

COUNTY OF SANTA CRUZ



DESIGN CRITERIA

CONTAINING STANDARDS FOR
THE CONSTRUCTION OF

STREETS
STORM DRAINS
SANITARY SEWERS
WATER SYSTEMS
DRIVEWAYS

WITHIN THE UNINCORPORATED PORTION OF
SANTA CRUZ COUNTY

APPLICABILITY

By reference, Public Works also means the Department of Public Works, DPW, CDI, Community Development and Infrastructure Department, and Community Development and Infrastructure. These terms may be used interchangeably throughout this document. The Director of Community Development and Infrastructure shall herein be referred to as the Director.

The *Design Criteria* standards contained herein, in addition to the latest edition of Caltrans *Standard Specifications* and *Standard Plans*, are minimum requirements for development within the unincorporated areas of Santa Cruz County. In the event of conflict, this *Design Criteria* shall control over Caltrans *Standard Specifications* and/or *Standard Plans*. In addition to being required standards for subdivision development, these standards shall apply to all other forms of development under the jurisdiction of the County Public Works, including but not limited to building permits, discretionary permits, encroachment permits, storm drainage improvements, and water and sewer line construction in County Service Areas and Sanitation Districts.

By reference, the Pleasure Point Community Plan is incorporated into this *Design Criteria*.

By reference, this *Design Criteria* is incorporated as part of the subdivision ordinance as set forth in the Santa Cruz County Code. Exceptions and/or conditional exceptions for subdivisions may be authorized by the approving body and must be reflected in the development use permit and/or the tentative map approval conditions.

The standards included in this *Design Criteria* are intended to comply with all applicable portions of the Americans with Disabilities Act and of Title 24, the State of California Administrative Code. Questions regarding compliance with these laws or the relationship of these laws to the standards contained herein should be directed to Public Works, by mail at 701 Ocean Street, Room 410, Santa Cruz, California 95060, or by telephone at (831) 454-2160.

General Announcement

The County of Santa Cruz does not discriminate on the basis of disability, and no person shall, by reason of disability, be denied the benefits of its services, programs, or activities. Information concerning the provisions of the Americans with Disabilities Act of 1990, and the rights provided thereunder, are available from the ADA Coordinator at (831) 454-2160, TDD number (831) 454-2123.

A Class A – General Engineering Contractors License from the Contractors State License Board (CSLB) shall be required for all Public Works Capital Improvement Projects, sub-division improvements, and work requiring an encroachment permit. The Director may waive or modify this requirement at their discretion.

Inspection requests shall be coordinated with the respective Public Works section and 48-hour minimum notice shall be provided.

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PART 1. GENERAL

Section A - Improvement Plan Preparation

1. The improvement plans shall be prepared by a Registered Civil Engineer, and shall be provided as an pdf (also acceptable is printed on bond paper.). The following items at a minimum shall be included on the plans:
 - a. Project vicinity map on the title sheet.
 - b. Locations of existing utilities. Utilities requiring relocation should be identified and their final locations shown on the plans.
 - c. Stationing along road and/or sewer and storm drain line, where applicable.
 - d. Location of sewer, storm drain, curb and gutter, and other proposed improvements and utilities with respect to road or utility easement centerline.
 - e. Benchmark datum. This must be County datum unless prior approval has been secured from the Director.
 - f. Driveway plans and profiles.
 - g. Sufficient topographic information to make clear the purpose and extent of proposed grading. Topographic information shall extend a minimum of 50 ft beyond the limits of work in all directions in order to show the effect of the proposed grading on adjacent property and to identify local drainage patterns. Abrupt changes in grade and existing retaining structures at property lines shall be clearly identified in plan and section views. Typically, existing and final contours, together with significant spot elevations, should appear on the plans. In cases where significant grading is required, cut and fill lines may be required.
 - h. When road or roadside work is required, existing centerline and flowline profiles for a minimum of 100 ft beyond the limits of work in both directions. In any case, the extent of profiles shall be such that good drainage and road design are possible. Offsite improvements may be required to provide adequate drainage or roadway transitions.
2. The scale of the improvement plan shall not exceed 1:600 (1" = 50') horizontal and 1:60 (1" = 5') vertical unless prior approval is obtained from the Director.
3. Arrangement of the improvement plans shall conform to Figure G-1 of this *Design Criteria*. Approval blocks for Public Works' signoff, per Figures G-2 and G-3, shall be included on the title sheet of the improvement plans. Approval blocks for the Planning Department, the appropriate Fire District, and the appropriate Water District shall also be included.
4. In some instances, the amount of information required on improvement plans makes division of the information into separate corresponding sheets or series of sheets advisable. Layout sheets containing complex surface work will appear less cluttered, and thus less subject to misinterpretation by contractors, if some or all of the subsurface work is shown elsewhere. Refer to Caltrans' "Project Plan Preparation," or to Chapter 4 of Caltrans' *Drafting and Plans Manual of Instruction*.

Section B - Improvement Plan Processing

1. The initial submittal of improvement plans for checking shall be made to the Director and shall consist a pdf of the plans (or an individual set on bond paper for scanning) for land divisions and encroachment permits. Public Works will forward the improvement plans to the appropriate fire agency and to the Planning Department for their comments to facilitate a coordinated review of the proposed improvements. Other agencies, including the water purveyor and utility companies, should be served with improvement plan sets by the developer.
2. The developer shall submit with the improvement plans a signed copy of the conditions of approval for the project from the Planning Department and the approved tentative map or other exhibits relevant to the development approval. All reports and letters of compliance from third parties required by the conditions of approval shall also be submitted with the improvement plans. In no case will improvement plans be reviewed without these supporting documents in their final approved form.
3. Upon completion of the checking process, the original drawings shall be submitted for approval signatures. The original drawings will be signed by Public Works engineers in stormwater management, sanitation, road planning, and survey; by Environmental Planning and by the Planning Director; by the appropriate fire agency; and, when requested, by the water purveyor prior to signature by the Director. The original drawings shall be accompanied by an engineer's estimate to be used to establish construction security requirements.
4. Subdivisions will be scheduled for the Board of Supervisors' approval when all deficiencies identified during the review process are addressed, and the plans and following items are deemed complete and acceptable by Public Works. Inno case will subdivisions be scheduled for approval by the Board of Supervisors until all items are complete
 - a. Planning Department letter of compliance with the tentative map and conditions of approval.
 - b. Final map and related conditions thereto met and approved by the County Surveyor.
 - c. Subdivision agreement and securities based on approved improvement plans, recorded agreements, and payment of all fees.
5. Refer to Section 14.01.501, et seq., of the County Code regarding fees, agreements, and construction securities for land divisions and Section 9.70, et seq., for encroachment permits.

6. A licensed Surveyor, at the developers expense, shall prepare and submit a digital copy of "as-builts" for all drainage facilities (with surface and invert elevations), grading and drainage patterns, and impervious area coverage after final landscaping is complete and prior to the Board of Supervisors' acceptance of subdivisions, or prior to permit final and occupancy for other types of projects. The submittal shall contain the following criteria:

Projection: State Plane Coordinate System - California III - Feet

Horizontal Datum: NAD 83

Vertical Datum: NAVD 88

Any CAD is acceptable. AutoCAD is preferred.

Data Points: Invert elevations

Surface elevations

Grading and Drainage patterns

Contour elevations at 2 ft intervals

Property boundaries

Limits of impervious areas

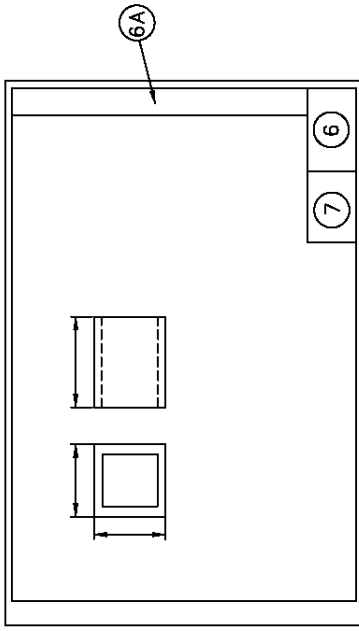
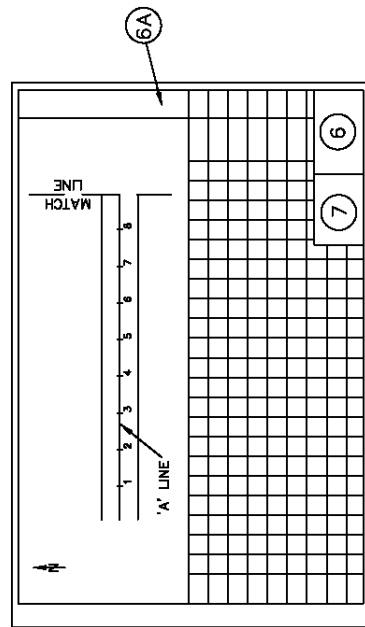
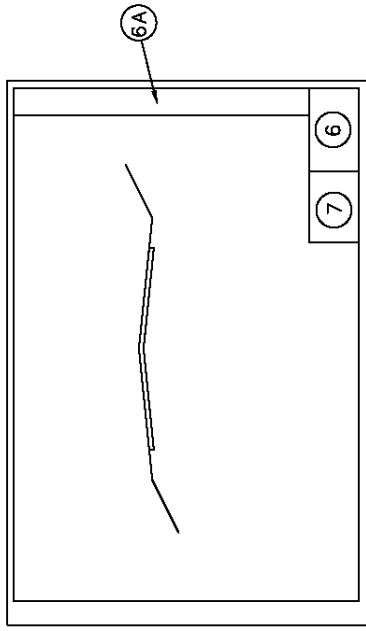
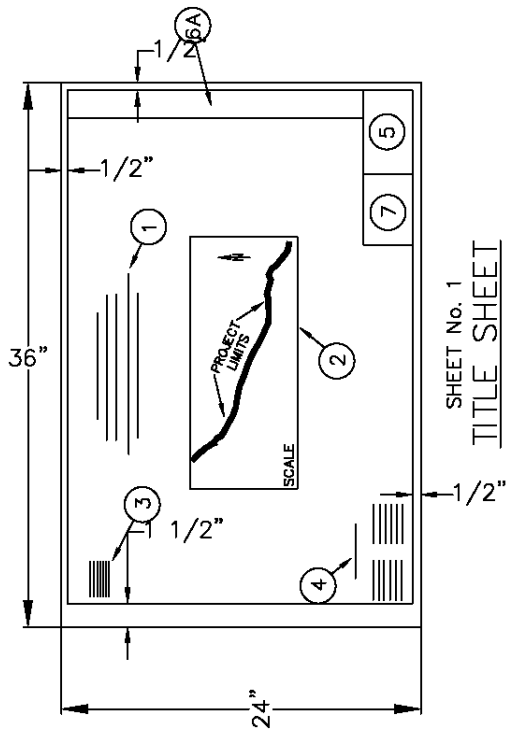
Section C – Erosion Control Requirements

1. The following requirements are made pursuant to Section 16.22, "Erosion Control," of the Santa Cruz County Code.
2. No land clearing or grading shall be done between October 15 and April 15, without review and approval of a separate winter erosion control plan. Winter erosion control plans for construction of common improvements pursuant to a subdivision shall be submitted to the Public Works Stormwater Management section for review and approval. All other winter erosion control plans shall be submitted to the Environmental Planning section for review and approval. Winter erosion control plans shall be submitted a minimum of 30 days prior to the start of construction.
3. Disturbance and removal of vegetation shall not exceed the minimum necessary to complete operations. All disturbed soil (particularly cut and fill slopes) shall be seeded and mulched in an approved manner prior to project completion but in no case later than October 15. The mulch cover shall be maintained until a good vegetative cover has been established. When permanent landscaping has been installed but is not fully established, any exposed soil shall be mulched between October 15 and April 15. Unless specific measures are shown or noted on the approved plans, all collected or concentrated runoff shall be percolated into the ground, carried to drainage courses in lined conduits, or dispersed over dense vegetation in an approved manner that will not cause erosion.
4. The desired end result of these measures is to control site erosion and prevent sediment transport off the site. It shall be the developer's responsibility to see that any additional measures necessary to meet this goal are implemented. If field inspections by County staff show this goal is not being met, additional measures will be required.
5. Pamphlets detailing seeding and mulching, runoff control, and winter erosion control plan requirements are available on request from the Environmental Planning Section of CDI, and are available on the County's internet site, www.sccoplanning.com.

6. The following wording shall appear as a standard note on all stormwater, street, or other improvement plans submitted to the Public Works or Planning for review and approval:

EROSION CONTROL PLAN

All construction shall conform to Part 1, Section C, “Erosion Control Requirements,” of the County *Design Criteria*. No clearing, grading, or excavation shall take place between October 15 and April 15 unless there is an approved winter erosion control plan. All disturbed soil shall be seeded, mulched, or otherwise protected by October 15



- ⑧ PROJECT TITLE
- ② VICINITY MAP
- ③ INDEX OF SHEETS
- ④ SYMBOLS & ABBREVIATIONS
- ⑤ DESIGN ENGINEER SIGNATURE
- ⑧ TITLE BLOCK
- ⑥A TITLE BLOCK (ALTERNATE LOCATION)
- ⑦ LEAVE BLANK (5" x 3" MIN.)

TYPICAL LAYOUT
FOR IMPROVEMENT PLANS

Figure G-1: Typical Sheet Layout for Improvement Plans

<u>6" (TYP)</u>		<u>3.5"</u>
DEPARTMENT OF COMMUNITY DEVELOPMENT AND INFRASTRUCTURE COUNTY OF SANTA CRUZ STATE OF CALIFORNIA		
REVIEWED BY		
ENVIRONMENTAL PLANNER:		
STAFF PLANNER:		
SANITATION ENGINEERING:		
SURVEY DEVELOPMENT REVIEW:		
STORMWATER MANAGEMENT:		
TRAFFIC AND ROAD PLANNING:		
SANITATION OPERATIONS:		
APPROVAL RECOMMENDED	<u>ASSISTANT DIRECTOR, UNIFIED PERMIT CENTER</u> <u>DATE</u>	
<u>ASSISTANT DIRECTOR, SPECIAL SERVICES</u> <u>DATE</u>	<u>ASSISTANT DIRECTOR, TRANSPORTATION</u> <u>DATE</u>	
APPROVED	<u>DIRECTOR OF COMMUNITY DEVELOPMENT AND INFRASTRUCTURE</u> <u>DATE</u>	

() FIRE PROTECTION DISTRICT COUNTY OF SANTA CRUZ STATE OF CALIFORNIA		<u>2"</u>
REMARKS:		
APPROVED	<u>FIRE MARSHAL</u> <u>DATE</u>	

Figure G-2: Agency Approval Blocks on Land Division Improvement Plans

6" (TYP)		
SANTA CRUZ COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, ZONE ____ STORMWATER PLAN		
REVIEWED BY:		
APPROVAL RECOMMENDED _____		
ASST. DIR., SPECIAL SERVICES	DATE	
APPROVED _____		
DISTRICT ENGINEER	DATE	
FOR INSPECTIONS, CONTACT PUBLIC WORKS CONSTRUCTION ENGINEER AT (831) 454-2160 48 HOURS PRIOR TO START OF WORK.		

2.5"

SANTA CRUZ COUNTY SANITATION DISTRICT		
REVIEWED BY:		
APPROVAL RECOMMENDED _____		
ASST. DIR., SPECIAL SERVICES	DATE	
APPROVED _____		
DISTRICT ENGINEER	DATE	

2"

Figure G-3: Agency Approval Blocks on Commercial Development Improvement Plans

PART 2. STREET DESIGN

Section A - Street Standards

1. Recommended standard and minimum rights-of-way and elements of geometric cross section shall be as shown in Figures ST-1a and ST-1b.
2. Existing County roads within the project shall be improved to the geometric, right-of-way, and structural standards of this *Design Criteria*. In the event an existing County road is on the boundary of a proposed improvement, the half of the road adjacent to the improvement shall be improved to the County standards, as specified in the conditions of approval, or as directed by the Director.
3. The Monterey Bay Area Complete Streets Guidebook is incorporated by reference into the County Design Criteria. The Complete Streets Guidebook shall apply to all projects affecting County maintained roadways, and appropriate Complete Streets elements shall be incorporated into said projects where feasible. Applicants shall fill out the “Project Review Checklist” found in Appendix H of the Complete Streets Guidebook and include it with their project submittal to the County for review. The Monterey Bay Area Complete Streets Guidebook may be found on the SCCRTC’s website (link shown below for reference).
<https://sccrtc.org/projects/multi-modal/santa-cruz-county-complete-streets/>
4. The EPA’s Green Streets Handbook is also incorporated by reference into the County Design Criteria. The Green Streets standards shall apply to all land development and redevelopment projects, and appropriate Green Streets facilities shall be incorporated into said projects where feasible. Public Works staff shall be expecting and inquiring about these facilities, during the review of said projects, where their utilization seems feasible. The EPA’s Green Streets handbook link is provided here:
<https://www.epa.gov/green-infrastructure/green-street-handbook>
5. The County of Santa Cruz requires sidewalks to be included in all access ways, except for Internal Driveways, to meet safety standards and implement Vision Zero and General Plan policies.

Section B - Street Alignment and Grades

1. General requirements shall be no less than the minimum set forth in Figure ST-2.
2. Vertical curves are required for all grade breaks of one percent or more.
3. The gradient of a street entering an intersection shall not be more than three percent within a distance of 20 ft from the curb line of the intersected street.
4. Streets shall be superelevated only if required by the Director.
5. Whenever possible, the crown should be at the design centerline of the road. However, the crown may be shifted to within 8 ft of the face of curb, at the discretion of the Director.
6. Minimum curb return radii shall be 30 ft measured at face of curb for arterial and collector streets and 20 ft for residential streets. At the intersection of a residential street with an

arterial or a collector, the lesser standard will apply at the discretion of the Director.

7. Minimum cul-de-sac radii shall be 32 ft, measured at curb flowline and 42 ft, measured at the right-of-way line.
8. On County roads and in rights-of-way offered to the County for dedication, dead-end streets shall be provided with a paved cul-de-sac of standard radius. Other dead-end streets longer than 150 ft shall be provided with barricades and turnarounds that meet the requirements of the appropriate fire agency, the Planning Department, and the Director.
9. Dead-end streets shall not exceed 500 ft in length unless an emergency access road is determined acceptable to the appropriate fire protection agency and the Director .
10. Streets and highways shall intersect one another at angles as near to a right angle as practical, and no intersections shall be at angles of less than 60 degrees.
11. Streets intersecting at an angle other than 90 degrees may require the use of setback lines, special rounding of corners, traffic circle, or other design details to assure desirable results as to traffic movement, visibility, and safety.
12. If the painted center lines of two streets intercepting the same street from opposite directions are offset from each other, said offset shall be a maximum distance of 10 ft, or a minimum distance of 200 ft, measured along the center line of the street intercepted.
13. The maximum cross slope for any pavement widening shall be 4%. The widening or other conform section shall be extended into the existing road as far as necessary to achieve a finished cross slope within tolerable limits (generally 2% to 4%), with the Director's approval. Improvement plans shall reflect the fact that the actual width of the new section depends upon this requirement.
14. Typical street sections appearing on improvement plans shall show the entire section, fully dimensioned, even though the plans may call for improving only a portion of the street section. Typical sections should show existing as well as proposed conditions, including lane striping.
15. When feasible, lane widths will be adjusted to account for striping width and provide for an enhanced bike lane width up to 6 ft.

[Section C - Structural Section](#)

1. The total structural section shall be designed by R-value (Test Method Calif. 301). The total structural section should be the reasonable result of a rational design method, such as Caltrans' flexible pavement design procedure. (See Section 608.4 et seq., of Caltrans' *Highway Design Manual*.)
2. Traffic Index values for new roads shall be based on the type of road and number of lots served in ultimate developments and approved by the Director.
3. Traffic Index values for existing County roads to be improved shall be determined by

the Director.

4. Except for minor private roads and driveways, the minimum required surface course shall be 3 in asphalt concrete Type B, ½ in maximum, medium aggregate gradation. A prime coat shall be applied before paving.
5. Except for minor private roads and driveways, the minimum required base course shall be 9 in of Class 2 aggregate, for all non-engineered road sections.
6. The balance of the pavement structural section may be comprised of aggregate subbase with a minimum R-value of 50.
7. With the approval of the Director, the minimum structural section for minor private roads and driveways shall be 2 in asphalt concrete Type B on 6 in of Class 2 aggregate base.
8. The minimum structural section for paving adjacent to a designated bus stop or turnout shall be 4 in asphalt concrete Type B on 12 in of Class 2 aggregate base or approved equivalent. This strengthened pavement section shall extend 10 ft from the lip of gutter or other street improvements.
9. The number and location of soils tests shall be subject to the approval of the Director, the minimum being one test for each 500 linear ft of proposed street. The R-value used for design purposes shall be the lowest test result, unless sufficient tests and soils investigations are made to determine the limit of the various soil types tested.
10. Relative compaction shall conform to the latest Caltrans specification. As a minimum standard the top 6 in of subgrade and the aggregate base material under all paved surfaces subject to vehicular use (including curbs, gutters, and driveway approaches) shall be compacted to a minimum 95% relative compaction. The top 6 in of subgrade under concrete sidewalks shall be compacted to a minimum 90% relative compaction, except where sidewalk is constructed next to Type B curb and gutter, in which case the top 6 in of subgrade under the sidewalk shall be compacted to a minimum 95% relative compaction.
11. In addition to R-value tests to determine the structural section, further soils tests may be required by the Director to determine erosion control, stability, or subdrainage requirements.
12. Redwood headers with minimum dimensions of 2 in x 6 in shall be installed along all exposed edges of asphalt concrete paving, when deemed necessary by the Director.
13. When overlaying existing asphalt concrete pavement next to existing concrete curb and gutter, the pavement next to the edge of the gutter shall be removed by grinding (See Figure ST-10) before applying the new surface course. Any traffic signal detector loops damaged by grinding shall be replaced at the developer's expense. The contractor shall notify the Public Works at least 48 hours prior to grinding near traffic signals.
14. For access roads serving more than one dwelling where portland cement concrete (PCC) is to be used, the minimum structural section shall be 6 in PCC on 4 in of sand or Class 2 aggregate base with 6 in x 6 in welded wire fabric placed appropriately in the PCC. Use of the minimum or other structural section shall be at the discretion of the

Director.

15. Concrete grass pavers shall not be used in County maintained right-of-way as part of a structural section subject to vehicular or pedestrian traffic.
16. Concrete grass pavers installed to manufacturers' specifications, and as shown on plans approved by the Director, may be used for restricted use secondary access roads, or for other traffic surfaces when warranted by significant environmental conditions, subject to the following:
 - a. The Director may disapprove the use of concrete grass pavers on access roads that slope towards the street, if the department determines that their use could result in the deposit of sediment on the street, or could otherwise cause significant problems within a County maintained right-of-way.
 - b. If appropriate, the Director may require provisions be made to accommodate pedestrian traffic, with a minimum of 4 ft wide asphalt concrete or portland cement concrete walkway.
 - c. The Director may require that compaction test results of the subgrade soil be submitted for review and that adequate compaction be demonstrated to the satisfaction of the department.

Section D - Grading

1. Santa Cruz County's grading ordinances as set forth in Chapter 16.20 of the County Code shall regulate all excavation, grading, and filling of land within the County.

Section E - Planting

1. Slope planting shall be performed, if required by soils report, tentative map, use permit, or the Director.

Section F - Curbs, Gutters, and Sidewalks

1. Portland cement concrete Type A curbs, gutters, and sidewalks shall be constructed for all development projects, unless, for reasons such as accessibility, preservation of rural character, nature of existing improvements, etc., a variation from this standard is approved through the Street Plan Line or roadside exception process.
2. Curb returns shall include ramps to provide access to the roadway grade and provide continuity of safe access for pedestrians. (See Figures ST-8a through ST-8e.)
3. Sidewalks shall be constructed to meet accessibility standards set forth in this *Design Criteria*. Sidewalk cross slopes shall not exceed two percent.
4. Sidewalk material and width requirements are as follows:
 - a. Portland cement concrete, Caltrans Standard Minor Concrete, on all arterial, collector, and local streets within the Urban Services Line.

- b. Certain residential streets have been designated to include colored concrete sidewalk or curb, gutter, and sidewalk. On streets which have been so designated and on all new local streets either the color pigment “Mesa Buff” produced by Davis Colors, or the color “Natural Honey” produced by Q.C. Construction Products shall be used to color this concrete. A list of existing streets which have been designated to include colored concrete improvements is maintained on file in the Planning and Public Works Departments.
 - c. Sidewalks shall be 4 ft wide (unobstructed) in residential areas and 6ft wide (4 ft unobstructed) in commercial areas; except that sidewalk widths shall match existing widths in various areas as appropriate and shall vary per accessibility standards set forth in this *Design Criteria* with the separated sidewalk design (Figure ST-6) being the standard design.
 - d. When new sidewalk terminates without connecting to existing sidewalk, an asphalt concrete conform section shall be constructed to provide a transition to existing grade at the termination. The slope of the conform section shall meet accessibility standards set forth in this *Design Criteria*.
5. Portland cement concrete Type B curb shall be permitted for use in residential infill areas only as necessary to conform to existing Type B curb on adjoining parcels or where other accessibility standards set forth in this *Design Criteria* are not practical, as determined through the roadside exception or Street Plan Line process.
 6. Portland cement concrete Type C curb shall be permitted on privately maintained driveways and parking areas at the discretion of the Director (Figure ST-4). Type C curb shall be permitted on County maintained roads only for median islands or similar installations, where the road surface drains away from the curb.
 7. Portland cement concrete curb, curb and gutter, or valley gutter shall be required on paved surfaces having a longitudinal slope of less than 1.5%.

Section G - Garbage Collection

1. Grates are to be provided in landscaped areas for garbage collection. Garbage collection shall not be conducted in the bicycle lanes.

Section H - Landscaping

1. Where landscaping is required, a landscape plan shall be prepared by a Licensed Architect or Licensed Landscape Architect. The plan shall show the species, location, number, and size of plants to be installed. Specifications for installation and establishment of plant materials shall be included. The landscape plan shall be coordinated with the site grading and drainage plans.
2. Where regular periodic irrigation of the established landscaping is necessary, an irrigation plan shall be prepared. The plan shall show the location, size, and type of materials to be installed.
3. Street trees shall be required as part of all projects on public streets inside the Urban Services Line. These trees shall be chosen, planted, and maintained in accordance with

the Santa Cruz County *Urban Forestry Master Plan*, when applicable, chosen from the County Street Tree List, or approved by the County’s Urban Designer. Trees shall be planted at a minimum rate of one tree per 25 lineal ft of frontage, with tree cluster an option for placement. Planting shall be done according to Figures ST-9a and ST-9b.

4. Street trees shall be maintained by the property owners and as directed by the approving body, unless the property is located on a “Primary Street Tree Street,” as defined by the *Urban Forestry Master Plan*, and that street has been accepted into the regular street tree maintenance program administered by the Santa Cruz County Redevelopment Agency.
5. Street trees in residential projects shall be planted in County right-of-way in a minimum 4 ft wide planting strip between the curb and the sidewalk. Where separated sidewalks are not possible, trees shall be planted per the *Urban Forestry Master Plan* or per the approving body. Trees shall be maintained by the County where applicable, or as directed by the approving body.
6. Street trees in commercial areas shall be planted in County right-of-way in a minimum 4 ft wide planting strip between the curb and sidewalk, or where 4ft of unobstructed sidewalk can be obtained, in a minimum 4ft wide by 6 ft long rectangular tree well cut out of the sidewalk behind the curb. Where separated sidewalks or tree wells are not possible, trees shall be planted outside the right- of-way or as recommended in the *Urban Forestry Master Plan*. Street trees shall be planted according to provisions of the *Urban Forestry Master Plan* and Figures ST-9a and ST-9b. Trees shall be maintained by the County where applicable, or as directed by the approving body.
7. Adequate sight distance shall be assured where landscaping is planted in or near the public right-of way. Vegetation shall be maintained in a manner that will ensure adequate sight distance.

Section I - Curb Ramps

1. Curb ramps shall be constructed at all crosswalks and at all curb returns where there is existing sidewalk or sidewalk is constructed, and necessary to provide continuity of safe travel for pedestrians. (See Figures ST-8a through- 8e.)

Section J - Inlet Location

1. Drainage inlets shall be placed outside the wheel path of passing vehicles. If this is not possible, the grate must be set to match the slope of the roadway.
2. Drainage inlets shall not be located within curb returns at intersections.

Section K - Survey Monument Boxes

1. A cast iron monument box (Forni type 80-60-03, Phoenix type P-2001, D&L type K-6001-2, or approved equal) shall be set, together with a standard bronze monument, at all beginning of curve, end of curve, and intersection points along the centerline of the right-of-way of all new roads intended to be County maintained. Street centerline monuments shall establish horizontal control. (See Figure ST-11.)

Section L - Placement of Utility Poles, Fire Hydrants, and Other Roadside Facilities

1. Utility poles shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk. Where it is not practical to place a utility pole behind the back of sidewalk, it may be located 1 ft from face of curb to face of pole, provided that a minimum of 4 ft of clear sidewalk width is constructed in conformance with Figure ST- 12.
2. Fire hydrants shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk. At midblock fire hydrant locations, the curb shall be painted red to ensure visibility. Fire hydrant location shall be indicated by installation of a blue reflective pavement marker at street centerline.
3. Where road widening, sidewalk construction, or other work of improvement is required of a development, it is the sole responsibility of the developer to relocate all affected surface utilities on the developer's property frontage and along off-site improvements, in conformance with the requirements of the County and the applicable utility agencies.
4. Individual and cluster mailboxes shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk, or as determined by the decision making body.
5. Traffic signage shall be located behind a sidewalk built adjacent to the curb, or in the planting strip between the curb and a separated sidewalk, except where such placement would conflict with good traffic engineering practice.

Section M - Street Lighting

1. Except as provided below, residential street lighting improvement standards apply to all residential development located within the County Urban Services Line on a County road, or on a road to be offered for dedication to the County. Residential development may be required to construct off-site street lighting improvements.
2. The developer of property within an area that does not currently have residential street lighting because of the historical opposition of residents to the installation of lighting may seek a variance from the residential street lighting requirements. A variance will be granted only if the applicant's engineer can satisfactorily document to Public Works that the failure to install lighting will not create a dangerous condition on public property that could have been avoided by the installation of lighting.
3. A street lighting plan shall be prepared by a Registered Civil Engineer or other appropriately licensed individual. The plan and design shall be in accordance with published Pacific Gas and Electric (PG&E) standards, or the Association of Illumination Engineers' standards. The plan shall also be consistent with County Service Area 9 - Highway Safety Lighting, and/or County Service Area 9, Zone A, Residential Street Lighting standards, before being approved by the County.
4. Appropriate street lights shall be installed at the developer's expense.

Section N - Retaining Walls

1. Retaining walls are not allowed in County right-of-way without substantial proof that

justifies the location. If allowed they shall be constructed of reinforced concrete or reinforced masonry and conform with current Uniform Building Code Standards, unless prior approval of an alternate material is obtained from the Director.

Section O – Physical Speed Control Devices (Road Bumps and Speed Tables)

(See Figure ST-13A and Figure ST-13B)

1. The length of the installation shall be 12 ft for road bumps and 22 ft for speed tables from the beginning of rise from the pavement surface to return to the pavement surface, with a profile view that is generally parabolic (a 10 ft middle flat segment is required for speed tables).
2. The height of the road bump and the speed table shall be 4 in per the template approved by the Director.
3. Road bumps and speed tables shall be tapered from zero elevation at the lip of gutter to the full height approximately 2 ft from the gutter and shall not interfere with drainage.
4. Road bumps or speed tables shall not be placed over manholes, watervalves, utility vaults or other underground structures.
5. Whenever possible, the edge of a road bump or speed table shall be at least 5 ft from the edge of a driveway.
6. Whenever possible, road bumps and speed tables shall be placed adjacent to street lights for better visibility.
7. Whenever possible, road bumps and speed tables shall be placed opposite property lines rather than mid-lot.
8. Whenever possible, road bumps and speed tables shall be placed at least 200 ft away from intersections and sharp horizontal curves and located to provide adequate sight distance in either direction. Road bumps and speed tables may be closer to intersections and curves with approval from the Director. Whenever possible road bumps and speed tables shall be placed at least 300 ft apart.
9. Warning signs and markings shall be used as follows:
 - a. "BUMPS AHEAD" warning signs at the beginning of the road bump and speed table area and at all entrances.
 - b. Speed advisory plates (15 MPH) mounted below the "BUMP AHEAD" warning sign.
 - c. Pavement markings at the road bump and speed table ("BUMP").
 - d. Double yellow centerline in the vicinity of the road bump and speed table where adequate width will allow (approximately 50 ft on either side).
 - e. "V" shaped white reflective pavement markings on the road bump and speed table for each direction of travel.
10. Road bumps and speed tables may be constructed out of asphalt or concrete as directed by the Director.

11. Road bumps and speed tables shall not interfere with street and sidewalk access for pedestrians.

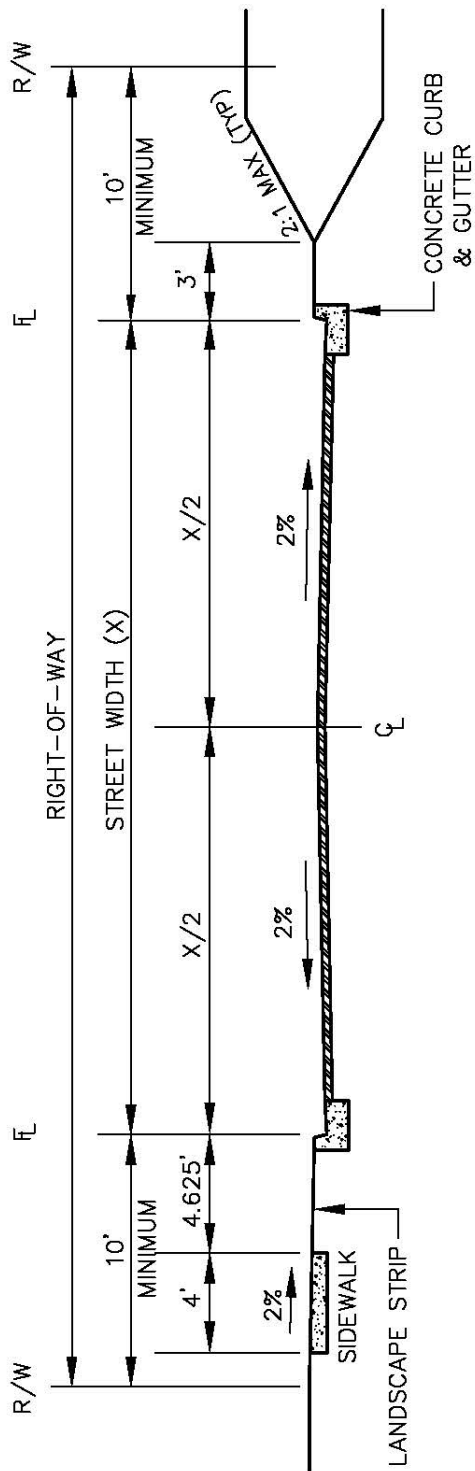
Section P - Street Plan Lines

1. In instances where the proposed improvements for a particular development application based upon the standards in the *Design Criteria* would not be practical or feasible due to existing roadway alignment, topographical or environmental constraints, or would not be compatible with adjacent improvements or previously approved route concepts, a plan line study will be required by the Director.

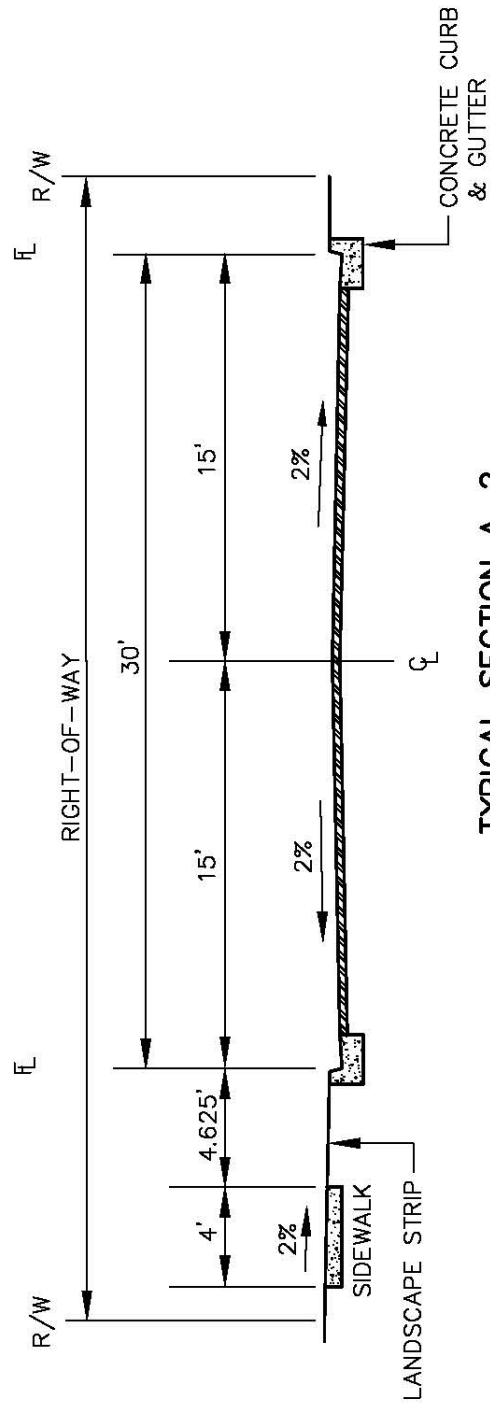
A plan line study would provide guidelines for the proposed improvements in relation to other development, or to public improvements which will be constructed in the future.

A plan line is a graphical representation on an aerial photograph (1:240 [1 inch=20 ft])* of an approved route concept or *Design Criteria* standards, as approved by the Board of Supervisors, depicting the ultimate improvement guidelines for a specific street segment, a written summary of potential impacts and, if required, an engineer's estimate for improvement costs. The plan line shall include the number and location of travel and turn lanes, bike lanes, on- street parking, roadside improvements, transit facilities, utility corridors, and estimates of required right-of-way.

* The existing aerial photographs will remain at 1:240. Future aerial photographs for plan lines may be required to be at a more standard true ratio scale, such as 1:250.



TYPICAL SECTION A-1

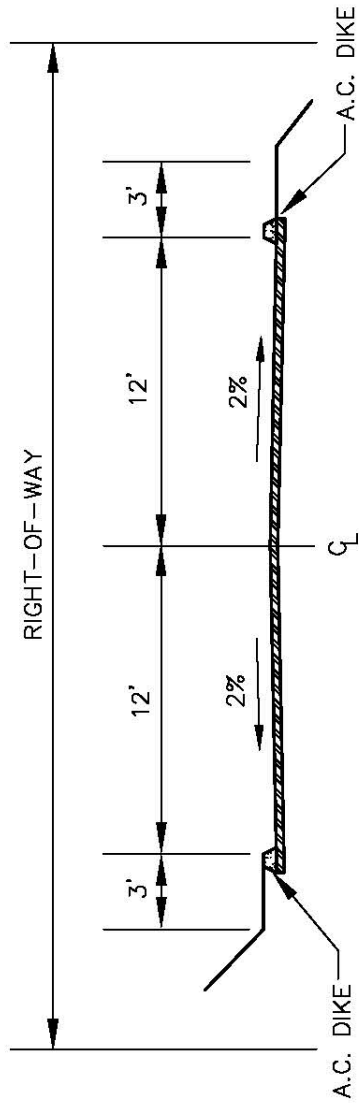


TYPICAL SECTION A-2

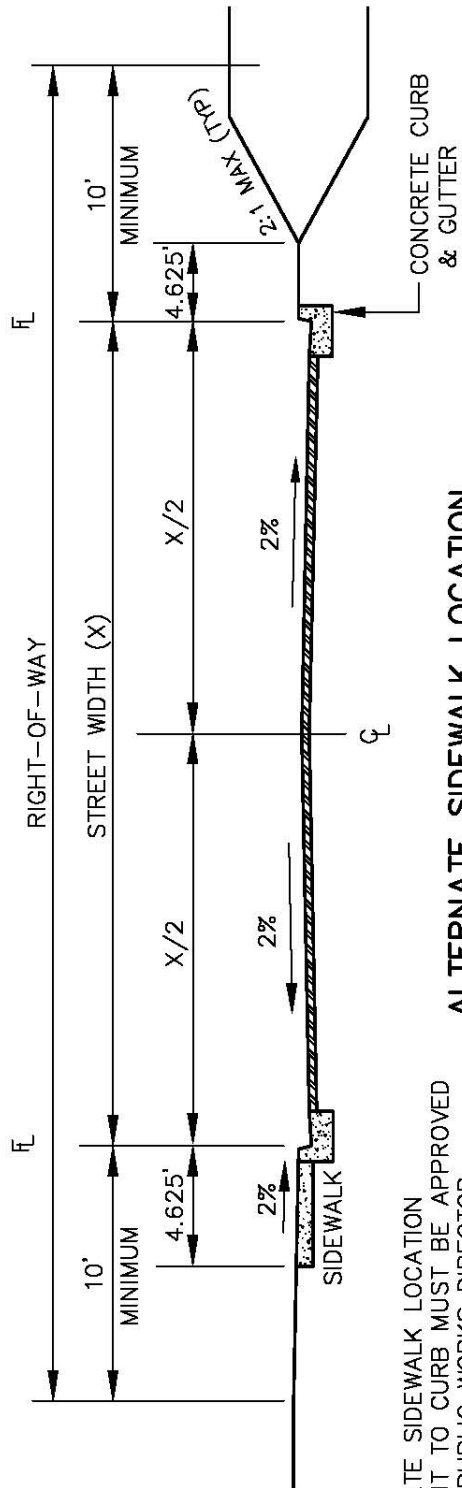
MINIMUM URBAN LOCAL STREET

GEOMETRIC CROSS SECTIONS

Figure ST-1a: Geometric Cross Sections (1 of 2)



TYPICAL SECTION A-3
MINIMUM RURAL LOCAL STREET



NOTE:
ALTERNATE SIDEWALK LOCATION
ADJACENT TO CURB MUST BE APPROVED
BY THE PUBLIC WORKS DIRECTOR.

ALTERNATE SIDEWALK LOCATION

GEOMETRIC CROSS SECTIONS

Figure ST-1a: Geometric Cross Sections (2 of 2)

URBAN ARTERIAL / MULTIMODAL CORRIDOR			
STANDARD SECTION	2-LANE STREET WIDTH (FT)	3-LANE STREET WIDTH (FT)	4-LANE STREET WIDTH (FT)
Travel lane (12')	24	24	24
Center lane (11'-12')		12	22
Bike lane (6'-8')	12	16	16
Landscape strip/curb (4.625')	9.25	9.25	9.25
Sidewalk (6')	12	12.00	12
Remainder	2.75	2.75	2.75
Required R/W (ft)	60	72	84
Multimodal roadways with 3 or more lanes will provide a buffered or protected bike lane.			

URBAN COLLECTOR / ACTIVE CONNECTOR		
STANDARD SECTION	2-LANE STREET WIDTH (FT)	3-LANE STREET WIDTH (FT)
Travel lane (11')	22	33
Bike lane (6')	12	12
Parking (7'-8')	8	14
Landscape strip/curb (4.625')	9.25	9.25
Sidewalk (6')	12	12
Remainder	2.75	2.75
Required R/W (ft)	66	83

URBAN COLLECTOR / MAIN STREET		
STANDARD SECTION	2-LANE STREET WIDTH (FT)	3-LANE STREET WIDTH (FT)
Travel lane (11')	22	33
Bike lane (5')	10	10
Parking (8')	8	8
Landscape strip/curb (4.625')	9.25	9.25
Sidewalk (6')	12	12
Remainder	2.75	2.75
Required R/W (ft)	64	75

Figure ST-1b: Standard Street Widths (1 of 4)

URBAN LOCAL / LOCAL RESIDENTIAL	
STANDARD SECTION	2-LANE STREET WIDTH (FT)
Travel lane (11')	22
Parking (7')	14
Landscape strip/curb (4.625')	9.25
Sidewalk (6')	12
Remainder	2.75
Required R/W (ft)	60

RURAL ARTERIAL / RURAL CONNECTOR	
STANDARD SECTION	2-LANE STREET WIDTH (FT)
Travel lane (12')	24
Bicycle Lane / Shoulder (6')	12
Remainder	4
Required R/W (ft)	40

RURAL LOCAL / MOUNTAIN - AGRICULTURAL	
STANDARD SECTION	2-LANE STREET WIDTH (FT)
Travel lane (12')	24
Remainder	16
Required R/W (ft)	40

Figure ST-1b: Standard Street Widths (2 of 4)

MINIMUM URBAN INTERIOR DRIVEWAY OR INTERIOR ROAD STANDARDS

1. The geometric cross sections (road sections) described below are minimum requirements for urban interior driveways and interior roads. If a higher standard is sought, the County road standards for an Urban Local Street with Parking and Cul-de-sac may be utilized as a guide.
2. For purposes of this section on urban interior driveways and roads, the number of parcels is the number of parcels accessed from the driveway or road. For example, if a tract with 7 parcels and a remainder parcel (total of 8 parcels) proposes a driveway serving two parcels and another access point with a road serving 5 parcels and the remainder parcel then the driveway would meet the standard for five parcels or less and the road would meet the standard for five to twenty five parcels.
3. The road section remainder may be used for components of the road section including fences, walls, retaining walls, and other road components.

DRIVEWAY/ROAD STANDARD, FIVE PARCELS OR LESS	
STANDARD SECTION	2-LANE STREET WIDTH (FT)
Travel lane (10')	20
Landscape strip/curb (4.625')	4.625
Curb (0.625')	0.625
Remainder	2.75
Required right of way (ft)	28
Driveways and streets off of arterials and collectors shall allow vehicles to turn around on-site, in the driveway, or in the interior road.	

ROAD STANDARD, SIX TO TWENTY-FIVE PARCELS	
STANDARD SECTION	2-LANE STREET WIDTH (FT)
Travel lane (10')	20.00
Landscape strip (4')/curb (0.625')	4.625
Sidewalk (4')/curb (0.625')	4.625
Remainder	2.75
Required right of way (ft)	32.00
At the end of the road shall be a minimum of a 24' x 24' rectangular turnaround, 34' diameter turnaround, or a Fire turnaround.	

Figure ST-1b: Standard Street Widths (3 of 4)

ROAD STANDARD, MORE THAN TWENTY-FIVE PARCELS	
STANDARD SECTION	2-LANE STREET WIDTH (FT)
Travel lane (10')	20.00
Bicycle lane (5')	10.00
Landscape strip (4')/curb (0.625')	4.625
Sidewalk (4')/curb (0.625')	4.625
Remainder	2.75
Required right of way	42.00
Roads shall have a cul-de-sac or fire turnaround at the end of the road.	

ADDITIONAL RIGHT-OF-WAY REQUIREMENTS:

The following components may be added to the standard improvements previously listed. Additional right-of-way will be required to accommodate these additional improvements as appropriate.

Additional components

Parking lane - 8 feet

Bike lane - 6 feet

Parking/bike lane - 14 feet

Sidewalk - 4 feet to 6 feet

Landscape strip - 4 feet

Median - 4 feet to 15 feet

Shoulder/swale – 3 feet to 8 feet

Bus turnout - 5 feet to 18 feet

Turn lane - 12 feet

Cul-de-sac - 42 foot radius (right-of-way), 32 foot radius (at gutter flowline)

Utility corridor - as necessary/6-foot PUE on new developments

EXCEPTIONS TO THE STANDARD REQUIREMENTS:

The above tables indicate standard County requirements. Exceptions to the standards must be approved by the Public Works Director pursuant to County Code Section 15.10.050

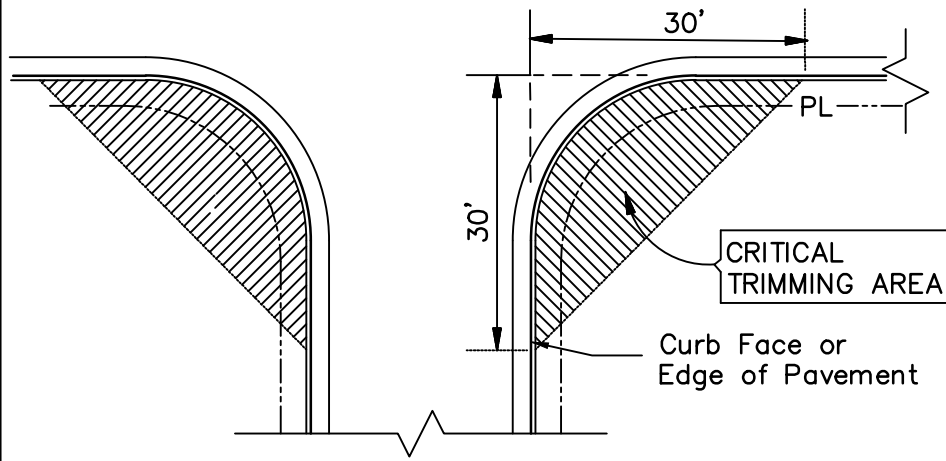
Figure ST-1b: Standard Street Widths (4 of 4)

GENERAL STREET REQUIREMENTS

Lots Served	Min Radius Horizontal Curves	Min Sight Distance Vert Curves	Min Length Vertical Curves	Maximum Grades (%)	Minimum Grades (%)
Over 500	650 ft	350 ft	200 ft	8	0.2
51 to 500	200 ft	200 ft	100 ft	15	0.2
26 to 50	150 ft	200 ft	100 ft	15	0.2
25 or less	75 ft	150 ft	50 ft	20	0.2
Sight distance controls over minimum length of vertical curve where there is a conflict.					

Figure ST-2: General Street Requirements

Typical Street Intersection



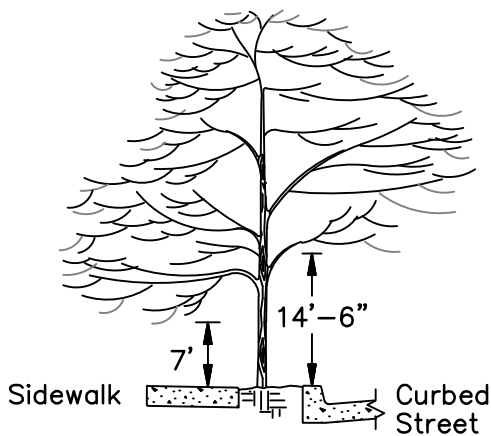
CONDITION A

INTERSECTION:

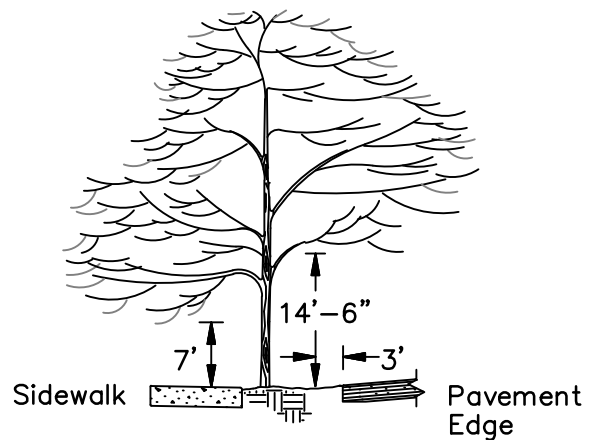
The minimum standard requires 30 feet of visibility along each curb line/edge of pavement.

Trim all landscaping (except trees) to a height of not more than 30 inches above the curb.

Low or overhanging tree branches shall be removed to allow drivers an unobstructed view, and shrubbery shall not be allowed to encroach into the street or sidewalk.

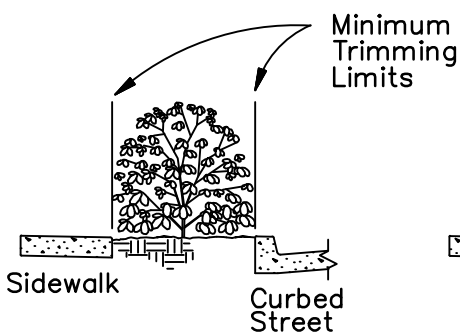


CONDITION B

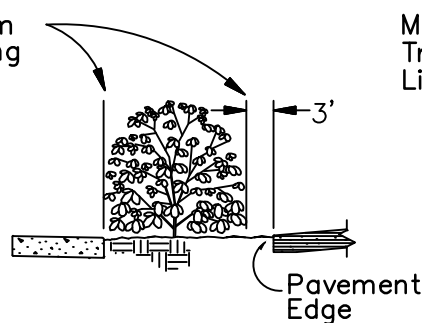


CONDITION C

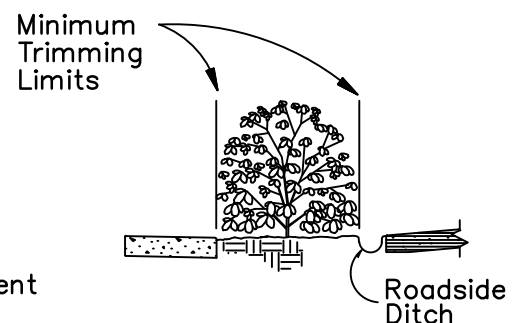
TREES: Minimum clearances shall be maintained as shown.



CONDITION D



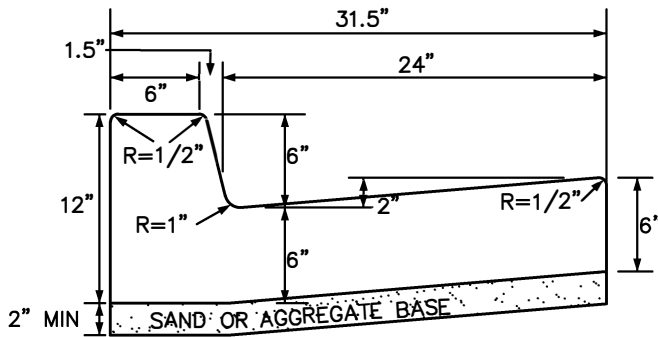
CONDITION E



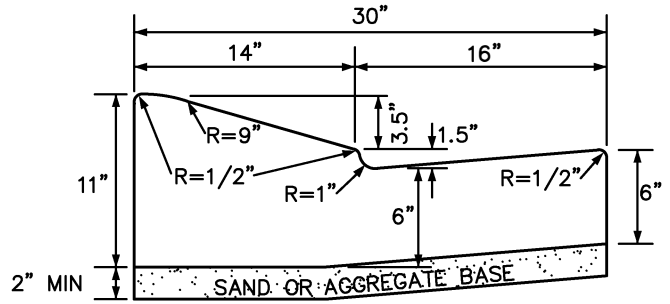
CONDITION F

VEGETATION: All growth shall be trimmed back so as not to encroach into the curb, sidewalk, or roadway. It's recommended that you trim an extra couple of feet to minimize the frequency of trimming.

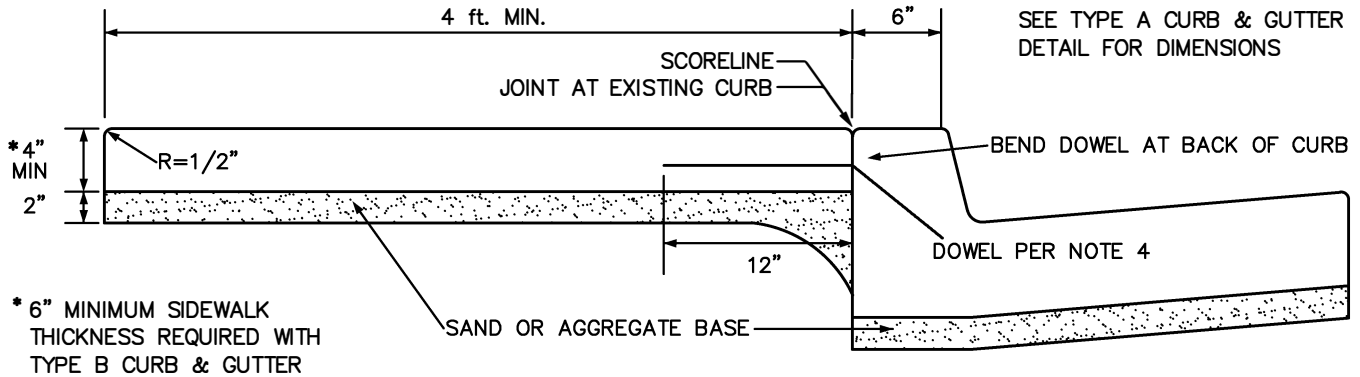
MINIMUM LANDSCAPE CLEARANCES



TYPE A CURB & GUTTER



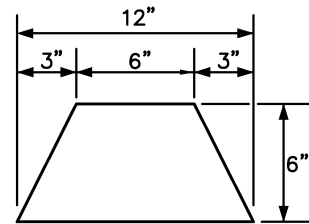
TYPE B CURB & GUTTER
(SEE NOTE 3)



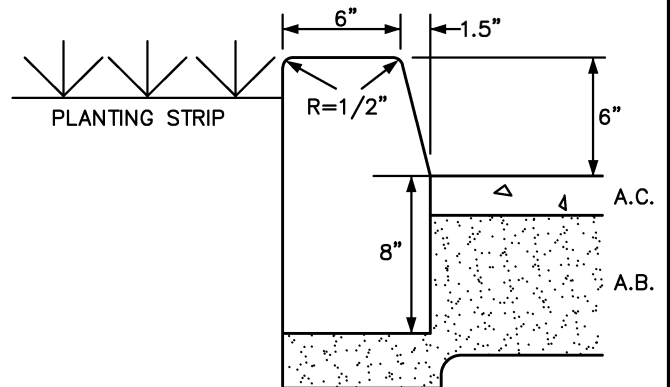
TYPICAL CURB, GUTTER, & SIDEWALK SECTION

NOTES

1. TYPE A, B, & C CURB, GUTTER, & SIDEWALK SHALL BE CONSTRUCTED OF CALTRANS STANDARD MINOR CONCRETE.
2. BASE MATERIAL SHALL BE COMPACTED TO 90% RELATIVE COMPACTION UNDER SIDEWALK AND 95% RELATIVE COMPACTION UNDER CURB, GUTTER, AND ASPHALT.
3. WEAKENED PLANE JOINTS SHALL BE CONSTRUCTED AT MAXIMUM 12' INTERVALS.
4. TYPE B CURB SHALL BE USED ONLY TO CONFORM TO EXISTING TYPE B CURB WHERE SPECIFICALLY APPROVED BY THE DIRECTOR OF PUBLIC WORKS.
5. IF SIDEWALK IS NOT INSTALLED MONOLITHICALLY WITH CURB & GUTTER, PLACE #4 DOWELS 18" LONG AT 4' O.C. IN BACK OF CURB 2" DOWN FROM TOP OF CURB, 6" INTO CURB.
6. DOWELS SHALL BE PLACED AT ALL JUNCTIONS WITH EXISTING CONCRETE.
7. WHERE CURB AND GUTTER IS REQUIRED TO BE REPLACED, REMOVE AND REPLACE A MINIMUM OF 2' OF ASPHALT ADJACENT TO NEW GUTTER, UNLESS WAIVED BY THE DIRECTOR OF PUBLIC WORKS.

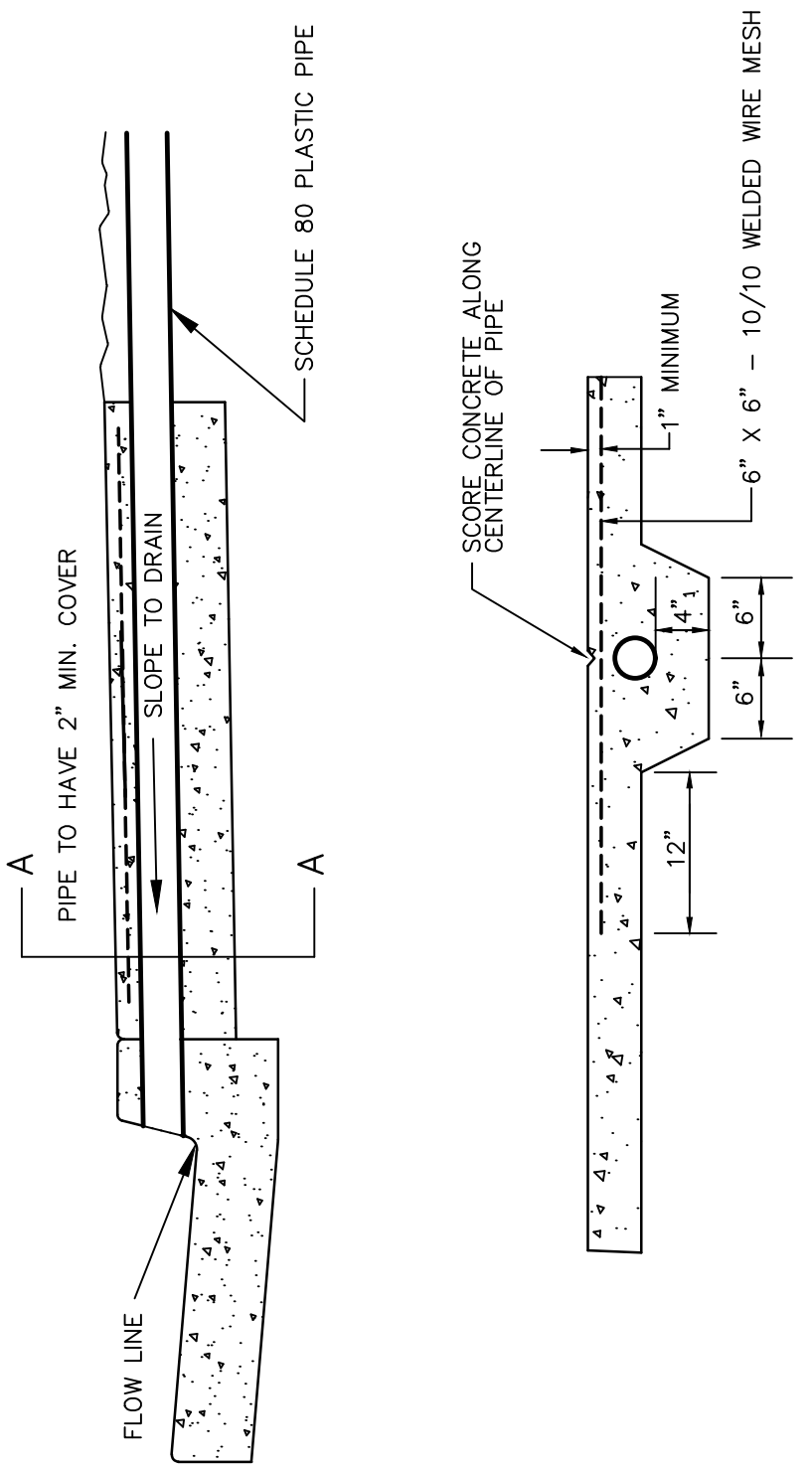


A.C. DIKE



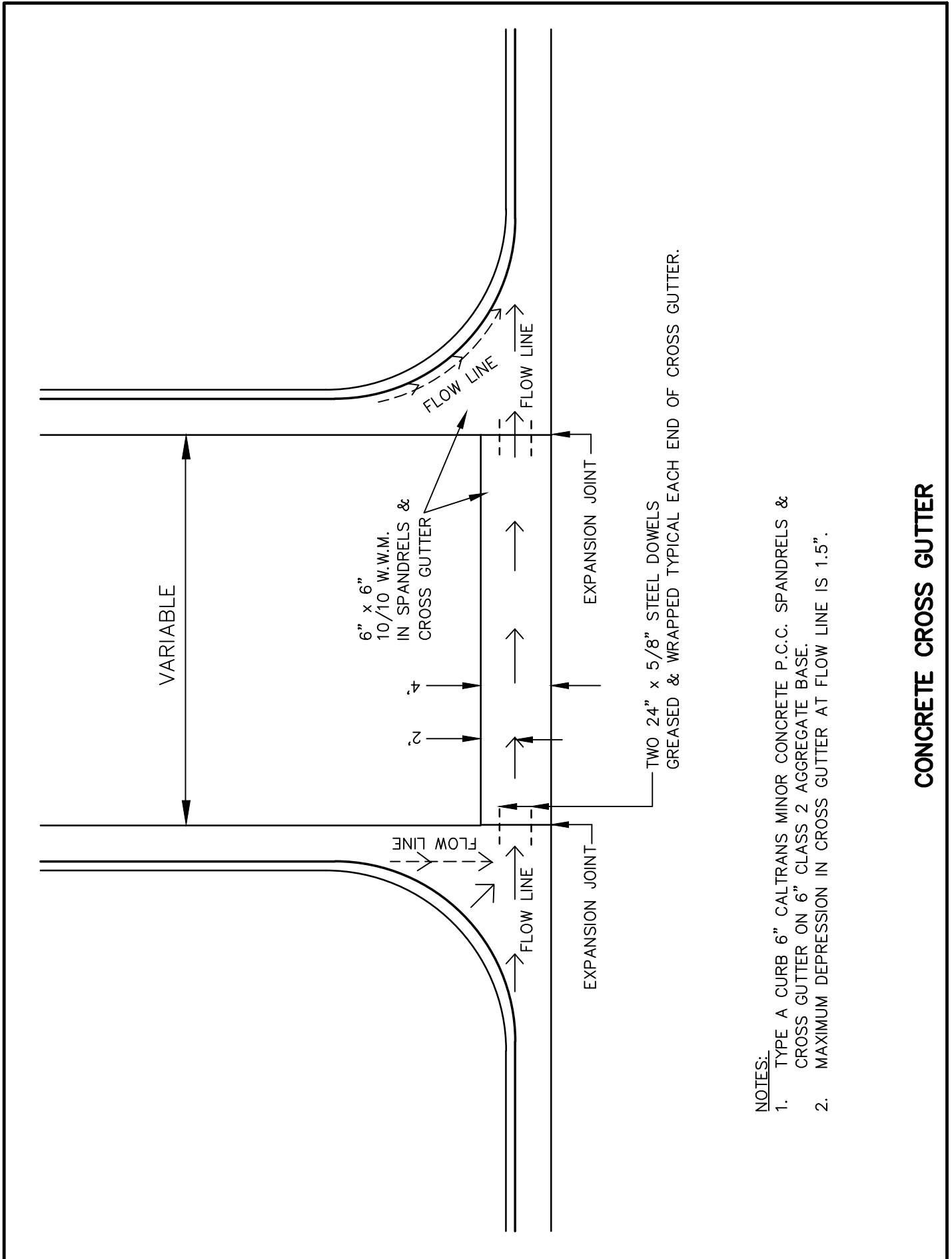
TYPE C CURB

CURB, GUTTER, SIDEWALK, AND DIKE DETAILS



NOTE:
 AS A GENERAL RULE, 3" I.D. SMOOTH SOLID WALL SCH. 80 PLASTIC PIPE SHALL BE USED FOR UNDER SIDEWALK DRAINS. HOWEVER, WHEN HYDRAULIC REQUIREMENTS DICTATE THE USE OF A LARGER PIPE AND/OR MULTIPLE PIPES, 4" I.D. PLASTIC PIPE MAY BE USED AT THE DISCRETION OF THE DIRECTOR OF PUBLIC WORKS. WHEN USING MULTIPLE PIPES, THE MINIMUM SPACING BETWEEN THE OUTSIDE WALLS OF THE PIPES SHALL BE 2".

