markers, street striping, chatter bars or any other traffic markings disturbed during work shall be replaced in kind by the Contractor to the satisfaction of the Engineer.

65-1.07 Laying Culvert Pipe

Unless otherwise specifically permitted by the Engineer, all pipe shall be laid upgrade. No pipe shall be laid which is cracked, checked, spalled, or damaged and which, in the opinion of the Engineer, is unsuitable for use.

Pipe joints shall be sealed with grout or by use of a rubber gasket. A joint lubricant recommended by the pipe manufacturer shall be used on gasket sealed pipe. All excess grout shall be removed from inside of grout sealed pipes.

Proper implements, tools, and facilities satisfactory to the Engineer shall be provided and used by the contractor for the safe and efficient execution of the work. All pipe, fittings, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. The pipes and accessories shall be inspected for visible defects prior to lowering into the trench. Any visibly-defective or unsound pipe shall be replaced.

The line and grade of existing utilities designated to remain shall not be altered. Any leakage caused in existing utilities by reason of the Contractor's operations shall be immediately repaired at the Contractor's expense.

Existing water lines shall be supported in place maintaining service during construction. The Contractor shall be responsible for any damage to the water lines during construction and any damage resulting from improper backfilling techniques. Water services shall be relocated where encountered during construction and as shown on the plans.

Existing sewer lines shall be supported in place maintaining service during construction. The Contractor shall be responsible for any damage to the sewer lines during construction and any damage resulting from improper backfilling techniques.

65-1.08 Television Inspection of Reinforced Concrete Storm Drain Pipe

Television inspection of reinforced concrete pipe shall be in accordance with City Standard 79.

~~SECTION 66. CORRIGATED METAL PIPE~~

~~Cast-in-place, non-reinforced concrete pipe, PVC and corrugated metal pipe is not allowed with the following exceptions. 20 linear feet of corrugated metal pipe may be installed at outfalls per City Standard 407.~~

~~Corrugated metal pipe shall meet the requirements of Section 66-3 of the Standard Specifications.~~

SECTION 70. MISCELLANEOUS DRAINAGE STRUCTURES

70-1.02 Structures

Storm drain manholes shall be standard 48" diameter precast concrete manholes or 60" diameter precast concrete manhole at the locations shown on the plans and in accordance with City Standard Details.

Concrete for manhole bases shall be portland cement concrete conforming to the requirements of Section 90 of the City Design and Construction Standards and shall be poured full thickness against the sides of the manhole excavation or shall be formed.

Manhole barrels and taper sections shall be precast concrete sections using Type II portland cement complying with ASTM Designation: C150. The barrel and taper sections shall be constructed in accordance with the applicable provisions of ASTM Designation: C478.

Top of manhole frames and covers shall be set accurately to the final finished grade in paved streets and to the elevation shown in unimproved areas.

Concrete for catch basins shall be portland cement concrete conforming to the requirements of City Design and Construction Standards.

Catch basin covers shall be concrete with cast iron frame and lid rings per City Standard. 405.

"No dumping" decals shall be applied to catch basins per City Standard. 409.

In lieu of the inspection of reinforcing steel and upon request, the Contractor shall furnish the Engineer with a certificate from the supplier of the reinforcing steel stating that the steel delivered complies with the requirements of Section 52-1.02 of the Standard Specifications.

Bar reinforcing shall conform to and be placed in accordance with Section 52 of the Standard Specifications.

Connections to existing storm drain structures shall be made with care to avoid unnecessary damage to any existing curb and gutter or sidewalk. Any damaged section shall be removed and replaced in accordance with City Standards and as approved by the Engineer. Pipe connections to the existing structures shall be sealed with cement mortar.

Drop inlets ~~and grates~~ shall be ~~bicycle-safe and~~ designed for H20 loading. ~~Frame and grate shall be hot-dipped galvanized after fabrication.~~

70-1.135 Mortar

70-1.135A Description

Mortar shall consist of a mixture of Type II p~~P~~ortland c~~C~~ement complying with ASTM C150, sand, and water. Sand for mortar shall be clean, dry, well-graded sand, free of organic or other deleterious matter, silt or other objectionable material.

Mortar shall conform to the requirements of Section 65-2.02E of the Standard Specifications.

70-1.135B Admixtures

No admixtures will be permitted unless authorized by the Engineer.

70-1.135C Curing

After placing, all surface of mortar shall be cured by the water method in accordance with Section 90-1.03B, "Curing Concrete" of the Standard Specifications, for a period of not less than 3 days.

SECTION 79. CLOSED CIRCUIT TELEVISION (CCTV) INSPECTION OF STORM DRAINS

79-1.01 Description

Television inspection of all new and modified storm drain pipes and structures is required.