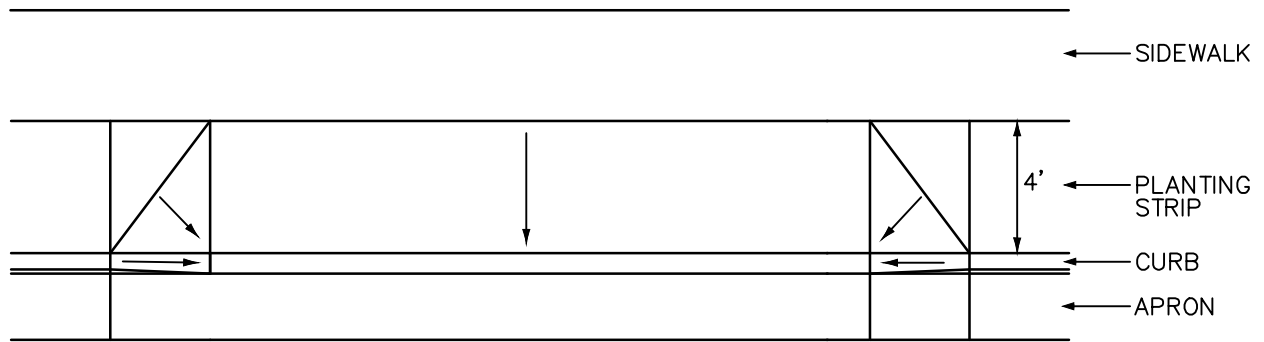
UNDER SIDEWALK DRAIN



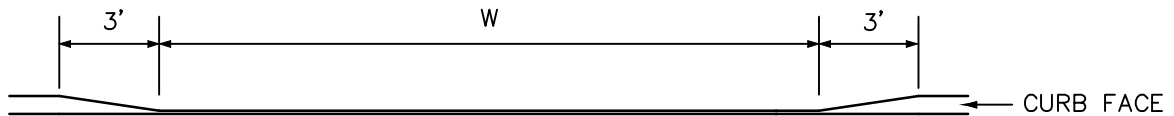
NOTES:

1. TYPE A CURB 6" CALTRANS MINOR CONCRETE P.C.C. SPANDRELS & CROSS GUTTER ON 6" CLASS 2 AGGREGATE BASE.
2. MAXIMUM DEPRESSION IN CROSS GUTTER AT FLOW LINE IS 1.5".

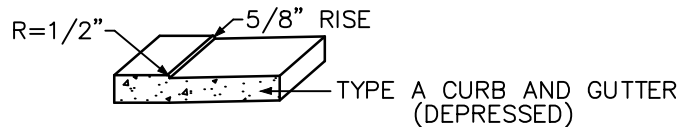
CONCRETE CROSS GUTTER



PLAN



ELEVATION



SECTION

NOTES:

THE WIDTH OF THE DRIVEWAY IS THE DISTANCE 'W'.

THE MAXIMUM WIDTH FOR RESIDENTIAL DRIVEWAYS IS 24'.

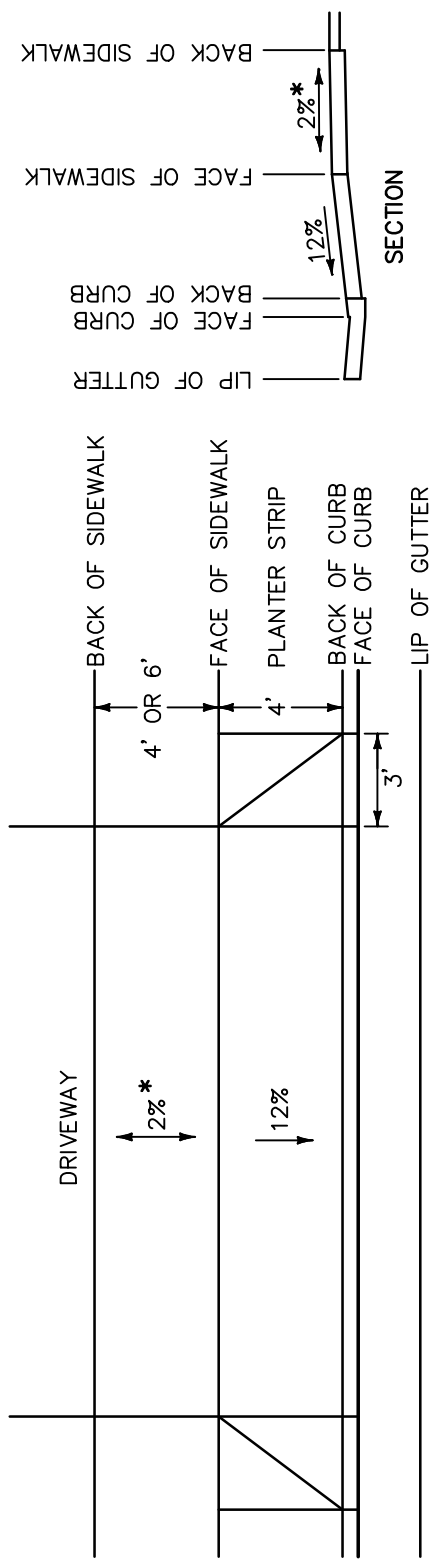
THE MAXIMUM WIDTH FOR COMMERCIAL DRIVEWAYS IS 40'.

DRIVEWAY CONCRETE SHALL BE 6" THICK ON 6" CLASS 2 AGGREGATE BASE.

WHEN MORE THAN ONE DRIVEWAY IS TO SERVE A GIVEN PROPERTY FRONTAGE, THE WIDTH OF ALL DRIVEWAYS SHALL NOT EXCEED 70 PERCENT OF THE FRONTAGE FOR COMMERCIAL PARCELS OR 50 PERCENT OF THE FRONTAGE FOR RESIDENTIAL PARCELS. NOT LESS THAN 20' OF FULL HEIGHT CURB SHALL BE PROVIDED BETWEEN DRIVEWAYS. THE DISTANCE BETWEEN DRIVEWAYS MAY BE REDUCED BY THE DIRECTOR OF PUBLIC WORKS DUE TO SPECIAL CIRCUMSTANCES.

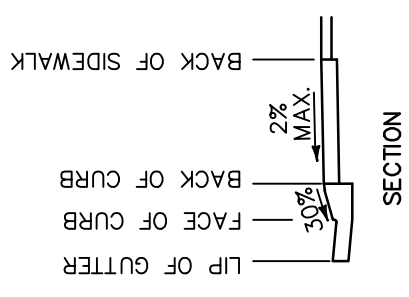
THE SIDELINE OF ANY DRIVEWAY SHALL NOT BE LESS THAN 10' FROM THE INTERSECTION CURB RETURN.

TYPICAL DRIVEWAY DEPRESSION



TYPE A CURB & GUTTER, SIDEWALK AND 4' PLANTER STRIP

N.T.S.

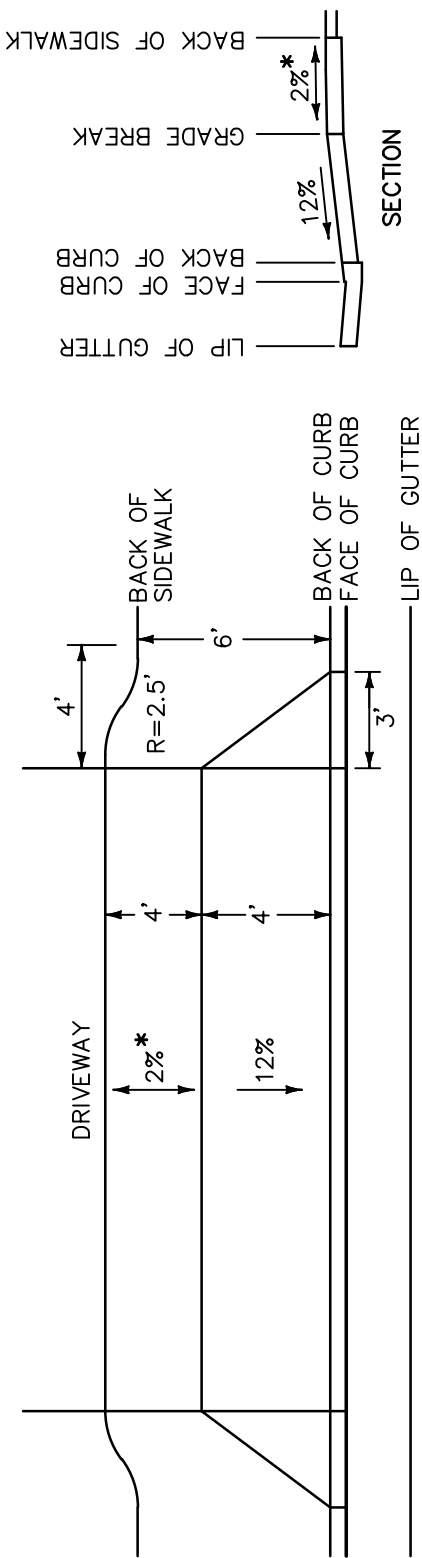


TYPE B CURB & GUTTER, AND 4' SIDEWALK

N.T.S.

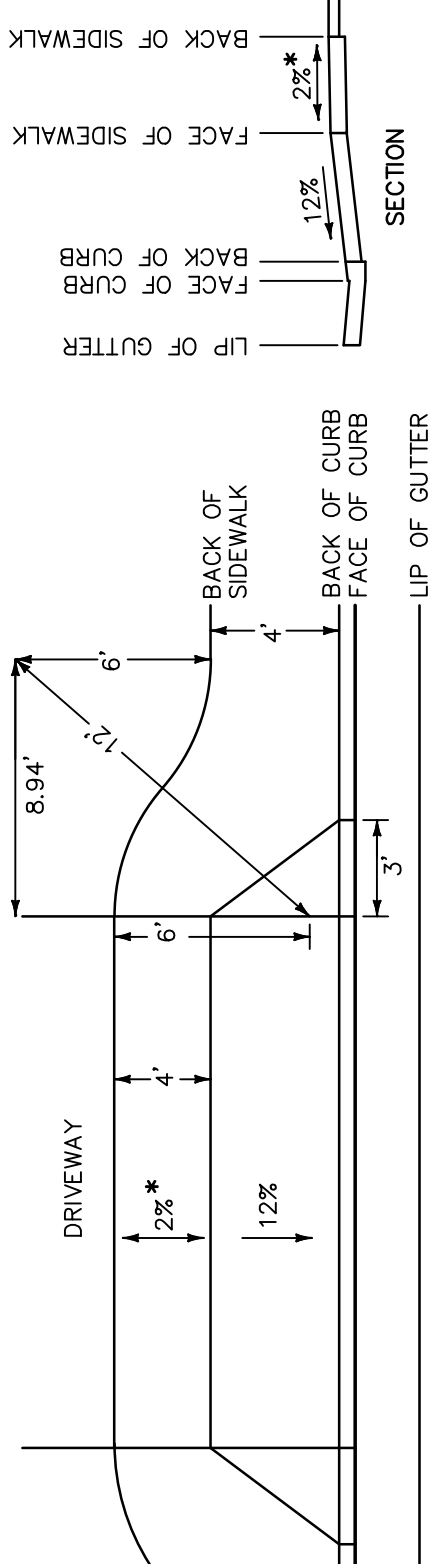
- NOTES:
- *2% MAX. SLOPE CAN BE TOWARDS OR AWAY FROM STREET, DEPENDING UPON DRIVEWAY GRADES.
 - ANY EXCEPTION TO SIDEWALK SLOPE SHALL BE APPROVED BY THE DIRECTOR OF PUBLIC WORKS.

DRIVEWAY CURB DEPRESSION, STANDARD SEPARATED SIDEWALK AND ROLLED (TYPE B) CURB



6' SIDEWALK WITH 4' PATHWAY BEHIND 4' DRIVEWAY DEPRESSION

N.T.S.



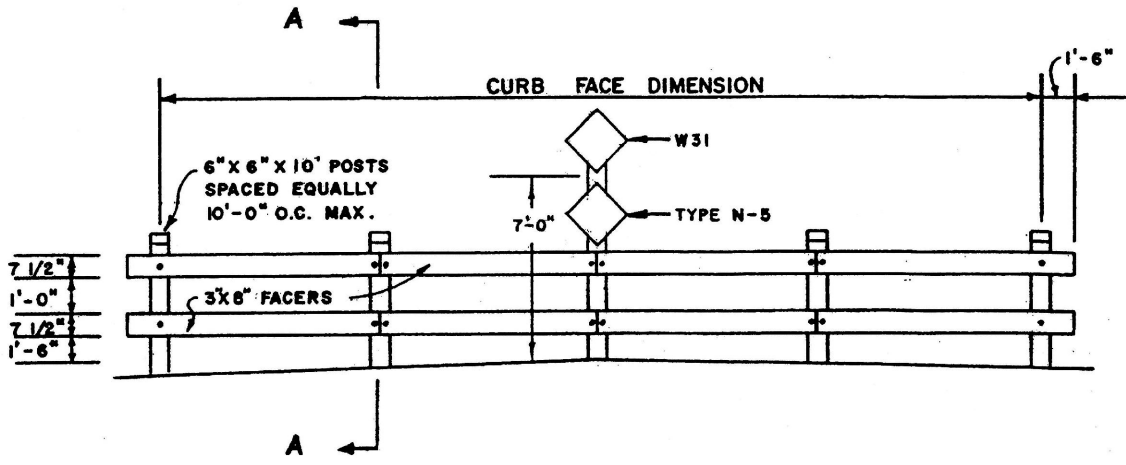
4' SIDEWALK WITH 4' PATHWAY BEHIND 4' DRIVEWAY DEPRESSION

N.T.S.

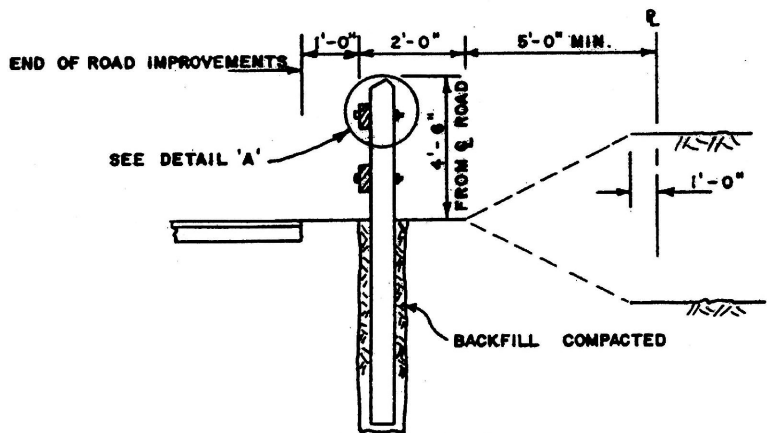
NOTES:

- * 2% MAX. SLOPE CAN BE TOWARDS OR AWAY FROM STREET, DEPENDING UPON DRIVEWAY GRADES.
- ANY EXCEPTION TO SIDEWALK SLOPE SHALL BE APPROVED BY THE DIRECTOR OF PUBLIC WORKS.

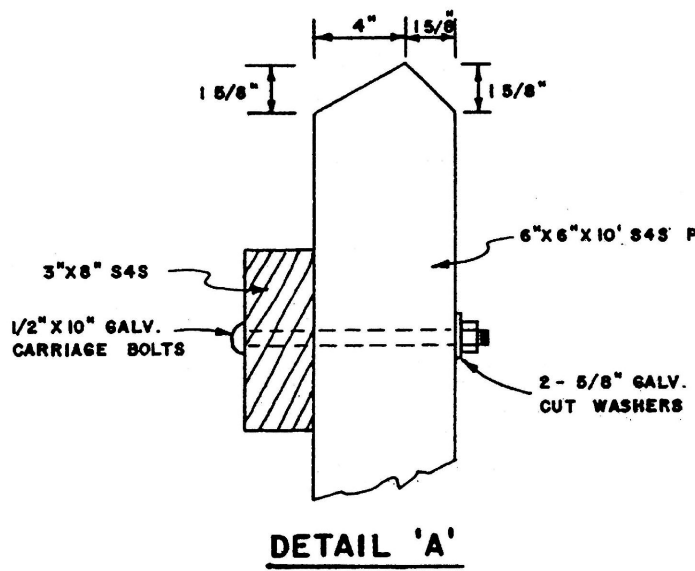
DRIVEWAY CURB DEPRESSION, 4' SIDEWALK, AND 6' SIDEWALK



ELEVATION



SECTION A-A

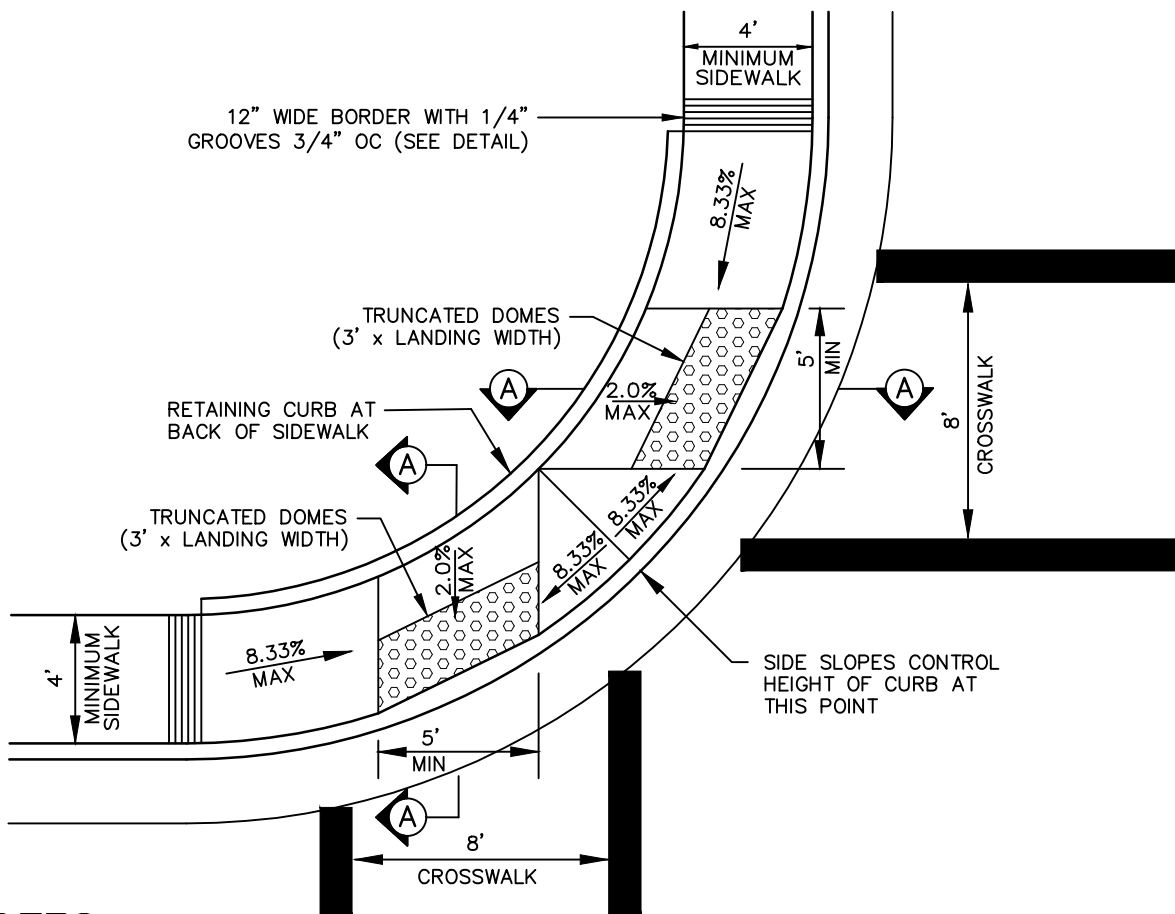


DETAIL 'A'

NOTE : 1. PAINT WITH 2 COATS OF WHITE PAINT.
 2. THE W31 AND TYPE N-5 SIGNS SHALL BE INSTALLED AT ALL BARRICADES, BOTH WOOD OR METAL.

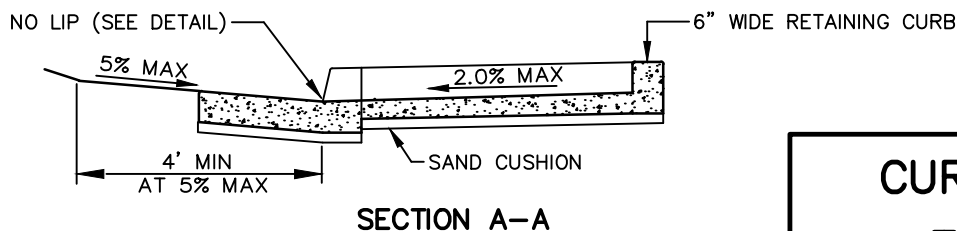
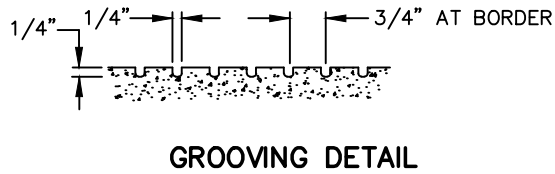
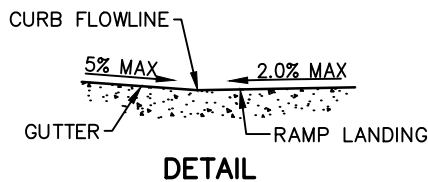
ROAD BARRICADE

ROAD BARRICADE

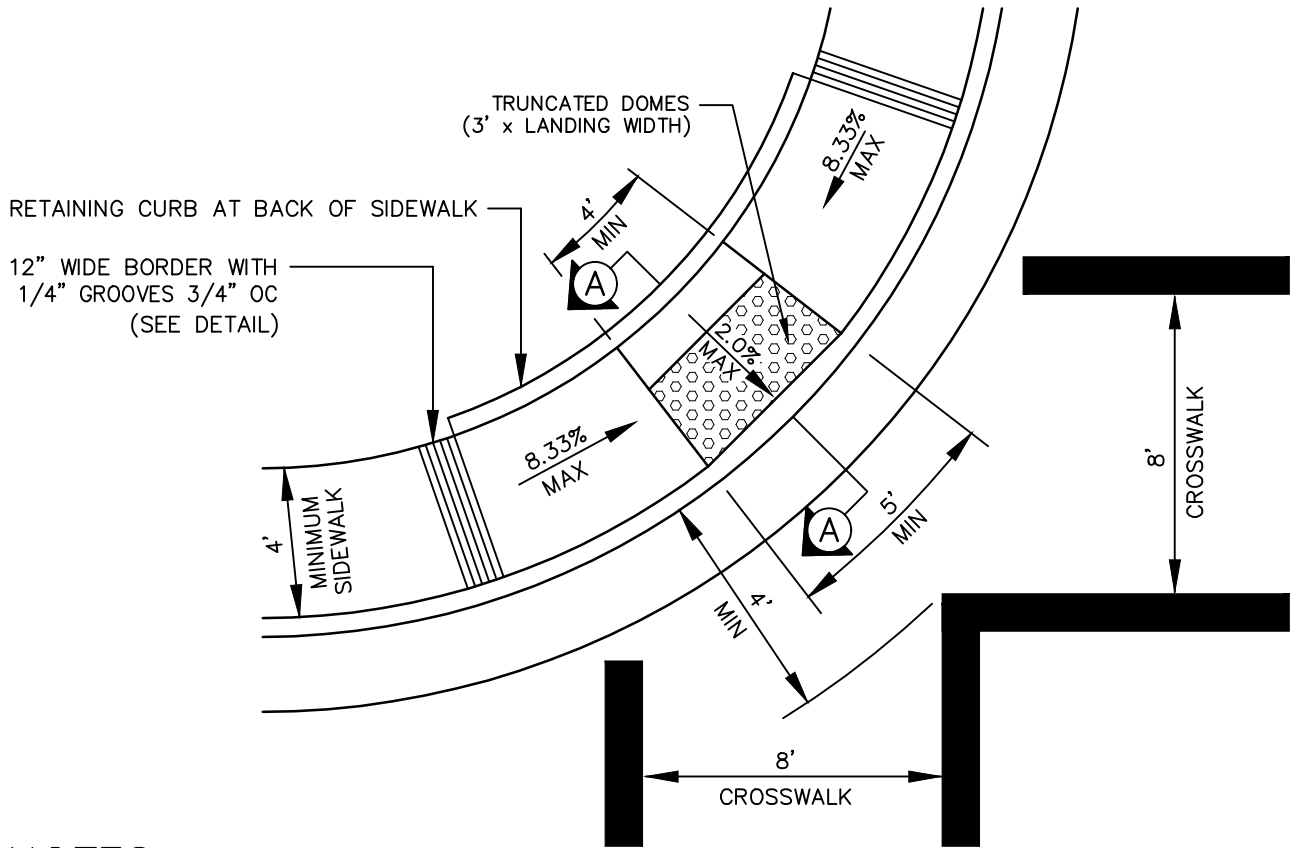


NOTES:

1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.
2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROOMED TEXTURE.
3. THE RAMP LANDING SHALL INCLUDE AN AREA OF TRUNCATED DOMES THREE FEET DEEP BY THE FULL WIDTH OF THE LANDING. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE YELLOW. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.
4. TRUNCATED DOME PANELS SHALL BE CAST INTO WET CONCRETE.

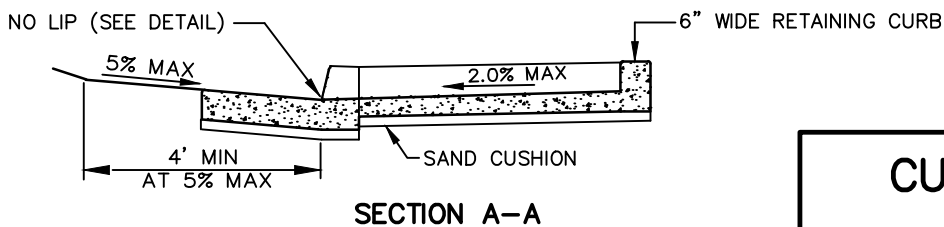
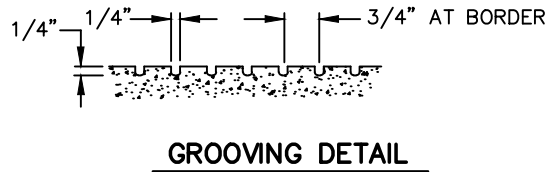
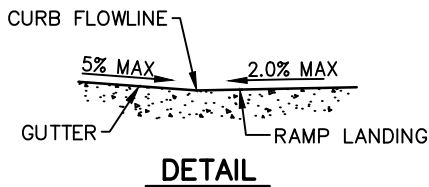


**CURB RAMP
TYPE A**

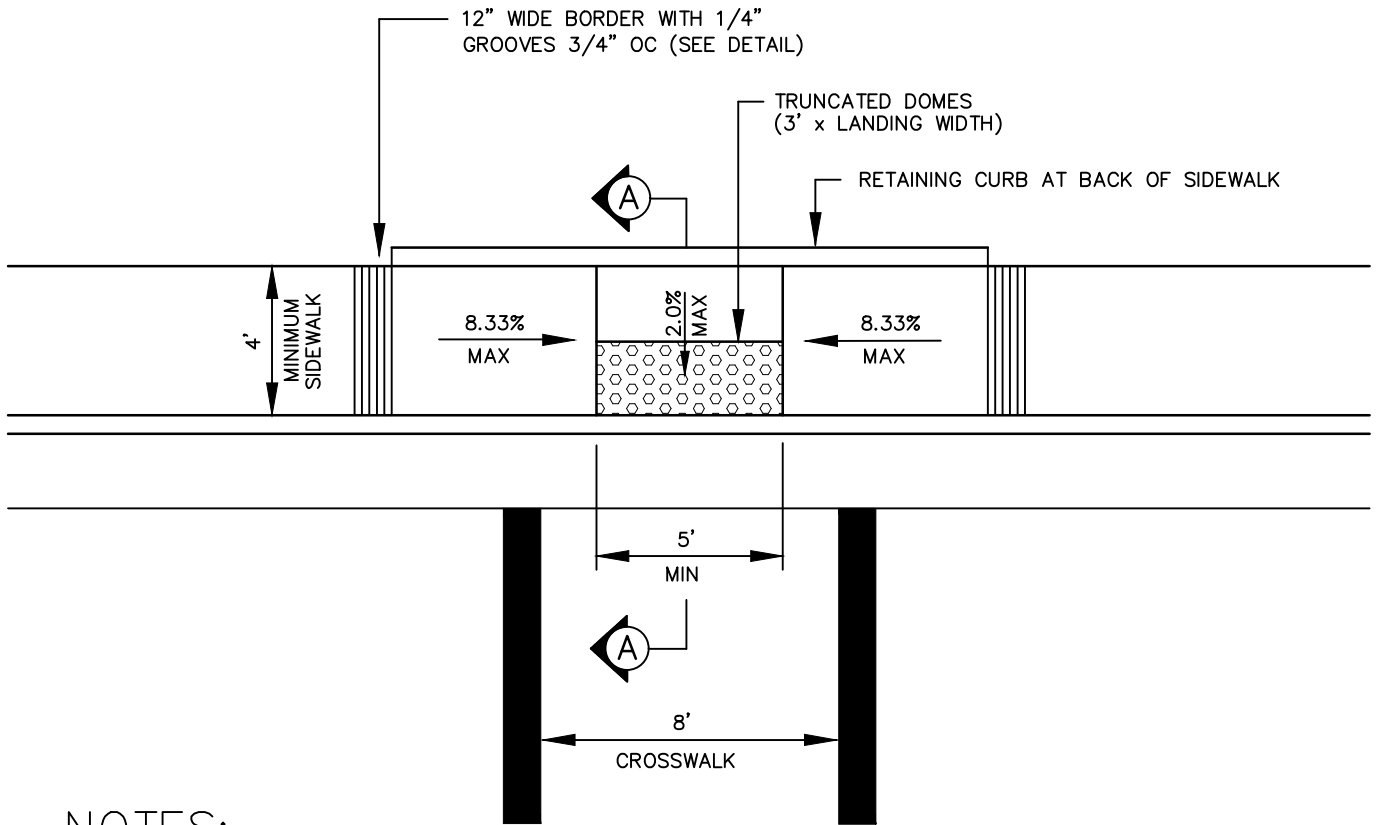


NOTES:

1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.
2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROOMED TEXTURE.
3. THE RAMP LANDING SHALL INCLUDE AN AREA OF TRUNCATED DOMES THREE FEET DEEP BY THE FULL WIDTH OF THE LANDING. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE YELLOW. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.
4. TRUNCATED DOME PANELS SHALL BE CAST INTO WET CONCRETE.

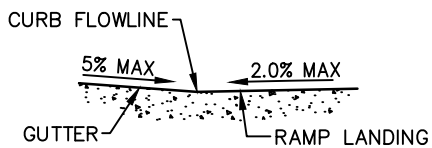


**CURB RAMP
TYPE B**

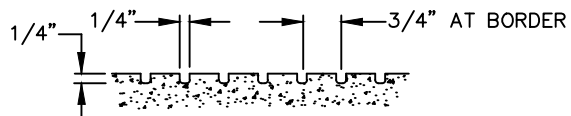


NOTES:

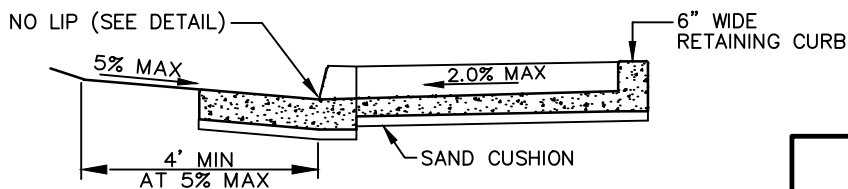
1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.
2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROOMED TEXTURE.
3. THE RAMP LANDING SHALL INCLUDE AN AREA OF TRUNCATED DOMES THREE FEET DEEP BY THE FULL WIDTH OF THE LANDING. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE YELLOW. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.
4. TRUNCATED DOME PANELS SHALL BE CAST INTO WET CONCRETE.



DETAIL

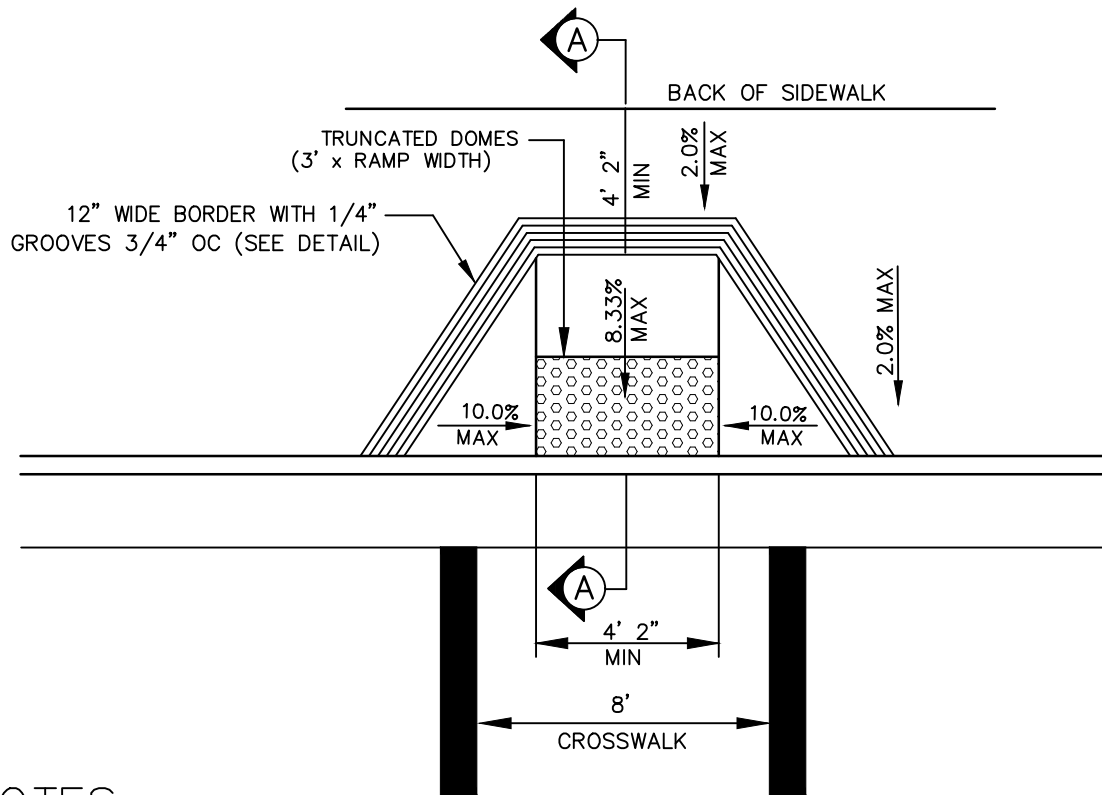


GROOVING DETAIL



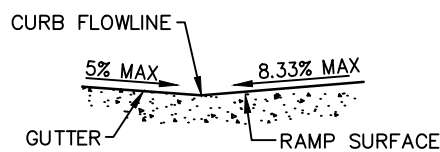
SECTION A-A

**CURB RAMP
TYPE C**

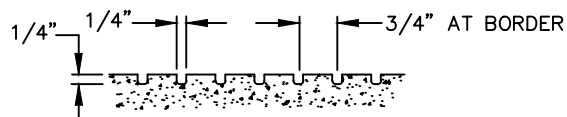


NOTES:

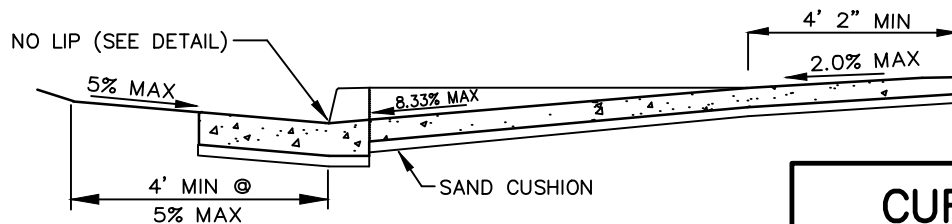
1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.
2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROOMED TEXTURE.
3. THE RAMP SURFACE SHALL INCLUDE AN AREA OF TRUNCATED DOMES THREE FEET DEEP BY THE FULL WIDTH OF THE RAMP. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE YELLOW. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.
4. TRUNCATED DOME PANELS SHALL BE CAST INTO WET CONCRETE.



DETAIL

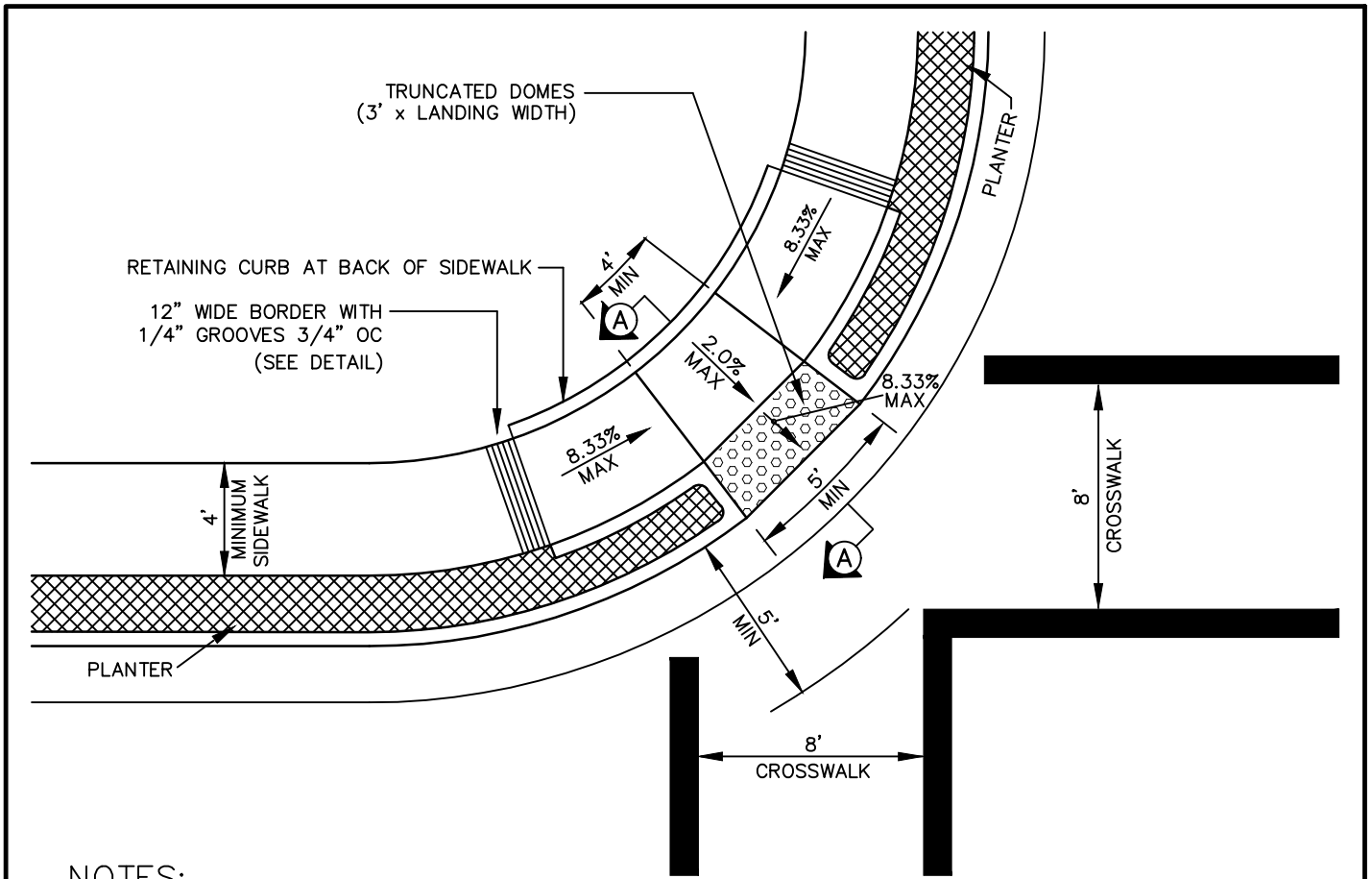


GROOVING DETAIL



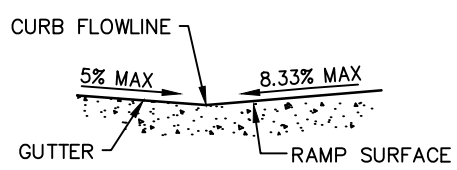
SECTION A-A

**CURB RAMP
TYPE D**

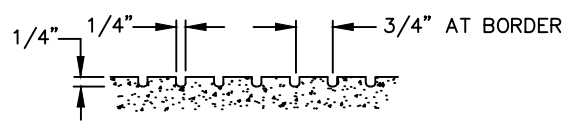


NOTES:

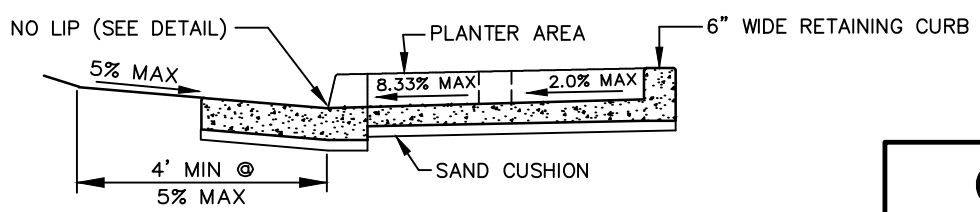
1. THE CURB AND GUTTER ADJACENT TO THE RAMP LANDING SHALL BE MODIFIED SO THAT THE CROSS SLOPE OF THE GUTTER DOES NOT EXCEED FIVE PERCENT.
2. THE RAMP SURFACE SHALL HAVE A ROUGH TRANSVERSE BROOMED TEXTURE.
3. THE RAMP TO THE STREET SHALL INCLUDE AN AREA OF TRUNCATED DOMES A MINIMUM OF THREE FEET DEEP BY THE FULL WIDTH OF THE LANDING. THE DOMES SHALL CONFORM TO ALL REQUIREMENTS OF THE AMERICANS WITH DISABILITIES ACT AND SHALL BE YELLOW. THE CONTRACTOR SHALL SUBMIT A PRODUCT SAMPLE TO THE COUNTY FOR APPROVAL PRIOR TO DELIVERY TO THE SITE.
4. TRUNCATED DOME PANELS SHALL BE CAST INTO WET CONCRETE.



DETAIL

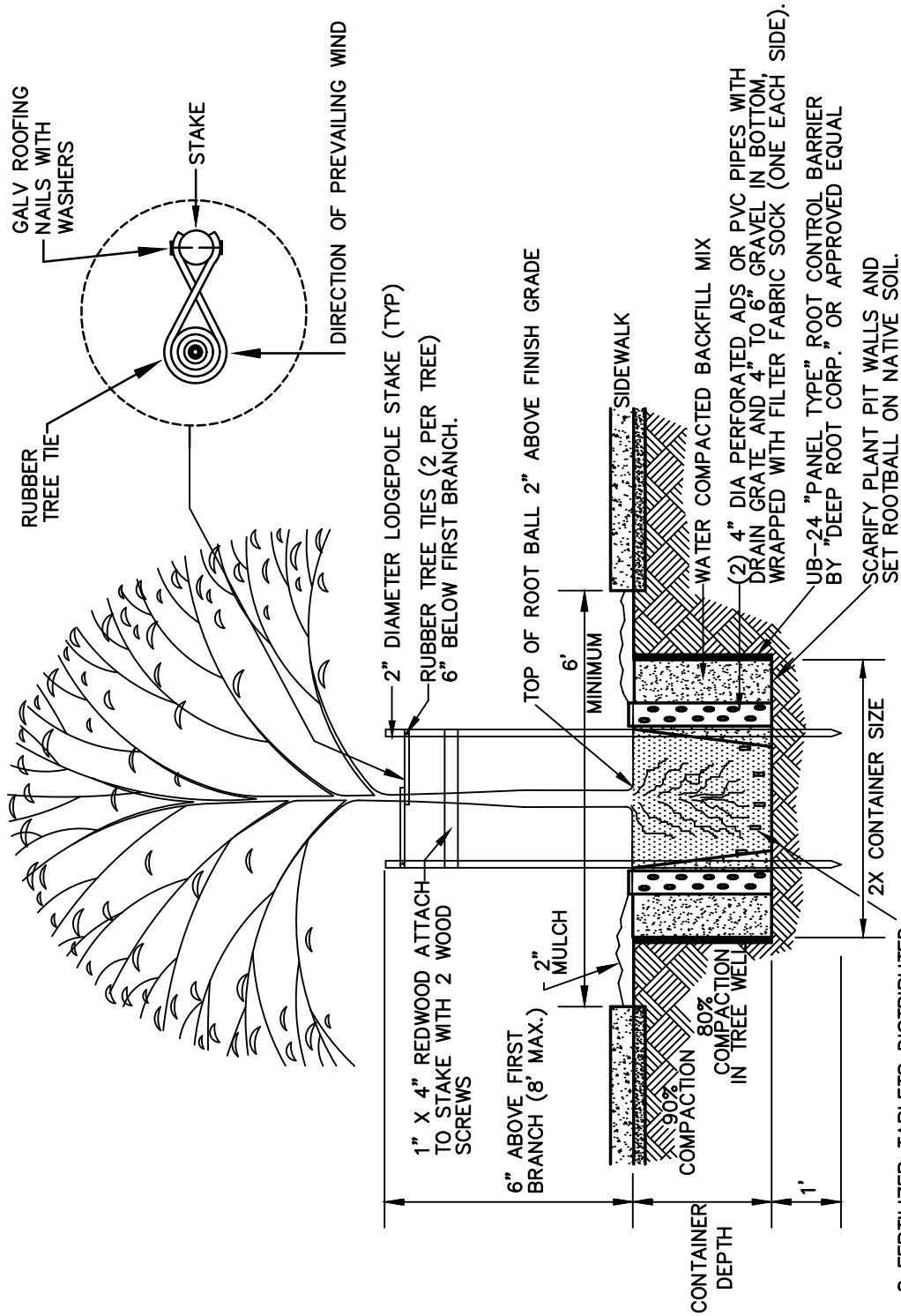


GROOVING DETAIL



SECTION A-A

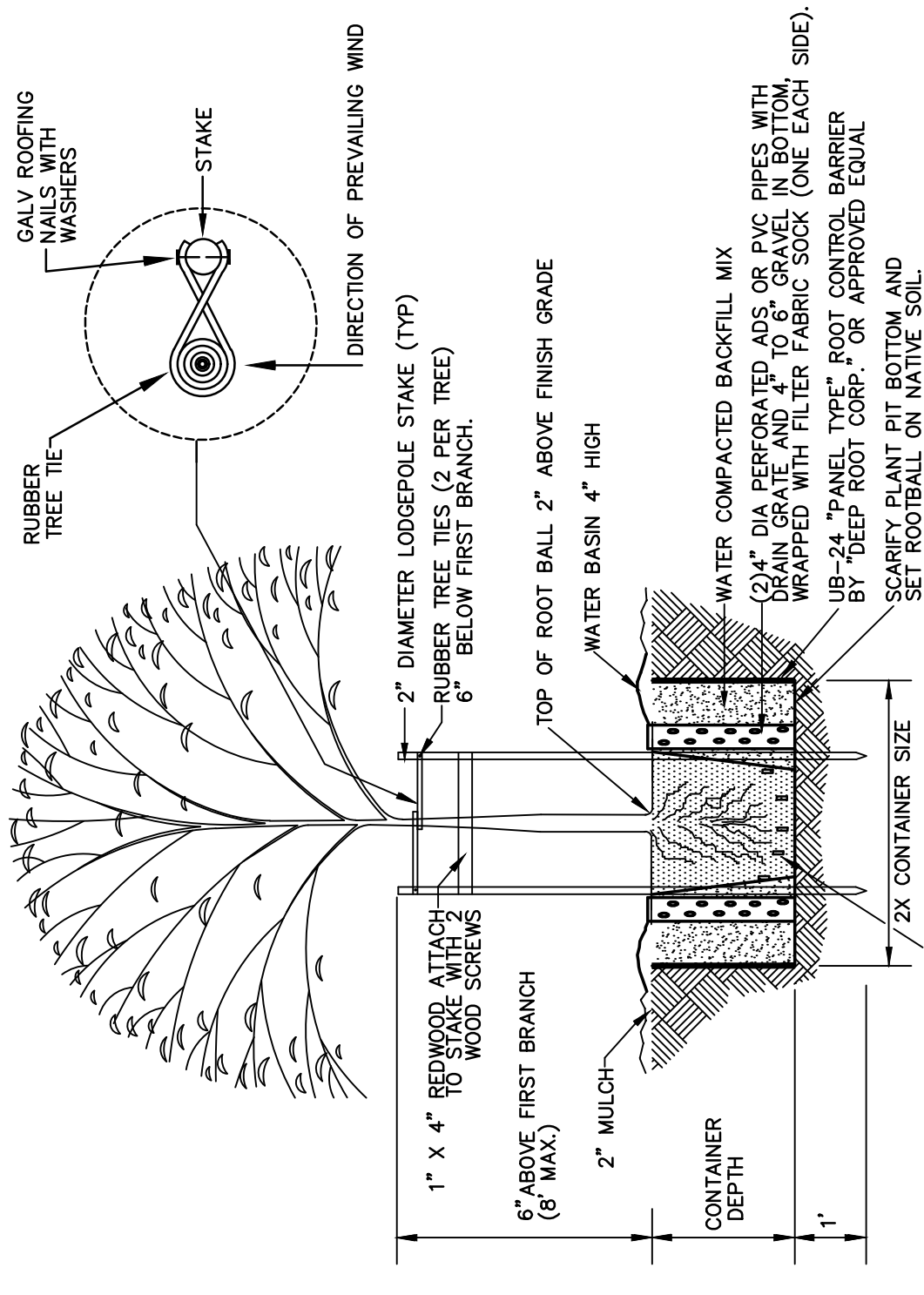
**CURB RAMP
TYPE E**



8 FERTILIZER TABLETS DISTRIBUTED AROUND ROOTBALL FOR EACH 24" BOX TREE OR 4 TABLETS FOR EACH 15 GALLON TREE.

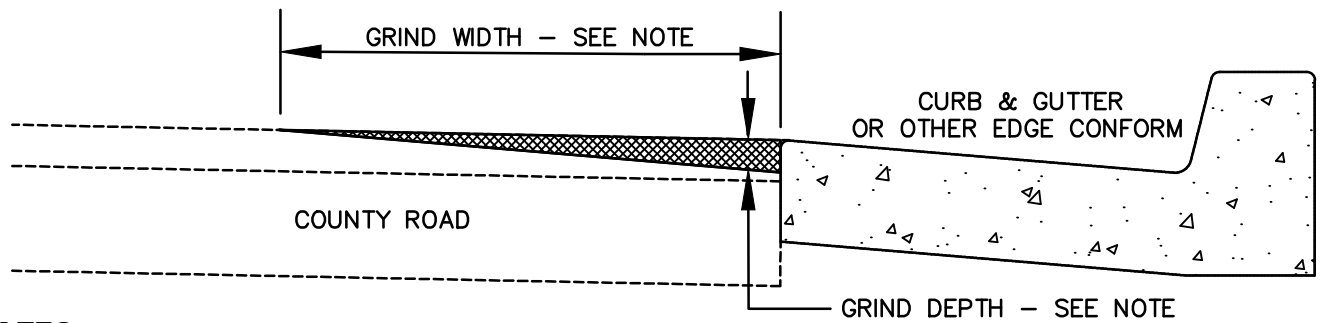
NOTE:
MINIMUM TREE WELL SIZE SHALL BE 4' X 6' X 2'.

TREE PLANTING IN TREE WELL OR PLANTING STRIP



8 FERTILIZER TABLETS DISTRIBUTED AROUND ROOTBALL FOR EACH 24" BOX TREE OR 4 TABLETS FOR EACH 15 GALLON TREE.

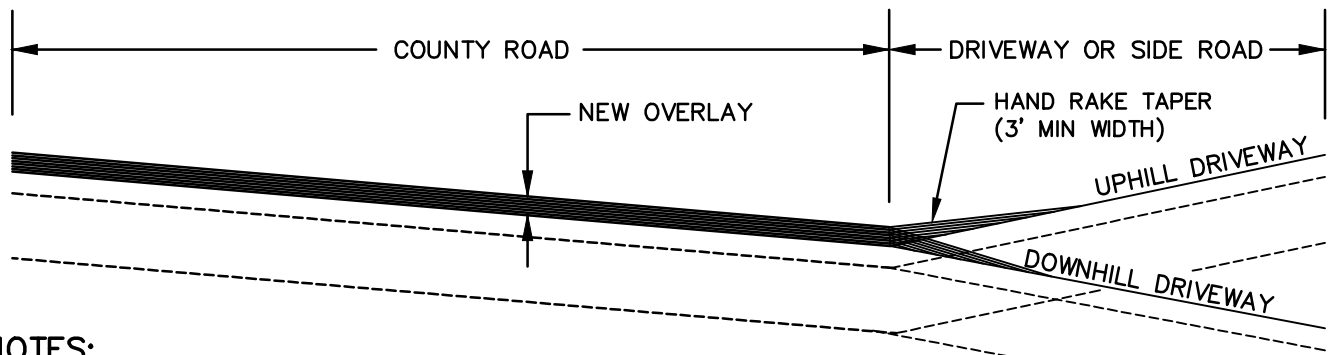
TREE PLANTING IN LANDSCAPE AREA



NOTES:

1. GRINDING DEPTH SHALL BE SUCH THAT FINISHED SURFACE LAYER IS FLUSH WITH THE GUTTER LIP OR OTHER CONFORM. THE DEVELOPER/ PERMITTEE SHALL BE RESPONSIBLE FOR DETERMINING APPROPRIATE GRINDING DEPTH. IF FINAL SURFACE LAYER IS LOWER THAN EXISTING GRADE AT CONFORM, THE DEVELOPER/ PERMITTEE SHALL BE RESPONSIBLE FOR PLACEMENT OF ADDITIONAL SURFACING LAYERS TO MAKE NEW SURFACING FLUSH WITH EXISTING CONFORM.
2. GRINDING WIDTH FOR GUTTER CONFORM OR OTHER LONGITUDINAL CONFORM SHALL BE 6' FOR ASPHALT OVERLAYS, OR 2' FOR SEAL COATS. GRINDING WIDTH FOR INTERSECTION CONFORMS SHALL BE 20' FOR ASPHALT OVERLAYS, OR 6' FOR SEAL COATS.
3. FOR SEAL COATS, EDGE GRINDING SHALL ONLY APPLY IN SITUATIONS WHERE EXISTING ROADWAY IS BOUND BY A CONCRETE GUTTER OR SIMILAR EDGE CONSTRAINT AND EXISTING SURFACE IS HIGHER THAN ADJACENT GUTTER LIP. IF EXISTING PAVEMENT IS FLUSH WITH GUTTER LIP OR LOWER THAN GUTTER LIP, GRINDING FOR SEAL COATS SHALL NOT APPLY. FOR MULTI-LAYER SEALS ADJACENT TO GUTTERS WHERE THE EXISTING PAVEMENT IS FLUSH WITH THE GUTTER, ONLY THE TOPMOST SEAL LAYER SHALL EXTEND TO THE GUTTER LIP AND ALL LOWER SEAL LAYERS SHALL STOP SHORT OF THE GUTTER BY 1 FOOT. FOR MULTI-LAYER SEALS ADJACENT TO GUTTERS WHERE THE EXISTING PAVEMENT IS LOWER THAN THE GUTTER LIP, LOWER LAYER SEALS MAY BE EXTENDED TO THE GUTTER LIP AS NEEDED TO ACHIEVE A FLUSH CONDITION WITH THE TOPMOST SEAL.
4. TACK COAT SHALL BE APPLIED AT A MINIMUM UNDILUTED RATE OF 0.06-GALLONS PER SQUARE YARD TO ALL CONTACT SURFACES TO RECEIVE ASPHALT PAVING.
5. THE CONTRACTOR SHALL NOTIFY THE DEPARTMENT OF PUBLIC WORKS AT LEAST 48 HOURS PRIOR TO GRINDING NEAR TRAFFIC SIGNALS. UNLESS OTHERWISE INDICATED, GRINDING OPERATIONS SHOULD AVOID TRAFFIC LOOPS IF POSSIBLE. ANY TRAFFIC SIGNAL DETECTORS DAMAGED BY GRINDING SHALL BE REPLACED BY THE DEVELOPER/ PERMITTEE.

DETAIL A – EDGE GRIND CONFORM



NOTES:

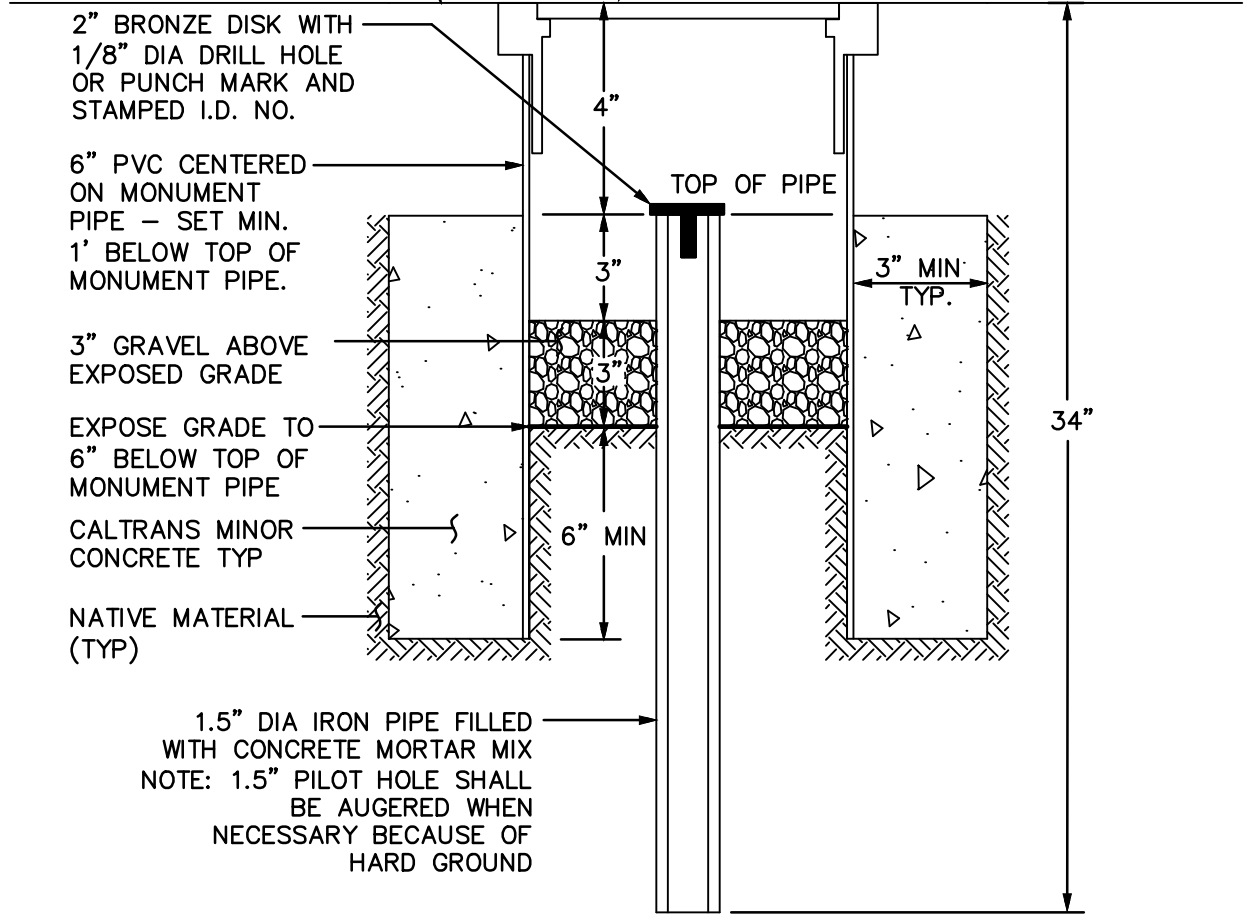
1. THIS DETAIL IS MEANT FOR SITUATIONS WHERE AN ASPHALT OVERLAY IS BEING PLACED IN AREAS WITH CURB & GUTTER OR OTHER SIGNIFICANT EDGE CONSTRAINTS AND SHALL ONLY BE USED IF DIRECTED BY THE COUNTY.
2. FOR LONGITUDINAL CONFORMS SUCH AS DRIVEWAYS OR CROSS STREETS, HAND RAKE TAPER SHALL BE A MINIMUM OF 3' IN WIDTH. INTERSECTIONS OR BEGINNING/END OF OVERLAY CONFORMS SHALL BE 20' IN LENGTH AND MAY BE ACCOMPLISHED EITHER BY HAND RAKE TAPER OR BY CONFORM GRINDING.
3. TACK COAT SHALL BE APPLIED AT A MINIMUM UNDILUTED RATE OF 0.06-GALLONS PER SQUARE YARD TO ALL CONTACT SURFACES TO RECEIVE ASPHALT PAVING.

DETAIL B – TAPER CONFORM

RESURFACING CONFORMS

SURFACE PER UTILITY LID
PAVING DETAIL EP-5

MONUMENT BOX, SEE NOTE BELOW



NOTE

MONUMENT BOX SHALL BE D&L No. K-6001-2 (TRAFFIC RATED AND WATER TIGHT) OR APPROVED EQUAL PRESSED INSIDE A 6" PVC PIPE. COVER SHALL HAVE THE WORD "MONUMENT" ENGRAVED ON TOP. BRONZE DISK SHALL BE PROVIDED BY THE COUNTY.

STANDARD MONUMENT DETAIL

SURFACE PER UTILITY LID
PAVING DETAIL EP-5

MONUMENT BOX, SEE NOTE BELOW

6" PVC CENTERED
ON MONUMENT
PIPE - SET MIN.
1' BELOW TOP OF
MONUMENT PIPE.

3" GRAVEL ABOVE
EXPOSED GRADE

EXPOSE GRADE TO
6" BELOW TOP OF
MONUMENT PIPE

CALTRANS MINOR
CONCRETE TYP

NATIVE MATERIAL
(TYP)

EXISTING IRON PIPE
TO REMAIN (SIZE
VARIES)
DO NOT REMOVE, DO
NOT ALTER HEIGHT
OR LOCATION.

VARIES

TOP OF EX. PIPE

3"

3"

6" MIN

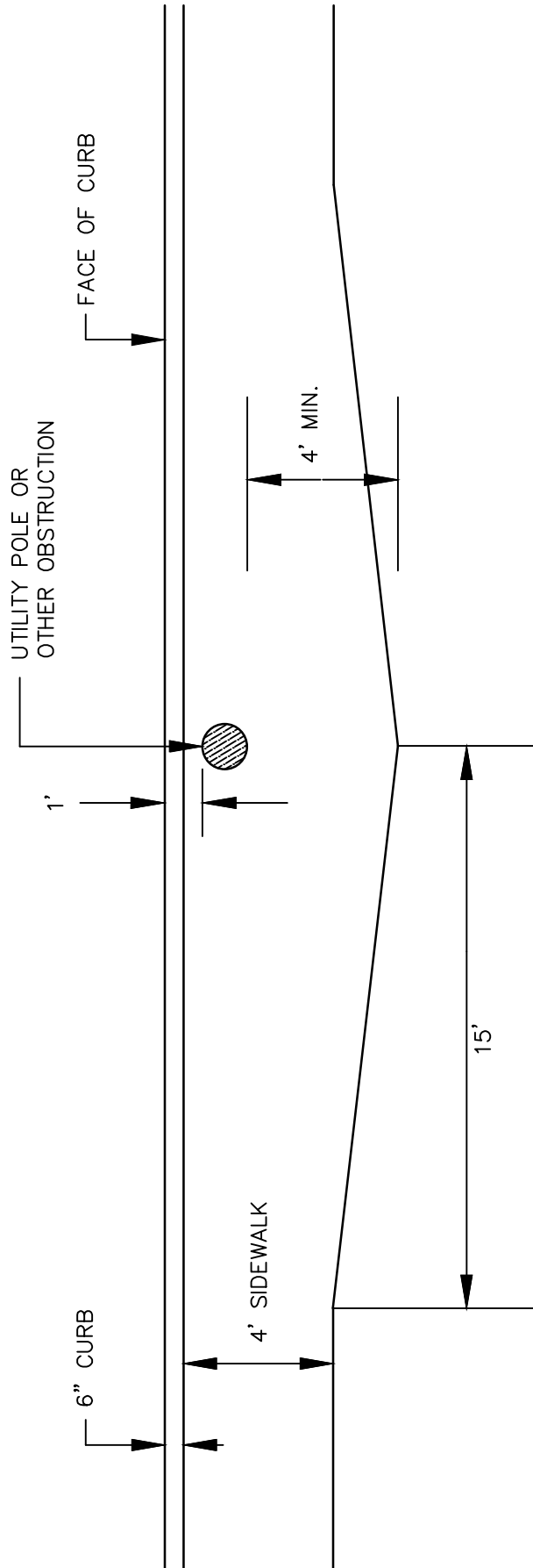
3" MIN
TYP.

12"

NOTE

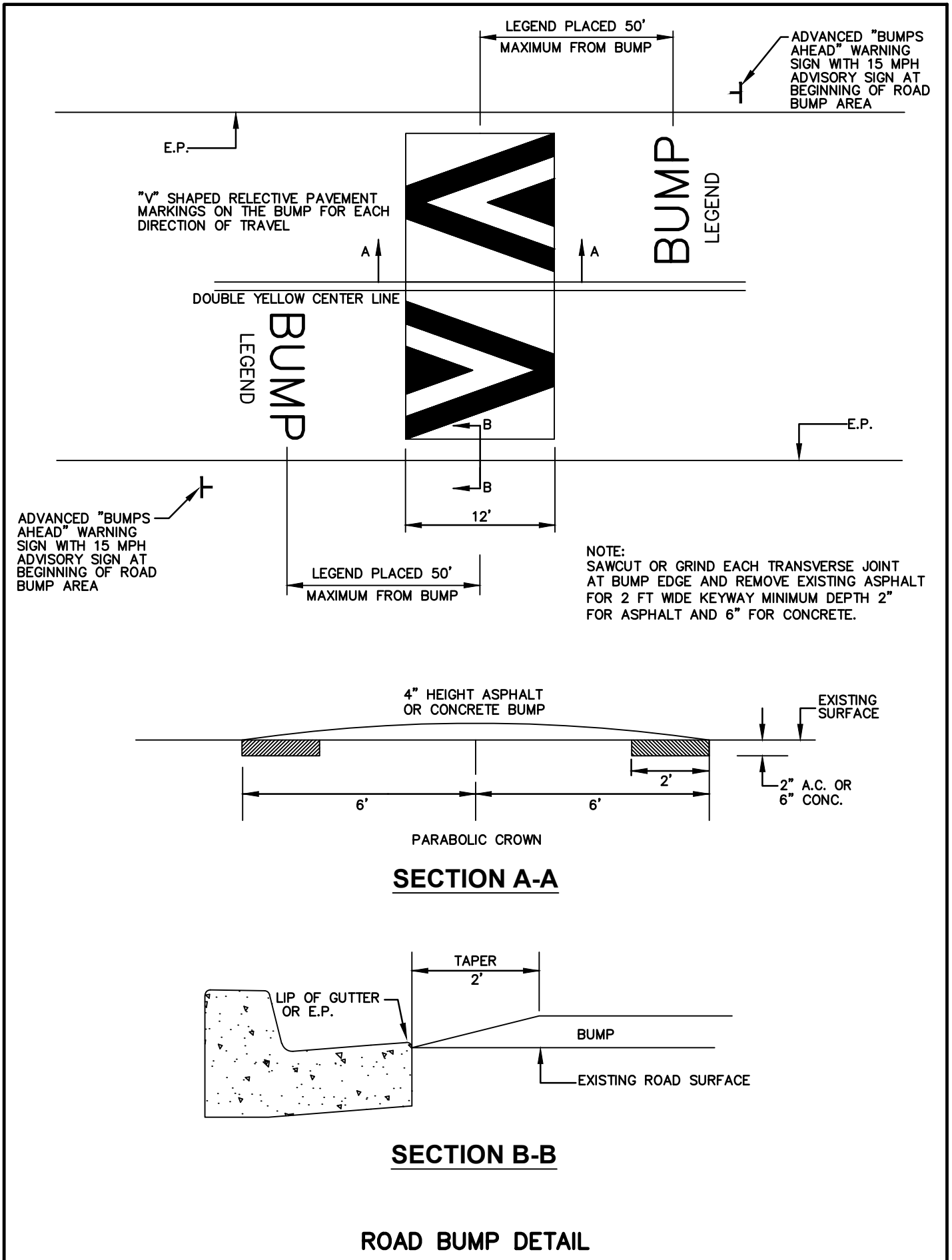
MONUMENT BOX SHALL BE D&L No. K-6001-2 (TRAFFIC
RATED AND WATER TIGHT) OR APPROVED EQUAL PRESSED
INSIDE A 6" PVC PIPE. COVER SHALL HAVE THE WORD
"MONUMENT" ENGRAVED ON TOP.

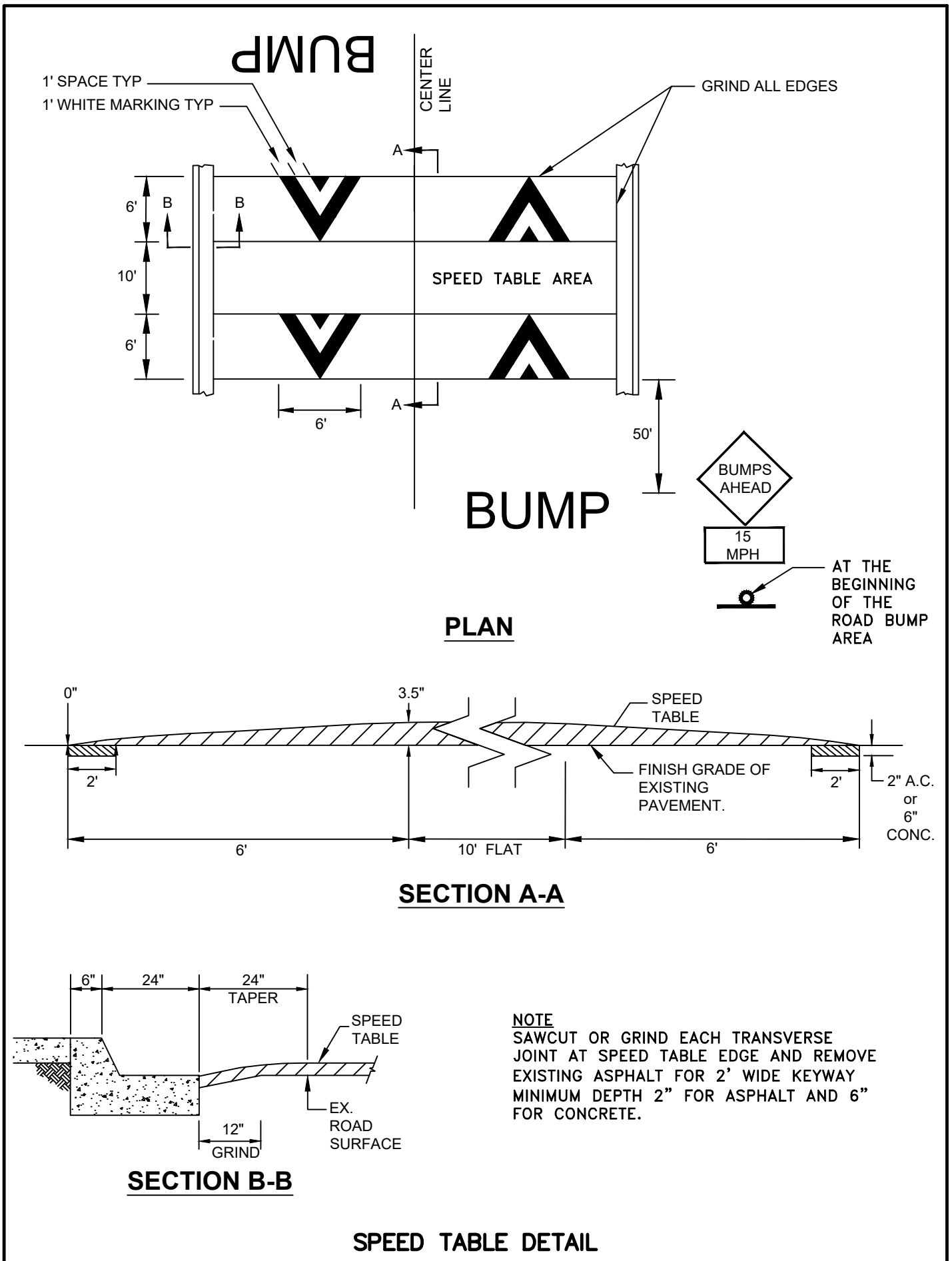
INSTALL STREET MONUMENT BOX OVER EXISTING MONUMENT

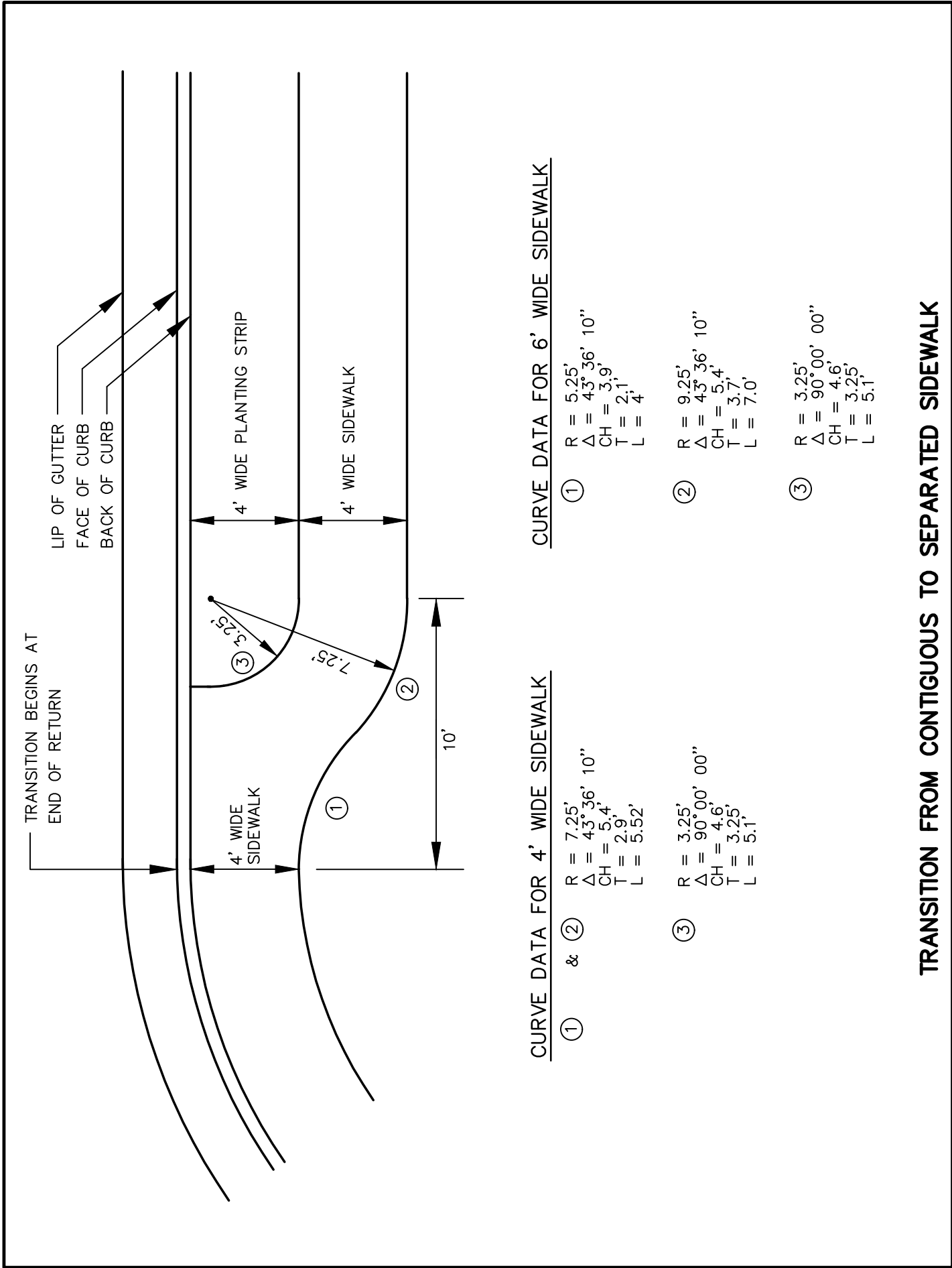


NOTE:
 PROVIDE A 4' CLEAR SIDEWALK PER THIS DETAIL AT ALL
 UTILITY POLES OR OTHER OBSTRUCTIONS WHICH CANNOT BE
 PLACED BEHIND THE SIDEWALK. ALTERNATIVE TRANSITIONS
 SHALL BE APPROVED BY THE DIRECTOR OF PUBLIC WORKS.

SIDEWALK TRANSITION AT OBSTRUCTION







REV 5/19

FIG. ST-14

CURVE DATA FOR 4' WIDE SIDEWALK

- ① & ② $R = 7.25'$
 $\Delta = 43^{\circ} 36' 10''$
 $CH = 5.4'$
 $T = 2.9'$
 $L = 5.52'$
- ③ $R = 3.25'$
 $\Delta = 90^{\circ} 00' 00''$
 $CH = 4.6'$
 $T = 3.25'$
 $L = 5.1'$

CURVE DATA FOR 6' WIDE SIDEWALK

- ① $R = 5.25'$
 $\Delta = 43^{\circ} 36' 10''$
 $CH = 3.9'$
 $T = 2.1'$
 $L = 4'$
- ② $R = 9.25'$
 $\Delta = 43^{\circ} 36' 10''$
 $CH = 5.4'$
 $T = 3.7'$
 $L = 7.0'$
- ③ $R = 3.25'$
 $\Delta = 90^{\circ} 00' 00''$
 $CH = 4.6'$
 $T = 3.25'$
 $L = 5.1'$

TRANSITION FROM CONTIGUOUS TO SEPARATED SIDEWALK

PART 3. STORMWATER MANAGEMENT

SECTION A – GENERAL INFORMATION

Part 3 applies to new or redevelopment projects that require a County development or building permit and/or result in an increase or replacement of impervious area, or will alter drainage patterns on or from the project sites. If the project does not comply with these Design Criteria the project description shall include a request for a waiver to this criteria and shall provide technical justification for consideration of the waiver.

Phased projects shall evaluate the cumulative impacts for compliance with Design Standards, Mitigations and Requirements as set forth in the following sections of Part 3. The collective impact from phased projects shall be adequately offset through onsite mitigations that are appropriately designed to replicate pre-development patterns, replicate natural drainage patterns, and control runoff.

In addition, large projects located in the City of Capitola, and not reviewed by the City of Capitola staff, are subject to flood control sizing criteria (offsite improvements and maintaining pre- development runoff rates).

1. All projects shall address the following:

a. Source Control Measures

Projects with pollutant generating activities and sources as described in Section E are required to implement source control measures.

b. Storm Drain System Marking and Signage

All storm drain inlets and catch basins within commercial, industrial and multi- residential developments shall be marked with prohibitive language (such as: “No Dumping – Drains to Ocean. No Tire – Desecho Corre al Mar”) and/or graphical icons to discourage illegal dumping. Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping must be posted at public access points along channels and creeks within the project area. Legibility of markings and signs must be maintained by the property owner.

c. Safe Stormwater Overflow Requirements

All development and redevelopment projects, including discharges from pumped systems, shall clearly show that the proposed drainage patterns will not result in diversion of stormwater and will not adversely impact neighboring properties or damage drainage pathways.

d. Hydrology Requirements

See Section I – Hydrology – Minimum Design Requirements

e. Hydraulic Requirements

See Section J - Hydraulic Requirements

f. Storm Drainage Facilities Standards and Requirements See Section K – Storm Drain Facilities

g. Impervious Area Fees

If the project is located in Santa Cruz County Flood Control and Water Conservation District Zones 5, 6, 7A, or 8, impact fees based on the net increase in permitted impervious area will be assessed based on the current Unified Fee Schedule. The project may be eligible for fee credits for existing impervious areas previously permitted or built prior to the establishment of the flood control zone. To establish credit eligibility, documentation should be submitted with the project plans.

Documentation such as assessor's records, survey records, permit records, dated aerial photographs or other official records that will help establish and determine the construction date, structure/impervious area footprint, or to confirm that a permit was previously issued is acceptable. Zones 5, 6, 7A and 8 were established in 1969, 1986, 2005 and 1977, respectfully.

The County GIS may be used to determine the flood control district within which the project is located.

SECTION B – ACRONYMS

ASCE – American Society of Civil Engineers _

ASTM – American Society for Testing and
Materials

BASMAA – Bay Area Stormwater Management Agencies

Association BMP – Best Management Practice

CASQA – California Stormwater Quality Association

CCRWQCB – Central Coast Regional Water Quality

Control Board CEQA – California Environmental Quality

Act

LID – Low Impact Development SWP – Stormwater Management Plan

SECTION C – DEFINITIONS

Biofiltration – A method of filtering and controlling stormwater runoff through vegetated areas that meet both ASTM C33 / C33M and Central Coast Plant Guidance for Bioretention requirements.

Detention – A method of holding a specified volume of stormwater within a designed system that has a metered release rate. The controlled release is sized to replicate a site's predevelopment natural site conditions for a specific storm intensity. This type of stormwater management helps minimize impacts to the environment and downstream properties through effective flood control designs prepared by a registered civil engineer.

Development – For stormwater management purposes, development means land disturbing activity that results in the creation or addition of exterior impervious or semi-impervious surface area on a site. The following activities are not considered development: Public sidewalk and bicycle path or lane projects, where no other impervious surfaces are created or replaced and built to direct stormwater runoff to adjacent vegetated areas; trails and pathways, where no other impervious surfaces are replaced or created, and built to direct stormwater runoff to adjacent vegetated areas; underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics; photovoltaic systems installed on/over existing roof or other impervious surfaces, and panels located over pervious surfaces with well-maintained grass or vegetated groundcover, or panel arrays with a buffer strip at the most down gradient row of panels; temporary structures (in place for less than six months).

Directly Connected Impervious Area – The area covered by a building, impermeable pavement, and/or other impervious surfaces, which drains directly into the storm drain without first flowing across permeable land area (e.g. lawns or other vegetated areas).

Diversion – Altering drainage patterns from the natural flow path.

Impervious Surfaces – Impervious surfaces are hard, non-vegetated surfaces that prevent or significantly limit the entry of water into the soil mantle, as would occur under natural conditions, prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, oiled, macadam, compacted soils, or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities that are uncompacted shall not be considered as impervious surfaces for purposes of determining the thresholds of mitigation for the project or for calculating flood control district impact/impervious area fees.

However, for modeling purposes, open, uncovered facilities that retain/detain water (e.g. retention ponds, pools) shall be considered impervious surfaces.

Phased Projects – Sequential permit applications within a 5-year period shall be considered as a phased project.

Redevelopment - For stormwater management purposes, redevelopment means land disturbing activity that results in the replacement of exterior impervious surface area on a site on which some past development has occurred. Redevelopment also means the replacement of a structure.

Redevelopment does not include trenching, excavation and resurfacing associated with linear underground projects; pavement grinding and resurfacing of existing roadways; construction of new sidewalks, pedestrian ramps, or bike lanes on existing public roadways; or routine replacement of damaged pavement such as pothole repair or replacement of short, non-contiguous sections of roadway.

Replacement of Impervious Surface - Replacement of impervious surface is the removal of existing impervious surfaces down to bare soil or base course, and

replacement with new impervious surface. Replacement of impervious surfaces that are part of routine maintenance activities are not considered replaced impervious surfaces as long as the overall footprint and original line/grade are maintained.

Retention – A method of holding stormwater onsite to both infiltrate and filter runoff from collected areas. This type of stormwater management helps recharge groundwater basins, remove potential pollutants, and replicate a site’s natural and undeveloped conditions to protect the environment and our community.

Self-Mitigating Areas - Areas designed and constructed to retain the amount of rainfall (by ponding and infiltration and/or evapotranspiration) calculated for both the 2-year and 10-year storms without allowing any storm water runoff. Self-mitigating areas may include graded depressions with landscaping or semi-impervious surfaces.

Self-mitigating areas do not need to be included when: calculating thresholds of mitigation for the project, calculating flood control district impact/impervious area fees, or sizing mitigation facilities. Self-mitigating areas do not receive runoff from other directly connected impervious areas nor do they include any sub-surface piping. Design details and analysis shall be submitted for approval prior to permit issuance. A permit hold shall be placed on the final project requiring specific inspection testing for the constructed self-mitigating areas – testing shall adhere to either ASTM, Caltrans, or other approved test method. Final inspection results shall be submitted prior to acceptance.

See Fig SWM-11 for a standard self-mitigating area which does not require supporting calculations. Alternative self-mitigating area design requires supporting calculations for both the 2 and 10-year storms.

Semi-Impervious Surfaces – Semi-impervious surfaces are surfaces that prevent or limit the entry of water into the soil mantle, as would occur under natural conditions, prior to development.

Common semi-impervious surfaces include, but are not limited to: gravel, pervious concrete, pervious asphalt, pervious pavers, artificial turf, compacted soils, or other surfaces which similarly impede the natural infiltration of stormwater. When calculating the total impervious area added or replaced for the purpose of determining project threshold and flood control district impact/impervious area fees, semi-impervious surfaces shall be accounted for at a 50% rate. For mitigation and storm drain facility sizing purposes, runoff coefficients for semi-impervious surfaces shall take the specific design parameters (such as subgrade compaction, subdrains, liners/ geotextiles, materials, etc.) into account. Testing of semi-impervious surfacing may be required prior to finalizing the projects’ construction. If semi-impervious surfaces are designed to be self-mitigating areas, they do not need to be included in threshold and impact/impervious area fee calculations. Refer to Part 6 for additional details on semi-impervious driveways sloped to a County roadway.

Unpermitted Impervious & Semi-Impervious Area / Surface – Existing impervious & semi-impervious surfaces created without the benefit of a permit shall be recognized as NEW impervious and semi-impervious area for flood impact fees & in determining the

projects classification for mitigation requirements. When calculating the total impervious area added or replaced for the purpose of determining project threshold and flood control district impact/impervious area fees, unpermitted surfaces shall be accounted for at their respective rate depending on the definition for that surface as described in this section.

SECTION D – SMALL, MEDIUM AND LARGE PROJECT REQUIREMENTS

In addition to meeting the requirements in Section A, above, the following mitigation requirements are required based on the project threshold:

1. Small Projects (project adds and/or replaces less than 500 square feet of impervious area)

Minimum Submittal Requirements

The *Project Information & Threshold Determination Form* in Part 3 Appendix A shall be filled out and submitted with all applications for small projects. All requirements listed in the form shall be submitted with the application, as well as the requirements listed in Appendix B.

Additional information not listed in Appendix B may be requested, as determined by the Director or designee.

Design Standards, Mitigations and Requirements

Interior remodels and maintenance and/or repair projects are specifically excluded from these requirements. For slope repair projects, Source Control Measures (Section E), Hydrology (Section I), Hydraulic (Section J), and safe stormwater overflow requirements shall still be required.

It is recommended that small projects incorporate BMPs to limit pollutant and hydrologic impacts such as pervious pavement, disconnection of runoff from impervious surfaces, etc.

Applications shall not be made in piecemeal proposals. Building and/or discretionary permit applications made on a parcel within a 5-year period shall be reviewed based on their cumulative impacts and the highest level of mitigations may be required for each of the applications, following the first one made in the 5-year period, which may necessitate supplementing or reconstructing prior mitigations.

Small projects are exempt from specific quantitative requirements if there is adequate on and off-site drainage (no downstream restrictions). Qualitative measures, such as site BMPs to control, treat, and reduce runoff are recommended and shall be employed as feasible.

2. Medium Projects (project that adds and/or replaces between 500 square

feet and 5,000 square feet of impervious area)

Minimum Submittal Requirements

The *Project Information & Threshold Determination Form* in Part 3 Appendix A shall be filled out and submitted with all applications for Medium Projects. All requirements listed in the form shall be submitted with the application, as well as the requirements listed in Appendix C.

Additional information not listed in Part 3 Appendix C may be requested, as determined by the Director or designee.

Design Standards, Mitigations and Requirements

All new development and redevelopment projects shall incorporate Best Management Practices (BMPs) as specified herein to minimize and mitigate pollutant and hydrologic impacts due to development. These BMPs shall include Low Impact Development (LID) measures that emphasize the minimization of impacts as a first (for example: minimizing impervious areas).

Applications shall not be made in piecemeal proposals. Building and/or discretionary permit applications made on a parcel within a 5-year period shall be reviewed based on their cumulative impacts and the highest level of mitigations may be required for each of the applications, following the first one made in the 5-year period, which may necessitate supplementing or reconstructing prior mitigations.

Interior remodels and maintenance and/or repair projects are specifically excluded from these requirements.

Applications shall not be made in piecemeal proposals. Building and/or discretionary permit applications made on a parcel within a 5-year period shall be reviewed based on their cumulative impacts and the highest level of mitigations may be required for each of the applications, following the first one made in the 5-year period, which may necessitate supplementing or reconstructing prior mitigations.

a. Requirements for Stormwater Discharge Rates, Volumes, and Minimizing Stormwater Pollutants of Concern

Medium Projects are exempt from specific quantitative requirements if there is adequate on and off-site drainage with no known downstream restrictions. Qualitative measures, such as site BMPs to control and reduce runoff, shall be employed as feasible.

On-site retention and percolation of increased runoff from development shall be incorporated into the project design as feasible to meet this requirement. The use of detention, particularly in a closed system (pipe, lined basin, etc.) shall only be used if all other BMPs are demonstrated to be technically infeasible and

is required to employ additional BMPs for small storm mitigations. (also see General Plan Policies 5.5.12 and 7.23)

b. Requirements to Minimize Stormwater Pollutants of Concern

All development shall be designed to minimize the generation, transport and discharge of pollutants. Quantification is not required for medium projects, unless a Non-Retention Based Treatment System is proposed.

Below is design guidance for a Medium Project, listed in the order of priority (highest to lowest).

- i. Retention Treatment Systems: Infiltration of the 2-year, 2 hour storm consistent with Section H of the CDC.
- ii. Low Impact Development (LID) Treatment Systems: Implement harvesting and use, infiltration, and evapotranspiration measures.
- iii. Biofiltration Treatment Systems: Implement biofiltration treatment systems that prevent erosion, scour and channeling. When biofiltration treatment systems are used, following are the minimum requirements (Reference SWM-12):
 - (1) Minimum planting medium depth shall be 24 inches.
 - (2) Proper plant selection (see Bioretention Plant List available from the Central Coast LID Initiative at: <https://www.centralcoastlidi.org/resources.php>)
 - (3) Subsurface drainage/storage (gravel) layer with an area equal to the biofiltration treatment surface area and having a minimum depth of 12 inches.
 - (4) Underdrain with discharge elevation at top of gravel layer.
 - (5) No compaction of soils beneath the biofiltration facility (ripping/loosening of soils required if compacted).
 - (6) No liners or other barriers interfering with infiltration.
- iv. Non-Retention Based Treatment Systems – Implement stormwater control measures that collectively achieve at least one of the following hydraulic sizing criteria for non-retention based treatment system:
 - (1) Volume Hydraulic Design Basis – Treatment systems whose primary mode of action depends on volume capacity shall be designed to treat stormwater runoff equal to the volume of runoff generated by the 85th percentile 24-hour storm event, based on local rainfall data.

- (2) Flow Hydraulic Design Basis – Treatment systems whose primary mode of action depends on flow capacity shall be sized to treat:
 - (a) The flow of runoff produced by a rain event equal to at least two times the 85th percentile hourly rainfall intensity for the applicable area, based on historical records of hourly rainfall depths; or
 - (b) The flow of runoff resulting from a rain event equal to at least 0.2 inches/hour intensity.

The BMP(s) used for water quality treatment may be the same as those used to mitigate for stormwater discharge rates and volumes. When choosing BMP(s), emphasis shall be placed on source control BMPs rather than treatment BMPs.

c. Site Design and Runoff Reduction Requirements

All Medium Projects shall incorporate the following minimum site design and runoff reduction strategies as feasible:

- i) Limit disturbance to creeks and natural drainage features.
- ii) Minimize compaction of soils.
- iii) Limit clearing and grading of native vegetation at the site to minimum area needed to build the project, allow access, and provide fire protection.
- iv) Minimize impervious surfaces and concentrate improvements on the least sensitive portions of the site, while leaving the remaining land in a natural undisturbed state.
- v) Minimize stormwater runoff by implementing the following site design measures as feasible:
 - (1) Direct roof, driveway, parking lot, sidewalk, walkway, patio and other impervious surface runoff onto vegetated areas safely away from building foundations and footings, consistent with the California building code.
 - (2) Construct bike lanes, driveways, uncovered parking lots, sidewalks, walkways, patios and other hardscapes with permeable surfaces.
 - (3) Direct roof runoff to cisterns or rain barrels for reuse.

d. Proof of Ongoing BMP Maintenance

It is important to consider who will be responsible for maintenance of a

permanent BMP, and what equipment is required to perform the maintenance properly. As part of project review, if a project applicant has included or is required to include, structural or treatment control BMPs in project plans, the County will require that the applicant provide verification of maintenance provisions through such means as may be appropriate, including, but not limited to legal agreements, covenants, CEQA mitigation requirements and/or Conditional Use Permits.

Figure SWM-25A is an example Stormwater Management Maintenance Agreement for Medium Projects that can be updated for use on a specific project. The project designer or engineer shall establish specifications and requirements for the ongoing maintenance and monitoring to ensure proper functioning of stormwater management facilities and practices proposed as part of a development application and consistent with County Code 7.79. A Stormwater Management Maintenance Agreement shall be recorded by the property owner with the County Recorder's Office on the deed of any property to be served by a Stormwater Management Facility. The Stormwater Management Maintenance Agreement shall include the following information:

- i) Statement of the operating requirements to ensure proper performance of the Stormwater Management Facility.
- ii) Specification of any Best Management Practices that must be implemented and maintained.
- iii) Specification of any restriction on system use or property use, such as limitations on amount of impervious surface, limits on fertilizer or pesticide use, limits on vehicle parking or maintenance, restrictions on building additions, etc.
- iv) Notification that County staff may conduct routine inspections of the facility to ensure that the stormwater facilities are functioning properly and being maintained as needed.

Notification that the property owner may be assessed an annual service charge and/or re-inspection fee to cover the County costs of inspection and oversight. See the current Unified Fee Schedule for Stormwater Management Maintenance inspection and oversight fees.

- v) Notification that the property owner may be required to report to the County on the management and maintenance of the stormwater management facility.
- vi) Attach a site map that shows the location of all proposed BMPs and stormwater mitigation measures and that delineates the areas that drain to each facility.
- vii) The maintenance agreement shall be binding on and shall inure to the

benefit of the successors, heirs, executors, administrators, and assigns of the owner.

3. Large Projects (project that adds and/or replaces 5,000 square feet or more of impervious area)

Minimum Submittal Requirements

The *Project Information & Threshold Form* in Part 3 Appendix A shall be filled out and submitted with all applications for large projects. All requirements listed in the form shall be submitted with the application, as well as the requirements listed in Appendix D.

Additional information not listed in Part 3 Appendix D may be requested, as determined by the Director or designee.

Design Standards, Mitigations and Requirements

All new and development projects must incorporate Best Management Practices (BMPs) to minimize and mitigate pollutant and hydrologic impacts due to development. These BMPs shall include LID measures that emphasize minimization of impacts as a first priority (for example: minimizing impervious surfaces). Detailed site assessment and BMP analysis is required to demonstrate adequate mitigation design for large projects so that pre-development runoff rates are maintained for a range of storms while also maintaining pre-development groundwater recharge.

Where a redevelopment project results in an increase of more than 50 percent of the permitted impervious surface of a previously existing development, runoff from the entire project, consisting of all existing, new, and/or replaced impervious surfaces, must be included in the mitigation design to the extent feasible. Where a redevelopment project results in an increase of less than 50 percent of the permitted impervious surface of a previously existing development, only runoff from the new and/or replaced impervious surface of the project must be included. Unpermitted impervious surface shall be considered in calculating the new impervious surface area.

Interior remodel and maintenance and/or repair projects are specifically excluded from these requirements.

Applications shall not be made in piecemeal proposals. Building and/or discretionary permit applications made on a parcel within a 5-year period shall be reviewed based on their cumulative impacts and the highest level of mitigations may be required for each of the applications, following the first one made in the 5-year period, which may necessitate supplementing or reconstructing prior mitigations.

a. Requirements for Stormwater Discharge Rates and Volumes

Quantification demonstrating compliance with this section is required for all large projects, projects where there are known downstream restrictions, and others at the discretion of the Director.

The project shall be designed to maintain pre-development discharge rates for a range of storms while maintaining pre-development groundwater recharge rates.

Quantification demonstrating maintenance of the pre-development 10 year, 15-minute discharge rates (more stringent mitigations may be required if there are downstream restrictions) is required (refer to Section G for specific requirements). Pre- development discharge rates shall be evaluated based on reasonable assumptions of natural site conditions.

The project engineer shall conduct a downstream impact assessment in accordance with Sections I and J of the *Design Criteria* and shall assess the condition of the downstream system. If downstream restrictions are/have been identified the project shall include the improvements needed to repair systems in poor conditions and/or to upgrade the storm drain system such that local flooding due to insufficient capacities would be eliminated for the appropriate design rainstorm and/or the allowable post-development discharge rate shall be limited at the discretion of the Director.

On-site retention and percolation of increased runoff from development shall be incorporated into the project design as feasible to meet this requirement. The use of detention, particularly in a closed system (pipe, lined basin, etc.) shall only be used if all other BMPs are demonstrated to be technically infeasible and is required to employ additional BMPs for small storm mitigations.

Guidance for design of detention and retention systems is available in Sections G and H of this part of the *Design Criteria*.

i) Restricted Watersheds & Increased Threshold Requirements for Large Projects:

Where a project is recognized as a Large Project and located within one of the specified watersheds below with known downstream restrictions, heightened flood control requirements shall be incorporated into the project design so as to reduce peak flow impacts to these regional waterways and drainage courses:

- a. Arana Gulch | 25-year storage & 10-year release rate
- b. Soquel Creek | 25-year storage & 10-year release rate
- c. Noble Gulch | 25-year storage & 10-year release rate
- d. Aptos Creek | 25-year storage & 5-year release rate
- e. Corralitos Creek | 10-year storage & 5-year release rate
- f. Salsipuedes Creek | 10-year storage & 5-year release rate

b. Requirements to Minimize Stormwater Pollutants of Concern

All development shall be designed to minimize the generation, transport and discharge of pollutants. Quantification demonstrating compliance with this

section is required for all large projects.

The project shall be designed to treat runoff using one of the onsite measures below, listed in the order of priority (highest to lowest).

- i) Retention Treatment Systems: Infiltration of the 2-year, 2 hour storm consistent with Section H of these criteria. The use of measures other than retention treatment systems shall only be used after technical infeasibility has been established.
- ii) Low Impact Development (LID) Treatment Systems: Implement harvesting and use, infiltration, and evapotranspiration measures that collectively achieve the following sizing criteria:
 - (1) LID systems shall be designed to retain the volume of runoff generated by the 85th percentile 24-hour storm event based on local rainfall data. See: https://www.waterboards.ca.gov/centralcoast/water_issues/programs/storm_water/docs/lid/lid_hydromod_charette_index.html
- iii) Biofiltration Treatment Systems: Implement biofiltration treatment systems that are demonstrated to meet or be at least as effective as a system with the following design parameters:
 - (1) Maximum surface loading rate appropriate to prevent erosion, scour and channeling within the biofiltration treatment system itself and equal to 5 in/hr., based on the flow of runoff produced from a rain event equal to or at least:
 - (a) 0.2 inches/hour intensity; or
 - (b) Two times the 85th percentile hourly rainfall intensity for the applicable area, based on analysis of historical records of hourly rainfall depth.
 - (2) Minimum surface reservoir volume equal to the biofiltration treatment system surface area times a depth of 6 inches.
 - (3) Minimum planting medium depth of 24 inches. The planting medium must sustain a minimum infiltration rate of 5 inches/hour throughout the life of the project and must maximize runoff retention and pollutant removal. A mixture of sand (60%-70%) meeting the specifications of American Society for Testing and Materials (ASTM) C33 and compost (30%-40%) may be used. Projects may utilize an alternative planting medium if it is demonstrated that the alternative is equal or more effective at attenuating pollutants as the specified medium mixture.

- (4) Proper plant selection (see Bioretention Plant List available from the Central Coast LID Initiative at: <https://www.centralcoastlidi.org/resources.php>)
 - (5) Subsurface drainage/storage (gravel) layer with an area equal to the biofiltration treatment surface area and having a minimum depth of: 12 inches or the calculated depth that will drain within 48 hours, whichever is greater. To calculate the depth that will drain within 48 hours the designer may utilize the saturated soil permeability and hydraulic conductivity values from the published physical properties table within the USDA- NRCS soil survey, or actual test values from a standardized testing procedure (see Section H, On-Site Retention of Stormwater Runoff).
 - (6) Underdrain with discharge elevation at top of gravel layer.
 - (7) No compaction of soils beneath the biofiltration facility (ripping/loosening of soils required if compacted).
 - (8) No liners or other barriers interfering with infiltration.
- iv) Non-Retention Based Treatment Systems – Implement stormwater control measures that collectively achieve at least one of the following hydraulic sizing criteria for non-retention based treatment system:
- (1) Volume Hydraulic Design Basis – Treatment systems whose primary mode of action depends on volume capacity shall be designed to treat stormwater runoff equal to the volume of runoff generated by the 85th percentile 24hour storm event, based on local rainfall data.
 - (2) Flow Hydraulic Design Basis – Treatment systems whose primary mode of action depends on flow capacity shall be sized to treat:
 - (a) The flow of runoff produced by a rain event equal to at least two times the 85th percentile hourly rainfall intensity for the applicable area, based on historical records of hourly rainfall depths; or
 - (b) The flow of runoff resulting from a rain event equal to at least 0.2 inches/hour intensity.

The BMP(s) used for water quality mitigation may be the same as those used to mitigate for stormwater discharge rates and volumes however both requirements must be fully met. If water quality treatment is provided with volume based design, 100% of the water quality volume must be provided below the detention

release elevation.

Large projects that discharge runoff directly to the ocean, lake, river, or stream shall include a full trash capture system consistent with State Water Resources Control Board Requirements

(https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html)

These systems may be combined with other water quality treatment systems. The trash capture system shall be designed to treat all runoff from the project site and from upstream watershed areas that drain to/through the project site.

c. Site Design and Runoff Reduction Requirements

All large projects shall incorporate the following minimum site design and runoff reduction strategies as feasible:

- i. Limit disturbance to creeks and natural drainage features.
- ii. Minimize compaction of soils.
- iii. Limit clearing and grading of native vegetation at the site to minimum area needed to build the project, allow access, and provide fire protection.
- iv. Minimize impervious surfaces and concentrate improvements on the least sensitive portions of the site, while leaving the remaining land in a natural undisturbed state.
- v. Minimize stormwater runoff by implementing the following site design measures as feasible:
 - (1) Direct roof, driveway, parking lot, sidewalk, walkway, patio and other impervious surface runoff onto vegetated areas safely away from building foundations and footings, consistent with the California building code.
 - (2) Construct bike lanes, driveways, uncovered parking lots, sidewalks, walkways, patios and other hardscapes with permeable surfaces.
 - (3) Direct roof runoff to cisterns or rain barrels for reuse.

d. Proof of Ongoing BMP Maintenance

It is important to consider who will be responsible for maintenance of a permanent Best Management Practice (BMP), and what equipment is required to perform the maintenance properly. As part of project review, if a project applicant has included or is required to include, structural or treatment control BMPs in project plans, the County will require that the applicant provide verification of maintenance provisions through such means as may be appropriate, including, but not limited to legal agreements, covenants, CEQA mitigation requirements and/or Conditional

Use Permits.

Figure SWM-25B is an example of a Stormwater Management Maintenance Agreement that can be updated for use on a specific project. The project designer shall establish specifications and requirements for the ongoing maintenance and monitoring to ensure proper functioning of stormwater management facilities and practices proposed as part of a development application and consistent with County Code 7.79. A Stormwater Management Maintenance Agreement shall be recorded by the property owner with the County Recorder's Office on the deed of any property to be served by a stormwater management facility. The Stormwater Management Maintenance Agreement shall include the following information:

- i. Statement of the operating requirements to ensure proper performance of the stormwater management facility.
- ii. Specification of any Best Management Practices that must be implemented and maintained. These shall include source control BMPs and storm drain signage and markings.
- iii. Specification of any restriction on system use or property use, such as limitations on amount of impervious surface, limits on fertilizer or pesticide use, limits on vehicle parking or maintenance, restrictions on building additions, additional impervious area coverage, etc.
- iv. Notification that County staff may conduct routine inspections of the facility to ensure that the stormwater facilities are functioning properly and being maintained as needed.
- v. Notification that the property owner may be assessed an annual service charge and/or re-inspection fee to cover the County costs of inspection and oversight. See the current Unified Fee Schedule for Stormwater Management Maintenance inspection and oversight fees. All large projects are required to identify a single entity who will be responsible for paying any/all annual inspection and oversight fees.
- vi. Notification that the property owner may be required to report to the County on the management and maintenance of the stormwater management facility. All large projects are required to report on at least an annual basis regarding system maintenance and are expected to be assessed an annual service charge. All large projects are required to identify a single entity who will be responsible for submitting the annual report.
- vii. An attached exhibit that shows the stormwater management facility location/s on the project site along with delineations of the sub watershed area/s draining to each facility and, where applicable, the path of access to be used by equipment and personnel for maintenance/repair/replacement. Each facility shall be labelled with a unique identifier.

viii. Include an attached exhibit that lists at a minimum for each stormwater mitigation: the operation and maintenance requirements, inspection and maintenance intervals, and symptoms of system failure or not functioning as designed. The annual report shall address each item from the attached exhibit and shall include unique identifier, date/s of inspection, name/s of inspector/s, and a detailed list of maintenance and repairs completed. The annual report shall include photos, as necessary, to document operation, maintenance and repairs completed. The maintenance agreement shall be binding on and shall inure to the benefit of the successors, heirs, executors, administrators, and assigns of the owner. All structural BMPs shall include inspection, maintenance, and field measurements, testing methods, etc., consistent with 2nd Nature's BMP RAM Field Protocols (see: http://2ndnaturewater.com/documents/BMPRAM_FieldProtocols.pdf).

e. **Alternate Offsite Compliance / Waivers**

A waiver for meeting the Design Standards of this section on the project site can be granted by the Director. In order to receive an on-site waiver, the project applicant must submit a request along with technical documentation describing reason(s) of impracticability. A waiver of impracticability shall be granted only when all other Structural or Treatment Control BMPs have been considered and rejected as infeasible. Recognized situations of impracticability include:

- i. extreme limitations of space for treatment on a redevelopment project,
- ii. unfavorable or unstable soil conditions at a site to attempt infiltration, and
- iii. risk of groundwater contamination because a known unconfined aquifer lies beneath the land surface or an existing or potential underground source of drinking water is less than 10 feet from the soil surface.

Off-site compliance with these criteria will be required when technical impracticability limits or prevents compliance with on-site facilities. Off-site compliance will only be considered after on-site technical impracticability has been demonstrated by meeting the above requirements. Allowable off-site compliance must be located in the same watershed as the proposed development project, must be located on private property, must be built prior to final construction approval of the proposed development, and must be accompanied by recorded maintenance and easement agreement(s) that guarantee the function and maintenance of the off-site mitigations for the development project lifetime. Allowance of off-site compliance is subject to approval by the Director and the CCRWQCB Executive Officer.

SECTION E – SOURCE CONTROL MEASURES

All projects with pollutant generating activities and sources as listed below shall implement permanent and/or operation source control measures as applicable. Measures for the following pollutant generating activities and sources shall be designed consistent with recommendations from the California Stormwater Quality Association (CASQA) Stormwater BMP Handbook for New Development and Redevelopment or equivalent

manual (see reference section M.1.i).
These activities and sources include:

1. Accidental spills or leaks
2. Interior floor drains
3. Parking/storage area maintenance
4. Indoor and structural pest control
5. Landscape/outdoor pesticide use
6. Pools, spas, ponds, decorative fountains, and other water features
7. Restaurants, grocery stores, and other food service operations
8. Refuse areas
9. Industrial processes
10. Outdoor storage of equipment or materials
11. Vehicle and equipment cleaning
12. Vehicle and equipment repair and maintenance
13. Fuel dispensing areas
14. Loading docks
15. Fire sprinkler test water
16. Drain or wash water from boiler drain lines, condensate drain lines, rooftop equipment, drainage sumps, and other sources
17. Unauthorized non-stormwater discharges
18. Building and grounds maintenance

Sewer laterals shall be kept free and clear of any storm water mitigations. Where site restrictions provide limited alternatives, the sewer lateral shall be on continuous/fused sewer pipe or encased in slurry. Refer to Part 4 Sanitary Sewer Design.

SECTION F – RIGHT-OF-WAY AND EASEMENT DEDICATIONS

1. The minimum width for easements to be dedicated for stormwater pathways shall be:

Conduits	$3 * \text{Depth} + \text{O.D.},$ (Minimum 10 feet) <i>Where O.D. = outside diameter of conduit</i>
Earth and Lined Channels	$\text{Bottom Width} + 3 * \text{Depth},$ (Minimum 5 feet)

The above minimum easement requirements are results of the requirements in the California Code of Regulations (CCR), Title 8, Section 1541.1 Requirements for Protective Systems for Excavations.

2. Drainage improvements not within County right-of-way that are to be County maintained shall be accompanied by corresponding reservations or dedications to the County of drainage easements of a minimum 15 feet width or as otherwise specified in the above section, or as specified by the Director. These drainage easements shall generally contain the improvements and any

necessary appurtenances. The County will accept easements only when they are wide enough to allow for open excavation for repair and replacement and vehicular access for inspection and maintenance. The vehicular access strip shall be 10 feet wide along the entire drainage course offered for dedication to the County. County staff shall review for minimum width and configuration of drainage easements offered for dedication to the County prior to the project developer completing site design.

In cases where drainage improvements that are to be County maintained are too far removed from easy points of access, the County may require a separate easement in order to gain and maintain vehicular access to the drainage improvements. The Director may accept a narrower easement after a project applicant demonstrates that site specific soil conditions are such that a narrower easement will allow for open trench excavation and still meet the CCR requirements for slope protection systems.

No permanent structures of any kind shall be placed in County drainage easements without the written permission of the Director. Any gates which must be constructed over such easements shall be a minimum of 10 feet in width and be noted on applicable improvement plans. Such gates shall have locking mechanisms compatible with existing County padlocks. Any obstructions in County easements can be removed by the County without compensation of any kind to the owner.

If the County is unable to remove an obstruction in its easement placed there by others and the owner is unresponsive to requests by the County to remove the obstruction, the County shall move against the owner to recover the costs associated with any extra work or any damages attributable to the obstruction.

3. If the parcel being developed receives existing runoff from an adjacent drainage area, the recordation of a drainage easement, maintenance agreement, deed restriction, or other document recorded on the parcel deed may be required. The recorded document shall acknowledge that the parcel does and will continue to receive upstream runoff, that the property owner is responsible for maintenance of the drainage pathway (natural and/or man-made) through the parcel, and that the County and Flood Control District(s) are not responsible for the upstream runoff or for maintenance of the drainage pathway.
4. Drainage improvements that are to be maintained by a homeowners' association or other private entity, including water quality treatment units, stormwater detention or retention facilities, and drainage facilities that serve more than one parcel, shall be located within common area parcels or private storm drain easements. Adequate access shall be provided to allow for maintenance or repairs. The final map and/or easement language shall include a restriction on buildings or structures of any kind within the easement/common area and shall identify who is responsible for the maintenance/repair/replacement of the drainage improvements.

SECTION G – ON-SITE DETENTION OF STORMWATER RUNOFF

1. Method
 - a. The standard method for calculating the required detention volume is the modified rational method. Please see Figure SWM-16 for a design example. See reference, Section M.1.d., “Practices in Detention of Urban Stormwater Runoff,” for further guidelines and practice description.
 - b. Other methods may be used with prior approval by the Director; however, a 25% safety factor shall be added to the storage volume determined by any such approved alternate method.
 - c. Common methods of providing detention are shallow surface swales in landscaped areas, underground structures or pipes, dry and wet detention basins and constructed wetlands.
 - d. Rock or sand-filled trenches and excavations may be used with the approval of the Director.
 - e. Stormwater management plans shall incorporate methods of design that include both resource and flood control protections, effective for a broad range of storms. Detention systems are typically used to address flood impacts from larger storms. Resource impacts are typically addressed with retention systems as detailed in Section H, along with other best management practices (BMPs) found in the references shown in Section M.1.h and i.

2. General Site Selection
 - a. When on-site detention is to be utilized, it is required that the engineer make provisions for the system in the preliminary planning of the site development and landscaping plans.
 - b. Detention facilities shall not produce hazardous conditions. Potential future legal liability shall be carefully considered by the designer.
 - c. Detention facilities serving any development in common shall be located within reserved common space, easily accessed for maintenance and inspection. All detention systems shall be located on private property.
 - d. Site selection and design shall give proper consideration to the path for excess flows downstream of the designated detention area.
 - e. Detention structures shall not be located where concentrated point-source industrial contaminants could enter the facility

unless such contaminants are isolated, treated or removed prior to runoff entering the facility.

- f. Provide a minimum 5-foot separation between the bottom of the detention basin and high groundwater levels.

3. Design Storm and Calculation Procedures

- a. If a detention system is required, the minimum criteria for providing on-site detention is that the maximum rate of runoff leaving the developed site shall not exceed the runoff rate from the pre-development site based on a 10-year storm, 15-minute time of concentration, including a 25% safety factor.
- b. If a detention system is required to meet groundwater recharge or water supply watershed requirements, see Section H (On-Site Retention of Stormwater Runoff) for sizing requirements.
- c. Higher levels of protection, provided by a lower allowable release rate and/or a larger storm to be detained, may be required if a substantial flooding hazard exists downstream.
- d. Restricted Watersheds & Increased Threshold Requirements

Where a project is located within one of the specified watersheds below with known downstream restrictions, heightened flood control requirements shall be incorporated into the project design so as to reduce peak flow impacts to these regional waterways and drainage courses:

- a. Arana Gulch | 25-year storage & 10-year release rate
- b. Soquel Creek | 25-year storage & 10-year release rate
- c. Noble Gulch | 25-year storage & 10-year release rate
- d. Aptos Creek | 25-year storage & 5-year release rate
- e. Corralitos Creek | 10-year storage & 5-year release rate
- f. Salsipuedes Creek | 10-year storage & 5-year release rate

Other local restrictions identified downstream of a project may necessitate additional on-site detention design requirements.

- e. The modified rational method, and therefore the standard calculations, are applicable in watersheds up to 20 acres in size.
- f. Detention design curves for required storage volumes, Figures SWM-15-a,b,c,d are provided for use by design engineers. These curves are based on the modified rational method assuming a 15-minute pre-development time of concentration, and a 0.9 post-project coefficient of runoff. There is a 25% safety factor in the curves. These design curves can be used for projects that meet the assumed conditions, or when the assumed conditions are conservative relative to the project conditions.

- g. The detention system shall be designed to provide the required volume and maximum release rate for the specified design storm requirements as well as safe release/overflow for the required design return period (see Section I.1).
- h. Storage areas shall be completely drained by properly sized discharge structures or pipes that limit the discharge flow rate (Q) to pre-development rates. The discharge structure shall be designed such that the allowable release rate will not be exceeded for any potential hydraulic gradients occurring for the design storm. Discharge structures shall be designed on the basis of inlet or outlet control, whichever is applicable, reflecting the actual stage-discharge relationship, rather than assuming the structure is flowing under constant uniform flow as determined by Manning's equation.
- i. The use of pumps as the primary low flow bypass is not permitted.
- j. Detention systems shall be designed so that the facility completely drains within 48 hours from the cessation of storm runoff.
- k. Required detention volume determinations shall be based on all net new/and replaced impervious area, both on-site and off-site, resulting from the proposed project. Pervious areas shall not be included in detention volume sizing (an exception may be made for incidental pervious area less than 10% of the total area.) If existing impervious areas will be directed to the detention system, the system must be designed to accommodate all runoff that is directed to the system.
- l. On-site drainage systems, other than the detention facility, shall be designed to carry any off-site drainage entering the site from adjacent parcels. This off-site drainage shall bypass the on-site detention facility so that the storage volume is used only for the runoff generated by the development. If off-site drainage must enter the on-site detention system, calculations shall be submitted that demonstrate appropriate storage volume and release structure design.
- m. For underground structural detention systems, the pre-development runoff flow shall bypass the detention facility so that the storage volume is used only for the additional runoff generated by the development and/or redevelopment. Above ground detention systems may or may not allow bypass of pre-development runoff, depending on water quality treatment goals.
- n. Where a redevelopment project results in an alteration of less than 50 percent of the impervious surface of a previously existing permitted development, only runoff from the new and/or replaced impervious surface of the project are required to be routed to and included in the detention design. Runoff from other areas shall bypass the detention system and discharge separately from the site, unless an alternative design is approved in advance by the Director. Any runoff

not bypassed shall be included in the design of the detention system storage volume in addition to the volume required due to the project.

- o. Where both retention and detention requirements are made, a combined system may be designed. However, both requirements must be fully met, and 100% of the retention volume must be provided below the detention release elevation.
- p. Ground percolation as a means of disposal shall be substantiated with adequate soils data and will normally be approved only if soils conditions are particularly well suited for percolation.

4. Contaminant Screening

- a. Detention systems shall be designed to minimize clogging and future maintenance.
- b. Leaves, twigs, gravel, sand, silt, and other debris with a potential to clog outlet facilities shall be prevented from entering the detention structure by screening or filtering, or shall be separated from the flow with a hydraulic trap.
- c. Runoff from paved areas with concentrations of oils and other chemicals shall require water quality treatment upstream of the detention facility. Vegetative treatment measures can be used in place of structural devices. Such use is subject to approval by the Director.
- d. The end(s) of any runoff storage chamber shall be provided with a cleanout and inspection access riser reaching the ground surface. No cleanout riser shall be less than 6 in diameter.

5. Structural Components

- a. Gravel packed detention chambers shall specify on the plans aggregate that is washed, angular, and uniformly graded (of single size), assuring void space not less than 35%. The uniform gravel size may be chosen from sieve #4 to 2 inches. Well graded and rounded aggregates shall not be used.
- b. Gravel packed chambers shall be screened from surrounding soils with the use of a geotextile fabric filter envelope providing high permittivity. A sand/gravel filter envelope (6 inches min.) may be used in place of geotextile fabric, with supporting filter gradation design submitted.
- c. Structural pipe/arch detention chambers shall specify on the plans the materials used and the means of structural end closure. Corrugated steel, wood and other toxic or deleterious materials shall not be used.
- d. All structures shall be designed to bear the dead and live loads placed

upon them without harm to the long-term function of the detention facility.

6. Drainage Plan Drawing and Calculation Submittal Requirements
 - a. Designate and dimension the area to be used for the detention facility installation with a perimeter line, hatching, and specific notation.
 - b. Show the location of any leach field within 50 feet of the detention facility.
 - c. Note land slope gradient at and below the detention facility, and/or provide contours.
 - d. Describe soil profile layers and note permeability range(s), or provide site test results for facilities that incorporate ground percolation as a means of disposal.
 - e. Note surface vegetation type or mulch coverage for surface impoundments.
 - f. Draw and label pipe routings and related appurtenances.
 - g. Specify structural materials to be used.
 - h. Include drawn detail views and cross sections that assure adequate construction information for all components, including the inlet and outlet structures.
 - i. Provide a map showing boundaries of both impervious areas and actual drainage areas routed to the hydraulic control structure of the detention facility, clearly distinguishing between the two areas, and noting the square footage of each.
 - j. Provide calculations for detention volume sizing and the hydraulic control structures, based on the appropriate drainage areas.

7. Regulatory

The Environmental Protection Agency (EPA) defines a class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Such stormwater drainage wells are “authorized by rule.” For more information on these rules, contact the EPA. A web site link is provided from the [County DPW Stormwater Management web page](#). The County does not exclude the design and use of detention facilities that may fall under these EPA regulations.

8. Maintenance

- a. The developer/property owner shall record a maintenance agreement (Fig. SWM-25A or SWM-25B) for the future maintenance and inspection of the detention system in compliance with Section C.2.k/C.3.k. A copy of the recorded agreement shall be provided to Public Works.
- b. Drainage easements shall be provided, if required, to ensure perpetuity of detention areas when constructed as permanent drainage facilities.
- c. If special maintenance procedures are required to maintain the long-term functioning of the detention facility, these procedures shall appear on the final plans and shall be recorded with the maintenance agreement on the private property deed, or in the homeowners' association covenants, conditions, and restrictions (CC&Rs).
- d. It is the responsibility of the developer/owner to operate and maintain the detention system so that it meets the original design intent.
- e. The detention system shall be inspected at least once annually and maintained as needed by the owner. For all large projects, the owner shall forward a letter to the County Department of Public Works prior to October 15 of every year stating the date and type of services performed on the detention system.

SECTION H – ON-SITE RETENTION OF STORMWATER RUNOFF

1. Standard Methods

- a. Two standard methods are described in this section:
 - 1) Runoff retention by the Slope Infiltration Method
 - 2) Runoff retention by the Storage Percolation Method

Further conceptual description is provided for these methods within this section and in the design examples that follow (See Figures SWM-21 and SWM-23).

- b. For related procedures used to develop the storage percolation method, refer to the design examples for both detention and retention, and the reference listed in Section M.1.d., “Practices in Detention of Urban Stormwater Runoff.”
- c. This section establishes minimum standards for retention of stormwater runoff. Use of another retention design method may be allowed with

prior County approval but must equal or exceed the recharge capabilities provided by the standard criteria to the satisfaction of the Director.

- d. Stormwater management plans shall incorporate methods of design that include both resource and flood control protections, effective for a broad range of storms. Retention systems are typically used to address resource impacts from smaller storms, along with other best management practices (BMPs) found in the references shown in Section M.1.h and i. Flood impacts are typically addressed with structural detention systems detailed in Section F.

2. General Site Selection

- a. Implementation of retention systems shall be provided for in the preliminary planning of the site development layout, grading, and landscape plans to assure that suitable land areas are available and use conflicts do not arise.
- b. The selected area shall not be in conflict with other uses or conditions such as steep slopes, leach fields, parking areas, graded or compacted soils, or any use or condition compromising the infiltration capabilities of the designated retention area or the stability of the local area.
- c. Retention facilities shall not produce hazardous conditions. Potential future legal liability shall be carefully considered by the designer.
- d. Retention facilities serving any development in common shall be located within reserved common space, easily accessed for maintenance and inspection. All retention systems shall be located on private property.
- e. Site selection and design shall give proper consideration to the path for excess flows downstream of the designated retention area.
- f. Retention structures shall not be located where concentrated point-source industrial contaminants could enter the facility unless such contaminants are isolated, treated or removed prior to runoff entering the facility.
- g. Slope Method Site Selection
 - 1) The selected area shall have uniform planar to convex slopes, free of rills and channels that concentrate flow.
 - 2) The slope shall be biologically active and well vegetated with ground covering sod and plants, or heavy leaf, bark or pine needle mulches, or equivalent.

- 3) Perforated pipe shall be laid parallel to the slope contour, and preferably secured at the surface, or with minimal burial and protective cover.

- h. Storage Method Site Selection

Retention facilities with concentrated storage shall be located at least 10 feet from any habitable or high value structure (unless specifically approved by the project geotechnical engineer), and a minimum of 25 feet from any septic leach field.

3. Slope Stability

- a. Either method may be used on slopes up to 15% without special provisions.

For site locations on or in the near vicinity of prior landslides, consult a geotechnical engineer and provide a signed, stamped letter of feasibility.

- b. Slope Method Slope Stability

Retention site location on or immediately above slopes of 15% to 25% will require site-specific erosion analysis, and possibly additional improvement measures. (See Figures SWM-19a and 19b.) For slopes exceeding 25%, consult a geotechnical engineer and provide a signed, stamped letter of feasibility.

- c. Storage Method Slope Stability

Retention site location on or immediately above slopes exceeding 15% will require consulting a geotechnical engineer to provide a signed, stamped letter of feasibility.

4. Site Soils

- a. Saturated soil permeability and hydraulic conductivity values may be used conservatively (low end of the range provided) from the published physical properties table within the USDA- NRCS soil survey at the depth corresponding to the bottom of the retention facility, or use actual test values. Other soil information may be found within this survey, including engineering index properties, restrictive layers and high groundwater occurrence. A web site link to the soil survey for Santa Cruz County is provided from the [County DPW Stormwater Management web page](#). If actual test values will be used, provide test configuration results and analysis to account for surface area to volume ratio used (diameter of test holes, backfilling, etc.) and calculate an adjusted design infiltration rate. Percolation test results cannot be used directly as a design infiltration rate without making the above adjustments.
- b. Site-specific soil data from geotechnical or septic system investigations shall be used when available and appropriate.

c. Slope Method Site Soils

- 1) The slope infiltration method has limited applicability for fully effective infiltration on surface soils having less than 0.6 inches/hour permeability (4.00 um/sec saturated hydraulic conductivity) in the upper 12 inches of the soil profile. However, the method may still be used as a best management practice to provide partial infiltration, runoff retardance (delay), filtration and erosion control.
- 2) For project sites with saturated soil permeability less than 120% of the design storm intensity, the design engineer shall consider storage methods to percolate runoff.
- 3) Areas designated for slope infiltration shall be kept free and clear. Plans shall delineate the entire infiltration area to be maintained as part of the stormwater maintenance agreement.

d. Storage and Slope Method Site Soils

The maximum saturated permeability assumed shall be capped at 8.0 inches/hour.

5. Design Storm and Calculation Procedures

- a. A design storm of 2-year return interval and 2-hour duration shall be used for retention design.
- b. When using the Modified Rational Method procedure for retention, the 2-hour pre-development “retention threshold rate” shall be held as a constant value released to the soil, similar to detention procedure usage of “allowable release rate.”
- c. Required retention volume determinations shall be based on both on-site and offsite impervious areas. Pervious areas shall not be included in retention volume sizing (an exception may be made for incidental pervious areas less than 10% of the total area).
- d. All of the impervious area runoff, or equivalent volume, shall be routed to the retention facility. Initial bypass of pre-development design storm flows, or other smaller storms, is not allowed. Where more drainage area than the impervious surfaces is received, and for larger storms, appropriate overflow facilities shall be provided.
- e. A safety factor for volume is not required for the retention storage method.
- f. Where both retention and detention requirements are made, a combined system may be designed. However, both requirements must be fully met,

and 100% of the retention volume must be provided below the detention release elevation.

6. Contaminant Screening

- a. Retention systems shall be designed to minimize clogging and future maintenance.
- b. Leaves, twigs, gravel, sand, silt, and other debris with a potential to clog perforated pipes, structural chambers, or gravel packing shall be prevented from entering the retention structure by screening or filtering, or shall be separated from the flow with a hydraulic trap.
- c. Runoff from paved areas with concentrations of oils and other chemicals shall require water quality treatment upstream of any Storage Method retention facility. Vegetative treatment measures can be used in place of structural devices, and may be integral to the Slope Method retention facility. Such use is subject to approval by the Director.
- d. The end(s) of any perforated line or structural chamber shall be provided with a cleanout and inspection access riser reaching the ground surface. No cleanout riser shall be less than 6 inches diameter.

7. Structural Components

- a. Gravel packed retention chambers shall specify on the plans aggregate that is washed, angular, and uniformly graded (of single size), assuring void space not less than 35%. The uniform gravel size may be chosen from sieve #4 to 2 inches. Well-graded and rounded aggregates shall not be used.
- b. Gravel packed chambers shall be screened from surrounding soils with the use of a geotextile fabric filter envelope providing high permittivity. A sand/gravel filter envelope (6 inches min.) may be used in place of geotextile fabric, with supporting filter gradation design submitted.
- c. Structural pipe/arch retention chambers shall specify on the plans the materials used, perforation size and density, and the means of structure end closure. Corrugated steel, wood and other toxic or deleterious materials shall not be used.
- d. All structures shall be designed to bear the dead and live loads placed upon them without harm to the long-term function of the retention facility.

8. Sizing Limits

a. Slope Method

- 1) The maximum slope length for maintaining sheet flow shall not exceed 100 feet and shall be less as conditions dictate, with 30 feet typical. This requires site observation by the designer to determine.
- 2) The minimum length of perforated pipe shall be 6 feet. The maximum length shall be 40 feet or 60 feet if teed, per outfall.
- 3) For calculated pipe lengths less than 6 feet, disperse downspout runoff over a splash block or gravel pad.
- 4) Perforations shall be spaced no more than 6 inches apart, and be no smaller than 3/8 inches diameter, or equivalent.
- 5) The minimum perforated pipe diameter shall be 3 inches.
- 6) A 75% surface distribution efficiency factor shall be applied to the determined infiltration surface area.

b. Storage Method

- 1) The maximum runoff area to be directed to a Storage Method facility is 20 acres. For larger areas please consult with the Stormwater Management section.
- 2) Storage Method retention systems shall be designed so that the facility completely drains within 48 hours from the cessation of storm runoff.
- 3) Provide a minimum 5-foot separation between the bottom of the retention basin and high groundwater levels.

9. Drainage Plan Drawing and Calculation Submittal Requirements

- a. Designate and dimension the area to be used for the retention facility installation with a perimeter line, hatching, and specific notation.
- b. Show the location of any leach field within 50 feet of the retention facility.
- c. Note land slope gradient at and below the retention facility, and/or provide contours.
- d. Describe soil profile layers and note permeability range(s), or provide site test results.
- e. Note surface vegetation type or mulch coverage for surface

impoundments and runoff distribution slopes.

- f. Draw and label pipe routings and related appurtenances.
- g. Specify structural materials to be used.
- h. Include drawn detail views and cross sections that assure adequate construction information for all components.
- i. Provide a map showing boundaries of both impervious areas and actual drainage areas routed to the retention facility, clearly distinguishing between the two areas, and noting the square footage of each.
- j. Provide calculations for retention volume sizing and any hydraulic control structures, based on the appropriate drainage areas.

10. Exclusions and Non-Feasibility

- a. Small and Medium Projects as described in Section D are exempt from specific quantitative retention requirements. Qualitative measures, such as site best management practices to control and reduce runoff, shall still be employed as required.
- b. For situations where zoned GIS mapping is found to be in question, requests for exclusion shall be submitted by letter to the County hydrologist in the Environmental Health Department. This may specifically apply to mismatches between interrelated groundwater recharge, soils data, and parcel map digitized boundaries.
- c. Other claims of non-feasibility shall require a stamped and signed letter from an appropriate professional clearly stating the technical basis for the non-feasibility determination, including specific documentation of the conditions causing nonfeasibility. Generalized opinions of non-feasibility will not be accepted.
- d. Where retention is found to not be feasible lower priority on-site measures shall be employed to minimize stormwater pollutants of concern (see Sections D.2.b and D.3.b.b).

11. Regulatory

The Environmental Protection Agency (EPA) defines a class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Such stormwater drainage wells are “authorized by rule.” For more information on these rules, contact the EPA. A web site link is provided from the [County DPW Stormwater Management web page](#). The County does not

exclude the design and use of retention facilities that may fall under these EPA regulations.

12. Maintenance

- a. The developer/property owner shall record a maintenance agreement (Fig. SWM- 25A and SWM-25B) for the future maintenance and inspection of the retention system in compliance with Sections D.2.d and D.3.d. A copy of the recorded agreement shall be provided to Public Works.
- b. Drainage easements shall be provided, if required, to ensure perpetuity of retention areas when constructed as permanent facilities.
- c. If special maintenance procedures are required to maintain the long-term functioning of the retention facility, these procedures shall appear on the final plans and shall be recorded with the maintenance agreement on the private property deed, or in the homeowners’ association covenants, conditions, and restrictions (CC&Rs).
- d. It is the responsibility of the developer/owner to operate and maintain the retention system so that it meets the original design intent.
- e. The retention system shall be inspected at least once annually and maintained as needed by the owner. For all large projects, the owner shall forward a letter to Public Works prior to October 15 of every year stating the date and type of services performed on the retention system.

SECTION I – HYDROLOGY – MINIMUM DESIGN REQUIREMENTS

- 1. All drainage improvements shall be designed to convey a minimum 10-year storm. In addition, means of conveying flood overflows from the site as well as the total tributary drainage basin with full build-out based on current zoning or general plan land use shall be designed for in accordance with the following criteria:

TRIBUTARY DRAINAGE AREA	FLOOD OVERFLOW DESIGN RETURN PERIOD
a. 0 - 100 acres	25 year
b. 101 - 400 acres	50 year
c. Over 400 acres	100 year
d. Cross culverts on publicly maintained roads	100 year
e. Bridge structures	100 year or flood of record, if greater

- 2. The return period used may be required to be greater than the minimum cited

above, if in the opinion of the Director, project failure would cause unreasonable economic loss.