The contractor shall hire an independent pipe video inspection service to perform the inspection. The camera used shall be self-propelled or pulled, be able to pan and tilt and shall be equipped with high-intensity lights. A digital video compatible with and uploaded to ITpipes shall be produced along with a printed log of the inspection and delivered to the Engineer. The pipe inspection service shall be pre-approved by the City. All Closed Circuit Television (CCTV) inspections shall conform to current National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) standards. Additionally, the digital CCTV data shall meet the following requirements in order to be compatible with ITpipes:

1. NASSCO v7 PACP data exchange export file for CCTV and containing the complete project.
2. Each observation is required to have at minimum one snapshot associated showing the defect and each snapshot shall be referenced inside the PACP file.
3. Video shall be inside an h.264 video format and referenced inside the PACP file.
4. The video titler/overlay display shall have an initial start screen, inspection

Camera movement means, rotational and panning abilities, and pace shall meet NASSCO PACP standards.

Video and picture quality shall be a minimum of HD-1080p.

All cleaning water and debris shall be captured, removed and properly disposed. Cleaning water will not be allowed to discharge to the storm drain system.

The contractor is responsible for all stuck, broken or lost equipment and shall bear all necessary cost to retrieve said equipment including dig ups.

All work performed must meet quality and clarity standards set by the City of Santa Rosa and are subject to Public Works review. A pan and tilt color camera will be used for all video inspections of storm drains within the jurisdiction of the City of Santa Rosa.

The following conditions shall exist prior to the television inspection:

10. All storm drain pipes shall be installed, grouted, backfilled ~~to 5 feet over the top of the pipe or to subgrade~~, and compacted;

12.Conduits or pipelines for all underground utilities (sewer, water, cable television,

telephone, electrical, gas, street light) that cross storm drain trench shall be installed;

II.The bases of all structures shall be in place and grouted;

A.The system shall be cleaned and all debris removed;

11.Street shall be unpaved;

When the above work has been completed, the contractor shall notify the Engineer 48 hours in advance of the date for television inspection. Immediately before inspection the system shall be flushed with clean water. During this inspection, the contractor or authorized representative shall be present to observe the video as provided by the television camera.

The results of all observations will be logged and whatever data may be required for record purposes shall be prepared. Measurement for location of features along the pipe alignment shall be at ground level by means of a counting. The counting meter shall be mounted on the CCTV reel power winding assembly. The meter shall be equipped with a local mechanical readout for use at the rear of the television vehicle and an electronic counter which is connected to the data view system for display on the video tape. Marking on cable, or the like, which would require interpolation for depth of manhole will not be allowed. The counting meter shall accurately record the distance in feet, which the video cable has traveled. The measurement will be accurate to three-tenths (0.3) of a foot per ten (10) feet of inspected storm drain reach length.

At the beginning of each run of storm drain pipe the video shall display:

1. The project name;
2. Date;
3. Company performing the inspection;
4. Run number (unique designation for each section of pipe);
5. Street name (if applicable);
6. Pipe size;
7. Pipe material;
8. Structure numbers (as labeled on the plans) at each end of the pipe;
9. Direction of the camera;
10. Type of structure.

The video shall display the following information continuously during the run:

1. The camera's location via a continuously updated footage counter measuring the distance from point of entry;
2. Project name;
3. Structure numbers (as shown on the plans) at each end of the run;
4. Run number.

The camera shall stop at all structures, connections or defects (sags, bad joints, etc.) for a period of at least 10 seconds and be noted on the log sheet. The camera will be panned or tilted toward the connection or defect so that any portion of the connection or defect that is visible from within the pipe or structure can be completely inspected.

A printed record shall be made for each pipe run and shall clearly show the:

1. Run number;
2. Structure number at each end of the run;
3. Direction of camera travel;
4. Location and description of each defect discovered by the camera;
5. Line size;
6. Length of run;
7. Structure depths;
8. Location of blind connections.

The video inspection data shall be uploaded to ITpipes and report shall be delivered to the Engineer and become the property of the City of Santa Rosa. The inspection report shall meet NASSCO PACP standards.

The following video observations shall be considered defects in the construction of the storm drain system and will require corrections prior to acceptance:

A. Off grade - 0.08' or more deviation from grade;

B. Joint separations;

C. Offset joints;

D. Cracked or damaged pipe or evidence of the presence of an external object bearing upon the pipe (rock, root, etc.);

E. Debris or other foreign objects;

F. Pipe deflections greater than 7.5% of base diameter, measured inside the pipe;

G. Other obvious deficiencies when compared to approved Plans and Specifications, these Standards and City Design and Construction Standards.

The contractor will be notified in writing of any deficiencies revealed by the television inspection that will require repair, following which the contractor shall excavate and make the necessary repairs and request a television re-inspection. Television re-inspection shall be at the contractor's expense.

Any subsequent televising of the lines, if deemed necessary by the City, shall be

completed at the City's expense. Any defects found prior to or during the warranty period shall be corrected by the contractor.

IV. ENGINEER'S LIST OF APPROVED ITEMS FOR CONSTRUCTION

Engineer's list of approved Items can be found at:

www.srcity.org/2321/Design-Construction-Standards~~www.srcity.org/elai~~