3. The method of calculating storm runoff shall be based on the size of the tributary basin. The Rational Method, $Q=C_aC_iA$,* may be used for basins less than 80 hectares (200 acres). For larger areas, the Unit Hydrograph Method, Soil Conservation Service Methods, USGS Regional Regression Equations for the Central Coast Region (with a 25 percent safety factor), or other methodology approved in advance by the Director may be required.
4. Runoff coefficients to be used with the Rational Method are given in Figure SWM-1, or they may be calculated by the engineer subject to approval by the Director. Antecedent moisture conditions shall be taken into account in using the Rational Method. Factors are included in Figure SWM-1.
5. Rainfall intensity shall be determined by using the isopleths and the intensity and duration curves given in Figures SWM-2 and SWM-3. Alternatively, an equation is provided with Figure SWM-3 that can be used to compute intensity.
6. Minimum time of concentration used for intensity calculations shall be 10 minutes to the first inlet or culvert entrance, or less at the discretion of the Director.
7. Time of concentration for overland flow in a drainage basin with defined channels shall be determined by using the nomograph in Figure SWM-4, or by other methods approved in advance by the Director.

SECTION J – HYDRAULIC REQUIREMENTS

1. Generally, Manning's equation shall be used to determine flows in pipes or channels. Values for Manning's Roughness Coefficient (n) shall be as shown in Figure SWM-5.
2. Upstream and downstream flow conditions with associated backwater effects shall be taken into account where necessary. Hydraulic analysis of existing systems shall include verification that hydraulic capacity remains adequate by present standards throughout the system evaluated, and shall not rely solely on hydraulic structure entrance or exit dimensions. 'As-built' plans may be referenced, where such plans are not older than 20 years and there are no known alterations to the original system. Downstream and upstream channel or structure improvements may be required at the discretion of the Director, subject to approval by the reviewing body.
3. Design flood overflow protection shall provide 12 inches freeboard below the finish floor elevations of all affected existing and proposed habitable structures where possible.
4. In providing for design flood overflow protection, roadway overflow is not permitted, except on private roads where it can be shown that such overflow

will not create an unreasonably hazardous condition.

5. The maximum water depth permitted for flood overflow on onsite parking and driveway areas is 6 inches.
6. Culverts may be designed utilizing available head at the inlet, provided that adequate slope protection and energy dissipation are placed at both ends of the culvert to prevent scour and erosion.
7. The design flow (as specified in Section I) of drainage pipe systems shall allow for a minimum freeboard of 8 inches between the top of the inlet grate or manhole cover and the design water surface elevation for a 10-year storm.
8. Proper allowance for losses through junction structures, inlets, and manholes shall be made in determining the hydraulic grade line or water surface elevations.
9. Minimum velocity at design flow shall be 2 feet per second.
10. Gutter flow for the required design flow shall not exceed 5 inches in depth for Type A or C curb or 4 inches for Type B curb.
11. The effect of debris, erosion, and channel bedload during flood flows shall be considered in the design of inlets, culverts and bridge structures.
12. See Figures SWM-6 and SWM-7 for a standard drainage system calculation sheet and instructions.

SECTION K – STORM DRAIN FACILITIES

1. Concrete valley gutters are not permitted across collector or arterial streets, or across uncontrolled intersections.
2. Pipe Systems
 - a. Minimum pipe diameter shall be 18 inches within County rights-of way, easements, and offers of dedication. Smaller diameter pipe may be used only with prior approval of the Director.
 - b. Maximum spacing of access openings shall be 500 feet.
 - c. Access openings shall be provided at all horizontal angle points and changes in grade or pipe size.
3. Curves will be allowed in pipe systems only when the pipe diameter is 36 in or larger, at the discretion of the Director. Geometry of any such curves shall conform to the pipe manufacturer's specifications.

4. Pipe Materials

- a. Reinforced concrete, polyvinyl chloride (PVC), or high-density polyethylene (HDPE) pipe shall be used for all drainage facilities constructed in County rights-of-way except where approval is obtained from the Director for use of an alternate type of pipe. All pipes shall have smooth interior walls and shall withstand fill loads and H- 20 highway loading. All joints shall be rubber- gasketed and watertight.
 - b. Corrugated metal pipe (CMP) and pipe-arch may be used only with prior approval of the Director. All CMP must be galvanized and fully coated (both interior and exterior surfaces) with a bituminous material. Hydraulic demands may also dictate that CMP be fully paved with a durable bituminous lining applied to the inside surface, filling and covering the corrugations so as to form a smooth surface.
 - c. Corrugated aluminum pipe (CAP) may be used only with prior approval of the Director. To use bare aluminum pipe, a certified report must be submitted to Public Works, showing that the pH of the soil is between 5.5 and 8.5 and the resistivity is 1500 ohm-cm or greater. Additionally, the average velocity through the pipe shall be less than 10 feet/second with no significant abrasive channel bedload.
 - d. All culvert materials and trench backfill shall conform to the manufacturer's specifications, the provisions set forth in the latest edition of Caltrans' *Standard Specifications* and *Standard Plans*, and the *Design Criteria*.
 - e. Minimum pipe size is 18 inches for road culverts.
 - f. Minimum pipe size is 12 inches for driveway culverts.
 - g. Minimum pipe size is 12 inches for road cross drains with catch basins at both ends.
 - h. As a general rule a bridge structure will be required at drainage channel crossings where the peak design flow dictates a culvert 6 feet in diameter or greater. At the discretion of Planning, exceptions to this rule may be made based on drainage basin characteristics, such as slash and debris, soil type, bedload and channel geometry.
5. Headwalls, downdrains, rip-rap and/or other adequate channel slope and bottom protection measures shall be required at the inlet and outlet of all proposed drainage facilities that produce velocities greater than those shown in SWM-19b for the corresponding soil type. Erosion protection facilities shall be incorporated for design flood overflow conditions where reasonably possible.
 6. Inlets and Structures

- a. County standard type GO inlets shall be used within County right-of-way whenever possible (Figures SWM-8a and SWM-8b).
- b. Caltrans type G1 and G2 inlets (without curb openings) may be used where County standard inlets are not practical and with prior approval of the Director.
- c. Caltrans type GDO inlets may be used when larger inlets are needed.
- d. Storm drain manholes may be used as junction structures, or as inlets where inlet capacity is not critical (Figure SWM-10).
- e. Smaller precast concrete catch basins are permitted on private property where appropriate.
- f. Connections of new pipes to existing catch basins or other structures shall conform to Figure SWM-9.

SECTION L – FIGURES

Figure SWM-1: 10-Year Runoff Coefficients

<u>Type of Area</u>	<u>10-Year Runoff Coefficients</u>
Rural, park, forested; agricultural	0.10 – 0.30
Low residential (Single family dwellings)	0.45 – 0.60
High residential (Multiple family dwellings)	0.65 – 0.75
Business and commercial	0.80
Industrial	0.70
Impervious	0.90

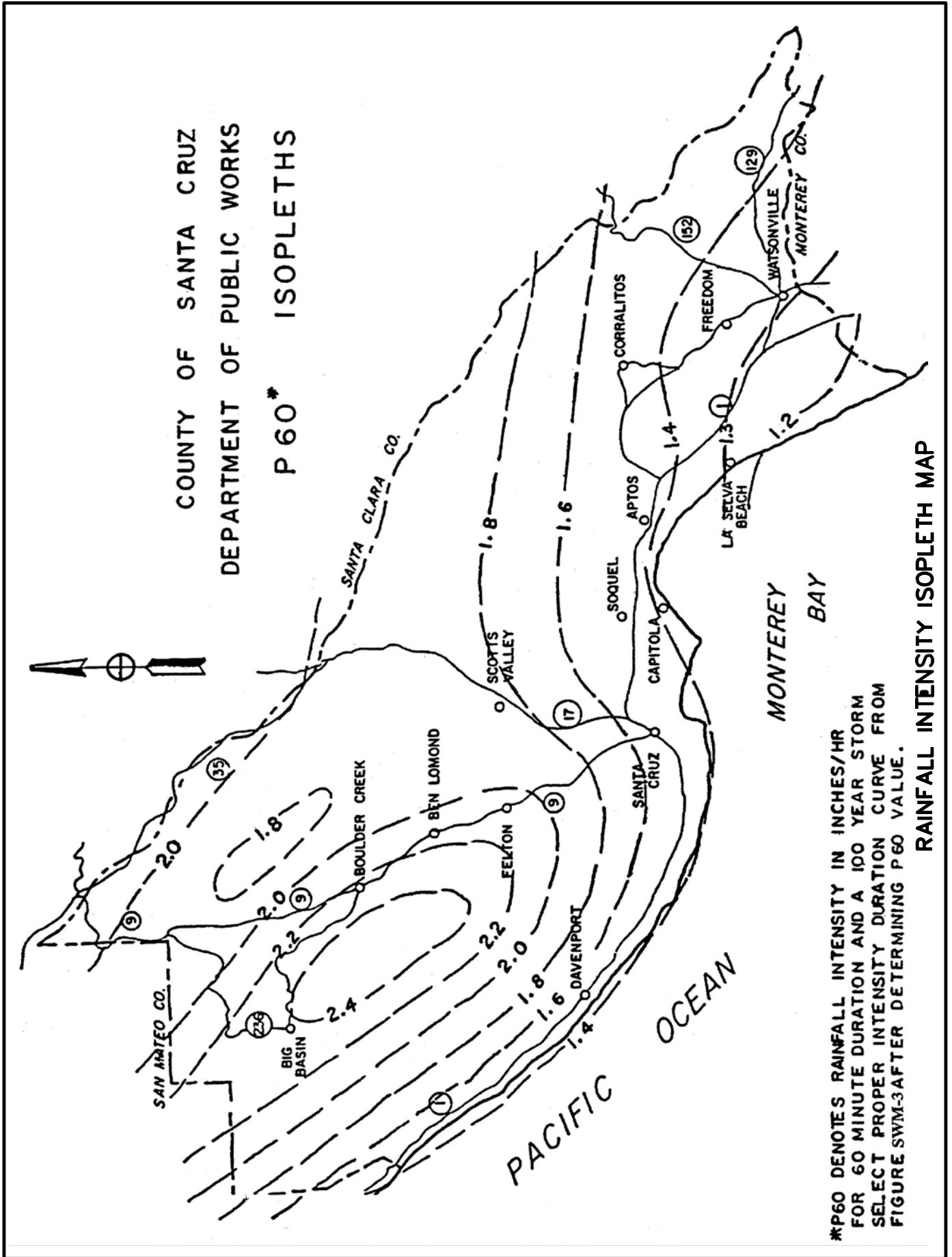
REQUIRED ANTECEDENT MOISTURE FACTORS (Ca) FOR THE RATIONAL METHOD*

<u>Recurrence Interval (Years)</u>	<u>Ca</u>
2 to 10	1.0
25	1.1
50	1.2
100	1.25

Note: Application of antecedent moisture factors (Ca) should not result in an adjusted runoff coefficient (C) exceeding a value of 1.00

*APWA Publication “Practices in Detention of Stormwater Runoff”

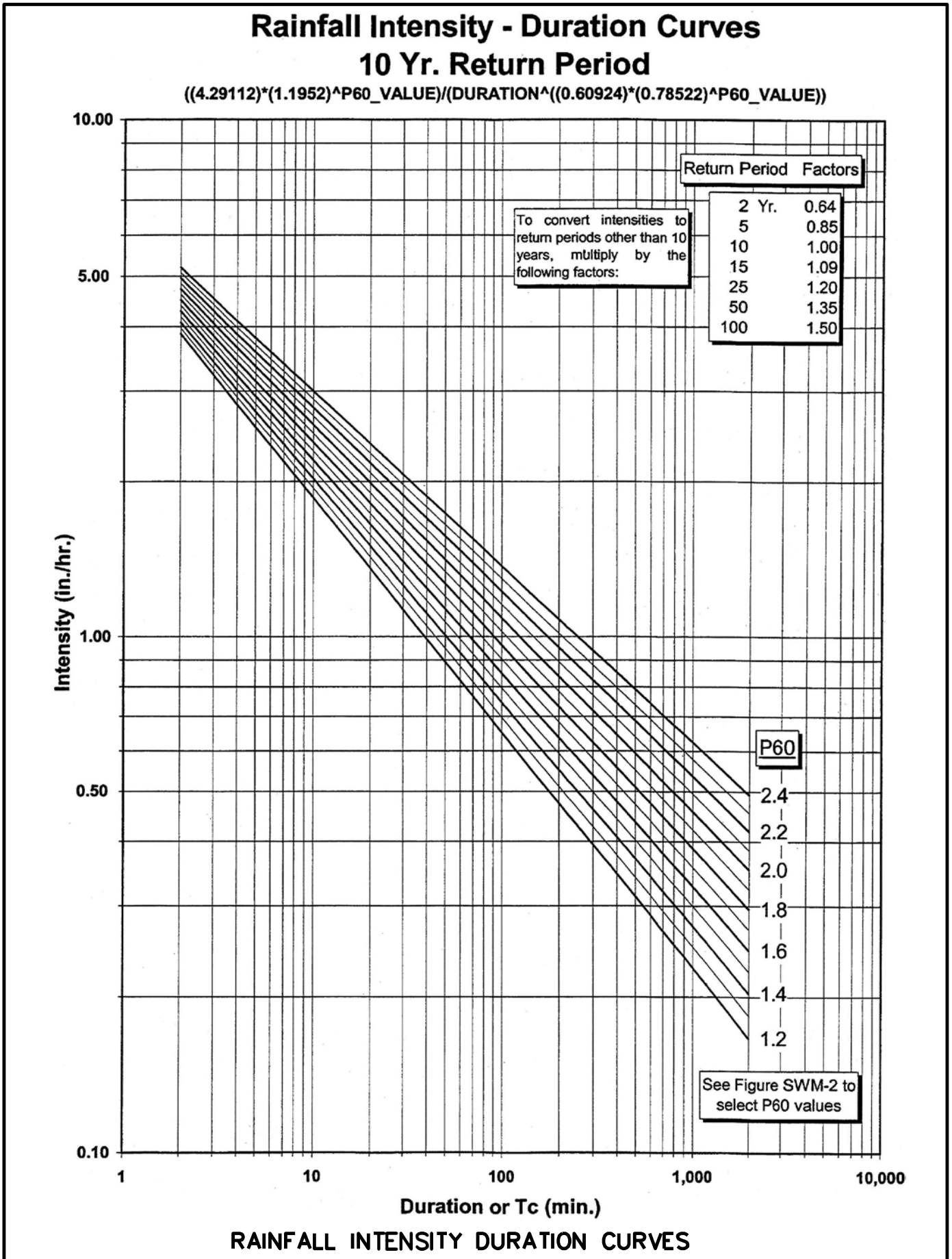
Figure SWM-2: Rainfall Intensity Isopleths



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FIG. SWM-2

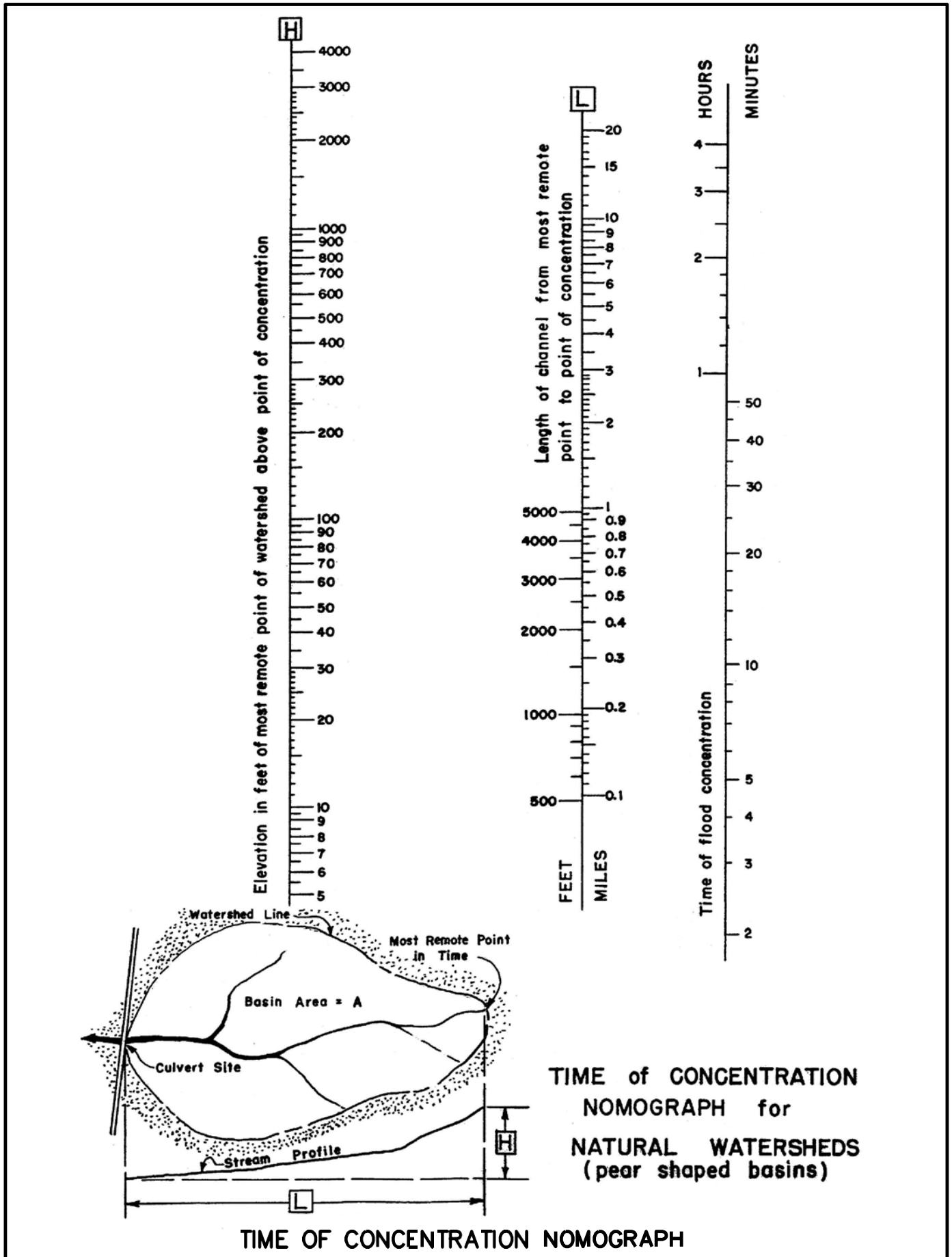
Figure SWM-3: Rainfall Intensity - Duration Curves



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FIG. SWM-3

Figure SWM-4: Time of Concentration Nomograph



REV 8/76

FIG. SWM-4

Figure SWM-5: Pipe and Channel Roughness Coefficients

<u>Type of Channel</u>	<u>Roughness Coefficient</u>
Plastic (PVC, ABS, or HDPE)	0.010 to 0.012
Concrete gutters	0.015
Corrugated metal (annular corrugations)	0.024
Reinforced concrete pipe 12 to 21 inches	0.015
Reinforced concrete pipe 24 to 33 inches	0.013
Reinforced concrete pipe 36 inches and larger	0.011
Lined Channels	
Concrete	0.014
Air Blown Mortar	0.016
Bituminous	0.018
Sacked Concrete	0.025
<p>To determine roughness coefficients for natural channels, refer to “Handbook of Hydraulics,” King & Brater; “Open-Channel Hydraulics,” V.T. Chow; or “Street and Highway Drainage,” Institute of Transportation, University of California</p>	
PIPE AND CHANNEL ROUGHNESS COEFFICIENTS	

Figure SWM-6: Drainage System Calculation Sheet

DRAINAGE SYSTEM CALCULATION																																																																																																												
PROJECT: _____	Return Period Factor _____	Antecedent Moisture Factor (Ca) _____	Calc by: _____	Date: _____	Date: _____																																																																																																							
P60 = _____	Design Storm _____	Years _____																																																																																																										
INLET OR JUNCTION STRUCTURE			ACCUMULATED FLOW				PIPE FLOW					LOSSES		Outlet Control		Inlet Control		PIPE F.L.		INLET FREEBOARD																																																																																								
1	AREA DESIGNATION	Area A (ac)	C	A°C	Tc (min)	I (in/hr)	Q (cfs)	CaCIA	Q (cfs)	I (in/hr)	Σ Tc (min)	Tc (min)	Σ A°C	PIPE LINE DESIGNATION	L (ft)	D (in)	Type	n	V (fpm)	V (fps)	Pipe Area (sq ft)	Sn	FRIC. L*Sn (ft)	Hi (ft)	Σ H (ft)	21	W.S. Elev.	T.G. Elev.	22	23	W.S. Elev.	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

DRAINAGE SYSTEM CALCULATION SHEET

COUNTY OF SANTA CRUZ

DEPARTMENT OF PUBLIC WORKS

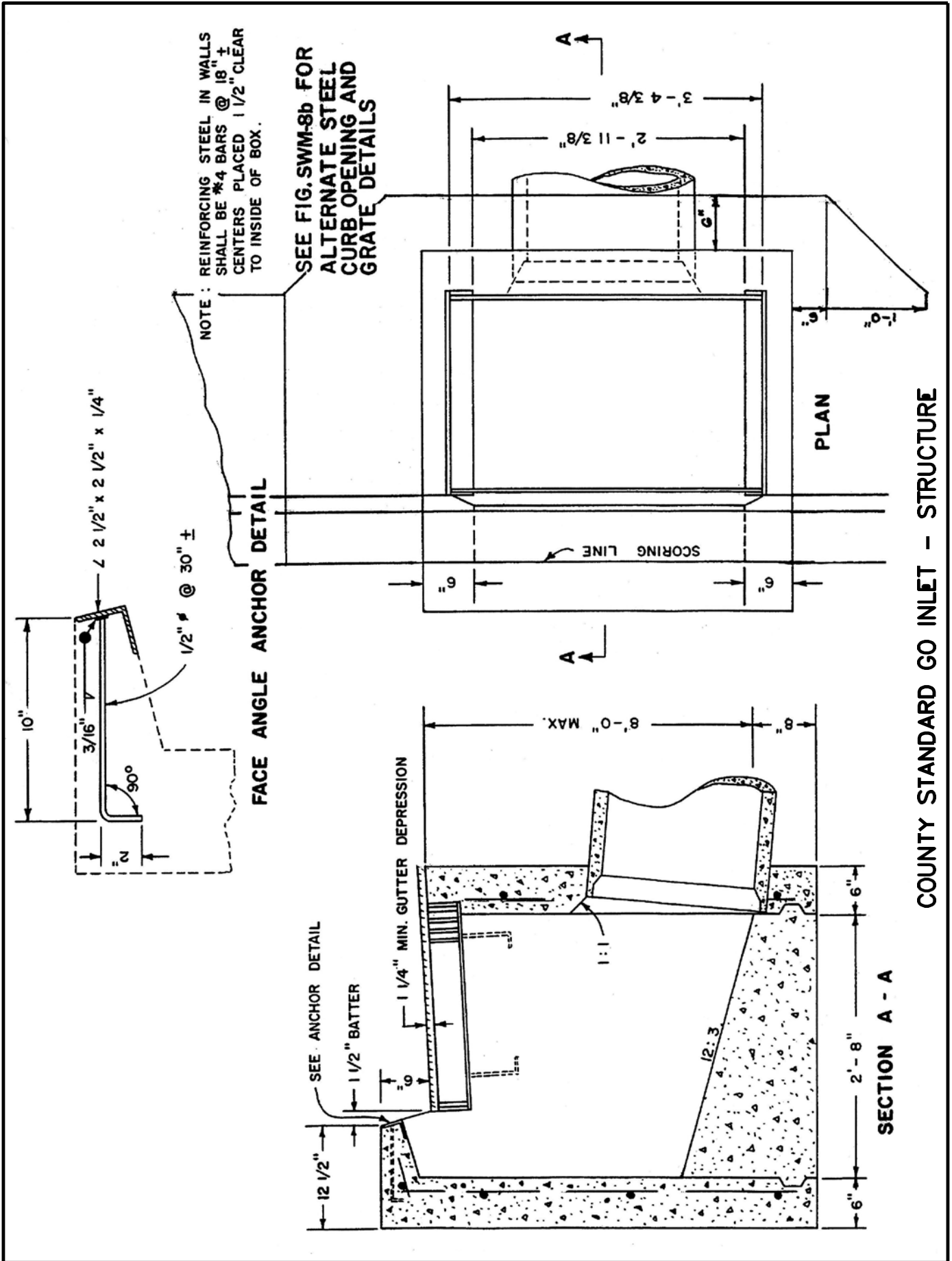
Instructions and notes for "DRAINAGE SYSTEM CALCULATION" sheet (SWM-6).

Circled numbers below refer to circled numbers shown in column headings on the calculation sheet.

- 1 **AREA DESIGNATION** — Designate each drainage area beginning with the uppermost reach by a letter (e.g., B).
- 2 **AREA A** — Areas in acres of each drainage area draining to inlet 7.
- 3 **C** — Runoff coefficient for drainage AREA A 2. See County Design Criteria (CDC). Future land use shall be taken into account.
- 4 **A * C** — Drainage AREA A 2 multiplied by runoff coefficient C 3.
- 5 **Tc** — Time of concentration in minutes for drainage AREA A 2. See CDC. Minimum time is 10 minutes, or less if required by the County.
- 6 **I** — Rainfall intensity in inches per hour for Tc 5. See CDC.
- 7 **Q** — Runoff flow in cubic feet per second from $Q = CIA$ (Rational Formula). Multiply A * C 4 by lower portion of I 5.
- 8 **JUNCTION DESIGNATION** — Designate each inlet and manhole by a number (e.g., 3) and each junction (more than one inlet pipe) by a number and J (e.g., 4J).
- 9 **Σ AC** — Progressive accumulation of A * C 4.
- 10 **Σ Tc** — Progressive accumulation of time of concentration to upstream end of pipe to be sized beginning with Tc 5. (e.g., Tc 5 + Δ Tc₂ 9 = Σ Tc₂ + Δ Tc₃ = Σ Tc₃). Use whichever is largest value Tc 5 or Σ Tc 9 for determining runoff Q 11.
- 11 **Δ Tc** — Pipe flow travel time in minutes. Divide L 13 by V (fpm) 16.
- 12 **I** — Rainfall intensity in inches per hour for Σ Tc 9. See CDC.
- 13 **Q** — Runoff flow in cubic feet per second for accumulated area. Multiply Σ A * C 8 by I 10.
- 14 **PIPE LINE DESIGNATION** — Designate each pipe line by number designation of upstream inlet and downstream inlet (e.g., 2 - 3).
- 15 **L** — Length of pipe in feet. Maximum inlet spacing is 500 feet.
- 16 **D** — Diameter of pipe in inches. Minimum diameter is 18 inches. Designate type (e.g. RCP, PVC).
- 17 **PIPE AREA** — Cross-sectional area of pipe in square feet. See King's Handbook.
- 18 **n** — Manning's n, roughness coefficient of pipe. See CDC.
- 19 **V (fps)** — Velocity of flow in feet per second. Divide Q 11 by PIPE AREA 15.
- 20 **V (fpm)** — Velocity of flow in feet per minute. Multiply V (fps) 16 by 60 sec/min.
- 21 **Sn** — Neutral slope in feet per foot. Identical to friction slope, slope of energy grade line, or slope from Manning's equation. See King's Handbook.
- 22 **FRIC** — Pipe friction loss in feet. Multiply L 13 by Sn 17 for pipe flowing full.
- 23 **H_i** — Entrance and exit head loss of pipe in feet. Usually equal to $1.4 V^2/2g$ for CMP, and $1.1 V^2/2g$ for other types of pipes. See King's Handbook.
- 24 **Σ H** — Summation of head losses in feet. 18 + 19 if flow is subcritical.
- 25 **W.S. ELEVATION** — Outlet Control. Water surface elevation at inlet, manhole or junction. Calculate by adding Σ H 20 to known downstream water surface elevation and progress upstream.
- 26 **T.G. ELEVATION** — Top of grate elevation, or top of cover for manholes and junction boxes.
- 27 **W.S. ELEVATION** — Inlet Control. Calculate by adding PIPE F.L. 24 + pipe diameter 14 + H_i from 19. Design value is the greater of 21 or 23.
- 28 **PIPE F.L.** — Elevation of pipe entrance flowline.

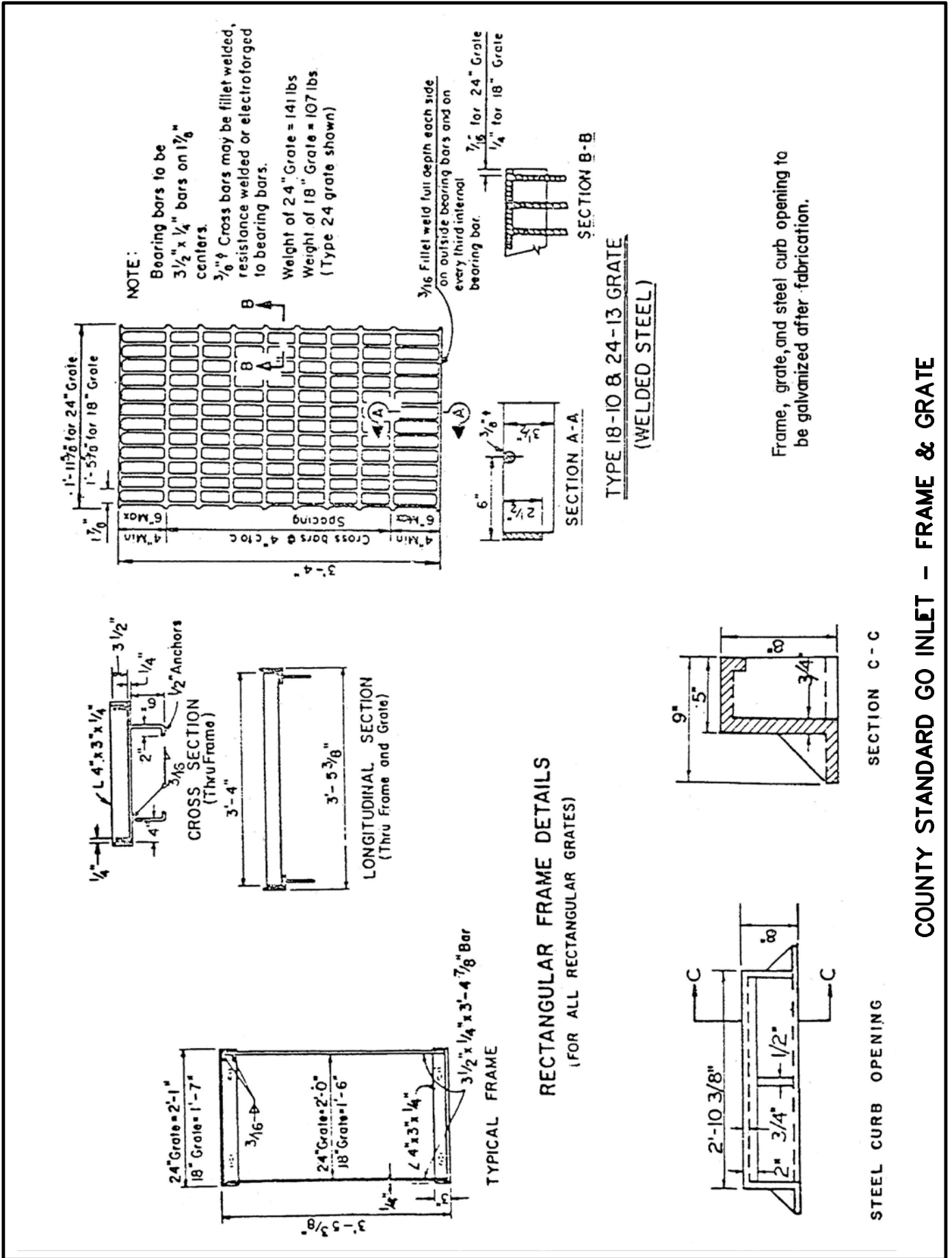
INSTRUCTIONS FOR DRAINAGE SYSTEM CALCULATIONS

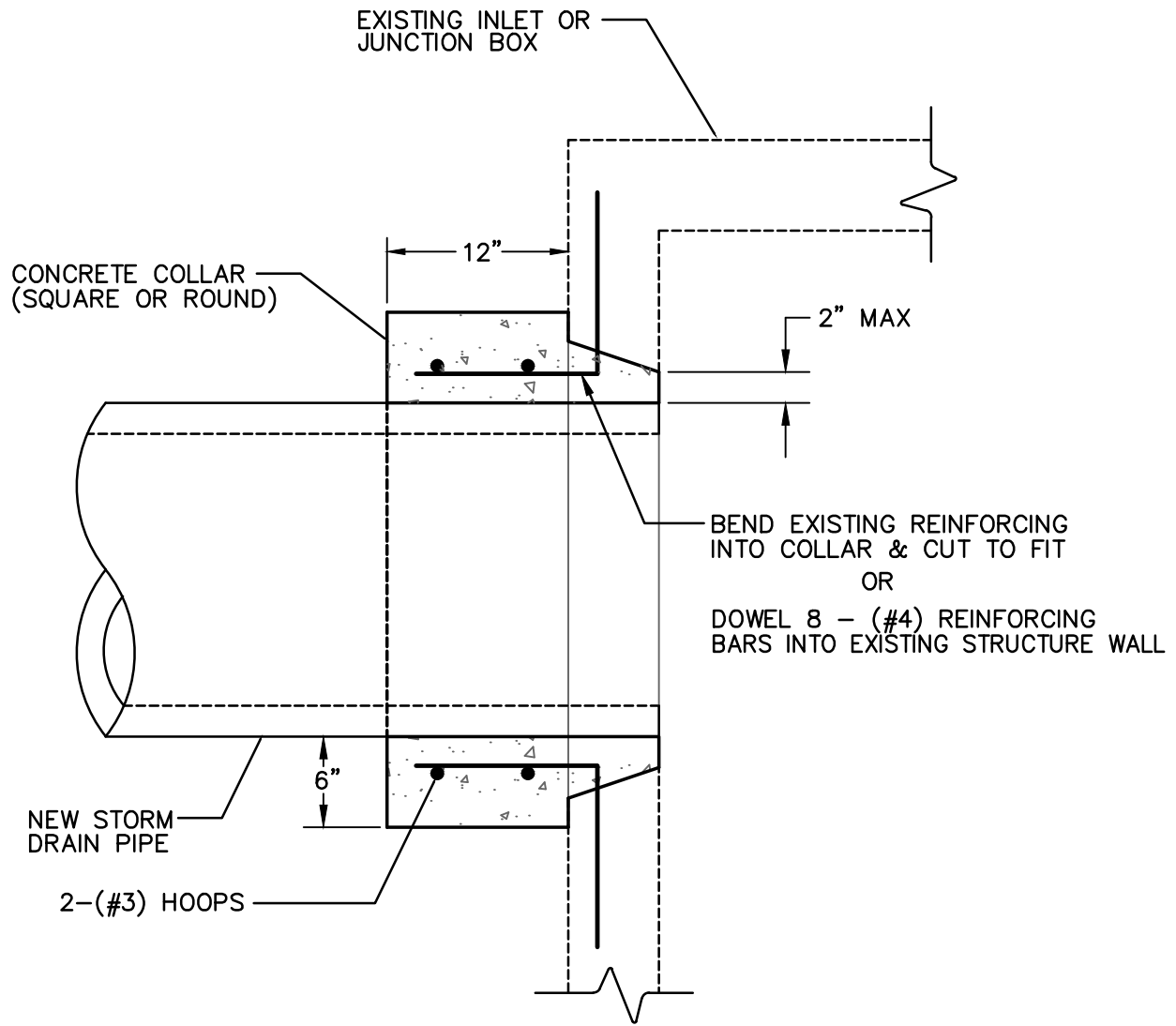
Figure SWM-8a: County Standard GO Inlet



COUNTY STANDARD GO INLET - STRUCTURE

Figure SWM-8b: Frame & Grate for GO Inlet

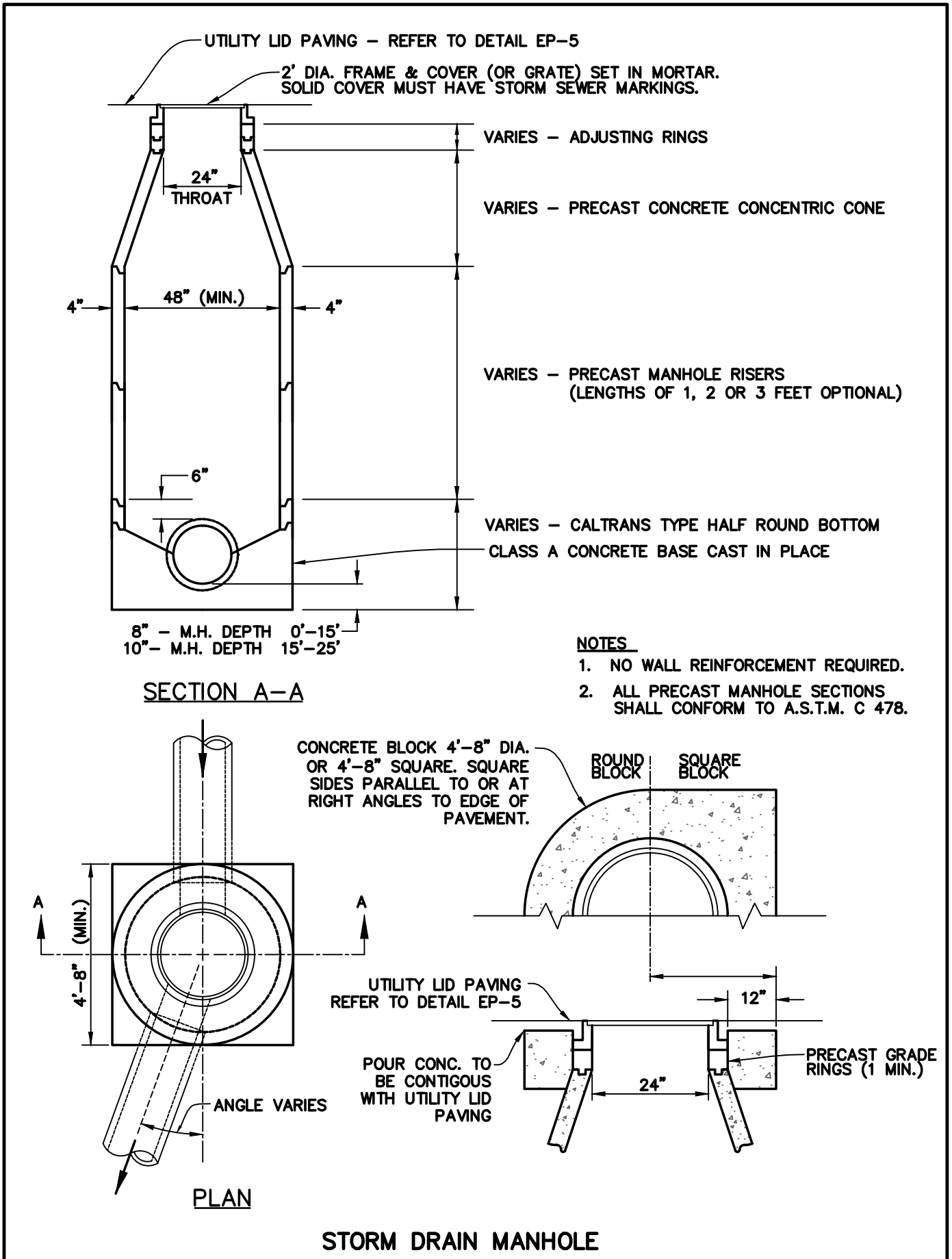




NOTE: FOR SMOOTH EXTERIOR WALL PIPE, INSTALL THE MANUFACTURER'S RECOMMENDED ADAPTOR OR A RUBBER RING GASKET TO INSURE A WATERTIGHT SEAL.

STORM DRAIN PIPE CONNECTION TO EXISTING INLET OR JUNCTION BOX

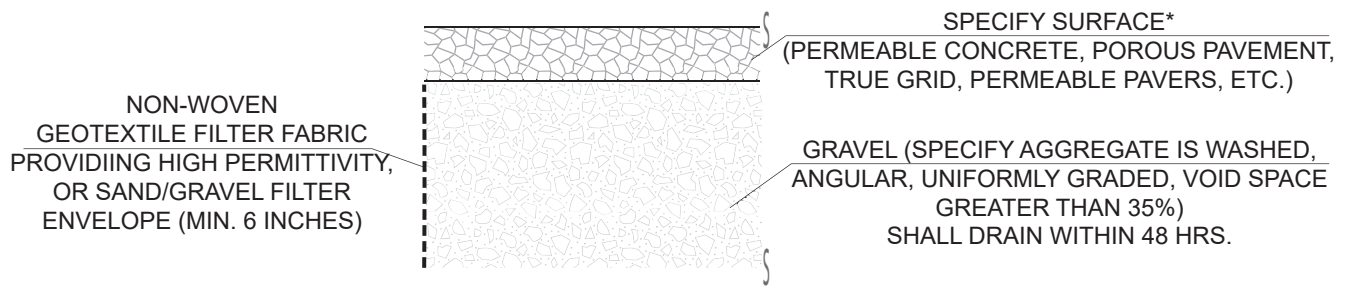
Figure SWM-10: Storm Drain Manhole



REV 5/19

FIG. SWM-10

Figure SWM-11: Self Mitigating Surface



NO COMPACTION OF SOIL BENEATH (RIPPING/LOOSENING SOIL REQUIRED IF COMPACTED)

NO LINERS OR OTHER BARRIERS BENEATH THAT MAY INTERFERE WITH INFILTRATION

DETAIL SHALL SPECIFY DIMENSIONS

*ADDITIONAL DETAIL SHALL BE PROVIDED FOR CONSTRUCTION OF PERVIOUS SURFACE PER MANUFACTURER, CIVIL ENGINEER, AND/OR DESIGNER'S RECOMMENDATIONS

INSTRUCTIONS FOR DETERMINING DEPTH// THICKNESS OF STORAGE VOLUME BENEATH POROUS SURFACE:

****PROVIDE DOCUMENTATION FOR SITE-SPECIFIC SATURATED SOIL PERMEABILITY.** VALUES MAY BE USED CONSERVATIVELY, AT BOTTOM DEPTH OF MITIGATION, FROM THE PUBLISHED PHYSICAL PROPERTIES TABLE WITH THE USDA-NRCS SOIL SURVEY, OR USE ACTUAL TEST VALUES (SEE DESIGN CRITERIA FOR MORE INFORMATION).

** BASED UPON THE SATURATED SOIL PERMEABILITY, SEE TABLE BELOW FOR THICKNESS OF GRAVEL. PLEASE NOTE, IF SATURATED SOIL PERMEABILITY IS SLOWER THAN 1/2 IN./HR., THEN PLEASE CONSULT WITH THE PROJECT GEOTECHNICAL ENGINEER TO CONFIRM THAT A SELF-MITIGATING SURFACE IS ACCEPTABLE.

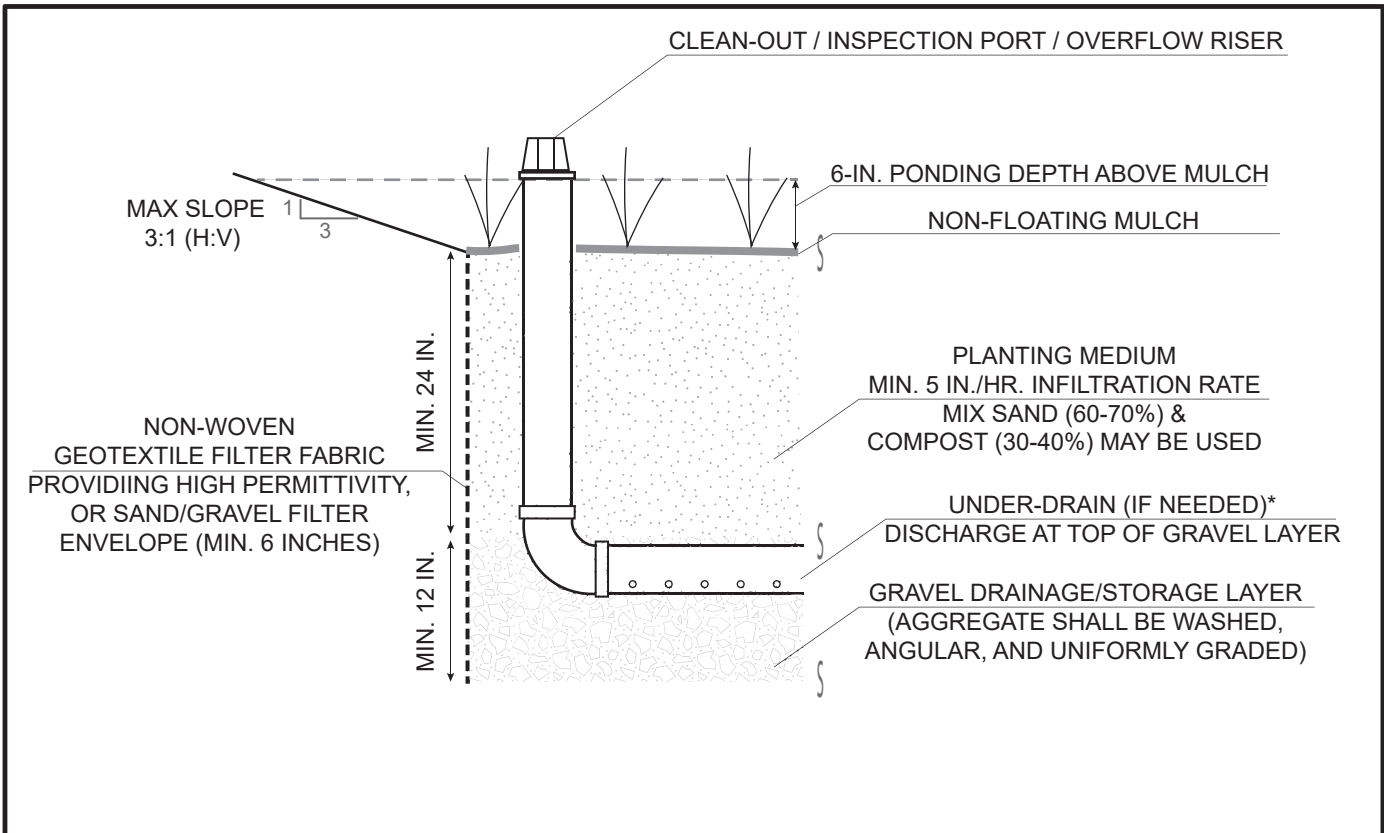
SATURATED SOIL PERMEABILITY (IN./HR.)**	MINIMUM THICKNESS OF GRAVEL OR AGGREGATE (INCHES)
> 1	4
< 1	15

NOTES & LIMITATIONS ON USE:

- SELF-MITIGATING SURFACES DO NOT RECEIVE RUNOFF FROM OTHER AREAS
- SELF-MITIGATING SURFACES DO NOT HAVE SUBSURFACE PIPING
- SITE SELECTION AND DESIGN SHALL CONSIDER PATH OF EXCESS FLOW DOWNSTREAM OF SELF-MITIGATING AREA (SAFE OVERFLOW; NO NEGATIVE IMPACTS TO NEIGHBORING PROPERTIES AND/OR DRAINAGE PATHWAYS)
- CONSULT WITH GEOTECHNICAL ENGINEER WHEN USING IN PROXIMITY OF SLOPES GREATER THAN 15%, WHERE WATER TABLE IS WITHIN 5 FEET OF BOTTOM OF GRAVEL, OR WHERE SURROUNDING SOIL STRATUM IS UNSTABLE
- FOR LARGE PROJECTS, PROVIDE A DETAIL FOR THE SELF-MITIGATING SURFACE THAT SPECIFIES AN INFILTRATION TEST METHOD AND MINIMUM INFILTRATION RATE THAT SHALL BE MET PRIOR TO CONSTRUCTION FINAL. THE TESTING METHOD, TEST RESULTS AT EACH LOCATION, AND INDIVIDUAL TEST LOCATIONS SHALL BE DOCUMENTED IN A LETTER THAT IS SIGNED BY THE PROFESSIONAL WHO PERFORMED THE TESTS.

SELF-MITIGATING SURFACE

Figure SWM-12: Biofiltration Treatment System



NO COMPACTION OF SOIL BENEATH (RIPPING/LOOSENING SOIL REQUIRED IF COMPACTED)
 NO LINERS OR OTHER BARRIERS BENEATH THAT MAY INTERFERE WITH INFILTRATION
 DETAIL SHALL SPECIFY TRENCH DIMENSIONS

*UNDER-DRAIN MAY BE NEEDED WHEN NATIVE SOIL PERMEABILITY IS LESS THAN 0.5 IN./HR.
 (SATURATED SOIL PERMEABILITY VALUES MAY BE USED CONSERVATIVELY FROM THE SOIL
 PROPERTIES TABLE WITHIN THE USDA-NRCS SOIL SURVEY, OR USE ACUTAL TEST VALUES
 FROM A STANDARDIZED TESTING PROCEDURE)

SELECT PROPER PLANTS (BIORETENTION PLANT LIST AVAILABLE FROM CENTRAL COAST LID
 INITIATIVE)

NOTES & LIMITATIONS ON USE:

- SITE SELECTION AND DESIGN SHALL CONSIDER PATH OF EXCESS FLOW DOWNSTREAM OF BIOFILTRATION TREATMENT AREA (SAFE OVERFLOW; NO NEGATIVE IMPACTS TO NEIGHBORING PROPERTIES AND/OR DRAINAGE PATHWAYS)
- CONSULT WITH GEOTECHNICAL ENGINEER WHEN USING IN PROXIMITY OF SLOPES GREATER THAN 15%, WHERE WATER TABLE IS WITHIN 5 FEET OF BOTTOM OF TRENCH, OR WHERE SURROUNDING SOIL STRATUM IS UNSTABLE
- BIOFILTRATION SYSTEM SHALL BE LOCATED A MINIMUM OF 25 FEET FROM LEACH FIELDS AND 10 FEET FROM STRUCTURES, WHERE FEASIBLE
- BIOFILTRATION SURFACE AREA SHALL BE APPROXIMATELY 4% OF IMPERVIOUS AREA DRAINING TO IT
- FOR LARGE PROJECTS, PROVIDE A DETAIL FOR THE BIOFILTRATION SYSTEM THAT SPECIFIES AN INFITRATION TEST METHOD AND MINIMUM INFILTRATION RATE THAT SHALL BE MET PRIOR TO CONSTRUCTION FINAL. THE TESTING METHOD, TEST RESULTS AT EACH LOCATION, AND INDIVIDUAL TEST LOCATIONS SHALL BE DOCUMENTED IN A LETTER THAT IS SIGNED BY THE PROFESSIONAL WHO PERFORMED THE TESTS.

BIOFILTRATION TREATMENT SYSTEM

Figure SWM-13: Reserved

Figure sheet has been reserved

Figure SWM-14: Reserved

Figure sheet has been reserved

Figure SWM-15a: Detention Storage Volume Graph

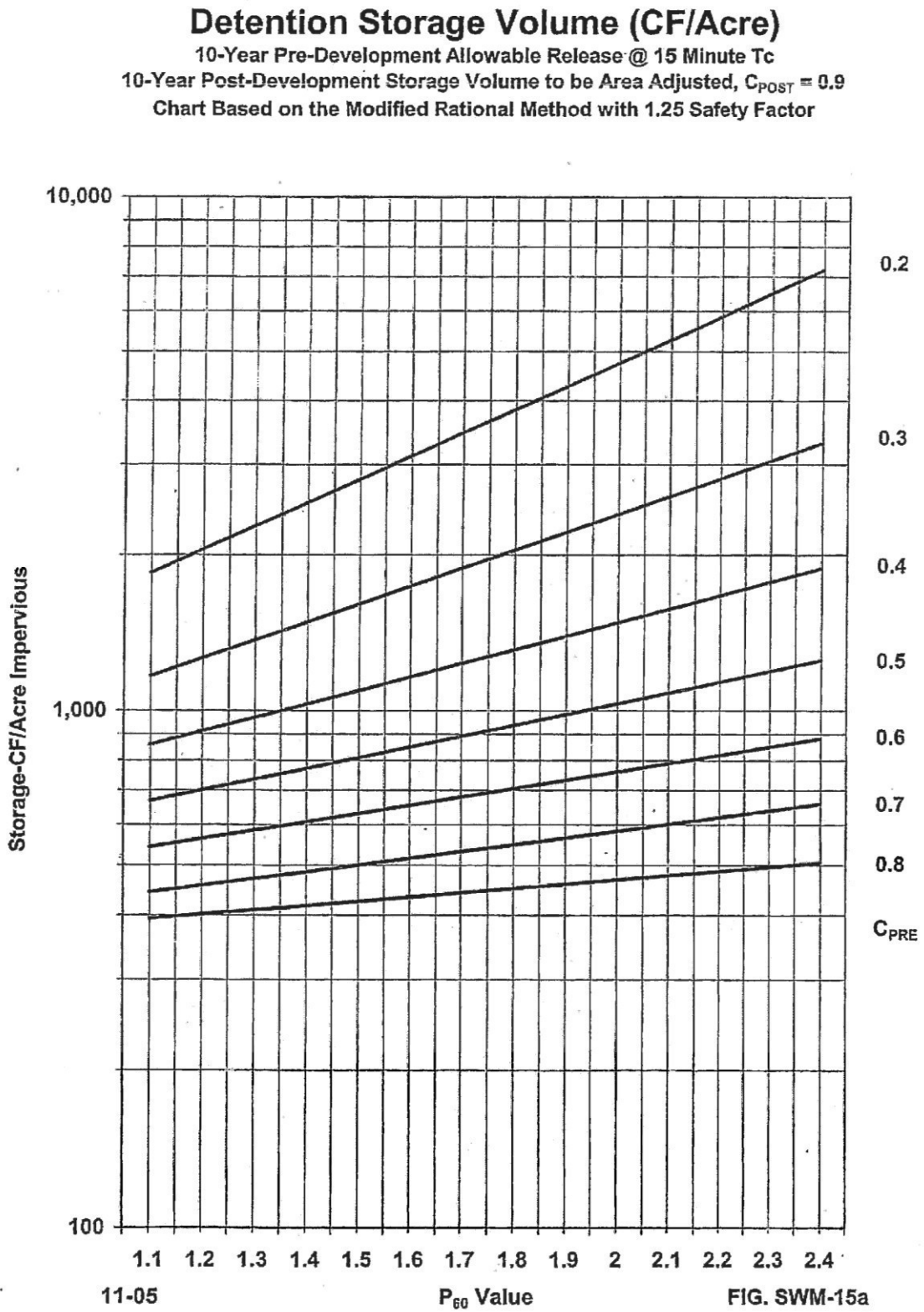


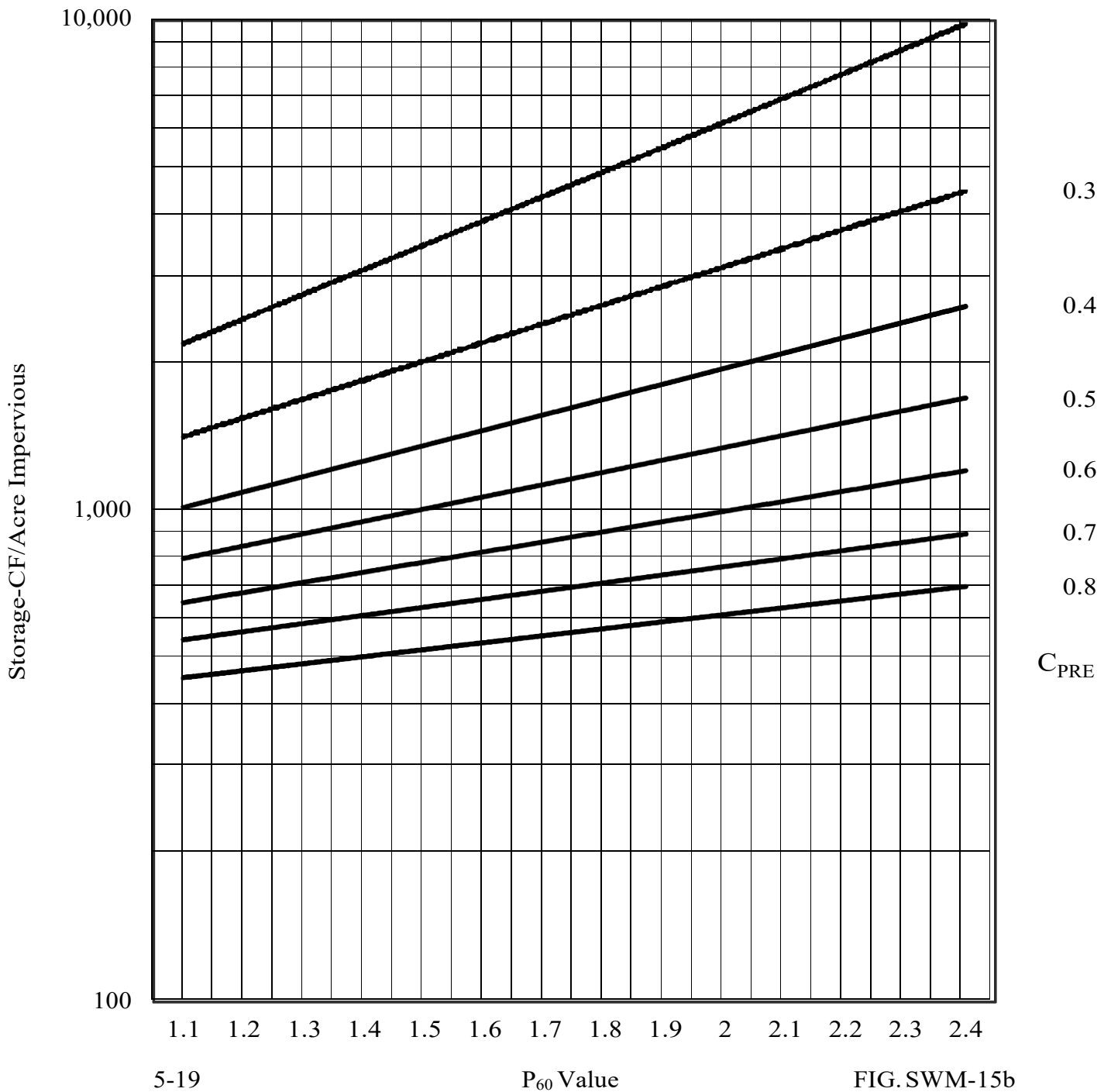
Figure SWM-15b: Detention Storage Volume Graph

Detention Storage Volume (CF/Acre)

5-Year Pre-Development Allowable Release @ 15 Minute Tc

10-Year Post-Development Storage Volume to be Area Adjusted, $C_{POST}=0.9$

Chart Based on the Modified Rational Method with 1.25 Safety Factor



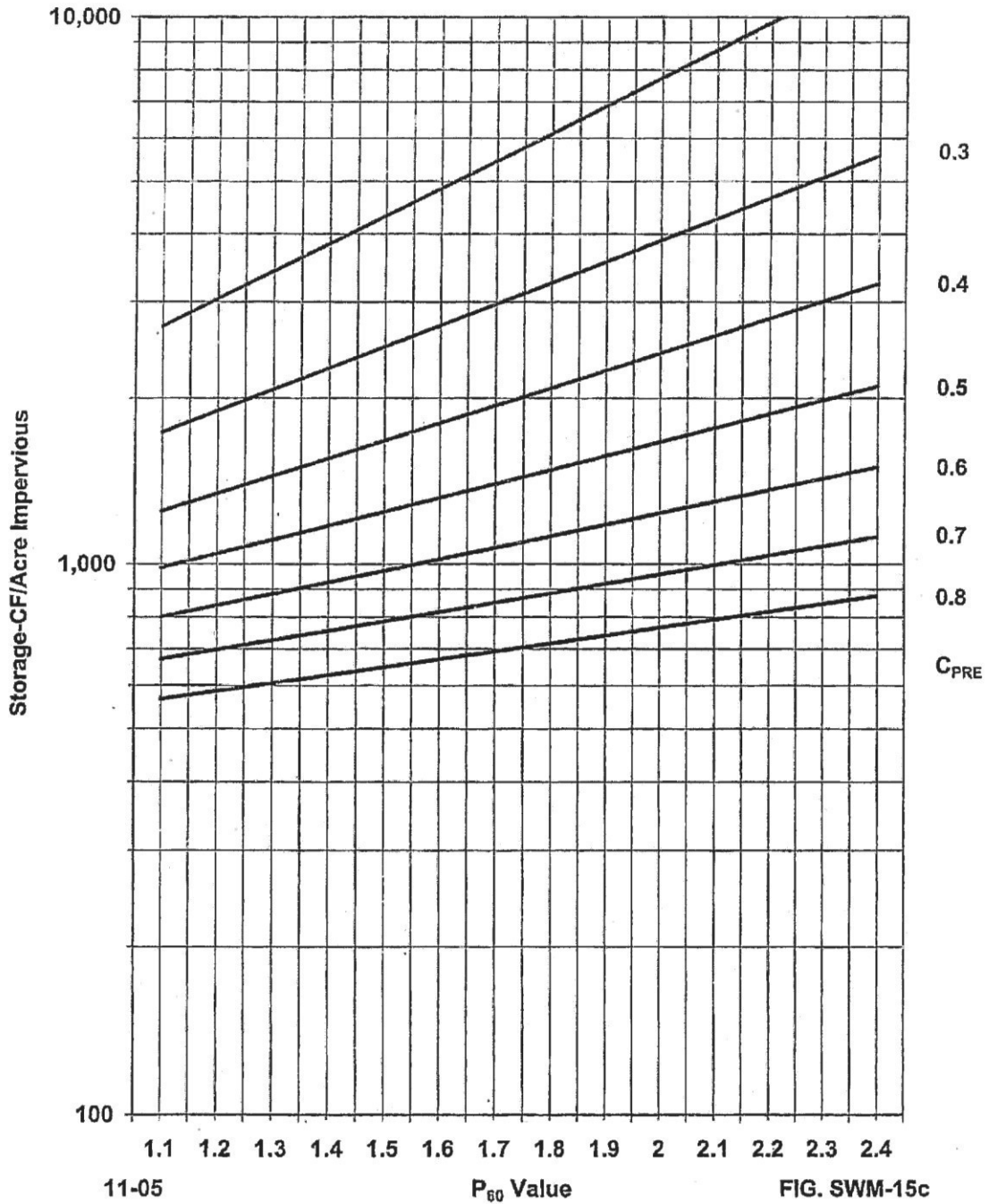
5-19

P₆₀ Value

FIG. SWM-15b

Figure SWM-15c: Detention Storage Volume Graph

Detention Storage Volume (CF/Acre)
10-Year Pre-Development Allowable Release @ 15 Minute Tc
25-Year Post-Development Storage Volume to be Area Adjusted, $C_{POST} = 0.9$
Chart Based on the Modified Rational Method with 1.25 Safety Factor



11-05

P₆₀ Value

FIG. SWM-15c

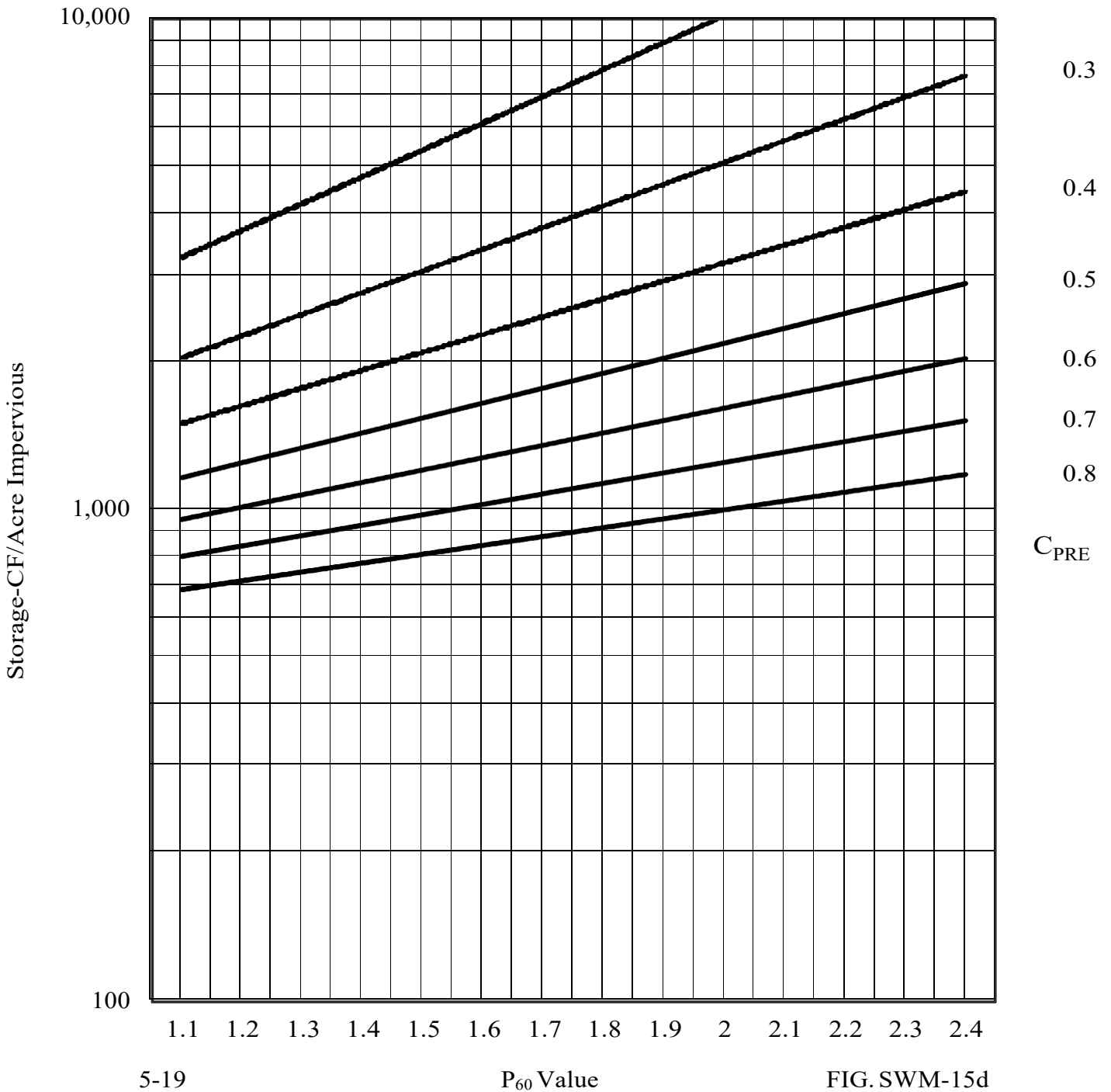
Figure SWM-15d: Detention Storage Volume Graph

Detention Storage Volume (CF/Acre)

5-Year Pre-Development Allowable Release @ 15 Minute Tc

25-Year Post-Development Storage Volume to be Area Adjusted, $C_{POST}=0.9$

Chart Based on the Modified Rational Method with 1.25 Safety Factor



5-19

P₆₀ Value

FIG. SWM-15d

Figure SWM-16: Detention Volume Design Example

Detention Volume Design Example:

Data to Collect -

Design Rainfall Frequency = 10 year	(from Design Criteria)
Pre-developed Runoff Coefficient (C_{pre}) = 0.25	(Fig. SWM-1 or from site estimate)
Post-developed Runoff Coefficient (C_{post}) = 0.90	(Fig. SWM-1 or from design plans)
Antecedent Moisture Factor (C_a) = 1.0 for 10 year	(Fig. SWM-1)
P60 Isopleth = 1.6 used to determine Intensity (I)	(Fig. SWM-2 & SWM-3 of Design Criteria)
Return Period Factor (I_a) = 1.0 for 10 year	(Fig. SWM-3)
Pre-developed Time of Concentration ($T_{c, pre}$) = 15 minutes	(Fig. SWM-4 or from site estimate)
Post-developed Time of Concentration ($T_{c, post}$) = 5 minutes	(Fig. SWM-4 or from design plans)
Impervious Area (A) = 5000 ft ²	(from design plans)
Safety Factor (SF) = 1.25	(from Design Criteria)

Calculations -

Step 1:

Using the Rational Equation develop a range of hydrographs for different storm durations representing the post-development condition.

Step 2:

Determine the allowable release rate (const.) representing the pre-development condition.

$Q_{pre} = C_a * C_{pre} * I_a * A / 43200$
 where 43200 is the conversion of in/hr to ft/s
 $Q_{pre} = 1 * 0.25 * 1 * 1.86 * 5000 / 43200 = 0.054 \text{ cfs}$

Note: "In normal flood routing, the maximum release rate will always occur at the point where the outflow hydrograph crosses the receding limb of the inflow hydrograph. For this reason the design release rate is forced to coincide with that point on the falling limb of the hydrograph resulting from the storm of duration equal to the time of concentration for the basin."
 (Reference B.1.d, page 56)

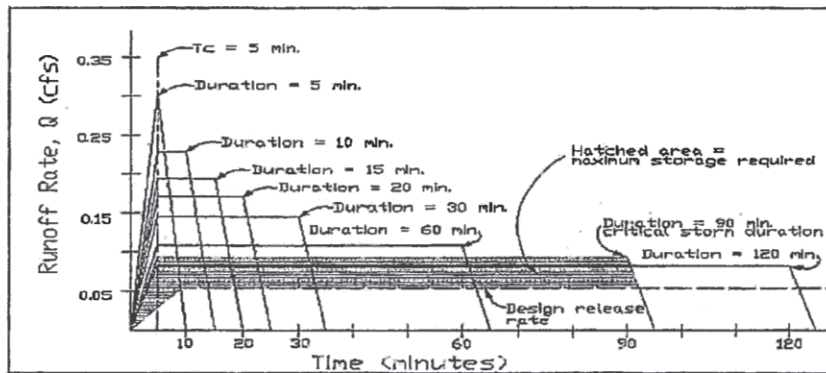
Step 3:

Determine the detention volume required.

The detention volume required is found by determining the maximum area between the inflow and allowable release hydrographs. This area can be approximated with the following formula which takes the rising limb of the allowable release hydrograph into account:

Required Storage Volume = $(Q_{post} - Q_{pre}) * Duration * 60$

	← Step 1	Step 2	Step 3
Rainfall Duration (min)	Rainfall Intensity (in./hr)	Peak Runoff Rate, Q_{post} (cfs)	Design Release Rate, Q_{pre} (cfs) / Required Storage Volume (ft ³)
5	2.93	0.305	75
10	2.20	0.229	105
15	1.86	0.194	0.054 / 126
20	1.65	0.172	142
30	1.40	0.146	165
60	1.05	0.109	199
90	0.89	0.093	209
120	0.79	0.082	204



Results -

The detention basin shall be designed to store a volume of $209 \text{ ft}^3 * 1.25 \text{ (SF)} = 261 \text{ ft}^3$

NOTE:

- 1) The detention basin hydraulic control structures shall be designed to account for the entire area routed to the system.
- 2) For more complete discussion of this method see reference B.1.d, pgs. 54-57, APWA, *Practices in Detention of Urban Stormwater Runoff*, special report No. 43, 1974

Figure SWM-17: Sample Detention Calculation Form

RUNOFF DETENTION BY THE MODIFIED RATIONAL METHOD					
Design Procedure: Press tab key & enter design values					
Site Location P60 Isoleth:	1.60	Fig. SWM-2 in County Design Criteria			
Rational Coefficients Cpre:	0.25	See note # 2			
Cpost:	0.90	See note # 2			
Impervious Area:	5000	ft ²	See note # 2 and # 4		
STRUCTURE DIMENSIONS FOR DETENTION					
326	ft ³ storage volume calculated				
100	% void space assumed				
326	ft ³ excavated volume needed				
Structure	Length	Width	Depth		
Ratios	25.0	2.0	2.0		
Dimen. (ft)	37.07	2.97	2.97		
10 YEAR STORM VALUES				DETENTION @ 15 MIN.	
Storm Duration (min)	10 Year Intensity (in/hr)	5 Year Release Qpre (cfs)	Qpost (cfs)	Detention Rate To Storage (cfs)	Specified Detained Volume (cf)
1440	0.28	0.007	0.029	-0.016	-1776
1200	0.30	0.007	0.032	-0.014	-1274
960	0.33	0.008	0.035	-0.011	-799
720	0.38	0.009	0.039	-0.007	-362
480	0.44	0.011	0.046	0.000	16
360	0.50	0.012	0.052	0.006	169
240	0.59	0.015	0.062	0.016	284
180	0.67	0.016	0.069	0.024	318
120	0.79	0.019	0.082	0.036	326
90	0.89	0.022	0.092	0.047	315
60	1.05	0.026	0.109	0.063	286
45	1.18	0.029	0.123	0.077	261
30	1.40	0.034	0.146	0.100	224
20	1.65	0.041	0.172	0.126	190
15	1.86	0.046	0.194	0.148	167
10	2.20	0.054	0.229	0.184	138
5	2.93	0.072	0.305	0.260	97

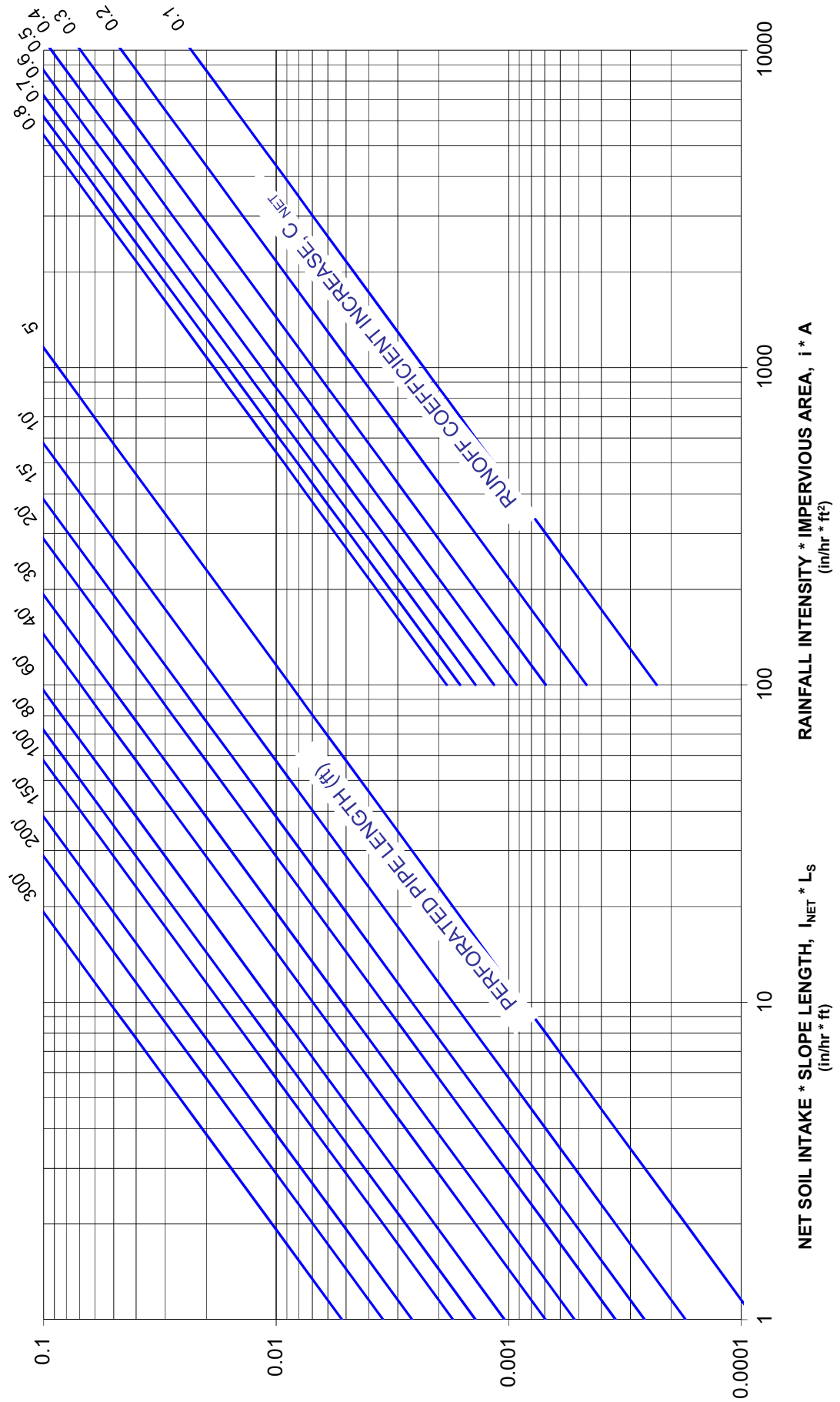
Notes & Limitations on Use:

- 1) The modified rational method, and therefore the standard calculations are applicable in watersheds up to 20 acres in size.
- 2) Required detention volume determinations shall be based on all new or replaced impervious areas, both on and off-site, resulting from the proposed project. Pervious areas shall not be included in detention volume sizing; an exception may be made for incidental pervious areas less than 10% of the total area.
- 3) Gravel packed detention chambers shall specify on the plans, aggregate that is washed, angular, and uniformly graded (of single size), assuring void space not less than 35%.
- 4) A map showing boundaries of both regulated impervious areas and actual drainage areas routed to the hydraulic control structure of the detention facility is to be provided, clearly distinguishing between the two areas, and noting the square footage.
- 5) The EPA defines a class V injection well as any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system. Such storm water drainage wells are "authorized by rule". For more information on these rules, contact the EPA. A web site link is provided from the County DPW Stormwater Management web page.

This method is available from the County Public Works web site in a computerized Excel spreadsheet format to simplify usage. <http://www.dpw.co.santa-cruz.ca.us/drainage.htm>

Figure SWM-18: Selection of Perforated Pipe Length

**SELECTION OF MINIMUM PERFORATED PIPE LENGTH
FOR USE WITH THE SLOPE INFILTRATION METHOD**



5-19

RUNOFF INCREASE, Q_{NET} (cfs)

FIG. SWM-18

Figure SWM-19a: Estimate Velocity Attained for Overland Flows

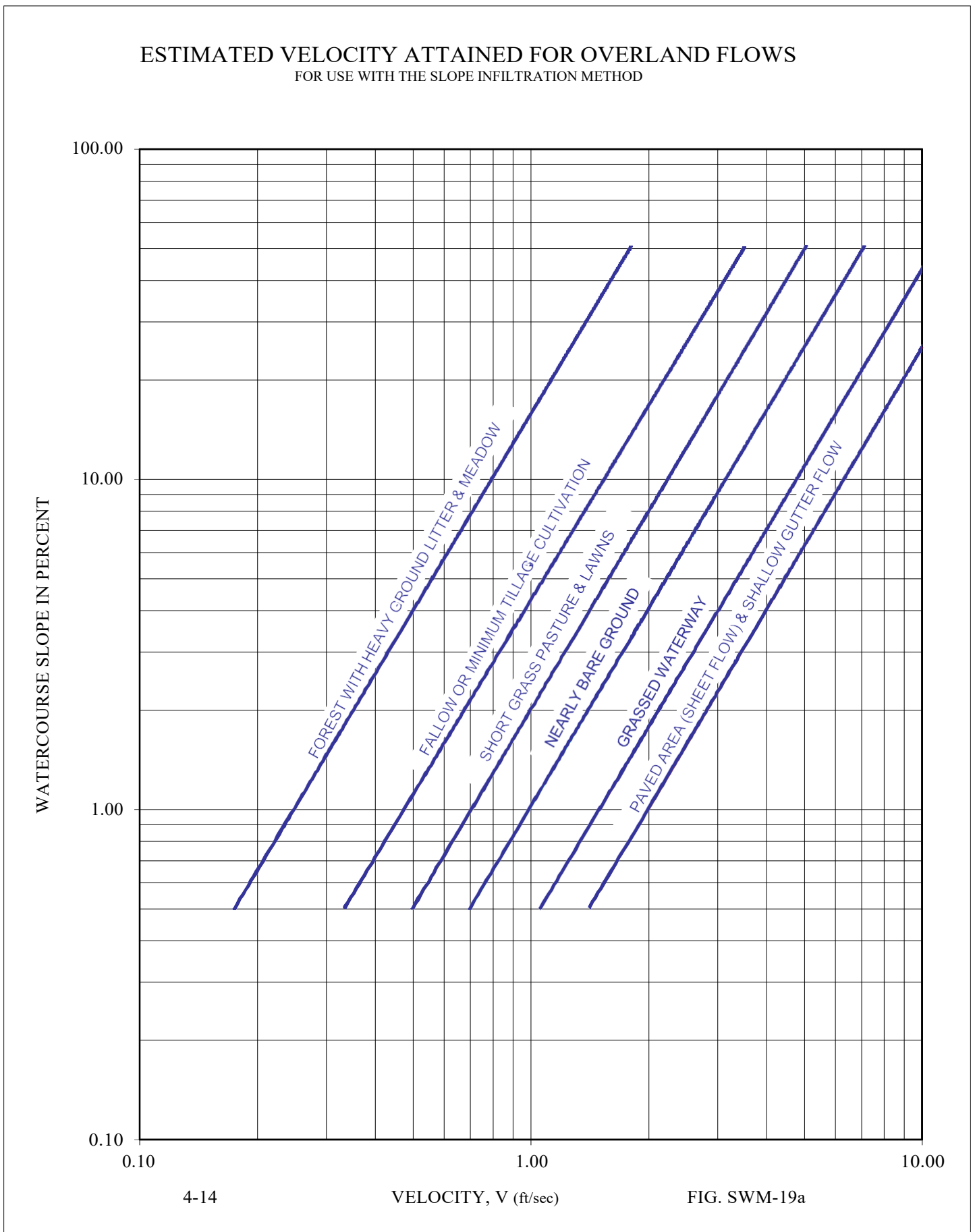


Figure SWM-19b: Permissible Velocity for Bare Soils

<u>Type of Material in Excavation Section</u>	<u>Permissible Velocity (feet per second)</u>
Fine Sand (Noncolloidal)	2.5
Sandy Loam (Noncolloidal)	2.5
Silt Loam (Noncolloidal)	3.0
Firm Loam	3.5
Volcanic Ash	3.5
Fine Gravel	4.0
Stiff Clay (Colloidal)	4.5
Graded Material (Noncolloidal)	
Loam to Gravel	5.0
Silt to Gravel	5.5
Gravel	6.0
Coarse Gravel	6.5
Gravel to Cobbles	
Under 6 inches	7.0
Over 8 inches	8.0

Figure SWM 20: Water Supply Watershed Detention Storage Volume

Water Supply Watershed Detention Storage Volume (CF/Acre)
2-Year Pre-Development Allowable Release @ 1 Hour Duration
2-Year Post-Development Storage Volume to be Area Adjusted, $C_{POST} = 0.9$
Chart Based on the Modified Rational Method without Safety Factor

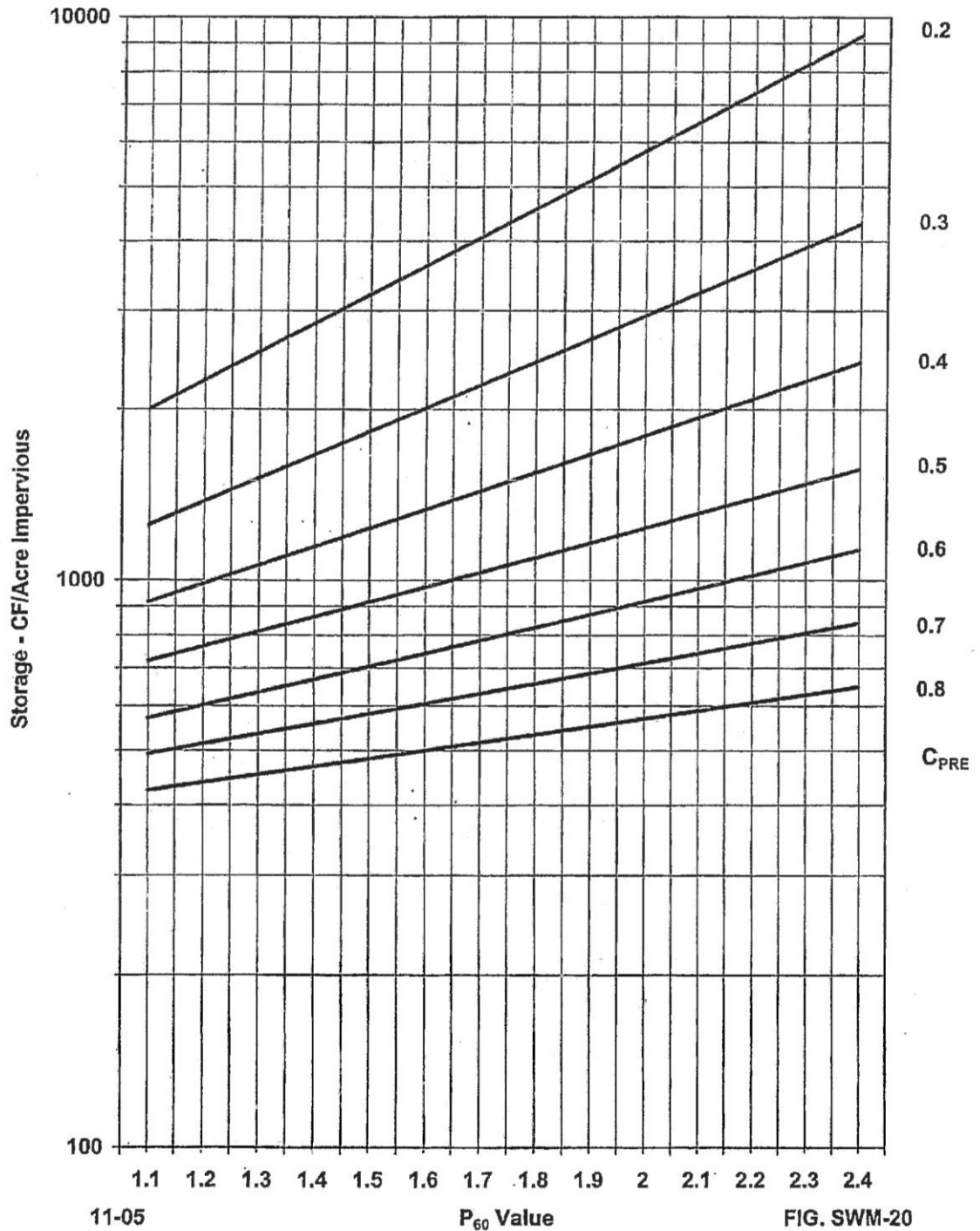


Figure SWM-21: Retention by the Slope Infiltration Method

RUNOFF RETENTION BY THE SLOPE INFILTRATION METHOD

Practice Concept:

Many soils have saturated permeability rates that exceed design storm rainfall intensities. The excess intake capability may be used to infiltrate delivered runoff from developed areas concurrently with the storm event, and without provision for storage volume. This procedure estimates an area of ground surface of adequate size to infiltrate net increases in impervious area runoff. Collected water must be redistributed across the surface of the slope width by a gravel-protected, perforated pipe, and spread slowly down the slope length by gravitational sheet flow. The slope must be uniformly smooth, vegetated, or heavily mulched to assist in the spread of water, maintain a porous soil surface, provide flow retardance, and prevent surface erosion.

The equation used to construct the log-log graph (Fig. SWM-18) is developed as:

W_P	= Width across slope contour to run perforated pipe (ft)	Eq: $W_P = Q_{NET} * 43200 / (I_{INF} - i) * L_S$
Q_{NET}	= Impervious runoff increase (cfs)	
I_{INF}	= Permeability rate of saturated soil (in/hr)	Where: $Q_{NET} = C_{NET} * i * A / 43200$
i	= Intensity of rainfall directly on infiltrating slope (in/hr)	(Rational Equation)
I_{NET}	= Net available infiltration rate = $I_{INF} - i$ (in/hr)	
L_S	= Length of slope distance for assumed sheet flow (ft)	So: $W_P = C_{NET} * i * A / I_{NET} * L_S$
A	= Impervious surface area (ft ²)	
C_{NET}	= Change in runoff coefficient = $C_{POST} - C_{PRE}$	
43200	= Unit conversion of ft/sec to in/hr	

Design Example:

Data to Collect -

Impervious Area (A) = 5000 ft ²	(from design plans)
2 yr, 2 hr Rainfall Intensity (i) = 0.50 in/hr	(Figs. SWM-2 and SWM-3)
Pre-Developed Runoff Coefficient (C _{PRE}) = 0.25	(Fig. SWM-1 or from site estimate)
Post-Developed Runoff Coefficient (C _{POST}) = 0.90	(Fig. SWM-1 or from design plans)
Saturated Soil Permeability Rate (I _{INF}) = 2.0 in/hr	(from NRCS soil survey or site test)
Available Sheet Flow Slope Length (L _S) = 25 ft	(from design plans and site inspection)

Find Pipe Length by Calculations -

$$W_P = C_{NET} * i * A / I_{NET} * L_S = (0.9 - 0.25) * 0.50 \text{ in/hr} * 5000 \text{ ft}^2 / (2.0 \text{ in/hr} - 0.50 \text{ in/hr}) * 25 \text{ ft}$$

$$= (0.65) * 2500 \text{ in/hr} * \text{ft}^2 / 37.5 \text{ in/hr} * \text{ft} = 43.3 \text{ feet}$$

A 75% slope distribution efficiency is applied to increase pipe length: = 58 feet

Find Pipe Length by Fig. SWM-18 -

First, find $i * A = 2500$ on the right side of the x-axis, and project a vertical line upwards to intercept with $C_{NET} = 0.65$. Then turn left and project a horizontal line towards the y-axis. Next, find $I_{NET} * L_S = 37.5$ on the left side of the x-axis and project a second line upwards to intercept with the horizontally projected line from the first step. The intersection point of these two projected lines indicates the length of perforated pipe, approximately 58 feet. This chart value has already been adjusted for slope distribution efficiency.

Figure SWM-22: Sample Retention Calculation Form

RUNOFF RETENTION BY THE SLOPE INFILTRATION METHOD

Notes & Limitations on Use:

Saturated soil permeability values may be used conservatively from the USDA-NRCS soil survey, or use actual test values.
 Projects with saturated soil permeability less than 120% of the design storm intensity should consider storage methods to percolate runoff.
 Maximum sheet flow length is 100 ft., with 30 ft. typical. This requires site observation by the designer to determine.
 Minimum length of perforated pipe is 6 ft., maximum length 40 ft., or 60 ft. if tee'd, per outfall.
 Minimum perforated pipe diameter is 3 inches.
 Perforated pipe is to be laid parallel to the slope contour, preferably secured at the surface, or with minimal burial and protective cover.
 This method may be used on smooth and uniform vegetated or mulched slopes under 15%, without special provisions.
 Slopes greater than 15%, or that are irregular, require site specific erosion consideration, and possibly surface improvements.
 For any slopes greater than 25% occurring nearby at lower elevation, consult a geotechnical engineer.
 A 75% efficiency factor is applied to the determined infiltration surface area.
 Table is based on computations using the Rational Equation for a 2-yr. return, 2-hr. duration storm.
 Refer to the County Design Criteria, Storm Water Management - Section H, for complete method criteria and example calculations.

Design Procedure: Press tab key & enter design values

Mitigation Area

Saturated Soil Permeability: **2.00** in/hr
 Est. Distance for Sheet Flow: **25** ft

Development Area

Rational Coefficients: **1.60** Fig. SWM-2
 Site Location P60 Isopeith: **0.25**
 Post: **0.90**

Table Value to Interpolate

Design Storm Intensity: **0.50** in/hr

Required Length of Perforated Pipe (ft)

Impervious Area (ft) ²	Design Storm Intensity (in/hr)																
	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80			
500																	
750																	
1000																	
1250																	
1500																	
1750																	
2000																	
2250																	
2500																	
2750																	
3000																	
3250																	
3500																	
3750																	
4000																	
4250																	
4500																	
4750																	
5000																	

This method is available from the County Public Works web site in a computerized Excel spreadsheet format to simplify usage. <http://www.dpw.co.santa-cruz.ca.us/drainage.htm>

Figure SWM-23: Retention by the Storage Percolation Method

RUNOFF RETENTION BY THE STORAGE PERCOLATION METHOD

Practice Concept:

Many soils have saturated permeability rates that exceed storm rainfall intensities. The excess intake capability may be used to infiltrate delivered runoff from developed areas. Additionally, storage volumes may be provided that hold runoff in a confined percolation area, commonly referred to as a retention facility. Such a storage structure allows lower permeability soils to be effectively used, or allows the facility size to be compressed into a smaller land area on soils of typical permeability, with the infiltration achieved over a longer time period than the storm event. This procedure estimates a volume of storage space required, balanced with the related size of permeable surface area created within this volume, such that it is of adequate size to percolate net increases in impervious area runoff. The retention facility may be located below grade as a chamber or trench, or at the surface as a shallow basin. The chamber or trench area may be held open with perforated pipe or arch support, or may be gravel-filled with void space providing the storage volume. In all cases, retained water must have extensive contact with permeable soils.

Method Adaptation:

This method's retention design procedure is based on the Modified Rational Method as used for detention structures, but with adaptations to account for soil infiltration and application to water resource protection.

First, the practice of assigning an allowable release rate, normally assumed in detention design, is still performed the same way, but is defined differently. "Allowable release rate" can be thought of as a "retention threshold rate," with the focus being on-site recharge into the soil profile that is desired of more frequent, longer duration, low intensity storms. This is in contrast to infrequent, short duration, higher intensity storms, and the resulting peak discharges and off-site releases to downstream drainage systems that are controlled with traditional detention design. The Storage Percolation Method requires a 2-year design storm with a 2-hour duration pre-development "retention threshold rate," which is intended to represent the upper range of storm events responsible for providing the bulk of natural recharge. Use of this upper range provides a structure size that is less prone to overflow when subject to brief but very intense storms, and also provides for adequate long-term function despite some performance loss over time.

The second adaptation is an extension to the Modified Rational Method procedure that accounts for the addition of direct rainfall occurring over the footprint of the facility, and the on-going subtraction of percolated water out of the storage volume and into the soil.

Finally, the adapted procedure necessitates an iterative calculation process that accounts for, and balances, the inter-relationship between retention structure volume and the internal surface area provided by the structure.

This adapted method is available from the County Public Works web site in a computerized Excel spreadsheet format to simplify usage. <http://www.dpw.co.santa-cruz.ca.us/drainage.htm>

Design Example:

Data to Collect -

P60 Isopleth = 1.6	(Fig. SWM-2)
2 yr, 2 hr Rainfall Intensity (i) = 0.50 in/hr	(Fig. SWM-3)
Pre-developed Runoff Coefficient (C _{PRE}) = 0.25	(Fig. SWM-1 or from site estimate)
Post-developed Runoff Coefficient (C _{POST}) = 0.90	(Fig. SWM-1 or from design plans)
Impervious Area (A) = 5000 ft ²	(from design plans)
Saturated Soil Permeability Rate (P _{SAT}) = 2 in/hr	(from NRCS soil survey or site test) Soil
Horizon/Layer Composition	(from NRCS soil survey or site test)
Structure Dimension Ratios = 25:2:2 (L:W:D)	(choose approx. dimensions that fit site)
Structure Internal Voids = 100%	(structural pipe is planned)

43200 = Unit conversion of ft/sec to in/hr

Calculations -

Step 1:

Make an estimate of the required retention storage volume. To provide a reasonable first estimate, try using the 2-yr return, 1-hour duration detention requirement chart (Fig. SWM-20), remembering to adjust for acreage.

At P60 of 1.6, read 2,600 ft³/ac, multiply by 5,000 ft²/43,560 ft²/ac = 298 ft³

Step 2:

Adjust volume up if void space is less than 100%. Ex. for 35% void space: 298 ft³/0.35 = 851 ft³

For this problem: 298 ft³/1.00 = 298 ft³

Step 3:

Choose a set of ratios to represent the proportions for length, width, and depth of the design structure volume, and calculate the product of these three numbers.

Ratios of 25:2:2 (Length:Width:Depth), Ratio Product = 25*2*2 = 100

Step 4:

Calculate the structure dimensions for each ratio value using the estimated design storage volume and the ratio product. As necessary, return to Step 3 and select new ratios if structure dimensions are significantly off from those desired. Note that all dimensions will change as iterations progress.

$$\text{Length} = 25 * (298 \text{ ft}^3/100)^{1/3} = 35.98 \text{ ft}$$

$$\text{Width} = 2 * (298 \text{ ft}^3/100)^{1/3} = 2.88 \text{ ft}$$

$$\text{Depth} = 2 * (298 \text{ ft}^3/100)^{1/3} = 2.88 \text{ ft}$$

Step 5:

Calculate the structure footprint area exposed to rainfall: $L * W = 35.98 \text{ ft} * 2.88 \text{ ft} = 103.6 \text{ ft}^2$

Step 6:

Calculate the structure internal surface area from the determined length, width, and depth, and adjust to effective surface area. Note that the 70% effectiveness value adjusts for variability within the soil profile layers and bottom sedimentation, as well as a correction for the structure not filling or draining instantaneously.

$$\text{Internal Surface Area} = \text{Sides} + \text{Ends} + \text{Bottom} = (L * D * 2) + (W * D * 2) + (L * W)$$

$$\text{Internal S.A.} = (35.98 \text{ ft} * 2.88 \text{ ft} * 2) + (2.88 \text{ ft} * 2.88 \text{ ft} * 2) + (35.98 \text{ ft} * 2.88 \text{ ft}) = 327.5 \text{ ft}^2$$

$$\text{Assume 70\% Effective Surface Area: } 327.5 \text{ ft}^2 * 0.70 = 229.2 \text{ ft}^2$$

Step 7:

Calculate the design Storage Volume (SV) by the Modified Rational Method for a full range of storm durations.

$$\text{SV} = (\text{Req. Retention Rate} + \text{Direct Rainfall Rate} - \text{Soil Infiltration Rate}) * \text{Storm Duration} * 60$$

Where:

Required Retention Rate = $Q_{\text{POST}} - Q_{\text{PRE}}$, with $Q = C * i * A$ by the Rational Equation

$$Q_{\text{PRE}} = C_{\text{PRE}} * i * A = 0.25 * 0.50 \text{ in/hr} * 5,000 \text{ ft}^2/43,200 = 0.0145 \text{ CFS} \quad (\text{held constant})$$

$$Q_{\text{POST}} = C_{\text{POST}} * i * A = 0.90 * (i) \text{ in/hr} * 5,000 \text{ ft}^2/43,200 = 0.1042 * (i) \text{ CFS} \quad (i \text{ varies w/duration})$$

Direct Rainfall Rate = Storm intensity * Structure Footprint Area

$$= (i) \text{ in/hr} * 103.6 \text{ ft}^2/43200 = 0.0024 * (i) \text{ CFS} \quad (i \text{ varies w/duration})$$

Soil Infiltration Rate = Saturated Soil Permeability Rate * Structure Effective Surface Area

$$= 2 \text{ in/hr} * 229.2 \text{ ft}^2/43200 = 0.0106 \text{ CFS} \quad (\text{held constant each iteration})$$

Per the table below, after the 1st iteration the storage volume peak adjusts from 298 ft³ to 218 ft³

Output table from Step 7, 1st iteration

Required Retention Rate (cfs)	Direct Rainfall Rate (cfs)	Soil Infiltration Rate (cfs)	Storm Duration (min)	Storage Volume (cf)
0.004	0.0004	0.0106	1440	-517

0.006	0.0005	0.0106	1200	-323
0.008	0.0005	0.0106	960	-143
0.010	0.0006	0.0106	720	17
0.015	0.0007	0.0106	480	146
0.019	0.0008	0.0106	360	192
0.025	0.0009	0.0106	240	Peak = 218
0.038	0.0012	0.0106	120	205
0.055	0.0016	0.0106	60	167
0.079	0.0021	0.0106	30	126
0.096	0.0025	0.0106	20	105
0.110	0.0029	0.0106	15	92
0.132	0.0034	0.0106	10	75
0.181	0.0045	0.0106	5	52

Step 8:

Return to Step 4 with the new peak storage volume and repeat through Step 7 until there is no longer variation in the answers for storage volume peak and effective surface area from the most recent iteration. The calculation process should close in about 6 to 8 iterations. These calculations are most efficiently performed on a computerized spreadsheet. If performed by hand, narrow the range of storm durations calculated in successive iterations of Step 7 to those clustered around the peak from the first iteration.

Results from each iteration of calculations showing closure

Iteration #	Structure Dimensions			Effective Surface Area	Storage Volume	
	Length	Width	Depth			
					298	
1	35.98	2.88	2.88	229	218	
2	32.27	2.58	2.58	184	215	
3	33.76	2.70	2.70	202	246	
4	33.18	2.65	2.65	195	234	
5	33.41	2.67	2.67	198	239	← Acceptable
6	33.31	2.67	2.67	196	237	
7	33.38	2.67	2.67	197	238	
8	33.34	2.67	2.67	197	237	← Design Values
9	33.34	2.67	2.67	197	237	← No Change

The structure dimensions for width and depth equate to a cross-sectional pipe area equivalent to 36" diameter.

$$2.67 \text{ ft} * 2.67 \text{ ft} = 7.13 \text{ ft}^2 \text{ so } \rightarrow ((7.13 \text{ ft}^2/3.14)^{1/2})*2*12 \text{ in/ft} = 36.2'' \text{ diameter}$$

This pipe structure would need to be provided with substantial perforations and set in a surrounding gravel pack envelope that assures extensive distributed contact with permeable soils. The additional void volume in this gravel pack is not included in the calculation example above.

Figure SWM-24: Sample Retention Calculation Form

PROJECT: Example Project - APN: XXX-XXX-XX Application: XX-XXXX Calc by: XXX Date: MM/DD/YYYY

RUNOFF RETENTION BY THE STORAGE PERCOLATION METHOD

Data Entry: **PRESS TAB KEY & ENTER DESIGN VALUES** Notes & Limitations on Use: SS Ver: 1.0

Site Location P60 Isopleth: 1.60 Fig. SWM-2
 Rational Coefficients Cpre: 0.25
 Cpost: 0.90
 Impervious Area: 5000 ft²
 Saturated Soil Permeability: 2.00 in/hr

Saturated soil permeability values may be used conservatively from the USDA-NRCS soil survey, or use actual test values.
 Site selection and design shall give proper consideration to the path for excess flows downstream of the designated retention area.
 Retention site location on, or immediately above, slopes exceeding 15% will require consulting a geotechnical engineer.
 Gravel packed structures shall use washed, angular, uniformly graded aggregate providing not less than 35% void space.
 Refer to the County of Santa Cruz Design Criteria, Stormwater Management - Section H, for complete method criteria.

2 - YEAR DESIGN STORM				RETENTION @ 120 MIN.			STRUCTURE DIMENSIONS FOR RETENTION			DETENTION @ 60 MIN.	
Storm Duration (min)	2 - Year Intensity (in/hr)	Qpre (cfs)	Qpost (cfs)	Retention Rate To Storage (cfs)	Specified Retained Volume (cf)	184 Ratios	ft ³ storage volume calculated	% void space assumed	Depth* #	Detention Rate To Storage (cfs)	Specified Detained Volume (cf)
1440	0.18	0.005	0.019	0.004	-811	40	25.00	2.00	2.00	-0.001	-56
1200	0.19	0.006	0.020	0.006	-566	459	41.56	3.32	3.32	0.001	59
960	0.21	0.006	0.022	0.008	-337					0.003	160
720	0.24	0.007	0.025	0.010	-128					0.006	241
480	0.28	0.008	0.030	0.015	51					0.010	292
360	0.32	0.009	0.033	0.019	121					0.014	300
240	0.38	0.011	0.039	0.025	171					0.020	288
180	0.43	0.012	0.044	0.030	184					0.025	270
120	0.50	0.015	0.052	0.038	183					0.033	238
90	0.57	0.016	0.059	0.045	174					0.040	214
60	0.67	0.019	0.070	0.055	156					0.050	182
45	0.76	0.022	0.079	0.064	142					0.059	160
30	0.89	0.026	0.093	0.079	121					0.074	133
20	1.06	0.031	0.110	0.096	102					0.091	109
15	1.19	0.034	0.124	0.110	89					0.105	94
10	1.41	0.041	0.147	0.132	74					0.127	76
5	1.88	0.054	0.196	0.181	52					0.176	53

* For pipe, use the square root of the sectional area.
 # If cell values displayed are corrupted, enter zero for depth, then re-enter a positive numeric value within allowed range.

This method is available from the County Public Works web site in a computerized Excel spreadsheet format to simplify usage. <http://www.dpw.co.santa-cruz.ca.us/drainage.htm>

Figure SWM-25A: Private Stormwater Maintenance Agreement

Recording requested by:

Upon recording return to:
County of Santa Cruz, DPW
Stormwater Management Section
701 Ocean Street, Room 410
Santa Cruz, CA 95060

(Space above this line for Recorder's use)

PRIVATE STORMWATER MANAGEMENT MAINTENANCE AGREEMENT

APN: _____

Application No. _____

_____, being the owner of the real property located at _____, California consents and agrees to inspect maintain annually "prior to the rainy season" and to maintain as necessary for ensuring proper performance of the _____ (stormwater management facility) on the subject property as shown on the plans prepared by _____ dated _____ per County Code 7.79 and to release, defend and indemnify the County from any and all claims or liability relating to my failure to perform this obligation. I understand that County staff may conduct inspections of the facility, and that as the property owner I may be assessed an inspection fee to cover the costs of inspection and oversight. I understand that no additional impervious or semi-impervious area shall be constructed without additional County permit review and approval and mitigation updates as necessary.

This document also acknowledges that if the parcel does and will continue to receive upstream runoff, that the property owner is responsible for maintenance of the drainage pathway (natural and/or man-made) through the parcel, and that the County & Flood Control District(s) are not responsible for the upstream runoff or for the maintenance of the drainage pathway.

I have read the above agreement and understand it. This agreement shall be binding on and shall inure to the benefit of the successors, heirs, executors, administrators, and assigns of owner.

Owner _____
(Printed Name)

Owner _____
(Signature)

Dated this _____ day of _____ - _____

(Note: The signature on this form must be notarized. Please attach a copy of the approved drainage plan and maintenance schedule to this form, then record the entire packet.)

Figure SWM-25B: Private Stormwater Maintenance Agreement

Recording requested by:

Upon recording return to:
County of Santa Cruz, DPW
Stormwater Management Section
701 Ocean Street, Room 410
Santa Cruz, CA 95060

(Space above this line for Recorder's use)

PRIVATE STORMWATER MANAGEMENT MAINTENANCE AGREEMENT

APN: _____

Application No. _____

_____, being the responsible party of the real property located at _____, California, consents and agrees to inspect and maintain annually "prior to the rainy season" and to maintain as necessary for ensuring proper performance of the stormwater management facilities on the subject property as shown on the plans prepared by _____ dated _____ per County Code 7.79. I understand that maintenance will be performed in accordance with the Operations and Maintenance Manual (attached) prepared by _____, dated _____ per County Code 7.79, and to release, defend and indemnify the County from any and all claims or liability relating to my failure to perform this obligation. I understand that County Department of Public Works staff may conduct inspections of the facility and that as the property owner, I may be assessed an annual service charge and/or re-inspection fee to cover the costs of inspection and oversight. I agree to forward a letter to the County Department of Public Works, prior to 15 October of every year, stating the date and type of service performed on these facilities. I understand that no additional impervious or semi-impervious area shall be constructed without additional County permit review and approval and mitigation updates as necessary.

This document also acknowledges that if the parcel does and will continue to receive upstream runoff, that the property owner is responsible for maintenance of the drainage pathway (natural and/or man-made) through the parcel, and that the County & Flood Control District(s) are not responsible for the upstream runoff or for the maintenance of the drainage pathway.

I have read the above agreement and understand it. This agreement shall be binding on and shall inure to the benefit of the successors, heirs, executors, administrators, and assigns of owner. The property owner is responsible for notifying County of Santa Cruz Stormwater Management if/when the property owner/person responsible for annual reporting changes.

Owner _____
(Printed Name) (E-mail) (Phone)

Owner _____
(Signature)

Dated this _____ day of _____ - _____

(Note: The signature on this form must be notarized. Please attach a copy of the O&M to this form, then record the entire packet.)

SECTION M – DESIGN REFERENCES

1. The design of storm drainage facilities shall conform to standard accepted engineering practice. Common reference texts are:
 - a. “Handbook of Hydraulics;” King & Brater
 - b. “Street and Highway Drainage;” The Institute of Transportation, University of California
 - c. “Highway Design Manual;” Caltrans
 - d. “Practices in Detention of Urban Stormwater Runoff, Special Report No. 43;” American Public Works Association
 - e. “Suggested Criteria for Hydrologic Design of Storm Drainage Facilities in the San Francisco Bay Region, California;” United States Department of the Interior, Geological Survey
 - f. “Design and Construction of Urban Stormwater Management Systems;” Water Environment Federation and ASCE (ASCE Manual and Report on Engineering Practice No. 77), 1992
 - g. “Urban Runoff Quality Management;” WEF and ASCE (ASCE Manual and Report on Engineering Practice No. 87), 1998
 - h. “Start at the Source, Design Guidance Manual for Stormwater Quality Protection,” 1999 Edition, Bay Area Stormwater Management Agencies Association, Forbes Custom Publishing.
<http://www.scvurppp-w2k.com/pdfs/0910/StartAtTheSource.pdf>
 - i. “Stormwater Best Management Practice Handbook,” 2 Vols.: Construction, New Development & Redevelopment; California Stormwater Quality Association,
<https://www.casqa.org/resources/bmp-handbooks>
 - j. “City of Santa Barbara Storm Water BMP Guidance Manual;” City of Santa Barbara, July 2013
 - k. “Low Impact Development Manual for Southern California;” The Low Impact Development Center, Inc., April 2010
 - l. “Stormwater C.3 Guidebook;” Contra Costa Clean Water Program.
<https://www.cccleanwater.org/development-infrastructure/development/stormwater-c-3-guidebook>
 - m. California Environmental Protection Agency State Water Resources Control Board

Phase II Small Municipal Separate Storm Sewer System General Permit 2013-0001-DWQ

https://www.waterboards.ca.gov/water_issues/programs/stormwater/phase_ii_municipal.html

- n. Central Coast Regional Water Quality Control Board Post Construction Stormwater Management Requirements for Development Projects in the Central Coast adopted by Resolution R3-2013-0032.
https://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/docs/lid/hydromod_lid_docs/User_Guide.pdf
- o. “Native Soil Assessment for Small Infiltration Based Stormwater Control Measures;” Earth Pacific Systems.
https://www.waterboards.ca.gov/centralcoast/water_issues/programs/stormwater/docs/lid/hydromod_lid_docs/infiltration_methodologies_12_19_13.pdf
- p. “Removing Barriers to Low Impact Development – Technical Memorandum #2 Permeable Pavement Details and Standards Review May 2017;” CASQA
https://www.casqa.org/sites/default/files/downloads/casqa_lid_barriers_grant_lid_tech_standards_review_tech_memo_2_-_may_2017.pdf
- q. “Green Street Handbook – Managing Wet Weather with Green Infrastructure Municipal Handbook;” Environmental Protection Agency (EPA).
<https://www.epa.gov/green-infrastructure/green-street-handbook>



County of Santa Cruz

Department of Community Development & Infrastructure

701 Ocean Street, 4th Floor, Santa Cruz, CA 95060-4070
(831) 454-2160

Appendix A - Project Information & Threshold Determination

Completion of this form shall be used as a guidance by the applicant for determining the projects stormwater requirements. Applicants are encouraged to contact the Stormwater Management staff with any questions.

PROJECT & CONTACT INFORMATION

Project Site Address:

Assessor's Parcel Number (APN):

Building Permit No./Discretionary Application:

Property Owner, Applicant, or Representative Name:

Contact Phone Number:

Flood Control District (additional permit fees for lot coverage may be assessed, refer to Unified Fee Schedule)

PROJECT DESCRIPTION

Lot Coverage	Actual	Adjusted
A. Total lot size:	_____ sq.ft.	
B. Existing Permitted Impervious Area:	_____ sq.ft.	
C. Replaced Permitted Impervious Area:	_____ sq.ft.	
D. Replaced Permitted Semi-Impervious* Area:	_____ sq.ft.	_____ 0 sq.ft.
E. Total proposed Self-mitigating Area:	_____ sq.ft.	
F. Proposed Impervious Area:	_____ sq.ft.	
G. Proposed Semi-Impervious* Area:	_____ sq.ft.	_____ 0 sq.ft.

Values in these tables are automatically calculated, user does not need to enter information here if filled out electronically.

Total REPLACED impervious & semi-impervious area [C + D]: _____ 0 sq.ft.

Total NEW impervious & semi-impervious area [F + (0.5*G)]: _____ 0 sq.ft.

Project Threshold Classification

(Value will auto-sum if filled out electronically, otherwise add **REPLACED** and **NEW** to obtain total for determining project size below)

 0 sq.ft.

- Small Project** (less than 500 sq.ft. created and/or replaced) - Use *Appendix B 'Small Project Submittal Requirements'* for submittal requirement guidance.
- Medium Project** (more than 500 sq.ft. but less than 5,000 sq.ft. created and/or replaced) - Use *Appendix C 'Medium Project Submittal Requirements'* for submittal requirement guidance.
- Large Project** (more than 5,000 sq.ft. created and/or replaced **OR** 50% increase in permitted impervious area**) - Use *Appendix D 'Large Project Submittal Requirements'* for submittal requirement guidance.

- 1. Application is part of a phased project OR master plan? Yes No
- 2. No diversion is proposed and pre-development runoff patterns will be maintained. Yes No
- 3. Application complies with Part 3 of the Design Criteria requirements. Yes No
- 4. Drainage has been evaluated. There are no existing drainage issues on/near the site and none anticipated. Yes No
- 5. Safe stormwater overflow has been incorporated into the project design. No adverse impacts to neighboring properties, drainage pathways, or roadways are anticipated. Yes No

Signature Required

By signing this form, the signee agrees the information provided here represents, to the best of their knowledge the scope of work being proposed. Signee acknowledges this document is to be used as a guidance for determining the project size and stormwater requirements, additional requirements and clarification may be required.

*Form will apply a 50% credit for semi-impervious areas as final count. Applicant shall not apply the credit.
** Projects that add more than 50% impervious area coverage are required to mitigate the entire site.

Appendix B – Small Project Submittal Requirements

Stormwater Submittal Requirements for Small Discretionary Projects

(< 500 square feet of new and/or replaced impervious/semi-impervious area):

At a minimum, the following items shall be provided in order to evaluate the Small project proposal with regards to discretionary Stormwater Management review:

1. Project Information:

- a. Provide a copy of the Stormwater Control Plan (SWP) – Project Information & Threshold Determination Form, determining the project threshold (Appendix A).
- b. Provide a project description.
- c. Include information on any phasing for project construction and implementation (project threshold shall be determined based on the total impact of all phases of a phased project).
- d. List relevant prior permit information (such as a minor land division, subdivision, or prior grading/building permit near the project location).

2. Conceptual Stormwater Management Plan (SWP):

Provide a conceptual SWP showing:

- a. Existing and proposed impervious, semi-pervious, self-mitigating, disturbed areas,
- b. Proposed best management practices (BMP),
- c. Existing and proposed stormwater (drainage) patterns – including areas that drain to/through the project site,
- d. Any/all easements (reference to the associated recorded document shall be placed on SWP),
- e. How will stormwater runoff will be conveyed and controlled. Safe stormwater overflow shall be incorporated into the project design and runoff shall not negatively impact neighboring properties or stormwater (drainage) pathways,
- f. Accommodation of existing upstream runoff in the project design without impact to upstream properties,
- g. A site assessment performed by the project Engineer, Architect, or Designer that notes whether there are any existing stormwater (drainage) issues on or near the site and if any stormwater (drainage) issues or impacts are anticipated resulting from the proposed improvements. If downstream restrictions are/have been identified, additional analysis and improvements may be required,
- h. Identify any conflicts between the proposed project design and the County Design Criteria (CDC). If the project does not completely comply with the CDC, the project description shall include a request for waiver to these criteria and shall provide technical justification for this waiver.

Stormwater Submittal Requirements for Small Building/Grading Projects

(< 500 square feet of new and/or replaced impervious/semi-impervious area):

At a minimum, the following items shall be provided in order to evaluate the Small project proposal with regards to building permit Stormwater Management review:

1. Project Information:

- a. Provide a copy of the Stormwater Control Plan (SWP) – Project Information & Threshold Determination Form, determining the project threshold (Appendix A).
- b. Provide a project description.
- c. Include information on any phasing for project construction and implementation.
- d. List relevant prior permit information (such as a minor land division, subdivision, or prior grading/building permit near the project location).

2. Final Stormwater Management Plan (SWP):

Provide a final SWP showing:

- a. Existing and proposed impervious, semi-pervious, self-mitigating, disturbed areas,
- b. Proposed best management practices (BMP),
- c. Existing and proposed stormwater (drainage) patterns - including areas that drain to/through the project site,
- d. Any/all easements (reference to the associated recorded document shall be placed on SWP),
- e. SWP shall illustrate how stormwater runoff will be conveyed and controlled.
- f. How safe stormwater overflow will be conveyed and controlled. Safe stormwater overflow shall be incorporated into the project design and runoff shall not negatively impact neighboring properties or stormwater pathways.
- g. Accommodation of existing upstream runoff in the project design without impact to upstream properties.
- h. A site assessment performed by the project Engineer, Architect, or Designer that notes whether there are any existing stormwater (drainage) issues on or near the site and if any stormwater (drainage) issues or impacts are anticipated resulting from the proposed improvements. If downstream restrictions are/have been identified, additional analysis and improvements may be required,
- i. Identify any conflicts between the proposed project design and the County Design Criteria (CDC). If the project does not completely comply with the CDC, the project description shall include a request for waiver to these criteria and shall provide technical justification for this waiver.

3. Fees:

Provide impervious area calculations. If the project is located in Santa Cruz County Flood Control and Water Conservation District Zones 5, 6, 7A or 8, impact fees based on the net increase in permitted impervious area will be assessed based on the current Unified Fee Schedule. The project may be eligible for fee credits for existing impervious areas previously permitted or built prior to the establishment of the flood control zone. To establish credit eligibility, documentation should be submitted with the project plans. Documentation such as assessor's records, survey records, permit records, dated aerial photographs or other official records that will help establish and determine the construction date, structure/impervious area footprint, or to confirm that a permit was previously issued is acceptable. Zones 5, 6, 7A and 8 were established in 1969, 1986, 2005 and 1977, respectfully. The County GIS may be used to determine the flood control district within which the project is located.

Notes:

1. Diversion of runoff resulting in altered stormwater (drainage) patterns from the project site is not allowed without prior approval by the Director.
2. Small projects with adequate on and off-site drainage are exempt from mitigation requirements. It is recommended that these projects incorporate BMPs to limit pollutant and hydrologic impacts such as pervious pavement, disconnection of runoff from impervious surfaces, etc.
3. The SWP may be combined with another plan set, at the discretion of the applicant. All information must be legible and consistent with standard engineering drafting conventions. SWP shall be consistent with grading, landscape, architectural, and utility plans (as applicable).

[Appendix C – Medium Project Submittal Requirements](#)

Stormwater Submittal Requirements for Medium Discretionary Projects

(> 500 but < 5,000 square feet of new and/or replaced impervious/semi-impervious area):

At a minimum, the following items shall be provided in order to evaluate the Medium project proposal with regards to discretionary Stormwater Management review:

1. Project Information:

- a. Provide a copy of the Stormwater Control Plan (SWP) – Project Information & Threshold Determination Form, determining the project threshold (Appendix A),
- b. Provide a project description,
- c. Include information on any phasing for project construction and implementation (project threshold shall be determined based on the total impact of all phases of a phased project),
- d. List relevant prior permit information (such as a minor land division, subdivision, or prior grading/building permit near the project location).

2. Conceptual Stormwater Management Plan (SWP):

Provide a conceptual SWP

- a. Existing and proposed impervious, semi-pervious, self-mitigating, disturbed areas,
- b. Proposed best management practices (BMP),
- c. Existing and proposed stormwater (drainage) patterns - including areas that drain to/through the project site,
- d. Any/all easements (reference to the associated recorded document shall be placed on SWP),
- e. SWP shall illustrate how stormwater runoff will be conveyed and controlled.
- f. How safe stormwater overflow will be conveyed and controlled. Safe stormwater overflow shall be incorporated into the project design and runoff shall not negatively impact neighboring properties or stormwater (drainage) pathways.
- g. Accommodation of existing upstream runoff in the project design without impact to upstream properties.
- h. Natural features (e.g., existing wetlands/streams, natural drainage routes, riparian areas) and required setbacks on and around the project site shall be included in the SWP,
- i. Existing and proposed drainage infrastructure on the site and nearby areas including the location of public and private storm drains, channels, ditches, BMPs, etc. shall be included in the SWP,
- j. A site assessment performed by the project Engineer, Architect, or Designer that notes whether there are any existing stormwater (drainage) issues on or near the site and if any stormwater (drainage) issues or impacts are anticipated resulting from the proposed improvements. If downstream restrictions are/have been identified, additional analysis and improvements may be required,
- k. Identify any conflicts between the proposed project design and the County Design Criteria (CDC). If the project does not completely comply with the CDC, the

project description shall include a request for waiver to these criteria and shall provide technical justification for this waiver.

3. Watershed Area Map(s):

- a. Show the boundaries of the stormwater (drainage) area(s) for each mitigation feature. Mitigation(s) shall be designed for all runoff being directed to each mitigation feature(s).

4. Best Management Practices:

- a. Indicate which Best Management Practices (BMPs) will be implemented to prevent runoff in excess of the pre-development conditions and to minimize the transport of pollutants.

Stormwater Submittal Requirements for Medium Building/Grading Projects

(> 500 but < 5,000 square feet of new and/or replaced impervious/semi-impervious area):

At a minimum, the following items shall be provided in order to evaluate the Medium project proposal with regards to building permit Stormwater Management review:

1. Project Information:

- a. Provide a copy of the Stormwater Control Plan (SWP) – Project Information & Threshold Determination Form, determining the project threshold (Appendix A).
- b. Provide a project description,
- c. Include information on any phasing for project construction and implementation (project threshold shall be determined based on the total impact of all phases of a phased project),
- d. List relevant prior permit information (such as a minor land division, subdivision, or prior grading/building permit near the project location).

2. Final Stormwater Management Plan (SWP):

Provide a final SWP:

- a. Existing and proposed impervious, semi-pervious, self-mitigating, disturbed areas,
- b. Proposed best management practices (BMP),
- c. Existing and proposed stormwater (drainage) patterns - including areas that drain to/through the project site,
- d. SWP shall identify any/all easements (reference to the associated recorded document shall be placed on SWP),
- e. SWP shall illustrate how stormwater runoff will be conveyed and controlled,
- f. How safe stormwater overflow shall be conveyed and controlled. Safe stormwater overflow shall be incorporated into the project design and runoff shall not negatively impact neighboring properties or stormwater (drainage) pathways.
- g. Accommodation of existing upstream runoff in the project design without impact to upstream properties.
- h. Natural features (e.g., existing wetlands/streams, natural drainage routes, riparian areas) and required setbacks on and around the project site shall be included in the SWP,
- i. Existing and proposed drainage infrastructure on the site and nearby areas including the location of public and private storm drains, channels, ditches, BMPs, etc. shall be included in the SWP,
- j. A site assessment performed by the project Engineer, Architect, or Designer that notes whether there are any existing stormwater (drainage) issues on or near the site and if any stormwater (drainage) issues or impacts are anticipated resulting from the proposed improvements. If downstream restrictions are/have been identified, additional analysis and improvements may be required,
- k. Identify any conflicts between the proposed project design and the County Design Criteria (CDC). If the project does not completely comply with the CDC, the project description shall include a request for waiver to these criteria and shall provide technical justification for this waiver.
- l. Provide final construction cross-section details for all permanent stormwater

mitigation features. The details must include all necessary information for the accurate construction of the proposed mitigation features (including, but not limited to: invert elevations, slope, pipe type and diameter, manufacturer specs if applicable, compaction guidelines/requirements, material type, methods of construction, dimensions).

3. **Watershed Area Map(s):** Show the boundaries of the stormwater (drainage) area(s) for each mitigation feature. Mitigation(s) shall be designed for all runoff being directed to each mitigation feature(s).
4. **Best Management Practices:** Indicate which Best Management Practices (BMPs) will be implemented to prevent runoff in excess of the pre-development conditions and to minimize the transport of pollutants.
5. **Maintenance Schedule:** Provide a final maintenance schedule on the project plans that includes inspection frequency and maintenance requirements for each of the permanent stormwater mitigation features proposed. Identify the single entity that shall be responsible for the long-term operation and maintenance of the stormwater facilities, source control measures, storm drain markings/signage, stormwater (drainage) patterns, and impervious area limits established with the project. A recorded maintenance agreement shall be required (not required for project approval) & will identify a single entity as being solely responsible for said operational & maintenance procedures.
6. **Fees:** Provide impervious area calculations. If the project is located in Santa Cruz County Flood Control and Water Conservation District Zones 5, 6, 7A or 8, impact fees based on the net increase in permitted impervious area will be assessed based on the current Unified Fee Schedule. The project may be eligible for fee credits for existing impervious areas previously permitted or built prior to the establishment of the flood control zone. To establish credit eligibility, documentation should be submitted with the project plans. Documentation such as assessor's records, survey records, permit records, dated aerial photographs or other official records that will help establish and determine the construction date, structure/impervious area footprint, or to confirm that a permit was previously issued is acceptable. Zones 5, 6, 7A and 8 were established in 1969, 1986, 2005 and 1977, respectfully. The County GIS may be used to determine the flood control district within which the project is located.

Notes:

1. Diversion of runoff resulting in altered stormwater (drainage) patterns from the project site is not allowed without prior approval by the Director.
2. Medium projects shall incorporate BMPs to minimize and mitigate pollutant and hydrologic impacts due to development. These BMPs shall include Low Impact Development (LID) measures that emphasize the minimization of impacts as a first priority consistent with the General Plan Policy 7.23.2 for Minimizing Impervious Surfaces.
3. The SWP may be combined with another plan set, at the discretion of the applicant. All information must be legible and consistent with standard engineering drafting conventions. SWP shall be consistent with grading, landscape, architectural, and utility plans (as applicable).

Appendix D – Large Project Submittal Requirement

Stormwater Submittal Requirements for Large Discretionary Projects (> 5,000 square feet of new and/or replaced impervious/semi-impervious area):

At a minimum, the following items shall be provided in order to evaluate the large project proposal with regards to discretionary Stormwater Management review:

1. Project Information:

- a. Provide a copy of the Stormwater Control Plan (SWP) – Project Information & Threshold Form (Appendix A),
- b. Provide a project description,
- c. Include information on any phasing for project construction and/or implementation (project threshold shall be determined based on the total impact of all phases of a phased project),
- d. List relevant prior permit information (such as a minor land division, subdivision, or prior grading/building permit near the project location).

2. Conceptual Stormwater Management Plan (SWP):

Provide a conceptual SWP:

- a. Existing and proposed impervious, semi-impervious, self-mitigating, disturbed areas,
- b. Best management practices (BMP) and mitigation proposals(s),
- c. Consistent with the Preliminary Stormwater Management Report and Watershed Area Maps,
- d. SWP shall illustrate how stormwater runoff will be conveyed and controlled,
- e. How safe stormwater overflow will be conveyed and controlled. Safe stormwater overflow shall be incorporated into the project design and runoff shall not negatively impact neighboring properties or stormwater (drainage) pathways,
- f. Accommodation of existing upstream runoff in the project design without impact to upstream properties,
- g. Natural features (e.g., existing wetlands/streams, natural drainage routes, riparian areas) and required setbacks on and around the project site shall be included in the SWP,
- h. Existing drainage infrastructure for the site and nearby areas including the location of public and private storm drains, channels, ditches, BMPs, etc. on and around the site shall be included in the SWP,
- i. A site assessment performed by the project Engineer, Architect, or Designer that notes whether there are any existing stormwater (drainage) issues on or near the site and if any stormwater (drainage) issues or impacts are anticipated resulting from the proposed improvements. If downstream restrictions are/have been identified, additional analysis and improvements may be required,
- j. Identify any conflicts between the proposed project design and the County Design Criteria (CDC). If the project does not completely comply with the CDC, the project description shall include a request for a waiver to these criteria and shall provide technical justification for this waiver.

3. Watershed Area Map/s:

- a. Provide a map with topographic information showing the existing and proposed boundaries of the drainage area used for design, the project boundaries, and existing and

proposed drainage patterns.

- b. Show all upstream areas draining to/through the project site and show how and where the site drains in both the existing and proposed conditions.
- c. Projects must demonstrate that the downstream drainage facilities can safely accommodate runoff from the project.

4. Tentative Map (for Minor Land Divisions & Subdivisions):

- a. Provide a tentative map showing all existing and proposed private drainage easements for common drainage facilities and facilities serving upstream offsite areas.

5. Preliminary Stormwater Management Report:

Provide a report with:

- a. Analysis supporting the conceptual stormwater management plan and demonstrating feasibility of methods proposed for compliance with these Design Criteria requirements.
- b. At a minimum, the report shall address the methods for complying with these items:
 - i. Minimize Stormwater Pollutants of Concern,
 - ii. Site Design and Runoff Reduction Measures,
 - iii. Stormwater Discharge Rates and Volumes.
 - iv. May include the Watershed Area Map/s.
- c. Documentation demonstrating technical infeasibility if design consistent with any portion of these Design Criteria is anticipated to not be achieved.
- d. Provide soils/infiltration data used to determine the feasibility/infeasibility of infiltration of stormwater on the project site for review.
- e. Provide approval from the project geotechnical engineer for the conceptual SWP prior to discretionary completeness.
- f. A downstream impact assessment. If downstream restrictions are/have been identified the project shall include the improvements needed to upgrade the storm drain system.

Stormwater Submittal Requirements for Large Land Division, Building, and Grading Permits (> 5,000 square feet of new and/or replaced impervious/ semi-impervious area):

At a minimum, the following items shall be provided and approved prior to recordation of the final map and/or approval of final improvement plans and/or issuance of any building/grading permits for all large projects:

1. Project Information:

- a. Provide a copy of the Stormwater Control Plan (SWP) – Project Information & Threshold Determination Form (Appendix A).
- b. Provide a project description.
- c. Identify any conflicts between the proposed project design and these Design Criteria.
- d. Include information on any phasing for project construction and/or implementation (project threshold shall be determined based on the total impact of all phases of a phased project).
- e. List relevant prior permit information (such as a minor land division, subdivision, or prior grading/building permit near the project location).

2. Final Stormwater Management Plan (SWP):

Provide a dated, signed and stamped Final SWP:

- a. Adequate construction level details including construction scheduling and phasing,
- b. Final Stormwater Management Report and Watershed Area Map/s,
- c. Show existing and proposed impervious, semi-impervious, self-mitigating and disturbed areas,
- d. Best management practices (BMP) and mitigation proposals(s),
- e. The plan shall clearly illustrate how stormwater runoff from all project areas will be conveyed and controlled (provide spot elevations, slopes, grade breaks, cross sections, roof plan, and other information as necessary) and how safe stormwater overflow has been incorporated into the project design,
- f. Natural features (e.g., existing wetlands/streams, natural drainage routes, riparian areas) and required setbacks on and around the project site shall be included in the SWP,
- g. Existing and proposed drainage infrastructure on the site and nearby areas including the location of public and private storm drains, channels, ditches, BMPs, etc. shall be included in the SWP.
- h. Final details, materials, specifications and methods of construction and methods for permeability/infiltration testing and acceptable thresholds for facilities that rely on infiltration. The design and materials shall be consistent with Section J – Storm Drain Facilities.

3. Watershed Area Map/s:

- a. Provide a map with topographic information showing the existing and proposed boundaries of the drainage area used for design, the project boundaries, and existing and proposed drainage patterns,
- b. Show all upstream areas draining to/through the project site and show how and where the site drains in both the existing and proposed conditions,
- c. Accommodation of existing upstream runoff in the project design without impact to upstream properties,
- d. Projects must demonstrate that the downstream drainage facilities can safely

- accommodate runoff from the project,
- e. Provide a catchment area map showing the entire project site that delineates the watershed area draining to each stormwater mitigation facility.

4. Final Map/Improvement Plans.

- a. Identify existing and proposed easements on the plan and include reference to associated recorded document/s. Private drainage easements shall be provided for all common drainage facilities (see Section E for requirements).
- b. Shall include language to keep private drainage facilities free and clear of buildings or structures of any kind.
- c. Acknowledgement that no additional impervious area coverage beyond the limits shown shall be constructed without prior approval by the County of Santa Cruz.

5. Final Stormwater Management Report:

Provide a dated, signed and stamped Final Stormwater Management Report:

- a. With analysis supporting the final stormwater management plan and demonstrating compliance with these Design Criteria requirements,
- b. At a minimum, the report shall address the following items:
 - i. Source Control Measures,
 - ii. Minimize Stormwater Pollutants of Concern,
 - iii. Site Design and Runoff Reduction Requirements,
 - iv. Stormwater Discharge Rates and Volumes,
 - v. Hydrology,
 - vi. Hydraulics,
 - vii. Safe Stormwater Overflow.
 - viii. May include the Watershed Area Map/s.
- c. Documentation demonstrating technical infeasibility if design consistent with any portion of these Design Criteria can not be achieved,
- d. A soils report or additional soils information regarding permeability of the site soils where applicable. Saturated soil permeability and hydraulic conductivity values may be used conservatively from the published physical properties table within the USDA-NRCS soil survey, or use actual test values. Other soil information may be found within this survey, including engineering index properties, restrictive layers and high groundwater occurrence. A web site link to the soil survey is provided from the [County DPW Stormwater Management web page](#). Site-specific soil data from geotechnical investigations shall be used when available and appropriate (such as depth to impervious layer/bedrock; depth to average and seasonal high groundwater; presence of unique geology; geotechnical hazards; documented soil and/or groundwater contamination; etc.). Provide information on all testing protocol followed as well as engineering calculations used to determine the design infiltration rate based on protocol and site conditions. Provide a site map showing locations of borings and testing. Provide approval from the project geotechnical engineer for the Final SWPs which references dated Stormwater Management Plan and Report.

6. Maintenance:

- a. Provide a recorded stormwater management maintenance agreement in addition to CC&Rs, road maintenance agreements, easements, and/or other legally enforceable

document/s that establishes who is responsible for the operation and maintenance of the stormwater facilities, source control measures, mitigation features, storm drain markings/signage, drainage patterns, and impervious area limits established with the project and which is consistent with and includes all required attachments as specified in Section C.3 of these Design Criteria.

- b. The recorded maintenance agreement shall identify a single entity who is responsible for submitting the annual maintenance report and paying associated annual fees.

7. Fees:

Provide impact fee calculation. If the project is located in Santa Cruz County Flood Control and Water Conservation District Zones 5, 6, 7A or 8 impact fees based on the net increase in permitted impervious area will be assessed based on the current Unified Fee Schedule. The project may be eligible for fee credits for existing impervious areas previously permitted or built prior to the establishment of the flood control zone. To establish credit eligibility, documentation should be submitted with the project plans. Documentation such as assessor's records, survey records, permit records, dated aerial photographs or other official records that will help establish and determine the construction date, structure/impervious area footprint, or to confirm that a permit was previously issued is acceptable. Zones 5, 6, 7A and 8 were established in 1969, 1986, 2005 and 1977, respectfully. The County GIS may be used to determine the flood control district within which the project is located.

*For all projects requiring an SWM-25B Maintenance Agreement that are not part of a land division, Public Works staff will inspect the construction of the drainage related items. Please provide engineer's estimate for the construction of the drainage items (there is a 3% inspection fee). A hold will be placed on the building permit for a preconstruction meeting with the Public Works Construction Engineer (please call at least 48 hours prior to construction to schedule the preconstruction meeting at 831.454.2160). A second hold will be made for approval of the final construction by the Public Works Construction Inspector.

Coordinate with the Surveyor's Office for inspection administration of land divisions' improvements, including the drainage facilities associated with land division(s).

Notes:

1. Diversion of runoff resulting in altered stormwater (drainage) patterns from the project site is not allowed without prior approval by the Director.
2. Large projects shall incorporate BMPs to minimize and mitigate pollutant and hydrologic impacts due to development. These BMPs shall include Low Impact Development (LID) measures that emphasize the minimization of impacts as a first priority with the General Plan Policy 7.23.2 for Minimizing Impervious Surfaces.
3. The SWP may be combined with another plan set, at the discretion of the applicant. All information must be legible and consistent with standard engineering drafting conventions. SWP shall be consistent with grading, landscape, architectural, and utility plans (as applicable).

PART 4. SANITARY SEWER DESIGN

PART 4. SANITARY SEWER DESIGN

Section A - Submittal Requirements

1. Sewer plans and specifications, containing the elements described below, will be reviewed for adequacy and completeness.
2. Design calculations and manufacturer's pump curves shall be required for all lift stations. When requested, design calculations shall also be submitted for other facets of projects.

Section B - Reference Manuals

1. The design and construction of sanitary sewers and lift stations shall conform to the practices and methods set forth in the following manuals:
 - a. American Society of Civil Engineers' Manual of Engineering No. 37
 - b. Wastewater Engineering, Medcalf & Eddy
 - c. California Plumbing Code, current approved edition
2. Requirements set forth in this *Design Criteria* shall prevail over practices set forth in the above manuals.

Section C - Design Flow Rates

1. Design flow rate shall be the peak flow rate, including infiltration and stormwater inflow, of the total ultimate tributary area.
2. Design flow rates in general shall be as given in Figure SS-1, or as approved or otherwise directed by the District Engineer.
3. Design flow rate for lift stations serving the equivalent of 29 dwelling units or less shall be based on a minimum of 3.5 gallons per minute times the number of equivalent dwelling units.

Section D - Design of Sewer Systems

1. All public sanitary sewer systems shall be designed as looped systems where topographically practical, with bypass connections at all intersecting streets, and shall be capable of serving all properties within the sewage basin, based on projected General Plan densities within the District's sphere of influence. Sewers shall be installed on the centerline of the roadway. Curved sewers shall not be allowed. New sewer pipe shall be located no closer than 5 feet from existing pipe systems except where approved by the District Engineer.
2. Diameter of gravity sewers shall be determined by Manning's pipe friction formula, using a roughness coefficient, "n" of 0.013, or the pipe manufacturer's recommendation, whichever is greater.

3. Sanitary sewers shall be designed and sized for the following depths of flow: pipes 12 inches in diameter or less at 1/2 full and pipes greater than 12 inches in diameter at 3/4 full.
4. The minimum pipe diameter shall be 8 inches for public collector lines.
5. A minimum velocity of 2 feet per second is required. Velocity shall be restricted to 15 feet per second maximum, unless special pipe or controls have been approved. Design depth of flow shall not exceed those standards established in number 3 above. The use of pipe slopes less than 1.0% for any new construction must have variance approval by the District Engineer and will only be allowed where a greater slope is not physically possible.

6. Minimum pipe cover:

Public sewer	5 feet
Laterals.....	3 feet

Cover less than above shall meet requirements of Figure SS-11.

Prior to initiating any grading in the vicinity of any existing public sewers where the above required minimum depths of cover cannot be assured, the contractor shall be required to assume any costs in determining the existing condition of the sanitary sewers in the affected area. This would require video recording the sewer main, by the project applicant pursuant to County specifications, if an existing video is not already on record with the County.

7. Manholes shall be provided at intervals not greater than 400 feet for 8 inches lines, 500 feet for 10 inches and larger lines, at all changes in horizontal or vertical alignment, and at the end of all public sewer mains. Cleanouts are not allowed at the end of a public sewer main. Horizontal interior angles between incoming and outgoing sewer lines shall not be less than 90 degrees. Manhole depth shall not exceed 20 feet without written approval of the District Engineer. Manholes and cleanouts shall not be located within any drainage way, valley, channel, gutter line, or other location where stormwater inflow could enter the sewer system.
8. Sewer mains shall conform to current State of California Department of Health Services criteria regarding separation between sewer and water mains.
9. Drop manhole connections will be allowed only with prior County approval. Refer to Figures SS-6 for details.
10. Cul-de-sac manholes (see Figure SS-7) may be installed at the end of all lines where more than one building connection could be made, and where it would not be feasible to extend the line any further.
11. Any development containing 30 or more equivalent dwelling units shall install flow metering and/or odor control equipment. Equipment shall be specified at time of development review. At the District Engineer's option, a payment equivalent to the

installed required equipment cost may instead be collected for future use.

12. For new commercial developments, an industrial waste sampling manhole shall be constructed, either on- or off-site, as part of the sewer system if any building or its dischargers will be used for industrial purposes. Details and specifications for each industrial waste sampling manhole shall be approved by the District Engineer during development review.
13. Backflow protection devices (see Fig. SS-14) shall be provided on all service connections in which the finished floor elevation is less than 12 inches above the next upstream manhole or cleanout cover. The device shall be located in such a way as to prevent damage to adjacent property as a result of sewage released through the device. Flip-top or dome valves shall not be placed in any structure that would hamper the free discharge of sewage.

Section E - Sewer Easement Requirements

1. Easements shall be provided for all County maintained sewers, except in rights- of-way currently maintained by the County. Easements shall also be required wherever necessary to facilitate connections to any future lines or line extensions, to serve adjacent parcels, or to provide access to existing sewers.
2. The easements shall be shown on either the final map or the parcel map and shall be offered for dedication to the Sanitation District as part of the Owner's Certificate. Easements shall be for access and maintenance for sanitary sewers and necessary appurtenances on or under the land so designated.
3. All easements shall be improved to a width of at least 20 feet, and shall be fully accessible to all County maintenance vehicles. No structures, fences, decks, landscaping, or other obstructions shall be placed over or in such easements. (The C.C. and R.'s for the development shall specifically prohibit any such encroachments.) Any gates that must be constructed over such easements shall be noted on the improvement plans as at least 10 feet wide, with standard locking mechanisms compatible with existing County padlocks.

Section F - Sewer Plan Layout

1. Design drawings shall show the following:
 - a. Location of manholes and cleanouts
 - b. Location of laterals and stubouts
 - c. Existing manhole numbers (available from on the [County GIS website](#)) and distance between new structures and existing manholes
 - d. Existing manhole rim and invert elevations, surveyed by a licensed land surveyor (based on the nearest County benchmark shown on the [County GIS website](#), NAVD88) with the benchmark listed on the plans
 - e. Manhole rim and invert elevations for proposed manholes
 - f. Size of sewer and class of pipe
 - g. Slope of pipe
 - h. Project-specific details
 - i. Location of existing sewers and laterals that are to be abandoned, and method of

- abandonment
 - j. Easements (existing and proposed)
 - k. Finished floor elevations
 - l. Grading and paving details for driveway construction (for access to sewer easement)
 - m. Portions of lines to be publicly or privately maintained
 - n. Sanitation District's "Standard Notes for Development" provided by County Sanitation.
2. Standard details and material specifications shall be per the Design Criteria.
 3. Condominium, townhouse and cluster development sewer systems shall be designed according to these County criteria, and as noted on Figure SS-3, although such systems shall be operated and maintained by their homeowners' association. Specific reference to sanitary sewer maintenance and operation shall be included in the C.C. & R.'s for all such developments.

Section G - Lift Stations

1. Refer to Section C regarding design flow rates for County maintained lift stations and private stations serving multiple units.
2. For lift stations serving more than one residence, request design standards from the County at the time of the Planning Application. The design and location of all lift stations shall be subject to the approval of the District Engineer. Where necessary, additional right-of-way shall be set aside within the development for such stations.
3. Lift stations shall be designed to provide for the following minimum force main diameters and flow velocities unless otherwise specified by the District Engineer:

District-Maintained Station

4-inch force main at 4 feet per second

Private Multi-Residential Station

3-inch force main at 3 feet per second

4. Private single residence pump stations shall conform to the provisions of Fig. SS-13 and to the California Plumbing Code. Their locations shall be included on the plot plan of the building permit application, together with a complete list of all equipment (including pump curves) and accessories that are to be installed.
5. Shop drawings (3 sets) of all lift station equipment shall be submitted to the District Engineer for review and approval prior to accepting the delivery of any such equipment.

Section H – Clarifiers, Interceptors, and Traps

1. All new Exterior Grease Interceptors shall be made of vinyl/composite materials; no

new installations of concrete structures will be allowed.

2. All new Hydromechanical Grease Traps shall be made of vinyl/composite material; no new installations of metal traps will be allowed.
3. All new Standard Clarifiers shall be made of vinyl/composite materials; no new installations of concrete structures will be allowed.
4. Refer to the California Plumbing Code for sizing criteria and requirements:
 - a. For Exterior Grease Interceptors, see Sections 1014.3.6 and Table – 1014.3.6 for sizing and 1014.3 – 1014.3.5 for additional requirements
 - b. For Hydromechanical Grease Traps, see Sections 1014.2 – 1014.2.2 and Table 1014.2.1 for sizing criteria and additional requirements
 - c. For Standard Clarifiers, see Sections 1017.0 – 1017.2 for sizing and additional requirements.
 - d. The County requires Clarifiers be at minimum, a 3-unit, 1,500 gallon structure with a 18-inch by 24-inch sample box.
5. The following apply to Vinyl/Composite Exterior Grease Interceptors, Vinyl/Composite Hydromechanical Grease Traps, and Standard Vinyl/Composite Clarifiers (Structure):
 - a. Size and model of Structure to be installed shall be approved by the District Engineer.
 - b. Secure necessary permits from the Building Department and check location and structural requirements before beginning installation of said Structure.
 - c. Installation shall be per District requirements, other County Department requirements, manufacturer’s recommendations, and California Plumbing Code requirements.
 - d. Install Structure such that no surface water, storm water, or rainwater may enter the Structure at any time.
 - e. Structure shall be installed prior to the time of the rough plumbing inspection. Schedule inspection of Structure 48 hours in advance of the installation by calling (831) 477-3907.
 - f. Structure foundation shall be prepared per the manufacturer’s requirements. If manufacturer does not have requirements, and water is present at the excavated depth, then a minimum of three inches of drain rock shall be laid in the bottom of the trench prior to setting the Structure.
 - g. All Structures must be set level.
 - h. All Structure covers shall be tight-fitting, removable, easily accessible, and supplied with a gasket-type seal.
 - i. Toilet facilities are prohibited from flowing through the Structure.
 - j. Garbage grinders are prohibited per District Code Section 7.04.510 J.
 - k. Automatic dishwashers must be approved by the District Engineer.
 - l. Venting shall be per the California Plumbing Code and manufacturer’s specifications. If odors from venting become excessive, the County may require the addition of a running trap and cleanout.
 - m. Inlet and outlet pipes in Structure shall be minimum 4” in diameter.

Section I - Construction Standards

1. All work within County right-of-way requires an approved encroachment permit. Improvement plan submittals for encroachment permits shall conform to the

requirements of Part I, General, of this *Design Criteria*. The County Encroachment Inspector shall be contacted at (831) 454-2160 at least 48-hours prior to commencement of any work.

Please be aware that there are locations in the County where one may expose asbestos cement pipe (ACP) fragments when digging. At these locations, asbestos sewer pipes were replaced with new HDPE or fusible PVC sewer pipes using a method called pipe bursting. The burst fragments remain in the existing pipe trench, very near the new sewer pipe.

Special precautions regarding asbestos handling shall be followed if excavation is planned within one foot of burst ACP. Please refer to the Asbestos Concrete Burst Pipe Locations map book (<https://www.dpw.co.santa-cruz.ca.us/ApplicationsandForms.aspx>) to check if you will be excavating in one of these locations. If so, note the following:

- a. 45-day written notification to the Monterey Bay Air Resources District is required prior to excavation within one foot of the burst ACP line. This applies to all connections to the new pipeline, or crossings of the pipeline (within one foot).
 - b. Soil within one foot of the pipe burst ACP line will be assumed to contain ACP debris and must be handled and disposed of as of Regulated Asbestos Containing Materials (RACM) hazardous waste.
 - c. Blanket encroachment permits are not valid when doing excavations at locations listed as containing burst ACP.
2. In order to allow for more reliable future location of existing sewer lines and laterals, tracer wire shall be installed in accordance with Figures SS-2 and SS-12. Tracer wire shall be insulated 10-gauge fully annealed, high carbon 1055 grade steel, high strength solid copper-clad steel conductor rated at 30 volts, insulated with 30 mil, high-density, high molecular weight polyethylene (HPDE). Conductivity must be at 21% conductivity for locator purposes. Tracer wire shall be attached to the top of new sewers and over those new sewer laterals that are constructed in the public right-of-way or sewer easements. Wire shall be brought up from outside of manhole, under manhole cover frame and shall make an easily accessible loop within manhole consisting of 18 inches of wire in accordance with Figures SS-4 and SS-5.
 3. Marking tape shall be installed one foot above the sewer pipe, over its entire length. Marking tape shall be green and read “Caution – Buried Sewer Line Below” at two-foot intervals along the tape.
 4. County survey crews will prepare “as-built” plans of all publicly-maintained sewers that are constructed as part of any land division or sewer main extension. The developer shall be responsible for all staff charges and preparation costs involved therein. All other sewers which are to be dedicated to the County shall be built through standard sewer extension agreement proceedings, with appropriate cash deposits required for all plan checking, inspection (including video inspection), and “as-built” survey costs.

Criteria for “as-built” plans shall include:

- Manhole and cleanout rim and invert elevations; reference to appropriate County benchmark (NAVD88);
- Length of sewers (distances between new manholes and both upstream and downstream existing structures);
- Pipeline materials;
- Offset distances to easements and edge of right-of-way; and

- Any horizontal alignment changes.
5. Following cleaning (balling, flushing, and screening of the debris) and testing of the new sewers, the developer shall be responsible for all costs to have the District-maintained sewer system (and private laterals at the discretion of the District Engineer) video inspected by a qualified firm. Video inspections shall be coded with manhole names assigned by the County. Recording shall be performed immediately after the introduction of clean water at the high point of the line to be examined (an adequate supply/flow of water shall remain to allow detection of any sags that may be present). The video recording shall be coded with NAASCO's PACP codes and supplied in a format compatible with GraniteNet (.WMV preferred). The video and report shall be exported using Target Standard: PACP/LACP v6.0 as a NAASCO database (*.mdb). The video inspection shall be submitted to the District Engineer on via Box.com (contact the County for upload instructions). The video shall be recorded at a speed not to exceed 20 feet per second.

The video picture shall be of such clarity that it shall afford the viewer a clear perspective of any defects, sags, or debris left in the pipeline, and shall indicate orientation of the camera with respect to the invert of the pipe. The depth of any standing water shall be indicated on the video by a measurement device, approved by the District, mounted ahead of the camera. If any sags are detected that are not within allowable tolerances, the contractor shall be required to re-lay said line by appropriate means, so as not to damage or otherwise dislodge said pipeline. Sags shall be considered out of tolerance if the depth of the sag exceeds 9 percent of the pipe diameter. Additional defects that may cause non- acceptance include, but not be limited to: mud and debris; slipped joints; an excessive number of sags in any particular segment; any improperly installed fittings; and any noticeable offsets.

The video inspection of the sewer line shall be done when the flow in the upstream pipelines has been bypassed. Flow from sewer laterals along the line being recorded shall require a delay, with recording to continue, for a minimum of 60 seconds to allow the flow from the lateral to properly clear.

If the line is found to have defects, once all defects have been corrected, the contractor shall then be required to submit a new video inspection of the entire affected pipeline(s). No permanent paving or other feature shall be constructed over a sewer line until all videos have been reviewed and approved by the District Engineer.

6. Approval of final occupancy of any dwellings constructed in conjunction with new sewerlines shall be further conditioned upon the completion and acceptance of all public or private downstream sewers. In cases where public sewers are involved, this will also require video inspection of said lines per the above criteria.

[Section J - Construction Specifications](#)

1. TRENCH BACKFILL.

Attention is directed to Section 19-3, "Structure Excavation and Backfill" of the Standard Specifications and these specifications. Compaction shall be measured by California Test No. 216 and/or Test No. 231. Sand equivalent shall be measured by California Test 217.

- A. Pipe Zone:** Pipe shall be laid on a bed of 3/4" drain rock material, extending from a minimum six inches below pipe bottom and over the installed pipe, resulting in six inches of cover on the pipe. Compaction lifts shall be limited to six inches. Material shall be hand tamped to a minimum ninety percent relative compaction. Gradation of 3/4" drain rock material shall comply with the table provided below:

3/4" Drain Rock Material Gradation

Sieve size	Typical Percentage Passing
1"	100
3/4"	80
1/2"	20
3/8"	11
No. 4	4

- B. Structural Backfill:** Structural backfill shall have a minimum sand equivalent value of 30 and be free of organic or other unsatisfactory materials. Gradation shall be 3-inch sieve size passing 100% and the No. 4 inch sieve passing 35-100%. Compaction lifts shall be limited to 24 inches (compacted depth).
- C. Slurry Backfill:** Slurry backfill shall conform to Section 19-3.02E, "Slurry Cement Backfill" of the Standard Specifications with these additional specifications. Slurry backfill shall be mixed in a transit mixer (weight master certificate required), consist of 94 pounds of cement for each cubic yard of material.

2. GRAVITY SEWER.

The gravity sewer may be flexible, or semi-rigid sewer pipe as described below. Installation shall be in accordance with the manufacturer's prescribed procedures and these specifications.

A. Flexible Sewer Pipe:

1. **Poly Vinyl Chloride Sewer Pipe.** Poly Vinyl Chloride (PVC) sewer pipe and fittings shall be manufactured in accordance with ASTM D 3034 (Type PSM), or F 679, and include the following requirements:
 - i. Pipe sizes 15-inches and smaller shall conform to ASTM D 3034 and shall provide a minimum standard dimension ratio (SDR) of 26 and a minimum pipe stiffness of $F/Y = 115$ psi when measured at 5 percent deflection.
 - ii. Pipe sizes greater than 15-inches shall conform to ASTM F 679 and shall provide a minimum pipe stiffness of $F/Y = 115$ psi when measured at 5 percent deflection.
 - iii. All pipe and fittings must be fitted with integral bell and spigot elastomeric joints conforming to ASTM D 3212.

- iv. Bells are to include integral PVC retainer rings for locking the rubber ring gasket into position.
 - v. PVC pipe and fitting markings shall include the appropriate ASTM and Cell Classification Numbers (12454-B or 12454-C or other ASTM approved classifications) and be GREEN in color.
2. **High Density Polyethylene Sewer Pipe.** High Density Polyethylene Sewer Pipe (HDPE) shall be DR17 designated PE4710 with a cell classification PE345434C as specified within ASTM D3350. It will also meet the requirements of AWWA C901 and C906. Material taken from HDPE pipe will meet the minimum stability requirements of ASTM D3350. The material's Environmental Stress Crack Resistance shall have a $F_o > 5,000$ hours under ASTM D1693 Condition C.
- i. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification from the same raw material pipe. Pipe (excluding black colored pipe) stored outside shall not be used in recycling. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It shall be uniform in density and other physical properties.
 - ii. Pipe shall bear markings as required in AWWA C906, including manufacturer's name. Pipe shall have a conspicuous, continuous green stripe along the pipeline's exterior surface to denote that the pipe is for sanitary sewer application. Pipe interior color shall be approved by the County. White or black colored pipe will not be allowed.
 - iii. A qualified jointing technician shall perform all heat joint fusion joints.
 - iv. Pipe joints shall be butt fusion welded. Welding by using electrofusion coupling shall not be allowed unless otherwise approved by the County. The butt fusion welding equipment shall have data logging devices (data loggers) that can record equipment welding temperature, time and pressure conditions during joining. The data loggers shall have computerized system that can output the data into computer files or hardcopy prints. All pipe welds shall be performed at the ground level. The County reserves the rights to inspect the welds at any time.
 - v. Interior joint weld beads shall be removed. Any remaining beads after the removal procedure shall have a maximum depth of 1/16 inch. Any misaligned joints shall be cut out and the pipe re-welded.

B. High Strength Poly Vinyl Chloride (PVC). High-strength Poly Vinyl Chloride Sewer Pipe shall conform to AWWA C900, be rated Pressure Class 235, have an outside diameter to wall thickness ratio of 18 (DR18), shall meet ASTM D2122 and D3139, and conform to the restrictions listed below:

- 1. Joints in PVC pipe shall be push-on rubber gasket joints conforming to AWWA C900. Pipe shall have a bell with integral wall section with a factory installed, solid cross section elastomeric ring in accordance with ASTM F477. Swapping gaskets is not allowed.

2. The pipe must be able to withstand an impact of 100 foot-pounds without visible evidence of shattering or splitting as specified in ASTM D2444.
3. Installation shall conform to the recommendations of the pipe manufacturer.

C. Semi-rigid Sewer Pipe and Laterals:

Acrylonitrile Butadiene Styrene. Acrylonitrile Butadiene Styrene (ABS) pipe and fittings shall be Schedule 40 and conform to ASTM D 2661. Fittings not described by this standard shall be shop fabricated or molded from materials listed in paragraphs 4 and 5 of D2680 and shall be of equivalent quality to those described.

ABS pipe shall only be used for sewer laterals (outside the travel way) and is not permitted for sewer collection lines.

3. SEWER MANHOLE.

A. General

1. Sanitary Sewer Manholes consist of bedding, precast base, precast risers and cone sections, connections and coupling devices, interior joint gaskets, grade adjustment rings, exterior joints seals, frame and cover, and concrete block/collar.
2. Manhole cone sections shall be concentric. Manhole risers and cones shall not include steps or rungs, or perforations for rungs.
3. Below shelf connections may only be used with pre-approval by the County. This requirement includes private mains and laterals.
4. The bell lip of the connecting pipe shall be at, or just beyond, the exterior wall of the manhole. Subsequent joints may occur at any convenient distance beyond the manhole.
5. Pipes connecting shall be flush with inside manhole wall.
6. County-maintained and privately-maintained manholes shall have a cast iron frame and cover unless the County approves a composite frame and cover.
7. Concrete collar may be omitted if the manhole is outside of a roadway or access road. In this case, the rim shall be a minimum of 6 inches above the adjacent grade or as directed by the County.
8. In cases where precast concrete base is not appropriate, the County may allow a cast-in- place concrete base with prior approval. All other sewer manhole requirements apply. Cast-in-place bases shall include a minimum 10-inch reinforced concrete section conforming to the requirements of ACI 318. The cast-in-place base shall include an approved metal forming ring to accept the first precast joint and shall include a flexible sealing gasket between the base and first precast section. Detailed drawing of the manhole shall be submitted to the County for approval.
9. The integrity of all new manholes shall be tested in place prior to backfilling in

accordance with ASTM C 1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

10. Santa Cruz County Design Criteria figures shall be referenced for additional details and requirements such as backfill, collars, connection details, and development requirements.

B. Sanitary Sewer Manhole:

1. Precast manholes shall conform to the requirements of ASTM C 478.
2. All components of the system shall be designed to meet the minimum load condition of AASHTO HS-25 and shall include the effects of buoyancy where appropriate.
3. The minimum 28-day concrete compressive strength shall be 4,000 psi and the maximum water to cement ratio (w/c_m) of 0.45.
4. Manhole joints shall conform to the watertight requirements of ASTM C 443 and include either confined groove or single off-set joint and gasket configuration.
5. Pipe connections to manhole shall be resilient connections conforming to ASTM C 923.
6. Manhole bedding shall be a minimum of 9 inches of Class 2 Permeable Material conforming to section 68-2.02F(3), or approved alternative.
7. Concrete durability requirements are dependent on the location of the manhole. Where inflow, infiltration, or corrosion is expected, additional requirements may be required by the District. These additional requirements may include:
 - i. Portland cement conforming to ASTM C 150, Type II or Type V.
 - ii. Crystalline water proofing admixture. Products includes Xypex manufactured by Xypex Chemical Corporation, Crystal-X manufactured by Concrete Seal Technologies, or pre- approved equal.
 - iii. Composite manhole lining system. Products includes Mainstay Composite Liner (2- component) by Madewell Products Corporation or pre-approved equal.
 - iv. Polymer Concrete Manhole. Products includes Armorock or pre-approved equal.
 - v. Antimicrobial admixture. Products includes BIO-SAN manufactured by Xypex Chemical Corporation, ConBlock MIC manufactured by Concrete Seal Technologies, or pre-approved equal. Brown color tinting shall be included to identify concrete that contains an antimicrobial admixture.

C. Sanitary Sewer Manhole Joints

1. All manholes shall have external joint seals between each manhole section, including the base, barrel and cone sections and grade rings. The external joint seal shall meet or exceed requirements of ASTM C 877, Type II with a minimum tensile strength of 4000 psi and a minimum tear resistance of 1500 psi. Exterior joint seals shall be a minimum nine (9) inch wide for concrete manholes and twelve (12) inches wide for polymer concrete manholes. Products include EZ Wrap by Press-Seal Corporation, or pre- approved equal.

D. Sanitary Sewer Manhole Frame & Cover

1. Composite frames and covers may only be used with pre-approval from the County and shall be EJ Durostreet COM260327A01 assembly (COM260210 frame and COM260327 lid) or approved equal.
 - i. Composite products shall be manufactured from fiber reinforced polymer (FRP). It shall consist of a FRP matrix consisting of between 45% to 70% fiber reinforcement by weight. Fiber reinforcement shall consist of fiberglass, carbon, aramid, basalt and/or natural fibers. The polymer matrix shall be thermoset consisting of a polyester, vinylester, epoxy, polyurethane, and/or hybrid chemical composition. The resin matrix must be thermoset.
 - ii. Composite products shall be tested against a fatigue performance consisting of 2 million cycles at 16,000 pounds. There shall be no visible damage, and must meet allowable permanent set for the applicable class.
 - iii. Traffic service castings shall have a first article proof load test conducted and the results of that proof load shall be made available to the purchaser upon request. The proof load shall be conducted in accordance with the method and procedure as outlined in AASHTO M 306.
 - iv. All steel hardware shall be grade 316 stainless steel.
 - v. No proprietary locking mechanisms shall be used.
 - vi. Each product shall be identifiable and show, at a minimum, the following: name of manufacturer, country of manufacture (such as “Made in USA”), material designation, and individual part number. Product shall include all lettering as shown on the specification drawing.
2. Unless otherwise approved by the County, manholes must have cast iron frames and covers. Cast Iron Frame and Cover shall be sound gray cast iron conforming to ASTM A48, Class 35B, as noted in Section 3.1 of AASHTO M306. The frame shall provide a minimum clear opening of 23 7/8 inches. The cover shall have a maximum weight of 140 pounds. Both the frame and cover shall be machined on three surfaces resulting in a tight, non-rocking fit and a 11 degree taper. The overall frame diameter shall be 34-inch diameter. The covers shall have a 3/4 inch non-curved open pick hole offset from the edge and a pry slot on the edge.

Castings shall have a first article proof load test conducted and the results of that proof load shall be submitted with the shop drawings. The proof load shall be

conducted in accordance with the method and procedure that is outlined in AASHTO M306, Section 7.0, "Proof Load Testing." The casting shall be tested on a suitable and calibrated load testing machine and the casting shall hold a 40,000-pound proof load for one minute without experiencing any cracks or detrimental permanent deformation. Each casting shall be identifiable and show, at a minimum, the following: name of producing foundry, country of manufacture, ASTM material designation, recycle symbol, individual part number, and the cast or heat date.

A foundry certification shall be furnished along with the shop drawings stating that samples representing each lot have been tested, inspected and are in accordance with these specifications.

E. Grade Rings

Grade rings shall be installed as required to meet finished grade elevations as measured in the field. A minimum 3 inch and a maximum 18 inch of grade rings shall be installed. Use manufacturer recommended sealing material between abutting manhole components. Grade ring dimension must provide full support of the frame. Rings must be set in a full bed of mortar and made secure.

1. Expanded Polypropylene (EPP) Grade Rings must be Cretex Pro-Ring™ or pre-approved equal. The grade rings must meet or exceed the requirements of AASHTO M306 for HS-20 and SH-25 loads, ASTM C1244, ASTM C969, ASTM D4819-12, and SAE J1885
2. Precast Concrete Grade Rings must conform to ASTM C-478 and shall be delivered to the jobsite in one piece, no field repairs allowed.
3. Precast Polymer Concrete Grade Rings must meet or exceed strength and loading requirements of ASTM C478 and ASTM C857, and manufactured by Armorock or approved equal.

4. ABANDON SEWER FACILITIES.

The ends of sewer pipelines shall be securely closed by a 0.5-foot thick tight-fitting plug or wall of commercial quality concrete containing not less than 470 pounds of cement per cubic yard per Figure SS-15. Any openings into existing structures that are to remain in place shall be plugged with commercial quality concrete.

Existing sewer pipelines, to be abandoned, that intersect the side slopes shall be removed to a minimum depth of 3 feet measured from the plane of the side slope before being plugged. The resultant void shall be backfilled in accordance with the provisions in Section 19, "Structure Excavation and Backfill," of the Standard Specifications.

To abandon an existing manhole, the structure shall be removed to a minimum depth of 5.0 feet. Drill two (2) 1-inch diameter holes at the bottom and opposite sides of the manhole wall to prevent the entrapment of waste. The remaining structure shall be backfilled with structural material and compacted to a minimum of 95% relative compaction if the manhole is in a vehicular travel way (otherwise minimum 90% relative compaction may be accepted). The County may require the existing frames and covers be salvaged.

Sewer facilities shall not be abandoned until their use is no longer required. The Applicant shall notify the County in advance of any intended facility abandonment.

5. REMOVE ASBESTOS CEMENT PIPE.

If pipe bursting, pipe reaming, or pipe removal of more than 260 lineal feet of Asbestos Cement Pipe (ACP) is proposed, the Contractor shall notify the Monterey Bay Unified Air Pollution Control District (MBARD) ten (10) working days prior to commencing the pipe bursting or pipe reaming activities.

The Contractor performing the removal shall be required to follow all Federal, State and County regulations for the safe removal, handling, storage and disposal of ACP materials and debris. The Contractor may be required to submit a hazardous waste disposal manifests for all ACP hauled from the project site.

All ACP material removed shall be stored in secure, airtight containers at all times. No broken or crushed ACP shall be left in the ground except where specifically allowed by law.

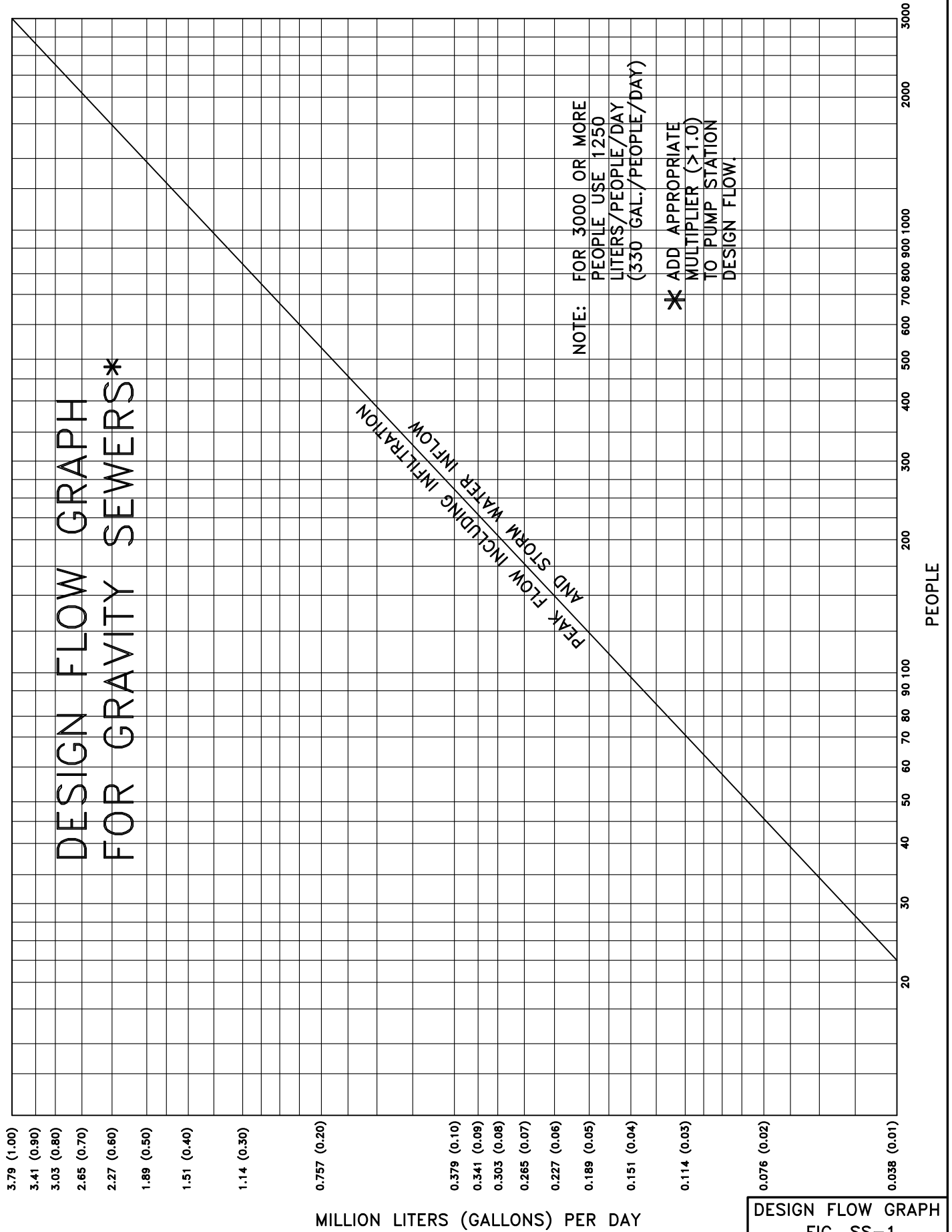
No ACP may be removed, stored or disposed of without the direct approval and authorization of the County. ACP material generated from the Contractor's excavation operations shall be disposed of offsite daily.

The County requires notice of all locations where ACP is burst or reamed. Current County requirements for working with asbestos cement pipe are listed on the [County's website](#).

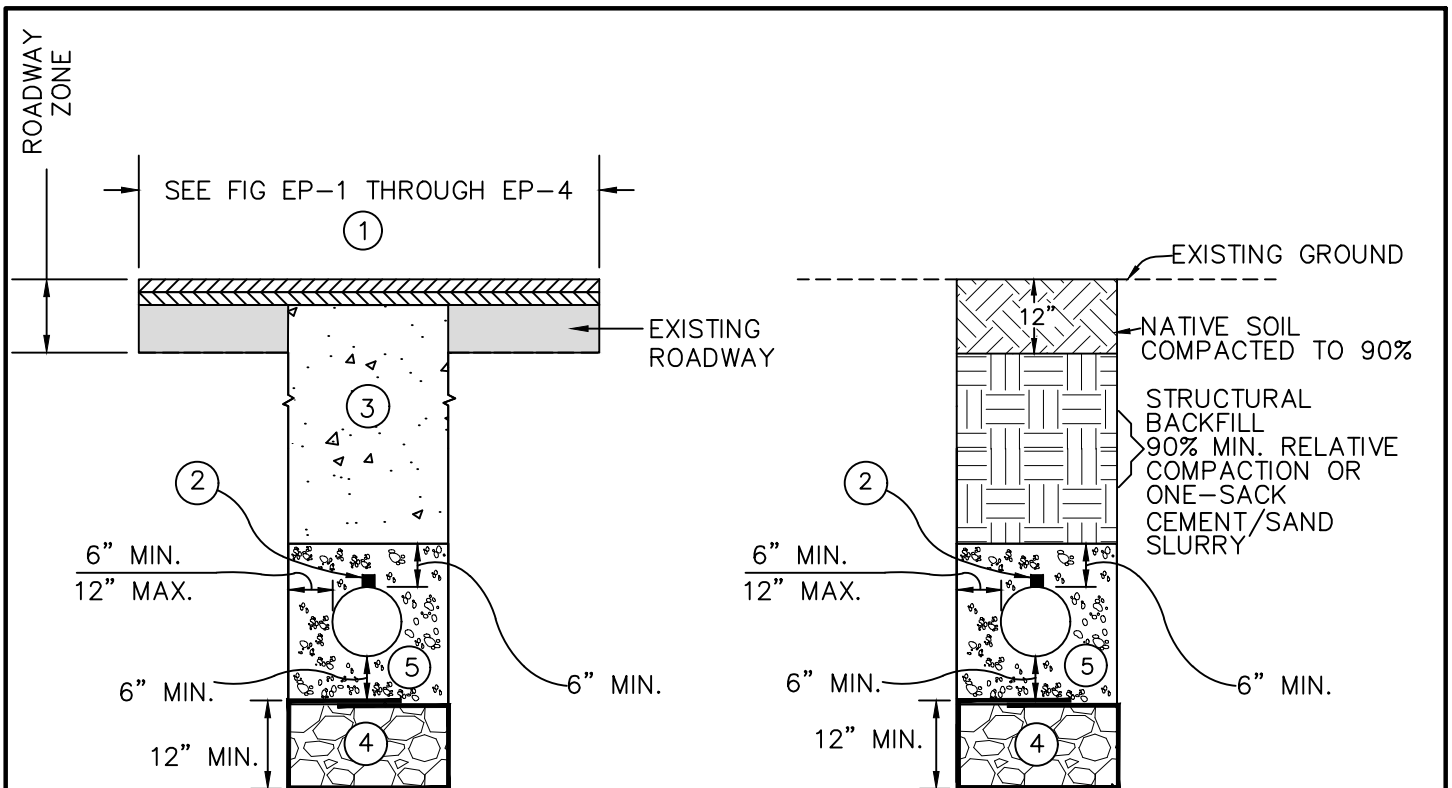
Section K - Glossary

- Infiltration – groundwater, or groundwater that is influenced by surface or sea water, that enters sewer pipes, manholes, or laterals through holes, breaks, joint failures, connection failures and other openings.
- Inflow – surface water that enters the wastewater system from yard, roof, and footing drains, from cross-connections with storm drains and downspouts, and through holes in manhole covers.
- Lateral – The part of the sewer line which connects the residence's or business's sewer to the sewer main in the street. Laterals are owned and maintained by the property owners. They extend from the building foundation and include the connection to the sewer main.
- Pipe Bursting – A trenchless method of replacing the buried pipelines (such as sewer or water pipes) without the need for a traditional construction trench. The existing pipe is opened and forced outward by a bursting tool that is pulled through the existing pipeline, typically by using a cable and winch. The burst pipe fragments remain in the ground, and a new pipe is installed in its place.
- Pipe Reaming – A trenchless method of replacing buried pipelines (such as sewer or water pipes) without the need for a traditional construction trench. A directional drill back-reams through the existing pipe enlarging the hole and the old pipe is ground up and replaced by the new sewer pipe. The fragments of the old pipe along with other cuttings are suspended in drilling fluid and pushed ahead of the reamer through the existing pipe to a recovery pit or manhole where they are extracted, separated, and disposed of. The new pipe attached to the reaming tool is pulled in as the reamer advances and is installed in place of the old pipe.

DESIGN FLOW GRAPH FOR GRAVITY SEWERS*



DESIGN FLOW GRAPH
FIG. SS-1



TRENCH DETAIL FOR TRAFFIC AREAS
(5' OR MORE OF COVER*)

TRENCH DETAIL FOR NON-TRAFFIC AREAS
(5' OR MORE OF COVER*)

*COVER = TOP OF PIPE TO FINISHED GRADE; SEE NOTE 3 BELOW FOR ADDITIONAL INFORMATION

① SEE FIGURE EP-1 THROUGH EP-4 FOR ROADWAY ZONE TRENCH SECTION DETAILS; SS-2 SUPERCEDES EP-1.

② TRACER WIRE: TRACER WIRE SHALL BE TIED TO ALL SEWER LINES AND RUN UP INTO ALL CONNECTING STRUCTURES FOR LOCATING ACCESS. FOR MANHOLES, PLACE WIRE UNDER MANHOLE COVER FRAME AND MAKE AN EASILY ACCESSIBLE LOOP WITHIN MANHOLE. LOCATING WIRE SHALL BE 10 GAUGE MINIMUM, FULLY ANNEALED, HIGH CARBON 1055 GRADE STEEL, HIGH STRENGTH COPPER CLAD STEEL, WITH 21% MINIMUM CONDUCTIVITY, AND AN RHoS COMPLIANT HDPE INSULATED JACKET (APWA UNIFORM COLOR CODE SEWER-GREEN).SEE SS-4/SS-5 FOR TERMINATION DETAILS.

③ ONE-SACK CEMENT/SAND SLURRY BACKFILL.

④ SELECT DRAINROCK AND APPROVED FILTER FABRIC IS REQUIRED AS "EXTRA WORK" WHERE SOIL OR GROUND WATER CONDITIONS ARE ENCOUNTERED DURING CONSTRUCTION OR AS CONTRACT WORK WHERE IT HAS BEEN SPECIFIED ON THE PROJECT PLANS (OVERLAP TOP 12" MIN.).

⑤ 3/4" DRAIN ROCK (3/8" MINUS AGGREGATE MAY BE USED AS AN ALTERNATIVE FOR LATERALS ONLY)

NOTES:

1. ALL PUBLICLY-MAINTAINED SEWERS OR PRIVATE LINES SHALL BE LAID WITH APPROVED CONTROLS. FOLLOWING CLEANING AND TESTING, PUBLIC SEWERS (OR PRIVATE SEWERS AT THE DISCRETION OF THE PUBLIC WORKS INSPECTOR) SHALL BE VIDEO RECORDED ENCODED WITH NASSCO'S PACP CODES (.MDB FILE FORMAT PER DISTRICT STANDARDS) AFTER BACKFILLING, BUT PRIOR TO FINAL PAVING, FOG SEALING, SLURRY SEALING, AND ACCEPTANCE BY DISTRICT.
2. IN NON-PAVED, NON-COUNTY MAINTAINED TRAFFIC AREAS, STRUCTURAL BACKFILL MAY BE ALLOWED IF APPROVED BY THE DISTRICT.
3. PIPES WITH LESS THAN 5' OF COVER SHALL COMPLY WITH FIG. SS-11.
4. COUNTY RESERVES THE RIGHT TO REQUIRE PAVEMENT RESTORATION PER EP-5, WHERE WARRANTED.

SANITARY SEWER MAIN & LATERAL
STANDARD TRENCH BACKFILL
FIG. SS-2

SEWER LAYOUT CRITERIA FOR DEVELOPMENTS

- I. Requirements for All Developments
 - A. No sanitary sewer facility may be installed within a storm water mitigation area.
 - B. No sanitary sewer main or lateral shall be installed under a structure; a new building's lateral will not be allowed to connect to an existing sewer that runs under a structure unless no other options existing AND the connection is approved by the District Engineer.
 - C. A private collector serving more than 2 units shall be 6" diameter, minimum.
 - D. Minimum private collector slope shall be 2% unless otherwise approved by the District Engineer.
 - E. A cleanout (Figure SS-10) is required at the end of every collector line. A cleanout is also required between the building and the collector line. See Figure SS-14 for backflow preventive requirements.

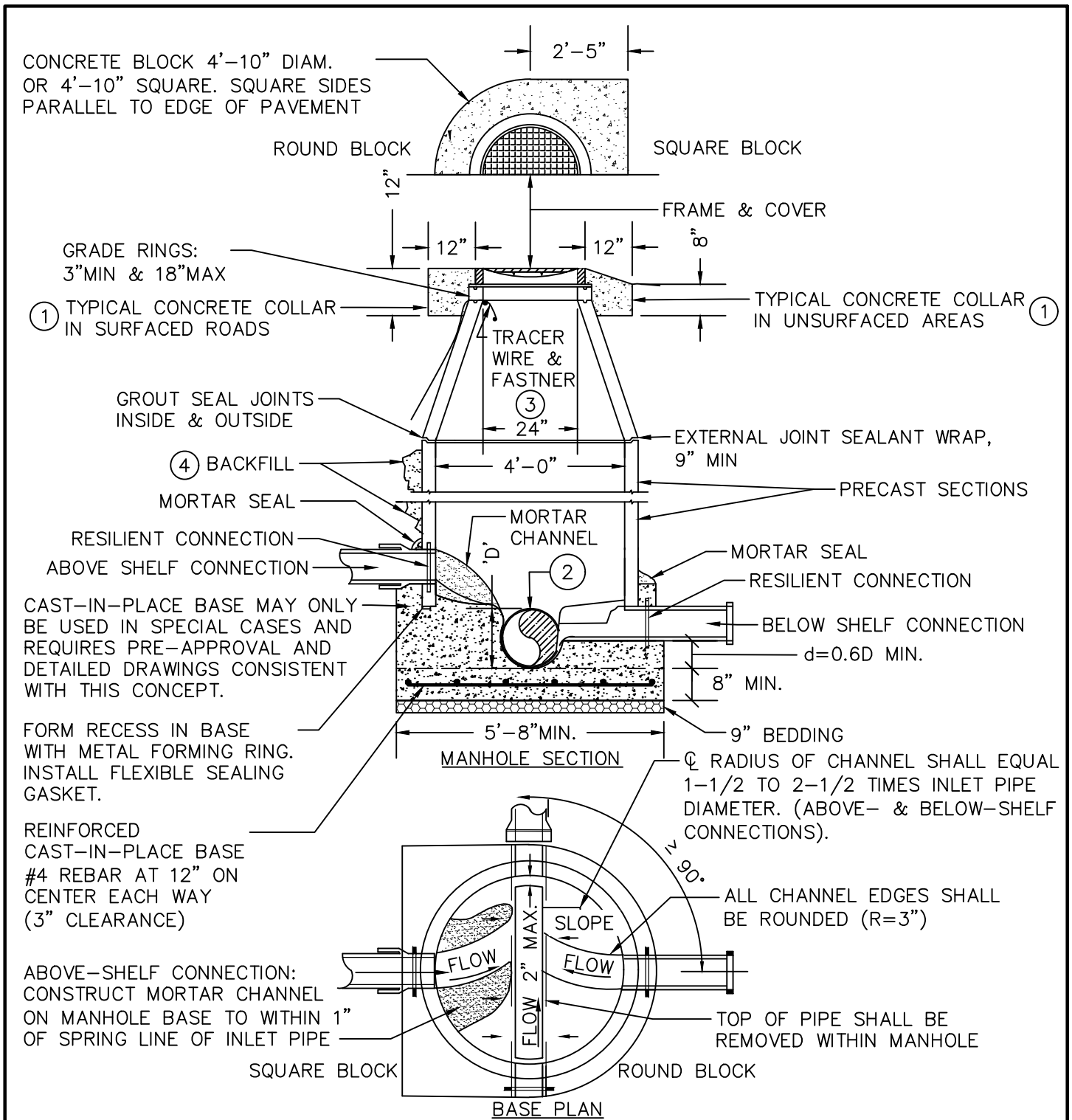
- II. Additional Requirements for Single Ownership of More than Two Dwelling Units on the Same Parcel
 - A. A wye connection to the public main may be allowed with District approval when 4 or less units are connected to an 8" diameter or larger public main. A cleanout is required every 100 feet.
 - B. A manhole is required when 5 or more units are connected to the private collector, or if the public main is 6" diameter.
 - C. A cleanout is required on the collector for every change in direction or slope.

- III. Additional Requirements for Single Ownership of Two Units on the Same Parcel

A 4" diameter sewer lateral may be used for a proposed development of two dwelling units (duplex or detached) with a "Y" configuration. The District inspector may require additional cleanouts where field conditions such as slope, distance between cleanouts, or vertical or horizontal angles of pipe warrant their installation.

- IV. Additional Requirements for Multiple Ownership
 - A. Townhouse or Condominium
 1. Private collector lines shall be located in private easements or common areas.
 2. Maintenance responsibility and maintenance schedule for private collector lines shall be included in the CC&R's. A copy of the CC&R's shall be provided to the District for review and shall be approved by the District prior to Public Works approval.
 3. A manhole is required at the connection to the public main.
 4. A manhole is required at every change in direction or slope of the private collector.
 - B. Single Family Dwellings
 1. Each unit shall be separately connected to a public main.
 2. Existing and proposed laterals shall be located and shown on the plans.
 3. A minimum 5' wide private sewer easement for laterals shall be shown on the recorded map, where necessary.

SEWER LAYOUT CRITERIA
FIG. SS-3

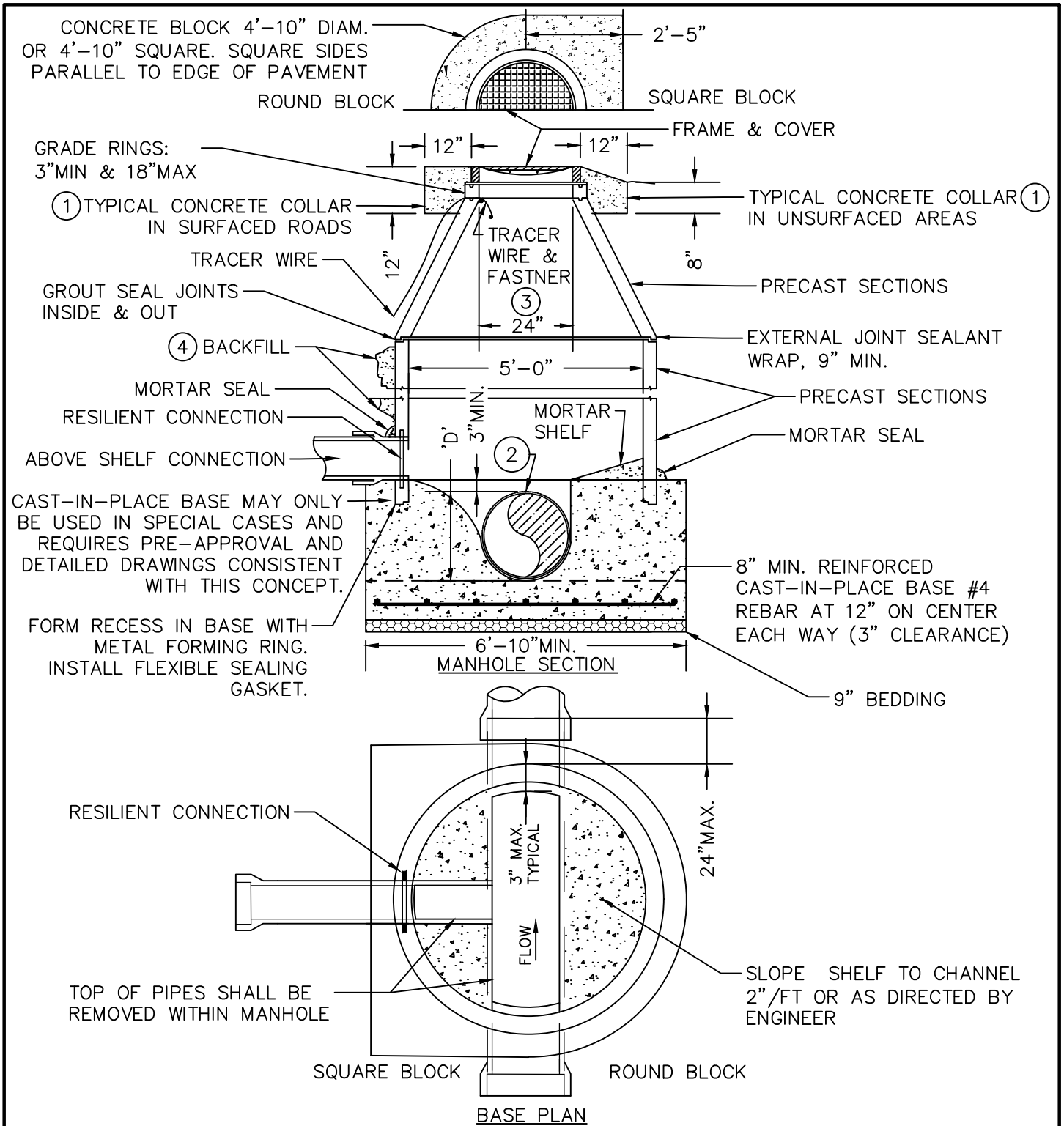


- ① POUR HIGH STRENGTH, REINFORCED, AND PIGMENTED (DRY SHAKE) CONCRETE TO TOP OF CASTING COVER SEE ALSO FIG. EP-9.
- ② LAY PIPE THROUGH MANHOLES WHEN POSSIBLE. OTHERWISE, FORM CHANNEL TO MAINTAIN PIPE SECTION FOR FULL PIPE DIAMETER
- ③ COIL AND SECURE TRACER WIRE AROUND NON-CORROSIVE FASTNER. LEAVE ENOUGH WIRE TO EXTEND 18" ABOVE MANHOLE COVER.
- ④ SEE FIG. SS-2 FOR BACKFILL REQUIREMENTS.

SEE SECTION J.3 "SEWER MANHOLES" FOR ADDITIONAL DETAILS & REQUIREMENTS.

STANDARD MAIN MANHOLE
FOR 16" OR SMALLER LINES
FIG. SS-4

REV.10/23



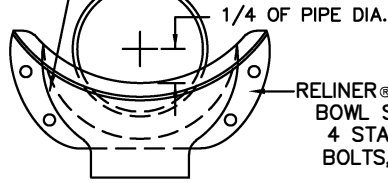
- ① POUR HIGH STRENGTH, REINFORCED, AND PIGMENTED (DRY SHAKE) CONCRETE TO TOP OF CASTING COVER SEE ALSO FIG. EP-9.
- ② LAY PIPE THROUGH MANHOLES WHEN POSSIBLE. OTHERWISE, FORM CHANNEL TO MAINTAIN PIPE SECTION FOR FULL PIPE DIAMETER
- ③ COIL AND SECURE TRACER WIRE AROUND NON-CORROSIVE FASTENER. LEAVE ENOUGH WIRE TO EXTEND 18" ABOVE MANHOLE COVER.
- ④ SEE FIG. SS-2 FOR BACKFILL REQUIREMENTS.

SEE SECTION J.3 "SEWER MANHOLES" FOR ADDITIONAL DETAILS & REQUIREMENTS.

STANDARD MAIN MANHOLE
FOR 18" OR LARGER LINES
FIG. SS-5

REV.10/23

SEAL BOWL TO INSIDE WALL OF MANHOLE WITH SILICONE SEALER

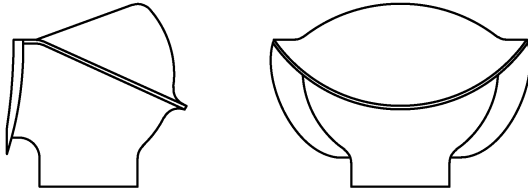


DROP BOWL MOUNTING POSITION

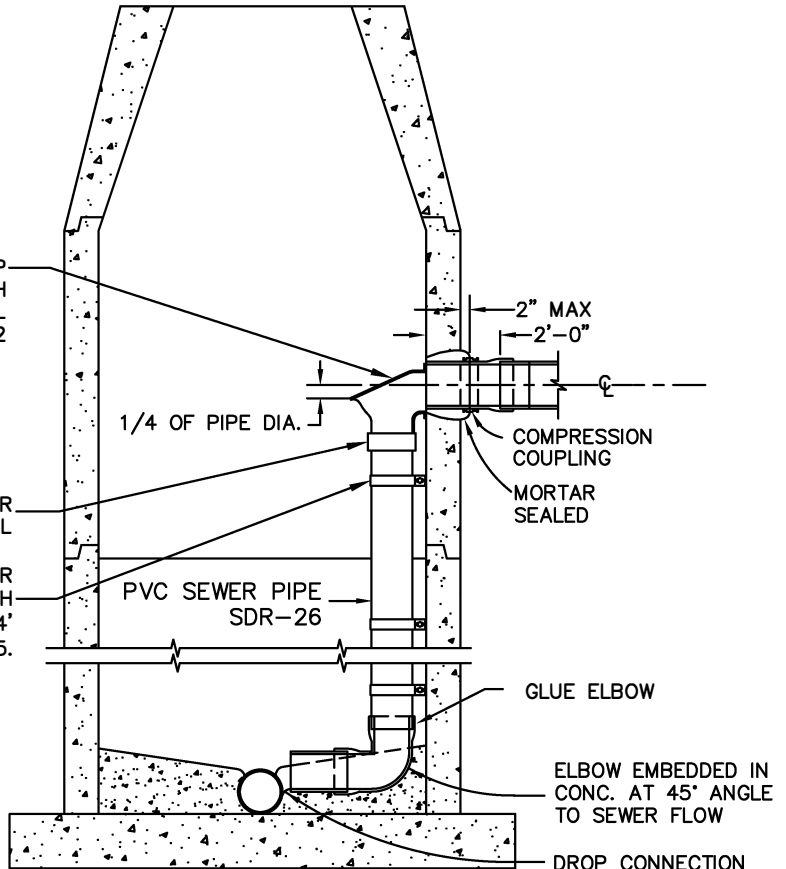
RELINER® INSIDE DROP BOWL SECURED WITH 4 STAINLESS STEEL BOLTS, SEE NOTE 2

CAST IRON/PVC CAULDER COUPLING OR EQUAL

RELINER® STAINLESS STEEL BRACKETS OR EQUAL. SECURE TO STRUCTURE WITH 2 STAINLESS STEEL BOLTS. STRAP AT 4' INTERVALS (MIN. OF 2). SEE NOTE 5.



FORCE LINE HOOD



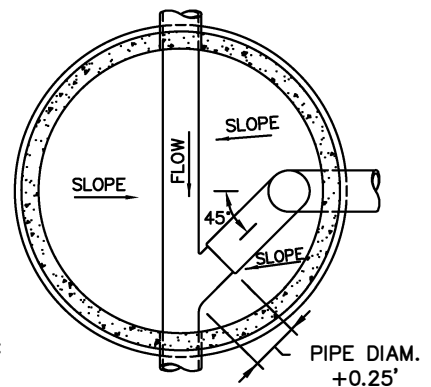
INSIDE DROP CONNECTION

ELBOW EMBEDDED IN CONC. AT 45° ANGLE TO SEWER FLOW

DROP CONNECTION PIPE INVERT SHALL MATCH THE SPRING-LINE OF THE EXIT PIPE.

NOTES:

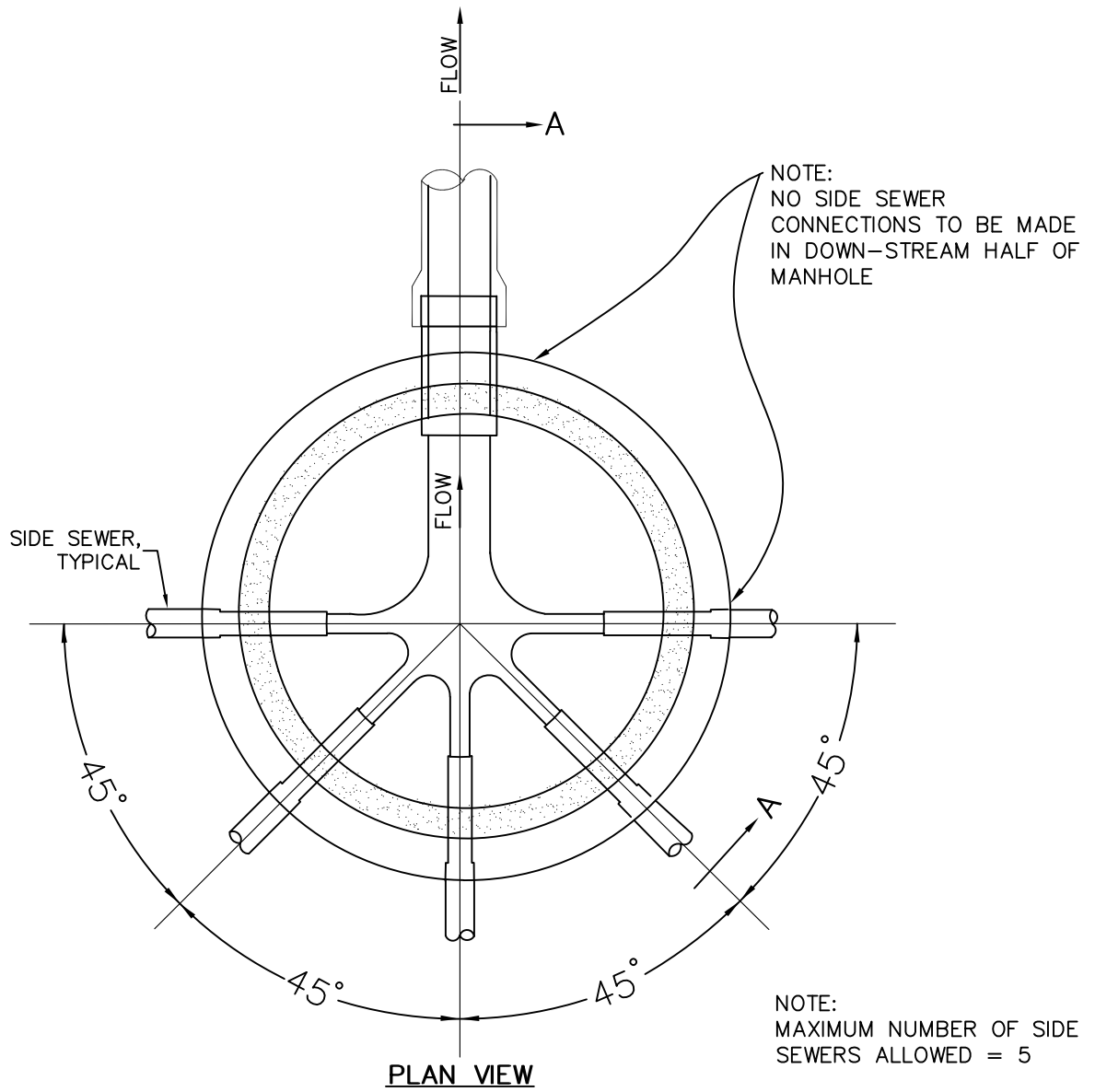
1. DROP MANHOLE CONNECTION WILL ONLY BE ALLOWED WITH PRIOR DISTRICT APPROVAL.
2. ALL INSIDE DROP CONNECTIONS FOR SERVICES AND COLLECTOR SEWERS SHALL USE THE DROP BOWL AS PRODUCED BY:
RELINER-DURAN, INC.
53 MT. ARCHER RD,
LYME, CT 06371
(800)508-6001 FAX: (877)434-3197, OR APPROVED EQUAL.
3. DROP BOWL MODEL "A-4" SHALL BE USED FOR ALL LINES UP THROUGH 6" INLETS. DROP BOWL MODEL "A-6" SHALL BE USED FOR ALL 8" INLETS. DROP BOWLS MODEL "B-8" SHALL BE USED FOR ALL 10" INLETS. DROP BOWLS ON LINES LARGER THAN 10" SHALL BE AS DIRECTED BY THE DISTRICT ENGINEER.
4. THE FORCE LINE HOOD SHALL BE ATTACHED ON MODELS "A-4" & "A-6" WHEN THE INCOMING LINE IS FROM A FORCE MAIN, OR THE SLOPE IS 3% OR GREATER, OR WHEN EXCESSIVE VELOCITY RESULTS IN SPILLING OUT OF BOWL.
5. SECURE DROP PIPE TO MANHOLE WALL WITH RELINER-DURAN, INC STAINLESS STEEL ADJUSTABLE CLAMPING BRACKETS OR APPROVED EQUAL.
6. ATTACH THE DROP BOWL & EACH CLAMPING BRACKET TO THE MANHOLE WALL WITH STAINLESS STEEL 3/8" X 3-3/4" RAMSET/RED HEAD BOLTS HELD INPLACE WITH 2 STAGE EPOXY PASTE. EPOXY SHALL MEET THE FOLLOWING REQUIREMENTS:
 - A. EPOXY PASTE SHALL BE A TWO COMPONENT, 100% SOLIDS, SIKADUR 31 HI-MOD GEL BY SIKA CORPORATION (PHONE (800)/933-7452), OR APPROVED EQUAL.
 - B. THE EPOXY PASTE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 16,000 PSI IN 28 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM D695 AT 73°F.
 - C. THE EPOXY PASTE SHALL DEVELOP A MINIMUM TENSILE STRENGTH OF 3,300 PSI IN 7 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM D638 AT 73°F.
 - D. THE EPOXY PASTE SHALL DEVELOP A MINIMUM BOND STRENGTH OF 2,200 PSI IN 2 DAYS WHEN TESTED IN ACCORDANCE WITH ASTM C882 (HARDENED CONCRETE TO HARDENED CONCRETE).
 - E. MANUFACTURER'S INSTRUCTIONS SHALL BE PRINTED ON EACH CONTAINER IN WHICH THE MATERIALS ARE PACKAGED.



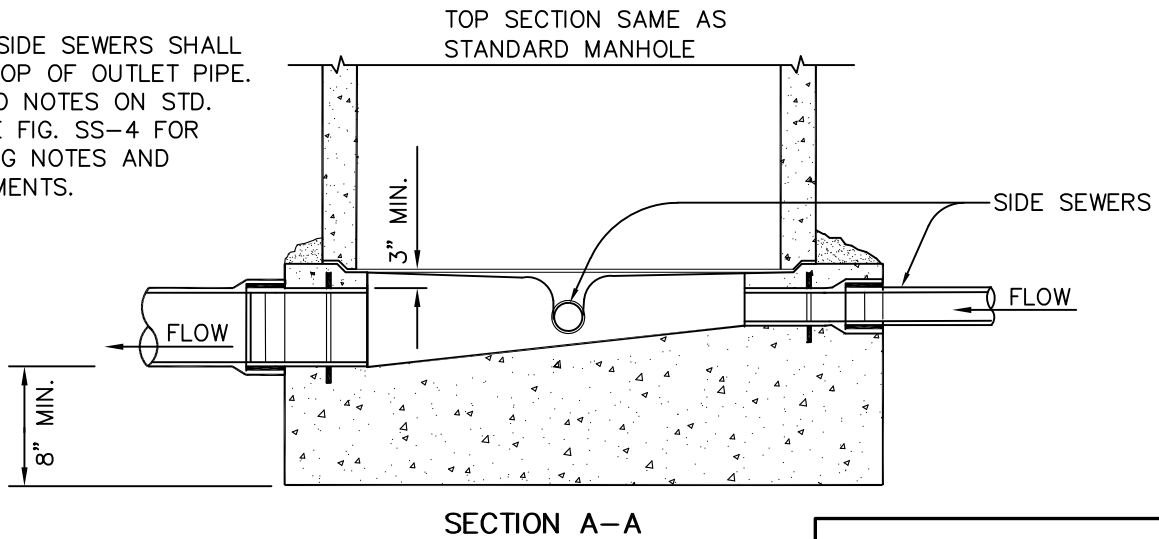
INSIDE DROP - PLAN

INSIDE DROP MANHOLE CONNECTION

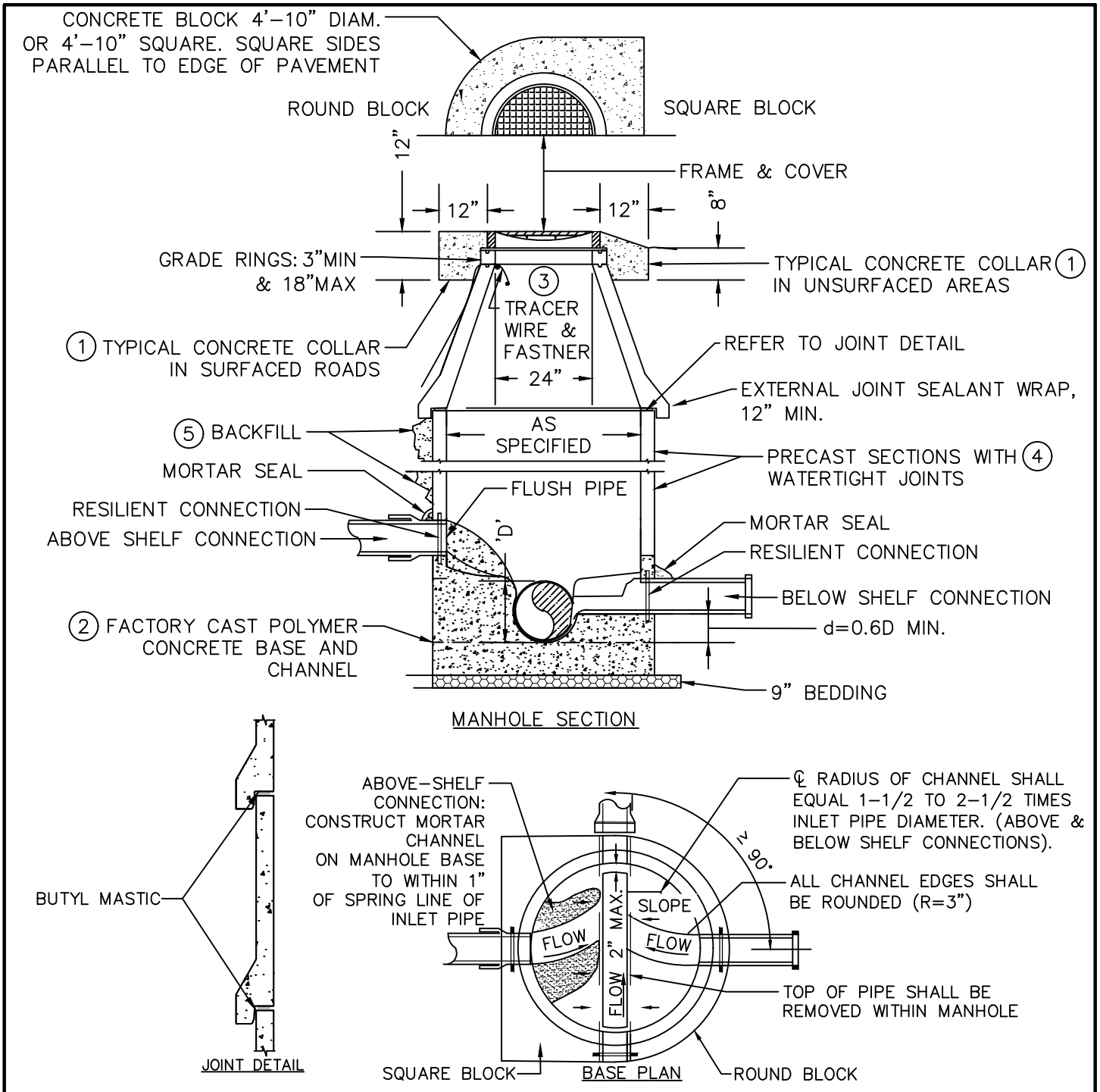
FIG. SS-6



NOTE:
TOP OF SIDE SEWERS SHALL MATCH TOP OF OUTLET PIPE. REFER TO NOTES ON STD. MANHOLE FIG. SS-4 FOR REMAINING NOTES AND REQUIREMENTS.



CUL-DE-SAC MANHOLE
FIG. SS-7

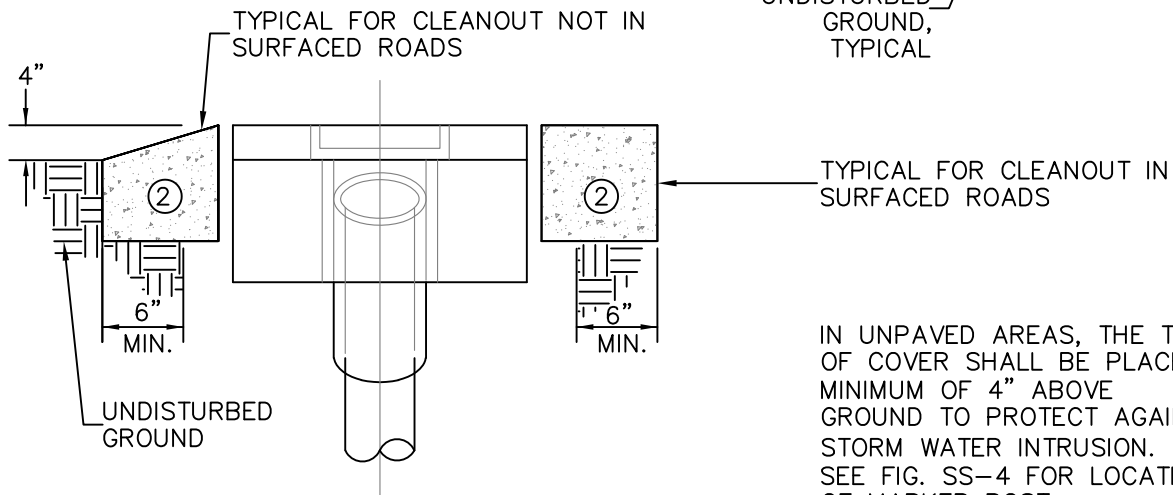
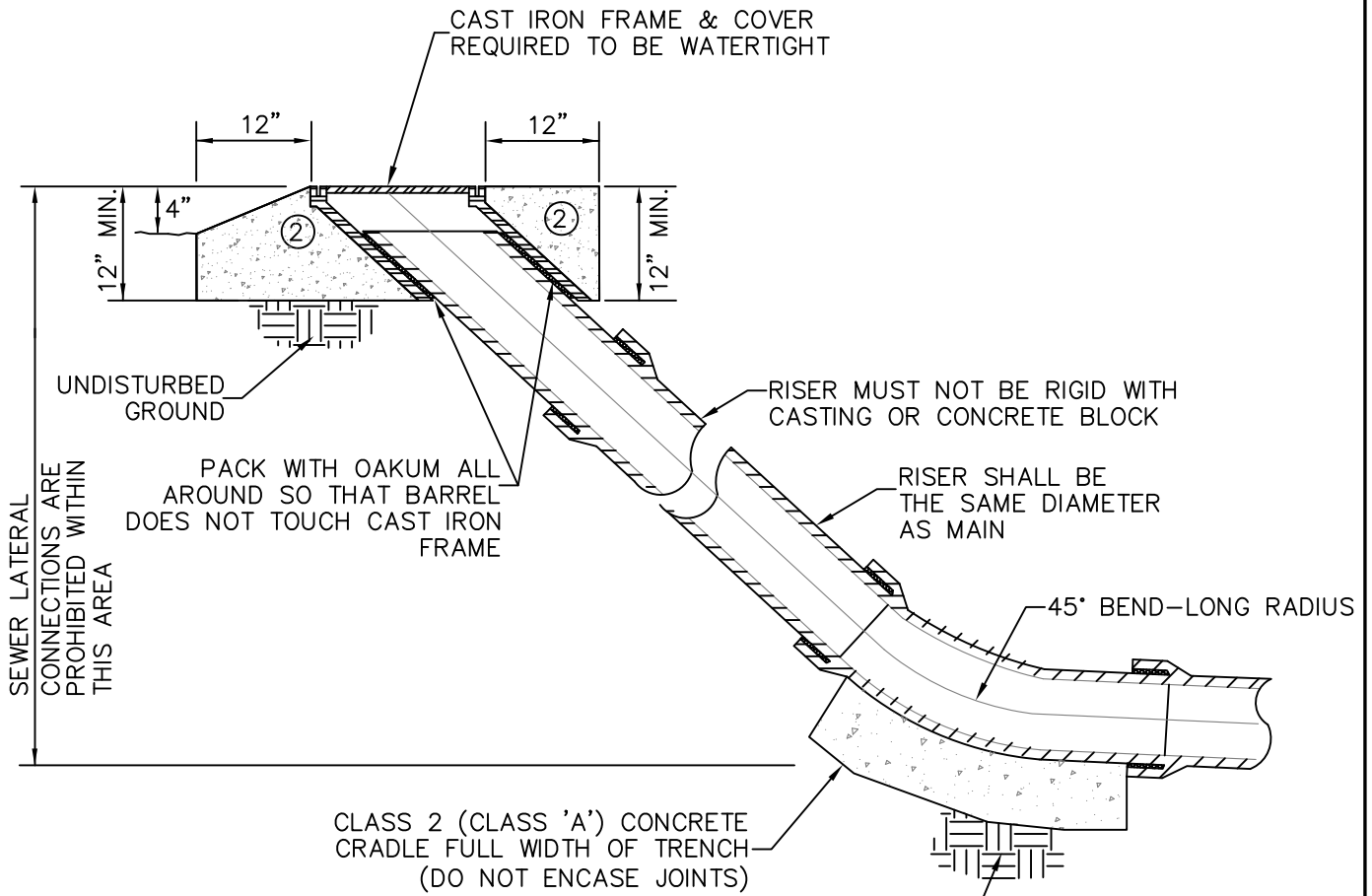


- ① POUR HIGH STRENGTH, REINFORCED, AND PIGMENTED (DRY SHAKE) CONCRETE TO TOP OF CASTING COVER SEE ALSO FIG. EP-9.
- ② AFTER FIELD VERIFICATION, MANUFACTURER SHALL DESIGN AND SUPPLY FACTORY CAST BASE AND FLOW CHANNEL.
- ③ COIL AND SECURE TRACER WIRE AROUND NON-CORROSIVE FASTENER. LEAVE ENOUGH WIRE TO EXTEND 18" ABOVE MANHOLE COVER.
- ④ PRECAST POLYMER CONCRETE SECTIONS AND CONES. MANUFACTURED BY ARMOROCK, OR APPROVED EQUAL. SEE JOINT DETAIL HEREON.
- ⑤ SEE FIG. SS-2 FOR BACKFILL REQUIREMENTS.

SEE SECTION J.3 "SEWER MANHOLES" FOR ADDITIONAL DETAILS & REQUIREMENTS.
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POLYMER CONCRETE MANHOLE
FIG. SS-8

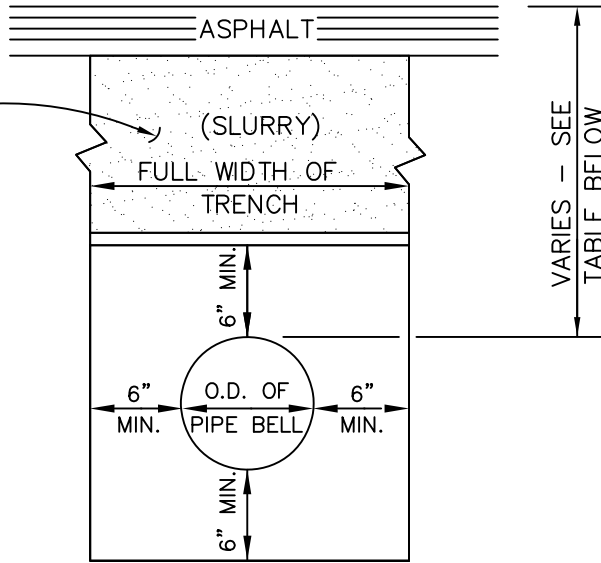
RESERVED



NOTE:

- ① THE INSTALLATION OF A CLEANOUT AT THE END OF A PUBLIC SEWER MAIN IS PROHIBITED. A SEWER MANHOLE SHALL BE CONSTRUCTED AT THE END OF ALL PUBLIC SEWER MAINS.
- ② POUR HIGH STRENGTH, REINFORCED, AND PIGMENTED CONCRETE TO TOP OF CASTING COVER PER FIG. EP-5. PIGMENT SHALL BE DRY SHAKE.

ONE SACK SLURRY BACKFILL.
SEE FIG. SS-2 FOR ASPHALT
PAVEMENT, FOG SEAL AND
OTHER BACKFILL
REQUIREMENTS.



SLURRY CAP

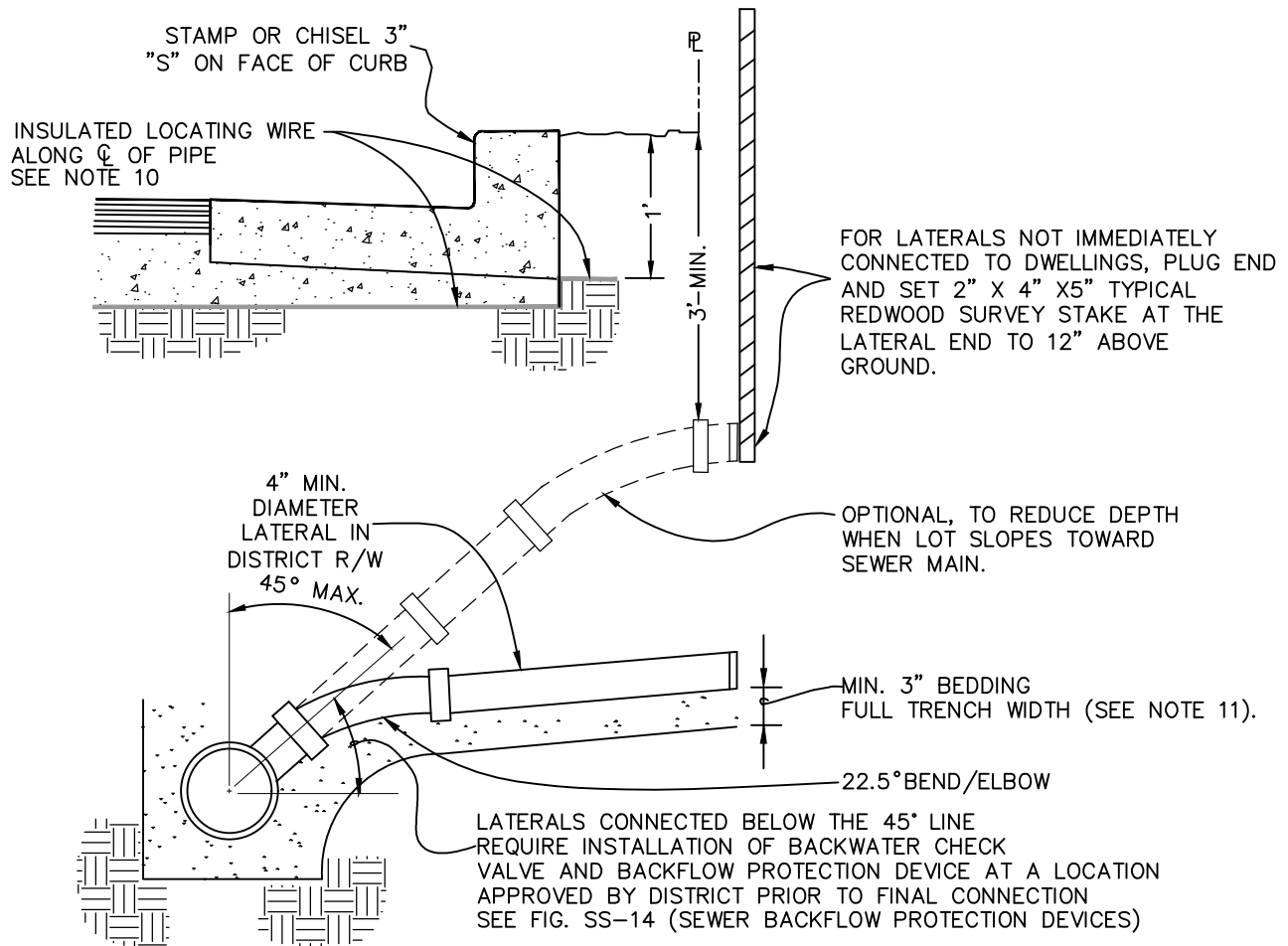
COVER	LOCATION	<u>SEWER MAINS</u>		<u>PRIVATE LATERALS</u>		
		C900 PVC DR18	ALL OTHER APPROVED PIPE	C900 PVC DR18	ABS	ALL OTHER APPROVED PIPE
1.0-1.50 FEET	TRAFFIC AREA	NOT ALLOWED	NOT ALLOWED	SLURRY CAP	NOT ALLOWED	NOT ALLOWED
	NON-TRAFFIC AREA	NOT ALLOWED	NOT ALLOWED	NO ADDED REQUIREMENTS	SLURRY CAP	
1.51-3.0 FEET	TRAFFIC AREA	NO ADDED REQUIREMENTS	NOT ALLOWED	SLURRY CAP	NOT ALLOWED	NOT ALLOWED
	NON-TRAFFIC AREA	SLURRY CAP	SLURRY CAP	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS
3.01-5.0 FEET	TRAFFIC AREA	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS	NOT ALLOWED	NO ADDED REQUIREMENTS
	NON-TRAFFIC AREA	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS	NO ADDED REQUIREMENTS

NOTES:

1. PRECAUTIONS SHALL BE TAKEN TO PREVENT FLOATING PIPE.
2. SLURRY SHALL BE CAST AGAINST UNDISTURBED EARTH.
3. SEE DESIGN CRITERIA PART 4, SECTION J.2 FOR GRAVITY PIPE MATERIAL REQUIREMENTS.

SLURRY CAP
DETAIL
FIG. SS-11

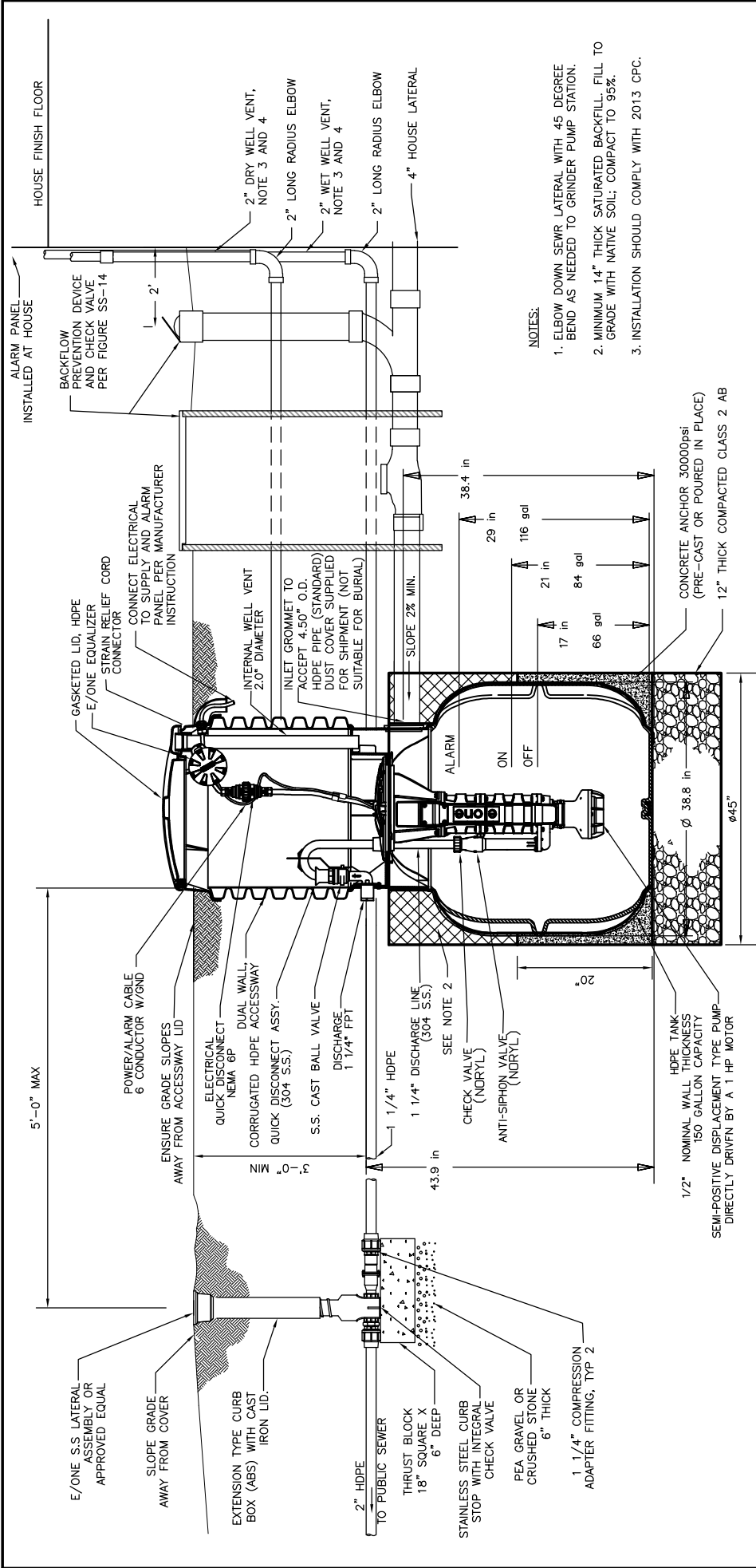
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NOTES:

1. DESIGN ENGINEER SHALL CONTACT THE DISTRICT TO DETERMINE REQUIRED METHOD FOR CONNECTION TO THE PUBLIC MAIN (WYE OR SADDLE). SADDLES TO BE "ROMAC" TYPE OR APPROVED EQUAL.
2. ALL LATERALS WITHIN THE COUNTY-MAINTAINED RIGHT-OF-WAY OR SEWER EASEMENT SHALL BE 4" DIAMETER. ALL LATERALS SHALL HAVE A MINIMUM 2.0% SLOPE.
3. LATERALS SHALL BE INSTALLED WITH A STRAIGHT GRADE AND STRAIGHT ALIGNMENT FROM SEWER MAIN TO PROPERTY LINE UNLESS OTHERWISE APPROVED BY THE DISTRICT.
4. LATERALS NOT IMMEDIATELY CONNECTED TO THE STRUCTURE ARE TO EXTEND A MINIMUM OF 5' BEYOND THE PUBLIC UTILITY EASEMENT OR PUBLIC RIGHT-OF-WAY, WHICHEVER IS GREATER.
5. NO PRIVATE SEWER LATERAL SHALL BE CONNECTED TO A PUBLIC SEWER MANHOLE OR CLEANOUT, EXCEPT FOR A CUL-DE-SAC MANHOLE, UNLESS APPROVED BY THE DISTRICT.
6. MINIMUM 3' SEPARATION BETWEEN SADDLE OR TAP CONNECTIONS ON ALL PIPE WITH THE EXCEPTION OF V.C.P. FOR V.C.P. MAINTAIN 5' SEPARATION (OR ONE CONNECTION PER PIPE SEGMENT IF V.C.P. IS STANDARD LENGTH).
7. REFER TO FIGURE SS-2 FOR BACKFILL REQUIREMENTS IN COUNTY MAINTAINED RIGHT-OF-WAY. REFER TO FIGURE SS-11 FOR ADDITIONAL REQUIREMENTS.
8. A SEPTIC ABANDONMENT PERMIT SHALL BE PROVIDED TO THE DISTRICT AS PROOF OF PUMPING AND FILLING OF ABANDONED SEPTIC TANKS, PRIOR TO SEWER MAIN CONNECTION. IF DISTRICT GIVES PRIOR APPROVAL FOR USE OF TANK AS A WET-WELL, THE TANK SHALL BE PUMPED AND MAY REQUIRE TESTING BY A METHOD APPROVED BY THE DISTRICT. THE DISTRICT SHALL HAVE FINAL DETERMINATION FOR USE OF THE TANK (SEE FIG. SS-13 FOR RESIDENTIAL PUMP STATION REQUIREMENTS).
9. INSPECTION OF ALL SEWER LATERAL INSTALLATIONS/CONNECTIONS BY THE DISTRICT INSPECTOR IS REQUIRED. CALL (831)454-2895 TO SCHEDULE INSPECTIONS.
10. LOCATING WIRE IS REQUIRED FOR NEW LATERALS AND SHALL BE 10 GAUGE MINIMUM, FULLY ANNEALED, HIGH CARBON 1055 GRADE STEEL, HIGH STRENGTH COPPER CLAD STEEL, WITH 21% MINIMUM CONDUCTIVITY, AND AN RHO S COMPLIANT HDPE INSULATED JACKET (APWA UNIFORM COLOR CODE SEWER-GREEN).
11. BEDDING SHALL BE 3/4" DRAIN ROCK, CLASS 2 PERMEABLE MATERIAL, OR 3/8" MINUS AGGREGATE.

SEWER LATERAL
CONNECTION DETAILS
FIG. SS-12

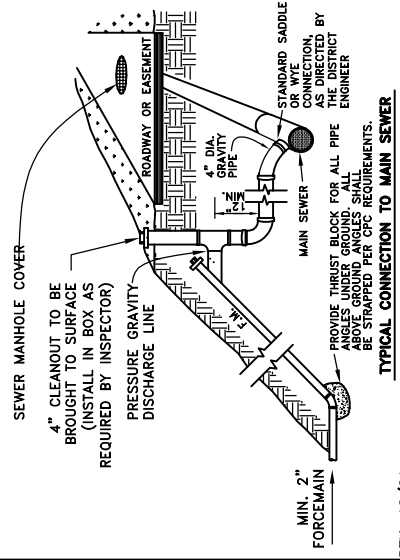


NOTES:

1. ELBOW DOWN SEWR LATERAL WITH 45 DEGREE BEND AS NEEDED TO GRINDER PUMP STATION.
2. MINIMUM 14" THICK SATURATED BACKFILL. FILL TO GRADE WITH NATIVE SOIL; COMPACT TO 95%.
3. INSTALLATION SHOULD COMPLY WITH 2013 CPC.

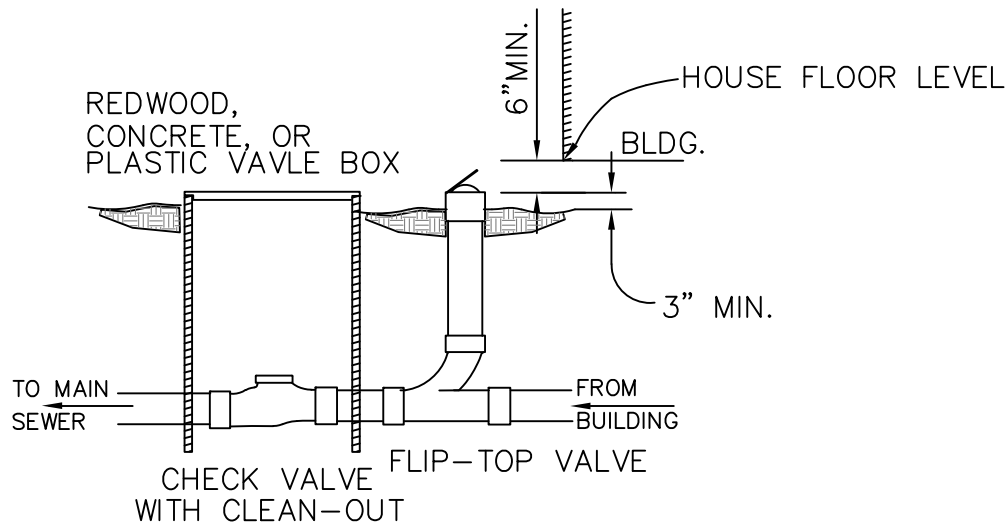
NOTES:

- GENERAL - THE MINIMUM REQUIREMENTS FOR A RESIDENTIAL SEWAGE PUMPING SYSTEM CONNECTING A SINGLE RESIDENCE OR EQUIVALENT TO THE DISTRICT'S SYSTEM ARE SPECIFIED IN THE FOLLOWING PARAGRAPHS. RESIDENTIAL = ONE SINGLE FAMILY DWELLING.
1. THE DISTRICT ACCEPTS NO RESPONSIBILITY FOR THE DESIGN, OPERATION, OR MAINTENANCE OR SUCH PRIVATELY-OWNED AND OPERATED SYSTEMS.
 2. ALL EQUIPMENT AND ACCESSORIES SHALL BE STANDARD MANUFACTURED ITEMS AND THOSE COMING IN DIRECT CONTACT WITH SEWAGE SHALL BE SPECIFICALLY MANUFACTURED FOR SEWAGE USE.
 3. THE MOTOR AND CONTROLS SHALL BE SHELTERED AND PROTECTED BY A WEATHER-PROOF, WELL-VENTILATED ENCLOSURE WHEN INSTALLED OUTSIDE OF BUILDING.
 4. A PRESSURE RELIEF STRUCTURE WILL BE REQUIRED WHEN SURCHARGE HEAD IS EXCESSIVE.
 5. THE PUMP SUMP COVER SHALL BE SECURELY ANCHORED TO THE PUMP SUMP BY BOLTS AND ALL JOINTS BETWEEN THE COMPONENT PARTS SHALL BE SEALED WITH A WATERPROOF MASTIC.
 6. ALL ELECTRICAL WORK AND CONTROLS SHALL CONFORM TO THE REQUIREMENTS OF THE CITY, COUNTY, AND/OR THE SANITARY DISTRICT, WHICHEVER, IN THE OPINION OF THE DISTRICT ENGINEER, IS THE GREATER.
 7. THE ELECTRICAL CONTROLS SHALL PROVIDE ADEQUATE PROTECTION FOR MOTOR AND EQUIPMENT.
 8. THE HIGH WATER ALARM SHALL BE CONNECTED TO A LIGHT OR BELL TESTED TO THE INSPECTOR'S SATISFACTION.
 9. A VENT 2" OR LARGER SHALL BE PROVIDED, AS REQUIRED BY THE INSPECTOR, WHERE THE SYSTEM IS LOCATED WITHIN THE DWELLING. A 2" OR LARGER VENT SHALL BE EXTENDED TO A POINT 10' ABOVE THE PUMP COVER, OTHERWISE REQUIRED BY THE CPC, WHERE THE SYSTEM IS LOCATED OUTSIDE THE DWELLING.
 10. THE PRESSURE PORTION OF THE DISCHARGE LINE, INCLUDING THE CHECK VALVE, GATE VALVE, AND FLEXIBLE COUPLINGS, SHALL BE EQUAL IN SIZE TO THE PUMP DISCHARGE. THE PIPE SHALL BE CAST IRON CLASS 150 CONFORMING TO USA STANDARD A21, PVC SCHEDULE 40 OR ABS SCHEDULE 40, OR APPROVED EQUAL.
 11. THE OWNER OR CONTRACTOR SHALL SUBMIT TO THE DISTRICT FOR APPROVAL A PLOT PLAN AND A COMPLETE LIST OF EQUIPMENT AND ACCESSORIES TO BE INSTALLED (INCLUDE PUMP CURVES).
 12. TANK AND INSTALLATION METHODS SHALL BE IN ACCORDANCE WITH SECTION 710 OF CPC. THE SIZE AND TYPE OF TANK SHALL BE APPROVED BY THE DISTRICT PRIOR TO INSTALLATION. OPERATIONAL TESTING OF THE PUMP AND TANK IS REQUIRED.



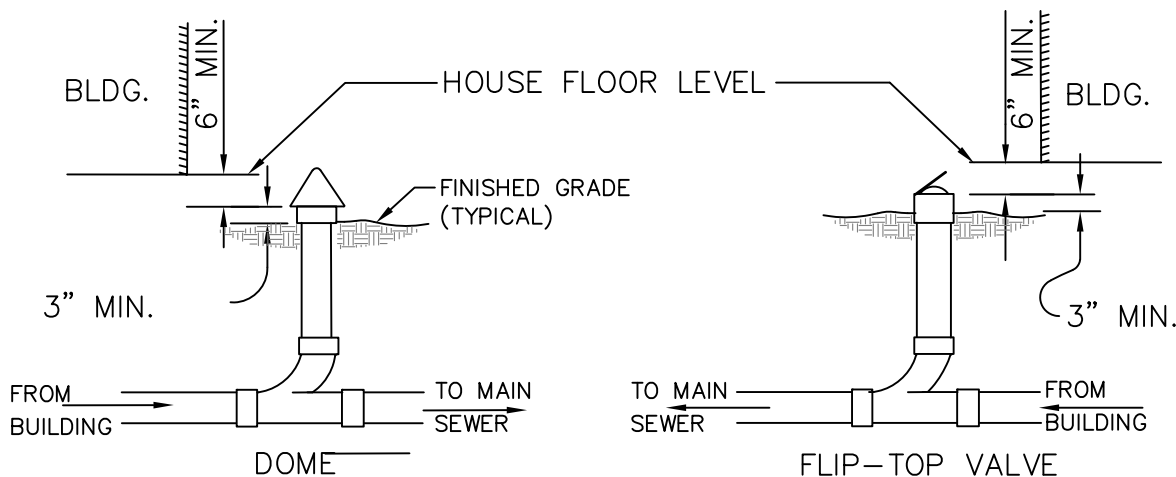
**RESIDENTIAL SEWAGE PUMP STATION
E/ONE (OR APPROVED EQUAL)
FIG. SS-13**

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BACKWATER CHECK VALVE AND BACKFLOW PROTECTION DEVICE

REQUIRED FOR NEW INSTALLATIONS
 PREFERRED ALTERNATIVE FOR EXISTING INSTALLATIONS



BACKFLOW PROTECTION DEVICES
 ALTERNATIVE FOR EXISTING SYSTEMS ONLY

NOTES:

1. BACKFLOW PROTECTION DEVICE IS REQUIRED AND SHALL BE INSTALLED PER SANITATION DISTRICT ORDINANCE WHEN THE FINISHED FLOOR ELEVATION OF THE BUILDING TO BE CONNECTED IS LESS THAN 1' ABOVE THE RIM OF THE NEAREST UPSTREAM MANHOLE (OR FLUSHING INLET), OR WHERE SEWER LATERAL HAS NOT BEEN CONSTRUCTED PER DESIGN CRITERIA REQUIREMENTS.
2. INSPECTION OF THE BACKFLOW DEVICE IS REQUIRED AFTER THE FINAL GRADING AROUND THE BUILDING IS COMPLETED. THE BACKFLOW DEVICE SHALL BE AS DETAILED ABOVE, OR APPROVED EQUAL.
3. CONSIDERATION MUST BE GIVEN TO THE DAMAGE POTENTIAL TO ADJACENT PROPERTY BY SEWAGE RELEASED THROUGH THE BACKFLOW DEVICE AND VALVES.
4. DOME AND FLIP-TOP TYPE VALVES SHALL NOT BE INSTALLED INSIDE A BOX.
5. RECTORSEAL CLEAN CHECK ®, OR APPROVED EQUAL, MAY BE USED IN LIEU OF CHECK VALVE IN BOX.
6. IN TRAFFIC AREAS, VALVE BOX LID SHALL BE TRAFFIC-RATED AND BOX SHALL BE SET ON 6" OF AGGREGATE.

BACKFLOW PROTECTION DEVICES

FIG. SS-14

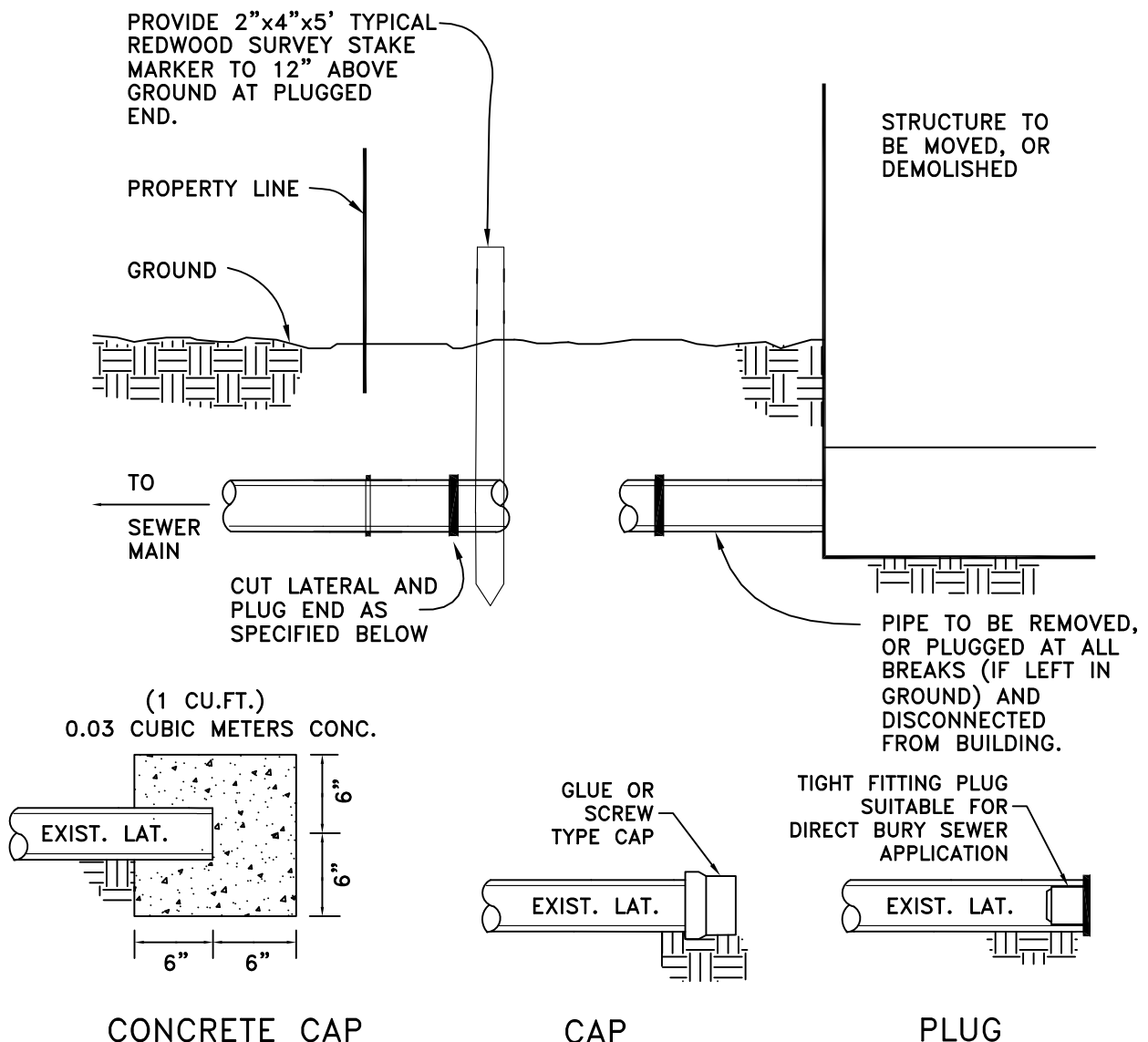
WHEN A HOUSE IS TO BE MOVED OR DEMOLISHED: THE CONNECTING SANITARY SEWER LATERAL SHALL BE CUT, PLUGGED WITH A TIGHT-FITTING CAP, AND A REDWOOD STAKE MARKER PLACED TO 12" ABOVE THE GROUND, PRIOR TO EITHER MOVING OR DEMOLISHING THE STRUCTURE.

THE END OF THE SANITARY SEWER LATERAL TO BE ABANDONED SHALL BE PLUGGED OR CAPPED.

TO OBTAIN THE NECESSARY INSPECTION OF THE PROPOSED ABANDONMENT AND CAPPING OF THE SEWER LATERAL, PLEASE CALL THE SANITATION DIVISION OF THE PUBLIC WORKS DEPARTMENT, COUNTY OF SANTA CRUZ, AT (831) 454-2895.

PLEASE NOTE THAT THE DEMO/MOVING PERMIT FOR A STRUCTURE CANNOT BE ISSUED UNLESS THE CAPPING HAS BEEN INSPECTED AND THE WORK CONFORMS WITH DISTRICT STANDARDS. IN THOSE INSTANCES WHERE MORE THAN ONE LATERAL IS INVOLVED, THE CONTRACTOR SHALL FURNISH THE INSPECTOR WITH A PLAN LOCATING EACH OF THE ABANDONED LINES.

PLUGGING/CAPPING OF ABANDONED SEWER LATERAL



LATERAL ABANDONMENT DETAILS

FIG. SS-15

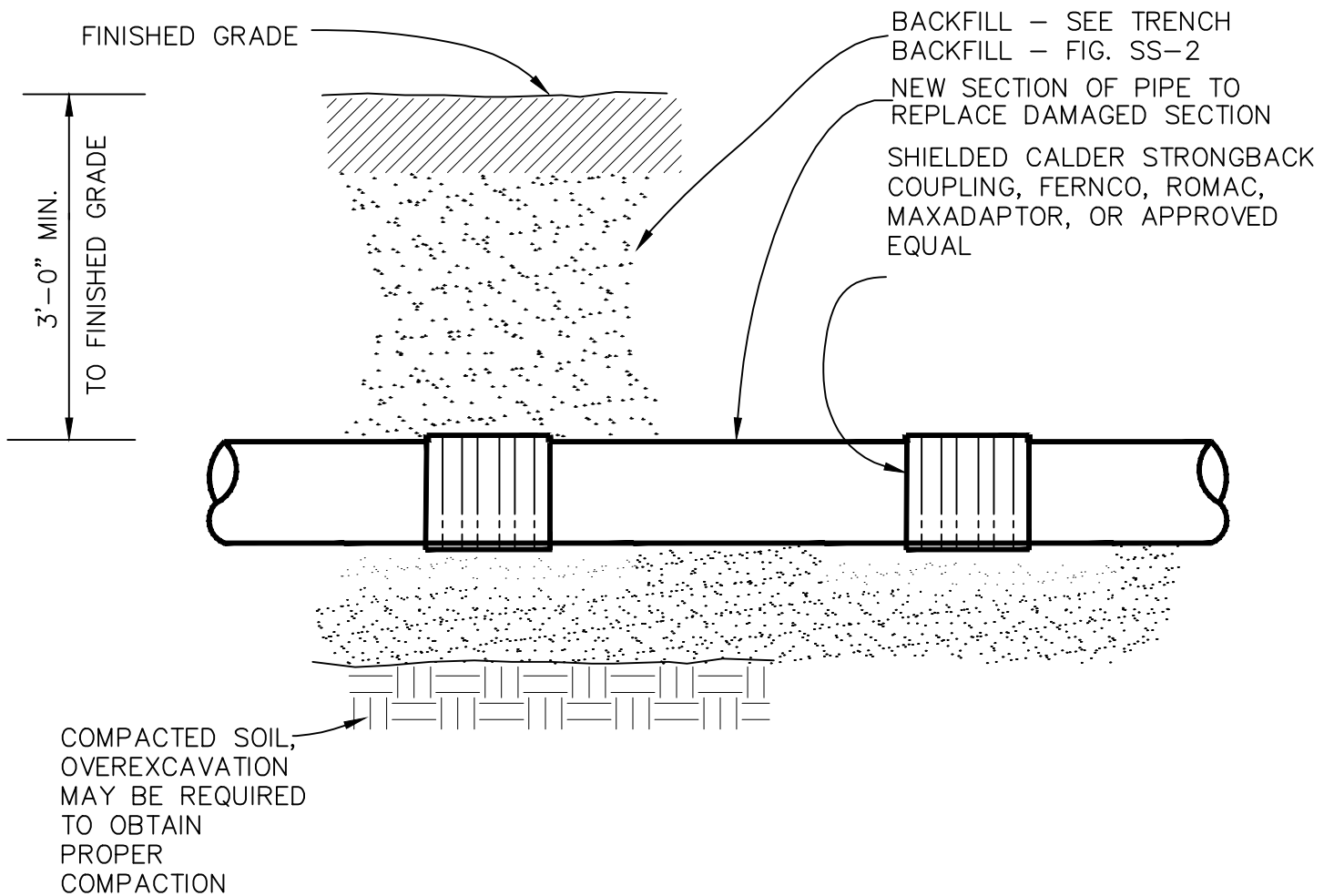
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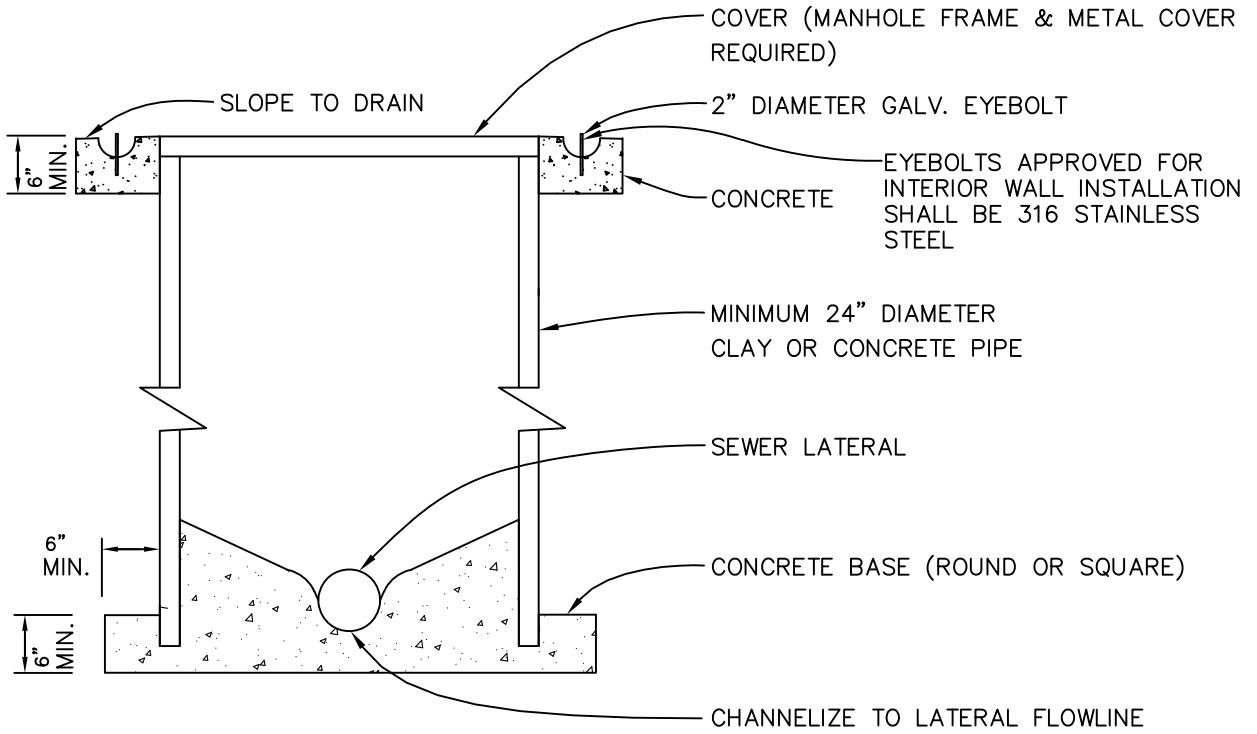
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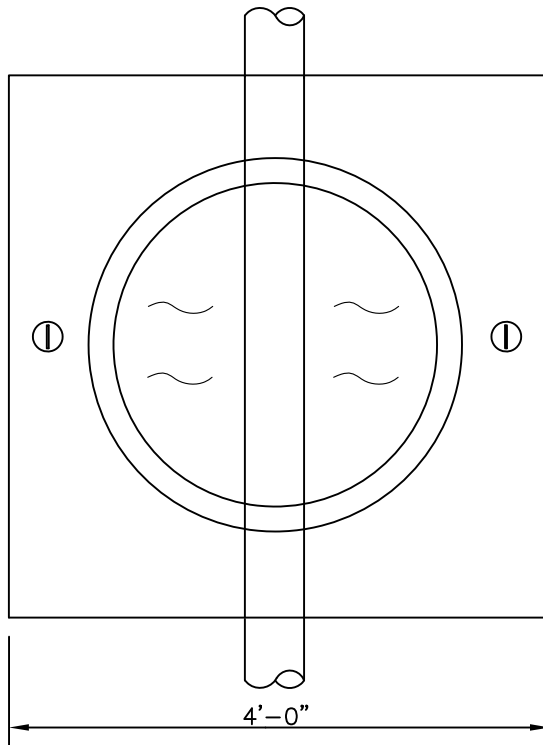


NOTES:

1. PROPERTY OWNER OR OWNER'S AGENT SHALL OBTAIN A LATERAL REPAIR PERMIT PRIOR TO EXCAVATION OF LATERAL. CALL (831) 454-2160 OR EMAIL DPW.LATERALPROGRAM@SANTACRUZCOUNTYCA.GOV TO REQUEST A PERMIT.
2. INSPECTION OF ALL BREAKS OR REPAIRS ARE REQUIRED BY THE DISTRICT INSPECTOR. CALL (831) 454-2895 TO SCHEDULE AN INSPECTION.
3. RUBBER BUSHINGS, OF APPROPRIATE THICKNESS, SHALL BE USED WHEN DIFFERENT TYPES OF PIPE ARE CONNECTED.



SECTION



SAMPLING MANHOLE POLICY

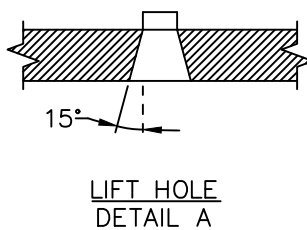
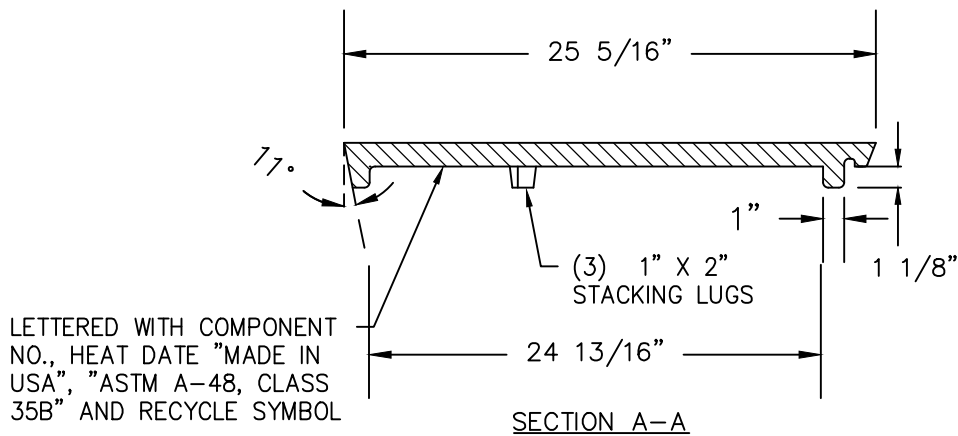
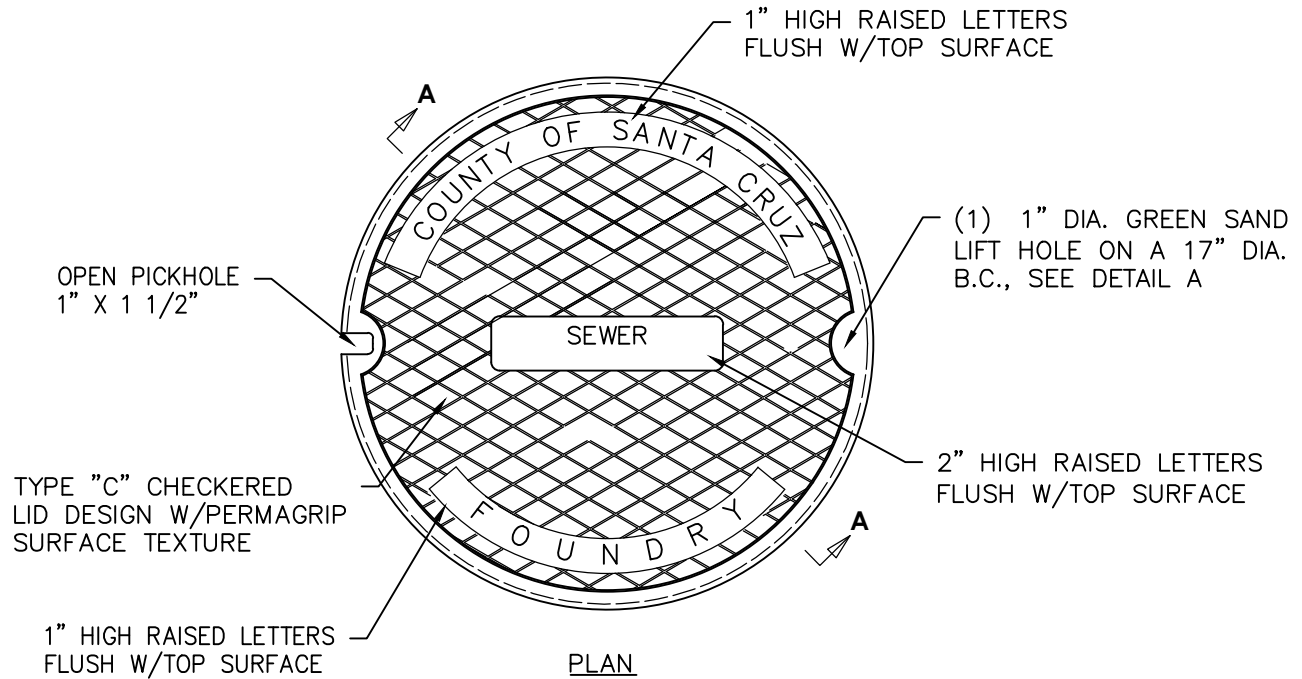
A SAMPLING MANHOLE WILL BE REQUIRED UNDER THE FOLLOWING CIRCUMSTANCES. BOTH INSTALLATION AND OPERATING COSTS OF THE SAMPLING MANHOLE WILL BE AT THE SOLE EXPENSE OF THE CUSTOMER.

- ① ANY NEW BUILDING AND/OR LAND DIVISION INTENDED FOR INDUSTRIAL OR COMMERCIAL USE WILL REQUIRE INSTALLATION OF SAMPLING STRUCTURES.
- ② ANY EXISTING BUILDING WHERE THE WASTE-WATER DISCHARGE IS SUSPECTED TO HAVE AN ADVERSE IMPACT ON TREATMENT AND COLLECTION SYSTEM FACILITIES IF NOT MONITORED, OR DOES NOT MAINTAIN UNIFORM CHARACTERISTICS.
- ③ ANY EXISTING BUILDING WHERE THE OPERATION INVOLVES USE OF CHEMICALS LISTED AS PRIORITY POLLUTANTS BY ENVIRONMENTAL PROTECTION AGENCY (EPA), OR CHEMICALS LISTED AS HAZAROUS BY FEDERAL, STATE OR COUNTY HAZARDOUS WASTE REGULATIONS.
- ④ ANY EXISTING BUILDING UNDERGOING PLUMBING MODIFICATION OR EXPANSION, AND/OR LAND DIVISION WILL BE FLAGGED FOR THE INDUSTRIAL WASTE INSPECTOR TO DETERMINE WHETHER A SAMPLING MANHOLE IS NECESSARY. THE NATURE OF THE BUSINESS ACTIVITY AND THE EXPENSE OF INSTALLING THE SAMPLING MANHOLE WILL BE EVALUATED.

NOTES:
 MANHOLE SHALL BE AT LEAST 24" DIAMETER TO ACCOMMODATE SAMPLING EQUIPMENT

PLAN

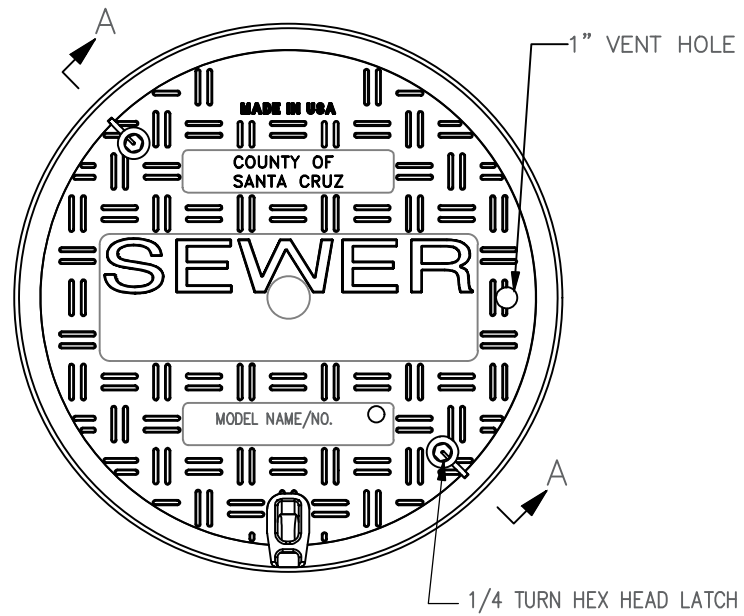
INDUSTRIAL WASTE SAMPLING MANHOLE
 FIG. SS-22



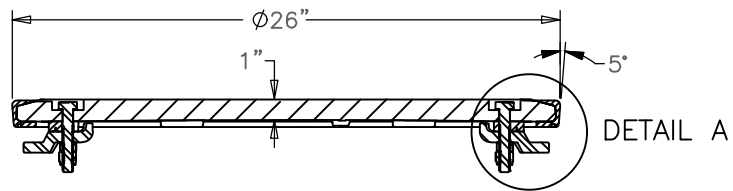
NOTES:

1. CAST IRON TO CONFORM TO ASTM A-48, CLASS 35B
2. CAST IRON MANHOLE COVERS ARE REQUIRED IN COUNTY ROADS

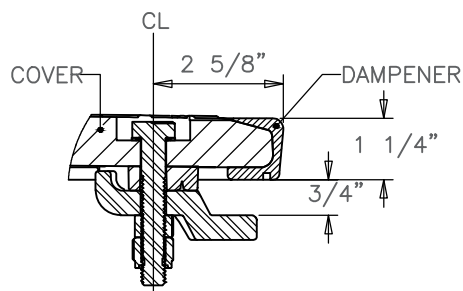
CAST IRON MANHOLE COVER
FIG. SS-23A



PLAN



SECTION A-A

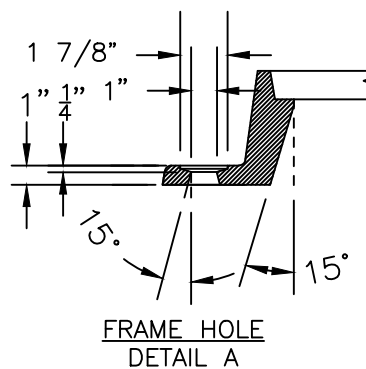
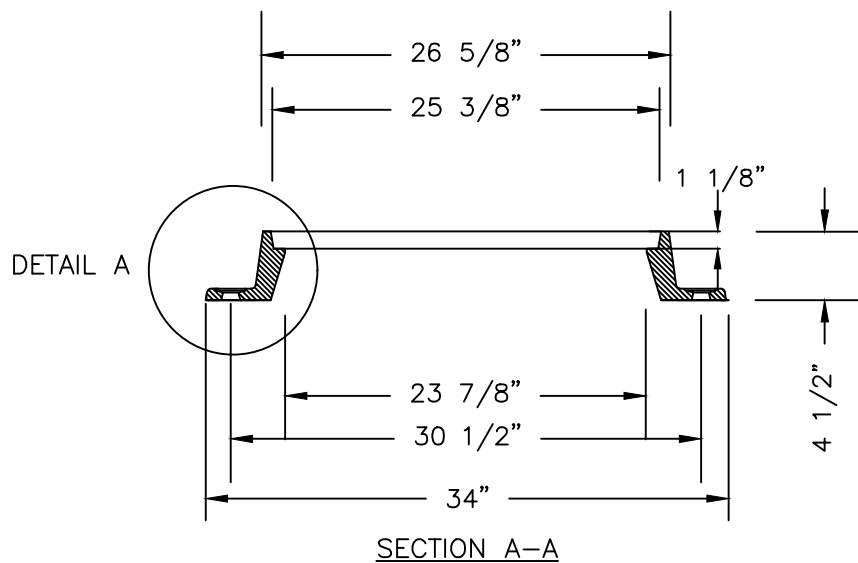
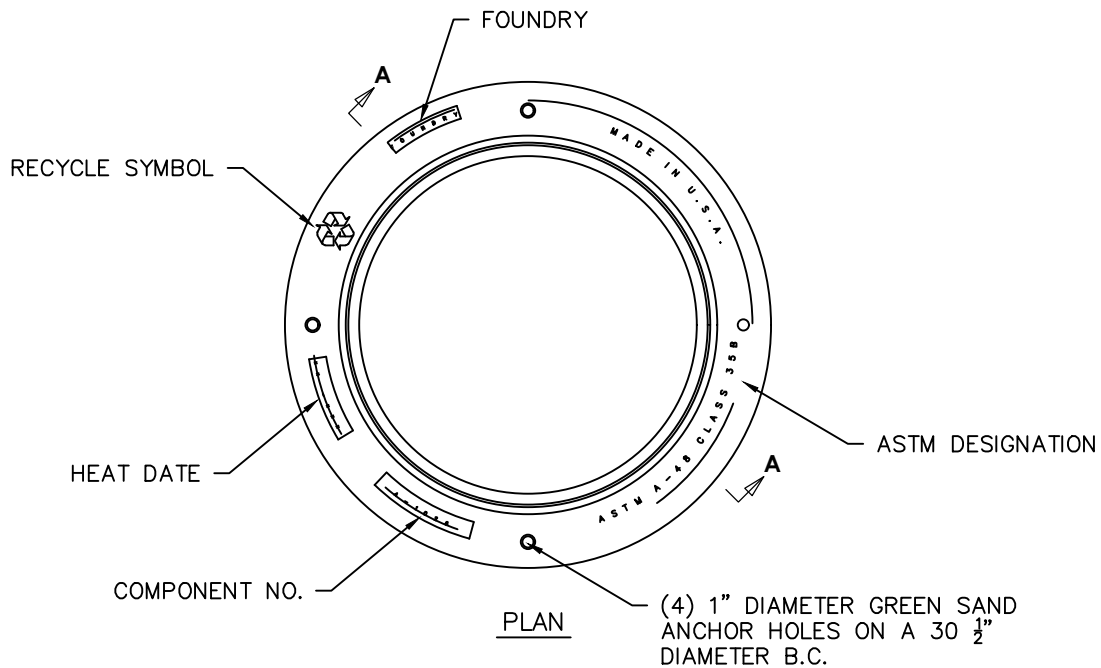


HEX LATCH
DETAIL A

NOTES:

1. EJ DUROSTREET COM260327 90R APPROVED EQUAL) LOAD RATING = H25
2. INSTALLATION OF COMPOSITE MANHOLE COVERS REQUIRES COUNTY APPROVAL.

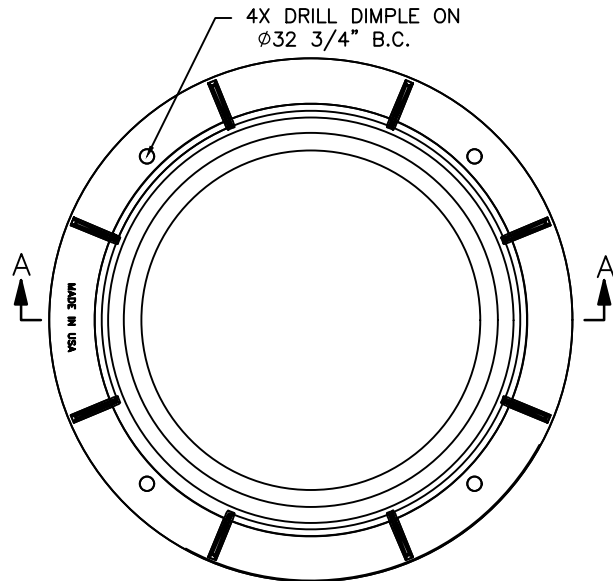
COMPOSITE MANHOLE COVER
FIG. SS-23B



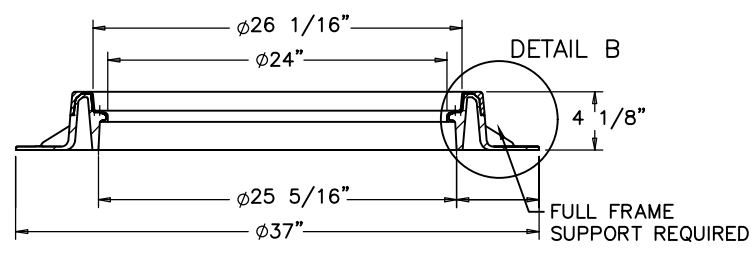
NOTES:

1. CAST IRON TO CONFORM TO ASTM A-48, CLASS 35B
2. CAST IRON MANHOLE FRAMES ARE REQUIRED IN COUNTY ROADS

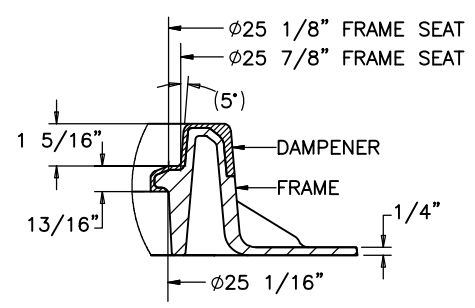
CAST IRON MANHOLE FRAME
FIG. SS-24A



PLAN



SECTION A-A



FRAME SEAT
DETAIL B

NOTES:

1. EJ DUROSTREET COM260210 90R, OR APPROVED EQUAL LOAD RATING = H25
2. INSTALLATION OF COMPOSITE MANHOLE FRAMES REQUIRES COUNTY APPROVAL.

COMPOSITE MANHOLE FRAME
 FIG. SS-24B

PART 5. WATER SYSTEMS

Section A - Purpose of Water Standards

1. The standards set forth in this article are minimum requirements for safe practice in the production and delivery of water for domestic use. They are to be interpreted as meeting only the minimum requirement of design, construction, maintenance, and operation of water utility systems. It is the intent of these standards to safeguard domestic water consumers from injury resulting from sanitary hazards, or structural hazards, or both, which may arise from inadequacies in the design, construction, maintenance, and operation of water utility systems. It is the purpose of these minimum requirements to utilize standards of design, construction, maintenance, and operation of domestic water systems that will provide protection of the public health and welfare.

Section B - Domestic Water System

1. Every lot shall be supplied water for domestic purposes from a domestic water system approved by the Santa Cruz County Environmental Health Service, and when required by California Health and Safety Code, Division 5, Part 1, Chapter 7, under a valid permit issued by the State Department of Health or the Santa Cruz County Health Officer. An approved domestic water system shall meet the requirements of this *Design Criteria* and the “Standards for Domestic Water Supply Wells,” State of California Department of Water Resources Bulletin No. 74-81 (December 1981).
2. All water service connections to the public water system shall conform to the Cross-Connection and Backflow Prevention requirements set forth in Title 17 of the California Code of Regulations. All backflow prevention devices shall be tested and approved by an organization recognized by the State Water Resources Control Board Division of Drinking Water.

Section C - Use of Existing Domestic Water Systems - Availability and Capability

1. When the water supply is to be from an existing domestic water system not under the ownership or control of the developer, the developer shall furnish evidence of agreements showing availability of the public water system to serve the improvement. When required by the Santa Cruz County Environmental Health Service, evidence shall be provided demonstrating the capability of the existing domestic water purveyor to extend service in conformance with Section G.

Section D - Use of Existing Domestic Water Systems - Quality Standards

1. The quality of water supplied for human consumption shall conform to the standards contained in the California Administrative Code, Title 22, the California Health and Safety Code, and the California Water Code.
2. In order to use an existing domestic water supply system as the water supply for the proposed improvement, it must have met the standards contained in the California Administrative Code, Title 22, the California Health and Safety Code, and the California Water Code during the preceding twelve months. If the system has been in existence for less than one year, it shall have met such

standards during the period of existence.

Section E - Use of Individual Springs or Wells

1. When a developer proposes that each lot in the improvement will be supplied by means of individual springs or wells, each spring or well shall be developed by the developer in conformance with the Santa Cruz County Code Chapter 11.40, Individual Water Systems, prior to the filing of the final map or parcel map.

Section F - Water System Improvement Plans

1. The developer shall prepare a detailed engineering report complete with plans and specifications showing compliance with all requirements of this *Design Criteria* when the water system for the improvement is not from an existing public domestic water system operating under a valid permit.

Section G - Quantity of Water for Domestic Service

1. The quantity of water from all the water sources and distribution reservoirs shall be sufficient to supply adequately, dependably, and safely the total requirements of all consumers under maximum demand conditions. The following minimum sources and storage requirements together with the pipe sizes specified in Section J are considered adequate to meet maximum domestic demand conditions.
 - a. Minimum source requirements shall be determined from Figure W-1 or W-2.
 - b. Minimum storage requirements shall be determined from Figure W-3 or W-4.
2. In lieu of the quantity requirements specified in Figures W-1 through W-4, minimum consumer domestic water requirements may be determined from adequately supported and documented system records.
3. A master water supply meter or other suitable measuring device shall be provided for each source of water supply.

Section H - Continuity of Service

1. Water systems with more than 15 connections shall have more than one source of supply and standby power generator or other means to assure that adequate water at minimum pressure is supplied to the distribution system under all conditions and circumstances.

Section I - System Pressure and Facilities Requirements

1. System Pressure
 - a. Normal operating pressure at the service connection shall not be less than 0.21 megapascals gauge (MPag) (30 pounds per square inch gauge (psig)) nor more than 0.86 MPag (125 psig), except that during periods of hourly

maximum demand at the time of peak seasonal loads the pressure may be not less than 0.14 MPag (20 psig) and that during periods of hourly minimum demand, the pressure may be not more than 1.03 MPag (150 psig). Variations in pressure under normal operation shall not exceed 50 percent of the average operating pressure. The average operating pressure shall be determined by computing the arithmetical average of at least 24 consecutive hourly pressure readings.

- b. In a water system supplying customers at widely varying elevations, the utility may furnish a service which does not comply with the foregoing pressure specifications, if the customer is fully advised of the conditions under which average service may be expected, and the customer's agreement is secured in writing.
- c. New water systems, or new pressure zones in existing water systems, supplying customers at substantially constant elevation shall be designed to maintain an operating pressure at the service connection of not less than 0.14 MPag (20 psig) nor greater than 0.69 MPag (100 psig).

2. Wells

For systems with approved well sources, additional wells shall be constructed in accordance with all local and State regulations. Proposed well sites shall be investigated to determine the distance from sewage collection and disposal facilities, and any hazards therefrom shall be eliminated prior to well construction. If wells are a new source of supply, application shall be made to the County Environmental Health Service for a new or amended water system permit.

3. Storage Reservoirs

Reservoirs and tanks from which water is delivered directly into the mains of a distribution system shall be adequately protected against pollution and shall be covered with waterproof covering. Drains and overflows shall not be directly connected to sewers or storm drains without gradient breaks guaranteeing that no back flow can occur.

4. Pumping Plants

Booster pumping plants shall be designed by a registered civil engineer.

5. Security

All operating facilities shall be protected against unauthorized entry and vandalism.

Section J - Distribution System Requirements

1. Water Main Materials
 - a. Water main materials shall meet the applicable standards listed in Table I.
 - b. Cast iron and ductile iron pipe shall be cement mortar lined in accordance with AWWA Standard C104-74.
 - c. Steel pipe shall be protected from internal and external corrosion. Table II lists various acceptable protective coatings and linings with appropriate standards.

TABLE II Steel Pipe Coatings and Linings	
<u>Type of Coating or Lining</u>	<u>Standard</u>
Cement Mortar Coating or Lining	AWWA C205-71 or Federal Specification SS-P-385a
Coal Tar Coating, Lining or Wrapping	AWWA C203-73
Asphalt Mastic Coating	Asphalt Institute M-2 CS-96
Extruded Plastic Coating	Federal Specification L-C-530B 1.03 MPag (1972)
Rubber-Alkyd Paint Coating	AWWA C204-75
Cold Applied Tape Coating	AWWA C209-76
Coal Tar-Epoxy Coating	AWWA C210-78
Asphalt Coating and Wrapping Construction	Standard Specifications for Public Works (1973), Section 207-10.4.4

TABLE I Material Standards	
<u>Pipe Material</u>	<u>Standard</u>
Cast Iron	AWWA C106-75
Ductile Iron	AWWA C151-76
Steel	AWWA C200-75
Copper	AWWA C800-66
Concrete	AWWA C300-74, C301-72, C302-74 or C303-70
Polybutylene	AWWA C902-78
Polyethylene	AWWA C901-78
Polyvinylchloride	AWWA C900-75

2. Water Main Selection and Installation

- a. Steel pipe shall be selected and installed in accordance with American Water Works Association (AWWA) Manual M-11 (1964), “Steel Pipe Design and Installation.” The design shall comply with Sections 6.1 and 6.2 of the manual, except that the minimum design pressure shall be at least the maximum anticipated system pressure, but in no case less than 1.03 MPag (150 psig).
- b. Cast iron and ductile iron pipe shall be selected and installed in accordance with the standards listed in Table III.
- c. Polyvinyl chloride pipe shall be selected and installed in accordance with Appendix A of AWWA Standard C900-75 as published in the American Water Works Association Journal, 67 (12): 701-704 (December 1975).
- d. Polybutylene pipe shall be selected and installed in accordance with Appendix A of AWWA Standard C902-78 as published by the American Water Works Association (Denver, Colorado, 1978).
- e. Polyethylene pipe shall be selected and installed in accordance with Appendix A of AWWA Standard C902-78 as published in the American Water Works Association Journal, 70 (4): 233-236 (April 1978).
- f. Plastic pipe shall not be used in areas subject to contamination by petroleum distillates.

TABLE III

Pipe Selection and Installation Standards	
<u>Type of Pipe</u>	<u>Standard</u>
Cast Iron	AWWA C101-67 and C600-77
Ductile Iron	AWWA C150-76 and C600-77

3. Layout of Water Mains

- a. Water mains should be laid out only in segmented grids and loops and should be located within streets. Dead-end water mains shall be installed only if:
 - 1) Looping or gridding is impractical due to topography, geology, pressure zone boundaries, unavailability of easements or locations of users; or
 - 2) The main is to be extended in the near future and the planned extension will eliminate the dead-end conditions.

4. Minimum Water Main Diameter and Length of Run

- a. Water mains shall have a nominal inside diameter of at least 4 in.
- b. Dead-end water mains exceeding 1,000 ft in length shall be constructed of pipe with a nominal inside diameter of at least 6 in.
- c. Dead-end water mains exceeding 2,000 ft in length shall be constructed of pipe with a nominal inside diameter of at least 8 in.
- d. The requirements of a, b, and c shall not apply to water main installations meeting one of the following criteria:
 - 1) The installation is designed under the direction of a qualified registered engineer to meet the requirements of Section 64566.
 - 2) The installation is approved by the District prior to construction.
 - A) If District approval is sought, the water supplier shall submit information needed by the District to evaluate the proposed installation.
 - B) Within ten working days after receiving the needed information, the District shall, in writing, either approve or reject the proposed installation.
 - C) If the District does not respond within ten working days, the proposed installation shall be deemed acceptable.

5. Water Main Installation

- a. Water mains shall be installed below the frost line or shall otherwise be protected to prevent freezing.
- b. Water mains shall not have less than 30 in of cover over the top of the pipe except where necessary to avoid underground obstructions or rocky conditions.
- c. Water mains shall be installed at least:
 - 1) 10 ft horizontally from and 2 ft higher than sanitary sewers crossing the main.
 - 2) 2 ft higher than sanitary sewers crossing the main.
 - 3) 10 ft, and preferably 25 ft, horizontally from sewage leach fields, cesspools, seepage pits and septic tanks.

- d. Separation distances specified in c. shall be measured from the nearest edges of the facilities.
- e. Where the requirements of c. and d. cannot be met due to topography, inadequate right-of-way, or easements or conflicts with other provisions of these regulations, lesser separation is permissible if:
 - 1) The water main and the sewer are located as far apart as feasible within the conditions listed above.
 - 2) The water main and the sewer are not installed within the same trench.
 - 3) The water main is appropriately constructed to prevent contamination of the water in the main by sewer leakage.
- f. Water mains shall be disinfected according to AWWA Standard C601-68 before being placed in service.
- g. Installation of water mains near the following sources of potential contamination shall require written approval by the District on a case-by-case basis.
 - 1) Storage ponds or land disposal sites for waste water or industrial process water containing toxic materials or pathogenic organisms.
 - 2) Solid waste disposal sites.
 - 3) Facilities such as storage tanks and pipelines where malfunction of the facility would subject the water in the main to toxic or pathogenic contamination.

6. Water Main Valve Locations

Sufficient valves shall be provided on water mains to minimize inconvenience and sanitary hazards during repairs. In general, valves on water mains of 12 in and smaller diameter should be located such that water main lengths of not more than 1,000 ft can be isolated by valve closures.

7. Water Main Valve Construction Standards

- a. Water main valves shall conform to the standards shown in Table IV.
- b. A valve box shall be installed over each valve stem to aid in locating and operating the valve.

TABLE IV
Water Main Valve Construction Standards

<u>Type of Value</u>	<u>Construction Standards</u>
Gate Valve	AWWA C550-71
Butterfly Valve	AWWA C504-74
Ball Valve	AWWA C507-73
Swing Check Valve	AWWA C508-76

8. Air and Vacuum Relief and Air Release Valves

a. Vent openings for air and vacuum relief and air release valves shall be:

1) Extended at least 12 in above grade and above maximum recorded high water.

2) Provided with a screened, downward-facing vent opening.

b. Where the requirements of 8.a.1) cannot be practicably met, vent openings may be located in a subsurface chamber or pit under the following conditions:

1) The pit is adequately drained.

2) The pit drain is not connected by pipe or other closed conduit to a sewer or storm drain without an air gap separation.

9. Water Main Joints

Joints and appurtenances shall safely withstand the same working pressures for which the water main is designed. Jute shall not be used as a backup gasket material.

10. Fire Hydrants

Fire hydrant laterals shall be provided with shutoff valves.

11. Flushing Valves and Blowoffs

a. A flushing valve or blowoff shall be installed at the end of each dead-end water main where stagnant conditions are likely to develop.

b. Flushing valves and blowoffs shall be capable of establishing the minimum continuous flushing flow in the main, indicated by Table V.

c. Flushing valves and blowoffs shall not discharge to a sewer without an air gap separation.

TABLE V
Minimum Water Main Flushing Flow

<u>Nominal Inside Diameter</u> <u>Inches</u>	<u>Minimum Flushing Flow</u> <u>Gallons/Minute</u>
2	25
3	50
4	100
6	225
8	400
10	600

12. Service Connection Pipe

- a. Service connection pipe and fittings shall be designed for cold water working pressures of not less than 1.03 MPag (150 psig). Copper tubing shall be commercial designation type K or L. Plastic tubing and fittings shall be products tested and certified as suitable for use in potable water piping systems by the national Sanitation Foundation Testing Laboratory, the Canadian Standards Association Testing Laboratory or another testing agency acceptable to the District.

Section K - Water Treatment

Water treatment shall be required when source facilities lack appurtenances or structures to satisfactorily guard against entry of foreign material into the water system. Minimum treatment requirements shall be in accordance with the following:

1. Wells or Springs

- a. When a well or spring meets construction standards and the water quality requirements, it will be approved without treatment.
- b. When either well or spring construction or water quality fails to meet standards, the minimum treatment considered for approval will be continuous automatic chlorination.
- c. When a well or spring is known or suspected to be contaminated with domestic sewage, approval will not be granted.

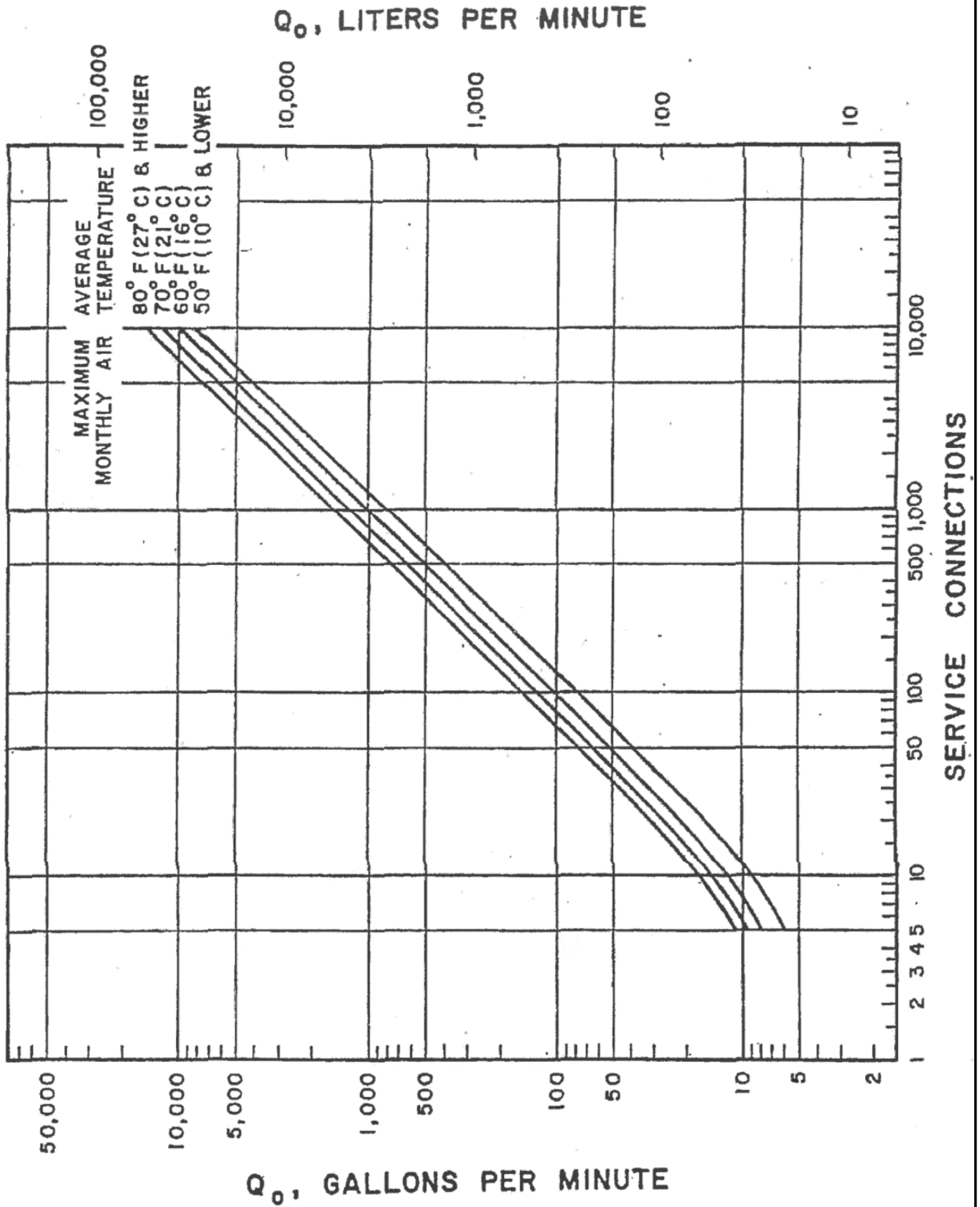
2. Streams or Lakes

- a. If a lake and/or stream and watershed is adequately protected, the minimum treatment for approval will be filtration and continuous automatic chlorination.
- b. Where it is impractical to provide adequate watershed protection, complete treatment of the water may be necessary for approval. The treatment required may include aeration, coagulation and settling, filtration, chlorination, and measures for odor and taste control.

Section L - Abandoned Wells

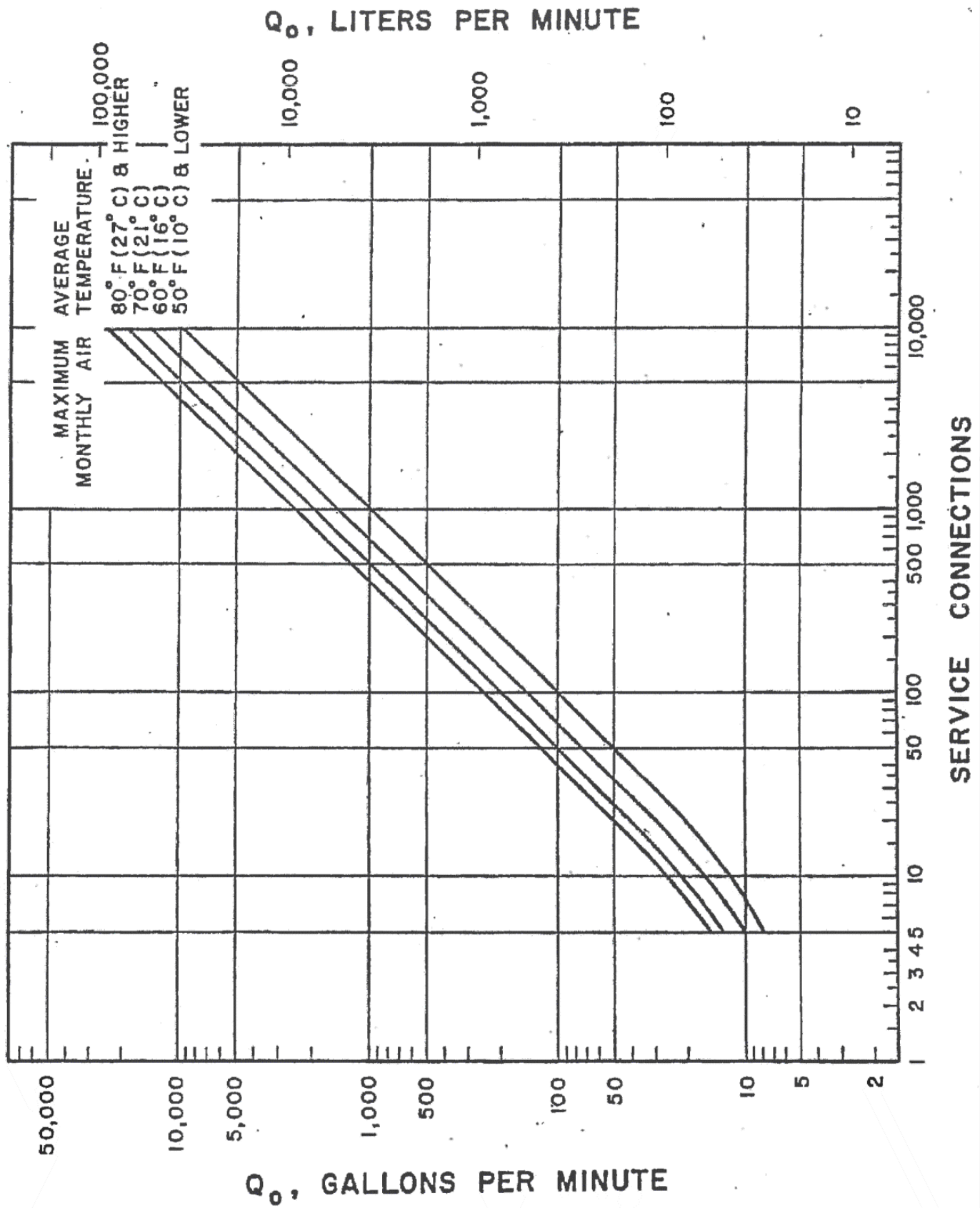
1. All abandoned wells shall be destroyed or sealed in accordance with Part II of Chapter V of the California Department of Water Resources Bulletin No. 74-81 Water Well Standards, December 1981. This shall be done under permit from the Santa Cruz County Division of Environmental Health.

MAXIMUM DAY DEMAND - METERED WATER SYSTEMS



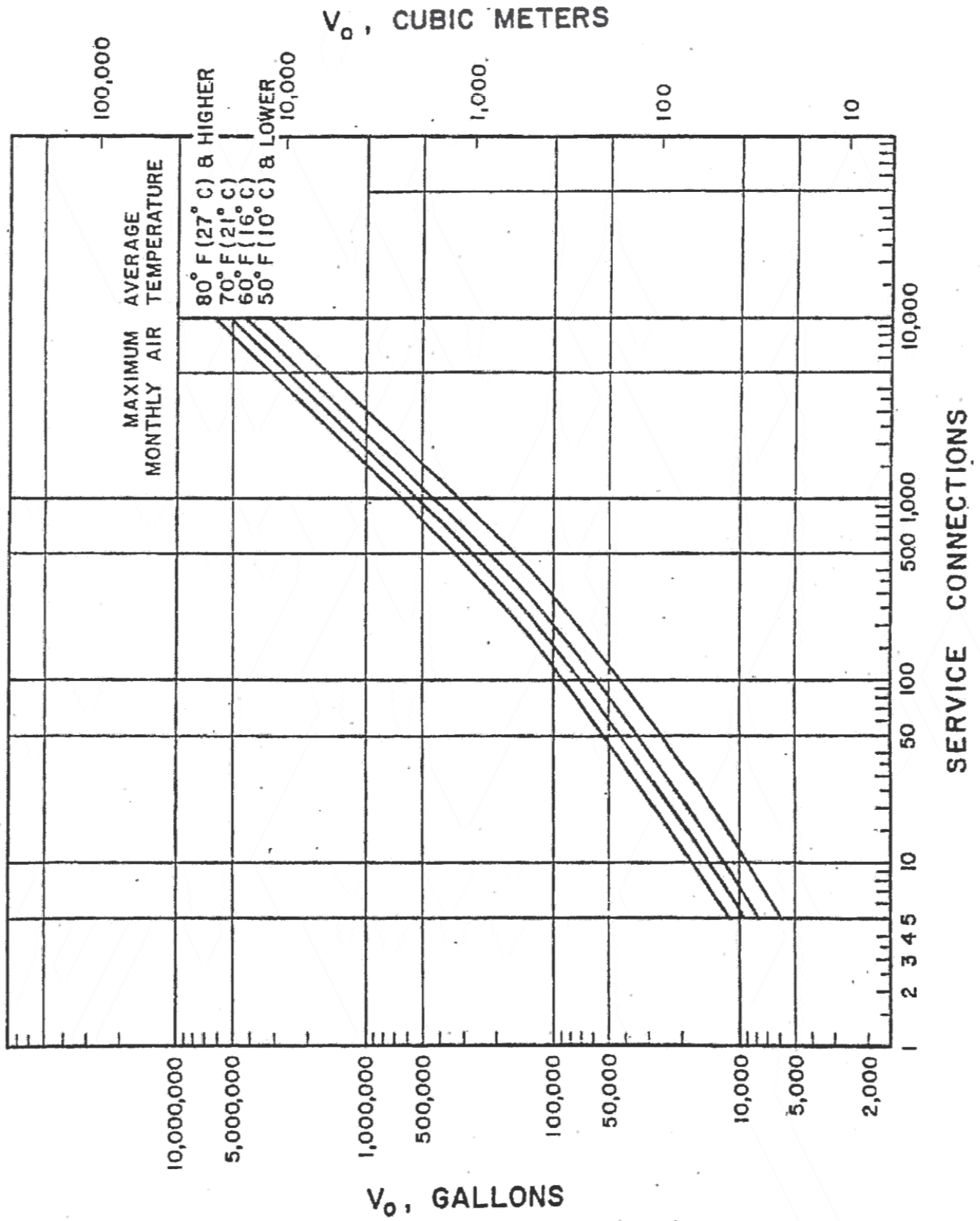
MAXIMUM DEMAND GRAPH FOR METERED WATER SYSTEMS FIG. W-1

MAXIMUM DAY DEMAND - FLAT RATE WATER SYSTEMS



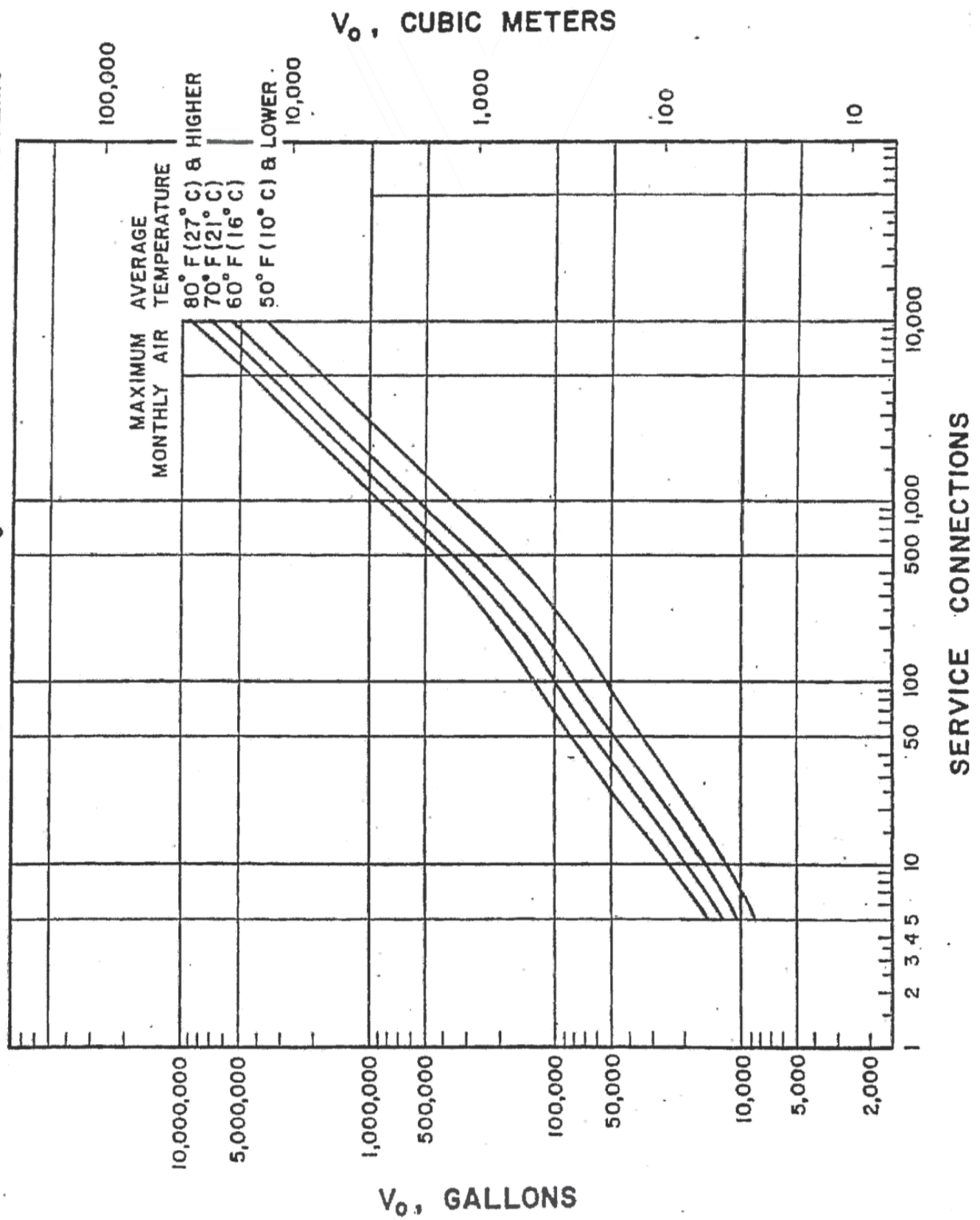
MAXIMUM DEMAND GRAPH FOR FLAT RATE WATER SYSTEMS FIG. W-2

NEEDED STORAGE VOLUME WHEN $Q = Q_0$ - METERED WATER SYSTEMS

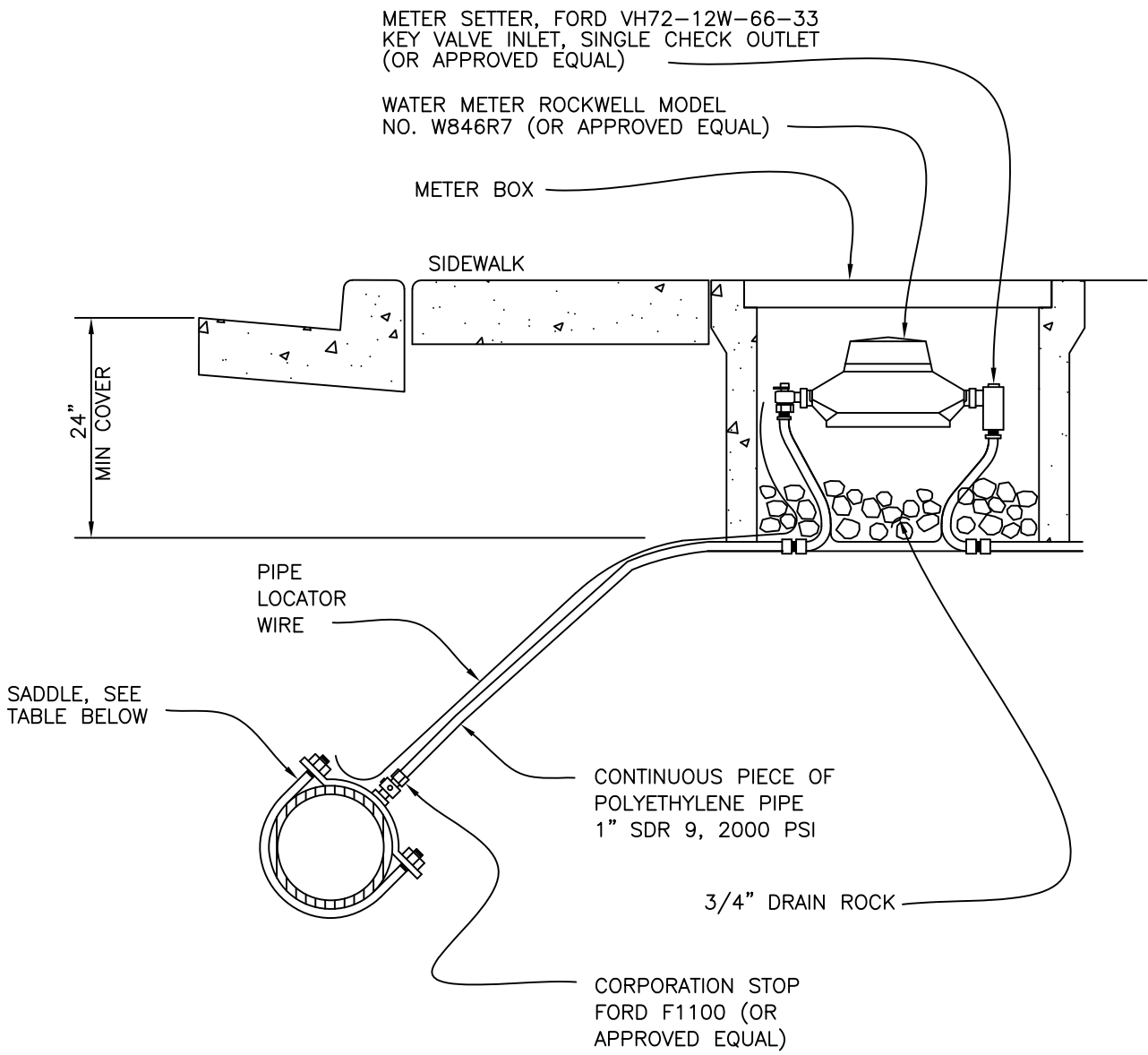


STORAGE CAPACITY GRAPH
FOR METERED WATER SYSTEMS
FIG. W-3

NEEDED STORAGE VOLUME WHEN $Q = Q_0$ - FLAT RATE WATER SYSTEMS



STORAGE CAPACITY GRAPHS
FOR FLAT RATE WATER SYSTEMS
FIG. W-4

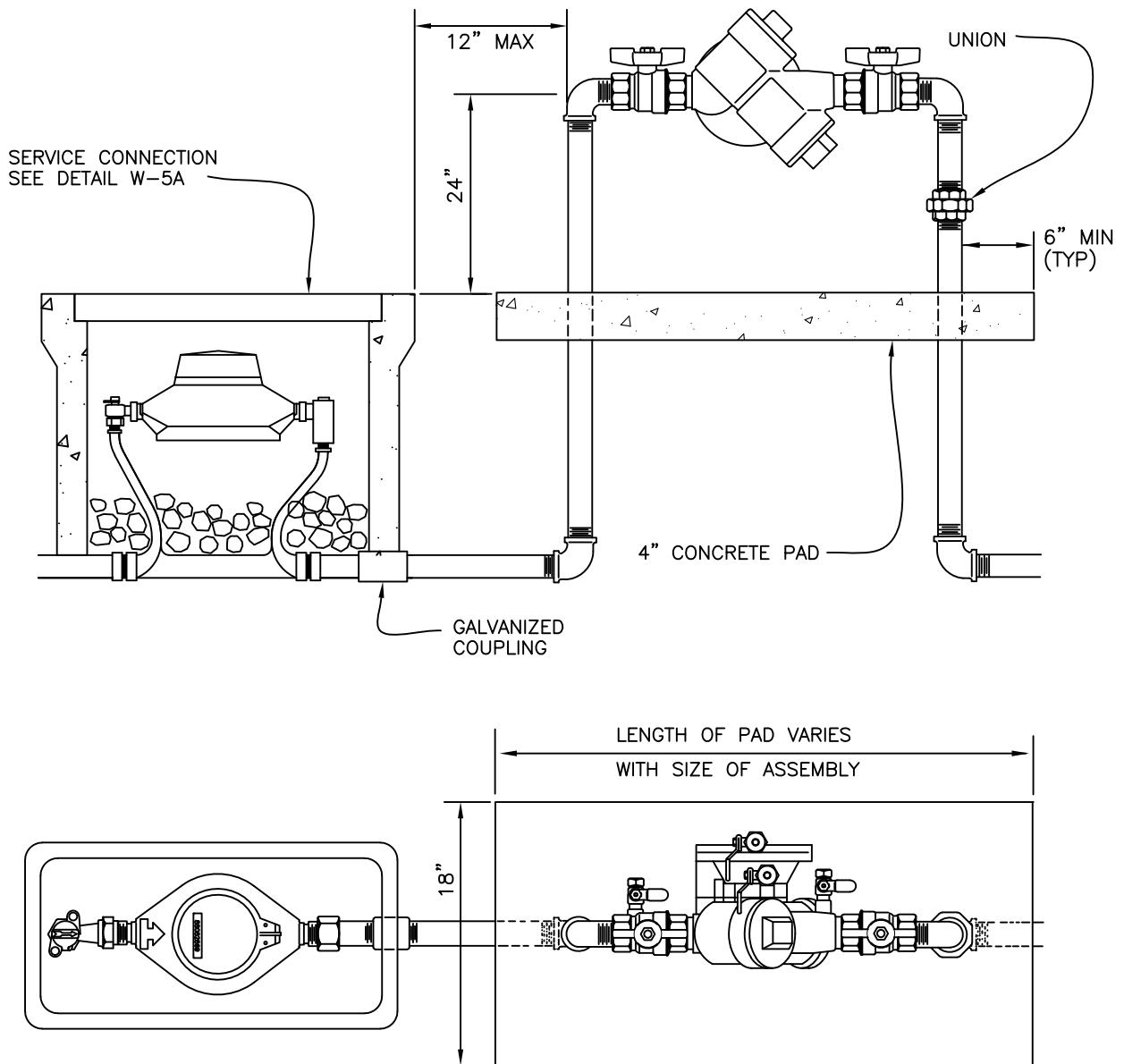


PIPE TYPE	JONES	FORD
PVC	J-995	101BS/202BS
C-900	J-996	101BS/202BS
AC, CI, DI	J-975	101B/202BS

NOTES:

1. DETAIL TO BE USED FOR 5/8" AND 3/4" METERS ONLY.
2. WHEN INSTALLING A NEW SERVICE AT AN EXISTING LOCATION, THE CONTRACTOR MUST REPLUMB THE CUSTOMER SIDE SO THE NEW INSTALLATION MEETS THIS PLAN AND REMOVE ALL ABANDONED PIPE.
3. IRRIGATION METERS WILL REQUIRE A BACKFLOW PREVENTOR PER DETAIL W-5B.
4. NEW INSTALLATIONS AT EXISTING LOCATIONS MUST BE RELOCATED INTO THE RIGHT-OF-WAY.

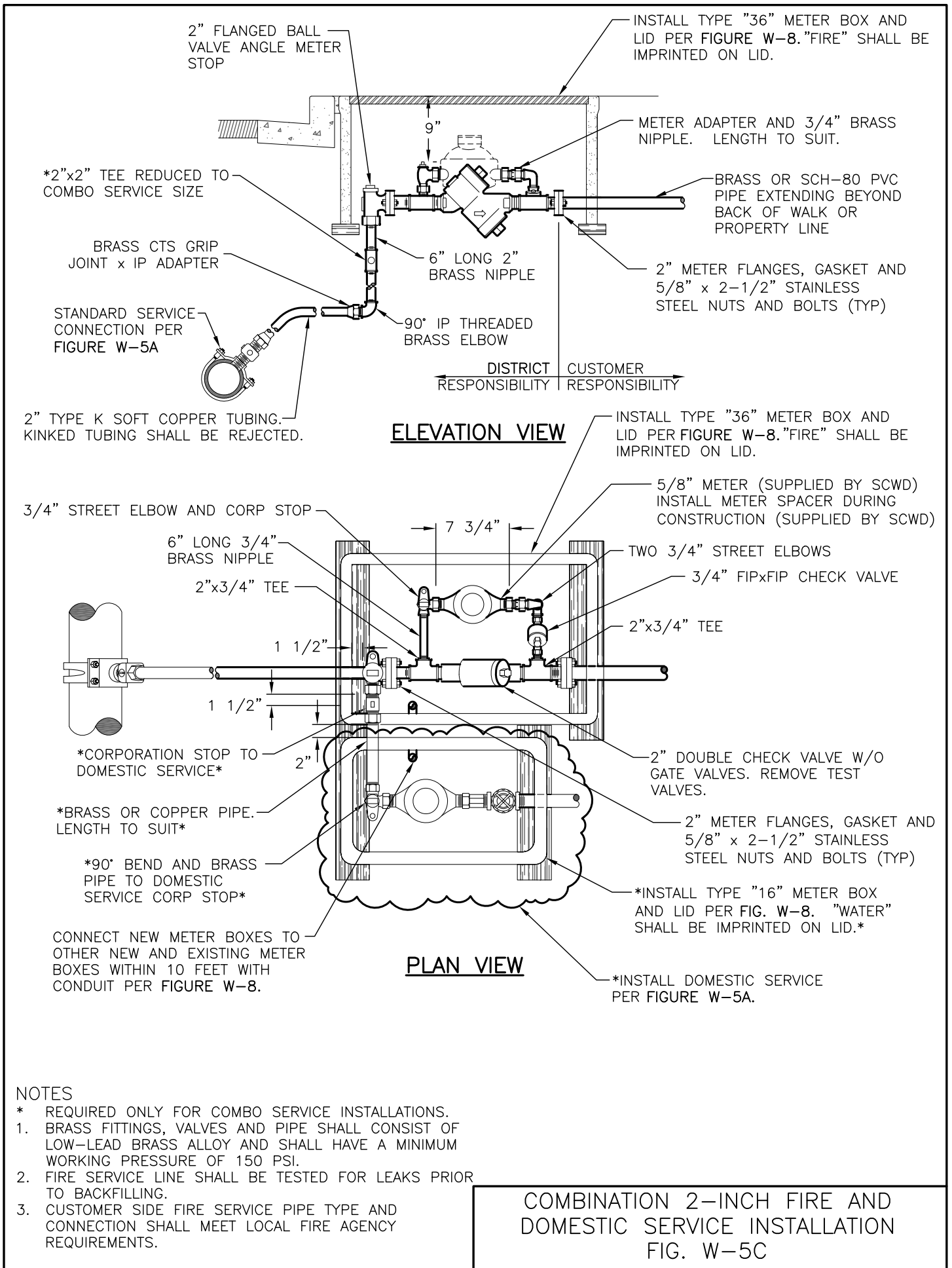
STANDARD WATER SERVICE CONNECTION
FIG. W-5A



NOTES:

1. REDUCED PRESSURE BACKFLOW PREVENTION ASSEMBLY SHALL BE FEBCO 825Y OR 825YA.
2. ASSEMBLY SHALL BE READILY ACCESSIBLE FOR REPAIR AND INSPECTION.
3. PIPE SHALL BE STANDARD GALVANIZED SCHEDULE 40 STEEL.
4. FITTINGS SHALL BE STANDARD GALVANIZED MALLEABLE IRON.
5. ALL PIPE AND FITTINGS BELOW GROUND OR IN CONCRETE TO BE PRIMED AND WRAPPED WITH PROTECTIVE TAPE.
6. PIPING ABOVE GROUND TO BE PAINTED WITH TWO COATS OF ENAMEL. AVOCADO GREEN, RUSTOLEUM # 7734.
7. ASSEMBLY TO BE SET LEVEL AND STANDPIPES PLUMB.

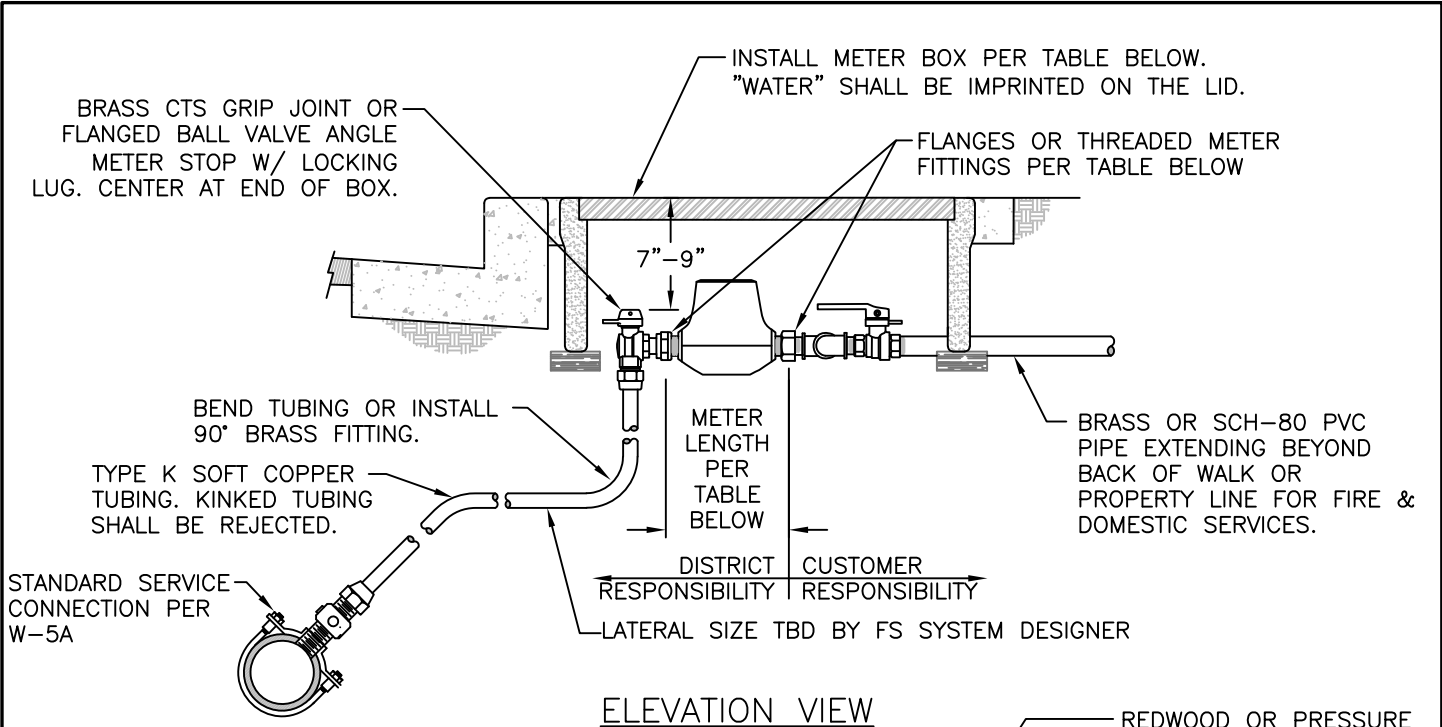
BACKFLOW PREVENTION ASSEMBLY
FIG. W-5B



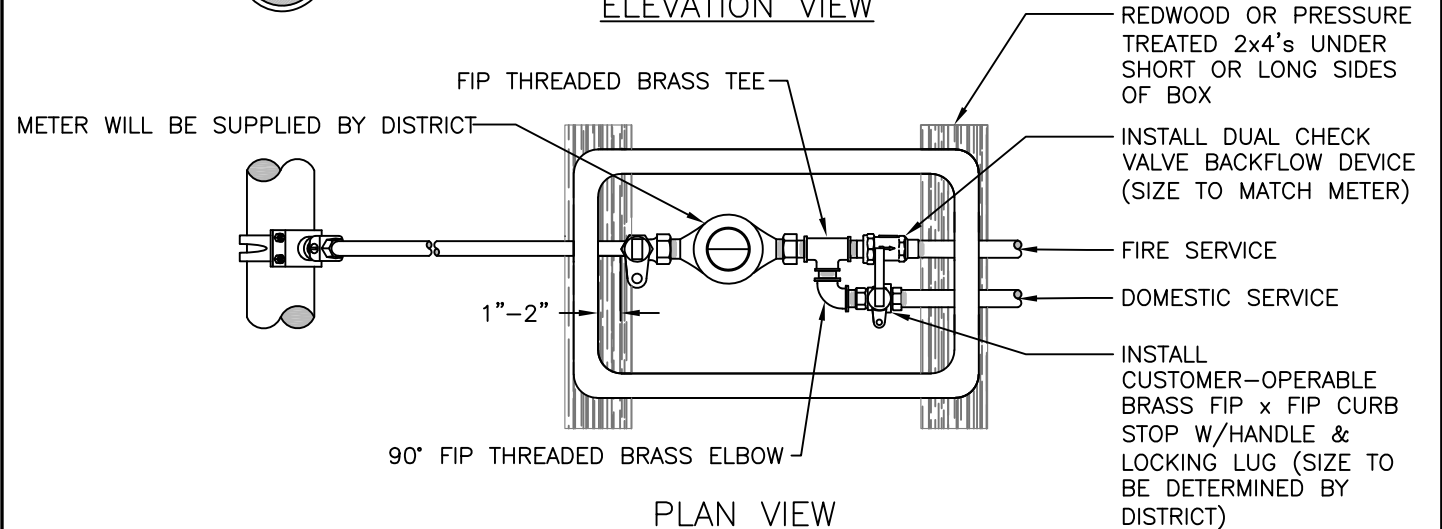
NOTES

- * REQUIRED ONLY FOR COMBO SERVICE INSTALLATIONS.
- 1. BRASS FITTINGS, VALVES AND PIPE SHALL CONSIST OF LOW-LEAD BRASS ALLOY AND SHALL HAVE A MINIMUM WORKING PRESSURE OF 150 PSI.
- 2. FIRE SERVICE LINE SHALL BE TESTED FOR LEAKS PRIOR TO BACKFILLING.
- 3. CUSTOMER SIDE FIRE SERVICE PIPE TYPE AND CONNECTION SHALL MEET LOCAL FIRE AGENCY REQUIREMENTS.

COMBINATION 2-INCH FIRE AND DOMESTIC SERVICE INSTALLATION FIG. W-5C



ELEVATION VIEW



PLAN VIEW

METER SIZE AND TYPE DETERMINED BY FS SYSTEM DESIGNER	BOX TYPE	METER LENGTH
3/4" THREADED	"16"	7 3/4"
1" THREADED	"36"	11"
1 1/2" FLANGED	"36"	13"

BOX TYPE	NON-TRAFFIC	TRAFFIC
TYPE "16"	CHRISTY B16 BOX W/ N16R LID OR EQUAL	CHRISTY B1324 BOX W/ B1324-51JH LID OR EQUAL
TYPE "36"	CHRISTY N36 BOX W/ FL36D LID OR EQUAL	CHRISTY B1730 BOX W/ B1730-51JH LID OR EQUAL

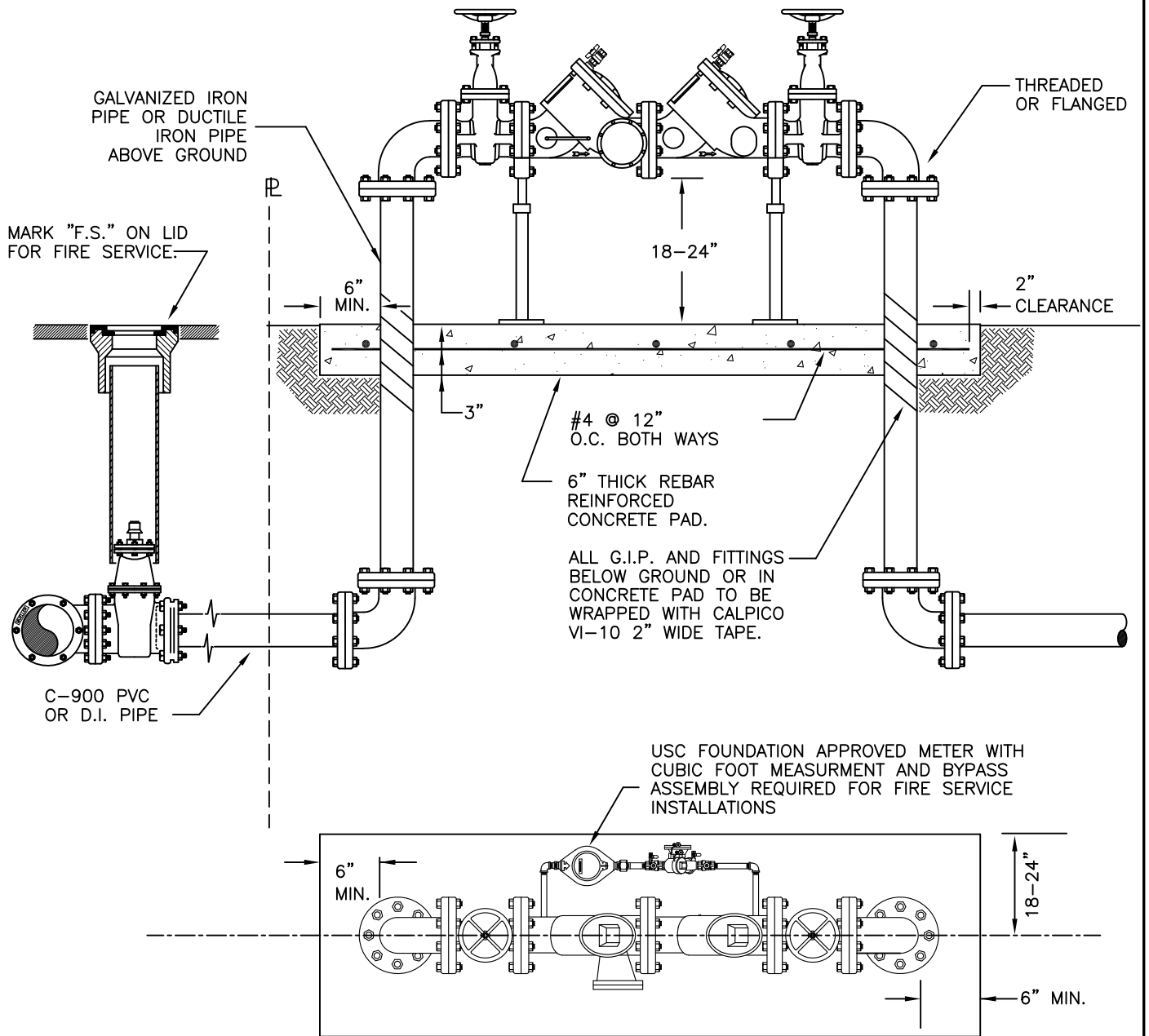
NOTES

- BRASS FITTINGS, VALVES AND PIPE SHALL CONSIST OF LOW-LEAD BRASS ALLOY AND SHALL HAVE A MINIMUM WORKING PRESSURE OF 150 PSI.
- FIRE SERVICE LINE SHALL BE TESTED FOR LEAKS PRIOR TO BACKFILLING.
- CUSTOMER SIDE FIRE SERVICE PIPE TYPE AND CONNECTION SHALL MEET LOCAL FIRE AGENCY REQUIREMENTS.

**DOMESTIC AND FIRE COMBINATION SERVICE INSTALLATION
FIG. W-5D**

DATE: 10/21

REDUCED PRESSURE PRINCIPLE OR DOUBLE CHECK
DETECTOR ASSEMBLY PER DISTRICT APPROVED LIST



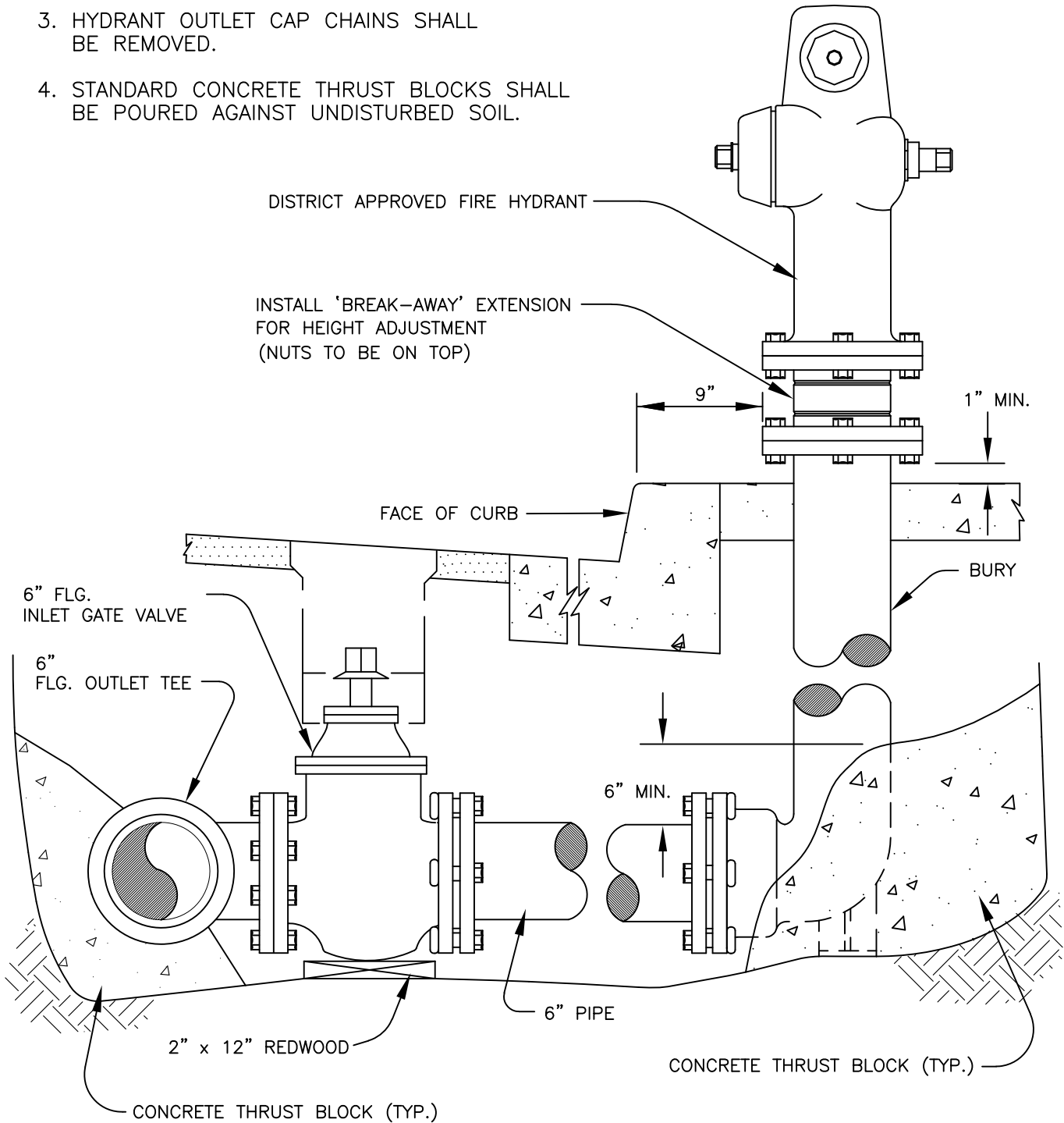
NOTES:

1. TEST COCKS AND RELIEF VALVE SHALL BE SET BACK 18" MIN. AND FACING AWAY FROM WALL.
2. ASSEMBLIES REQUIRE PIPE SUPPORTS UNDER EACH GATE VALVE.
3. INSTALLATION SHALL BE LOCATED ON THE PROPERTY SUCH THAT THE DETECTOR METER SHALL BE ACCESSIBLE AT ALL TIMES FOR READING AND MAINTENANCE PURPOSES. LOCATION MUST BE APPROVED BY WATER DISTRICT PRIOR TO INSTALLATION.
4. BACKFLOW ASSEMBLY GATE VALVES SHALL BE O.S. & Y. TYPE AND SHALL BE CHAINED IN THE OPEN POSITION.
5. DRAWING SHOWS REDUCED PRESSURE PRINCIPLE DETECTOR. CLASS I AND II INSTALLATIONS REQUIRING DOUBLE CHECK DETECTOR ASSEMBLY (DCDA) INSTALLATION SHALL BE IDENTICAL WITH THE EXCEPTION OF THE ASSEMBLY.

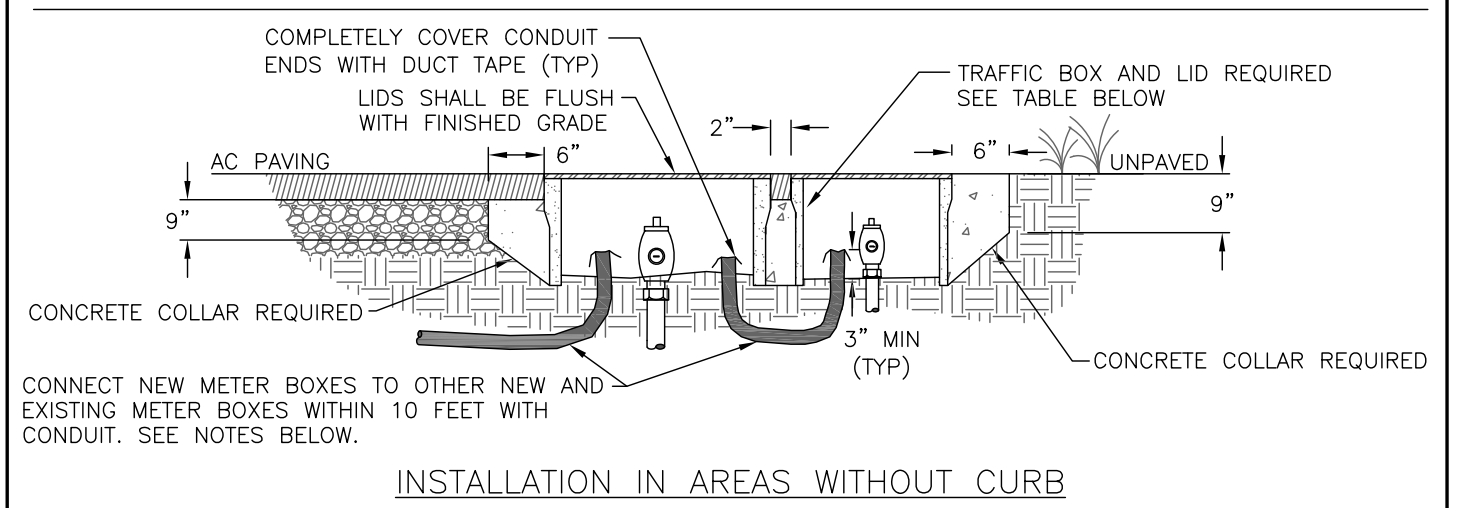
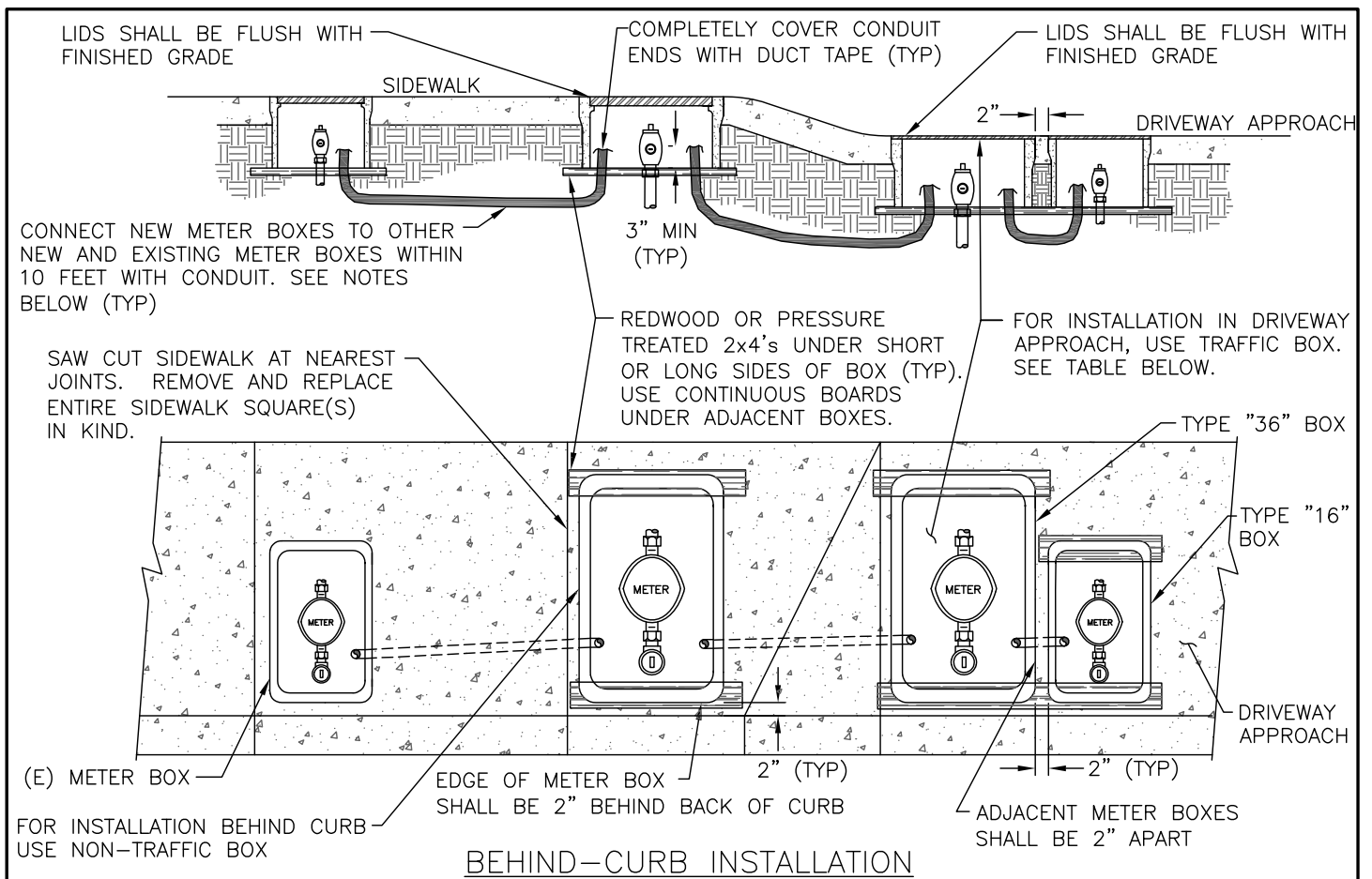
3" AND LARGER FIRE SERVICE
OR BACK FLOW PREVENTION ASSEMBLY
FIG. W-6

NOTES:

1. FIRE HYDRANT SHALL BE COVERED WITH BURLAP SACK UNTIL PUT INTO SERVICE.
2. PROVIDE VALVE BOX DETAIL ON PLANS FOR DISTRICT APPROVAL.
3. HYDRANT OUTLET CAP CHAINS SHALL BE REMOVED.
4. STANDARD CONCRETE THRUST BLOCKS SHALL BE POURED AGAINST UNDISTURBED SOIL.



STANDARD FIRE HYDRANT
INSTALLATION
FIG. W-7

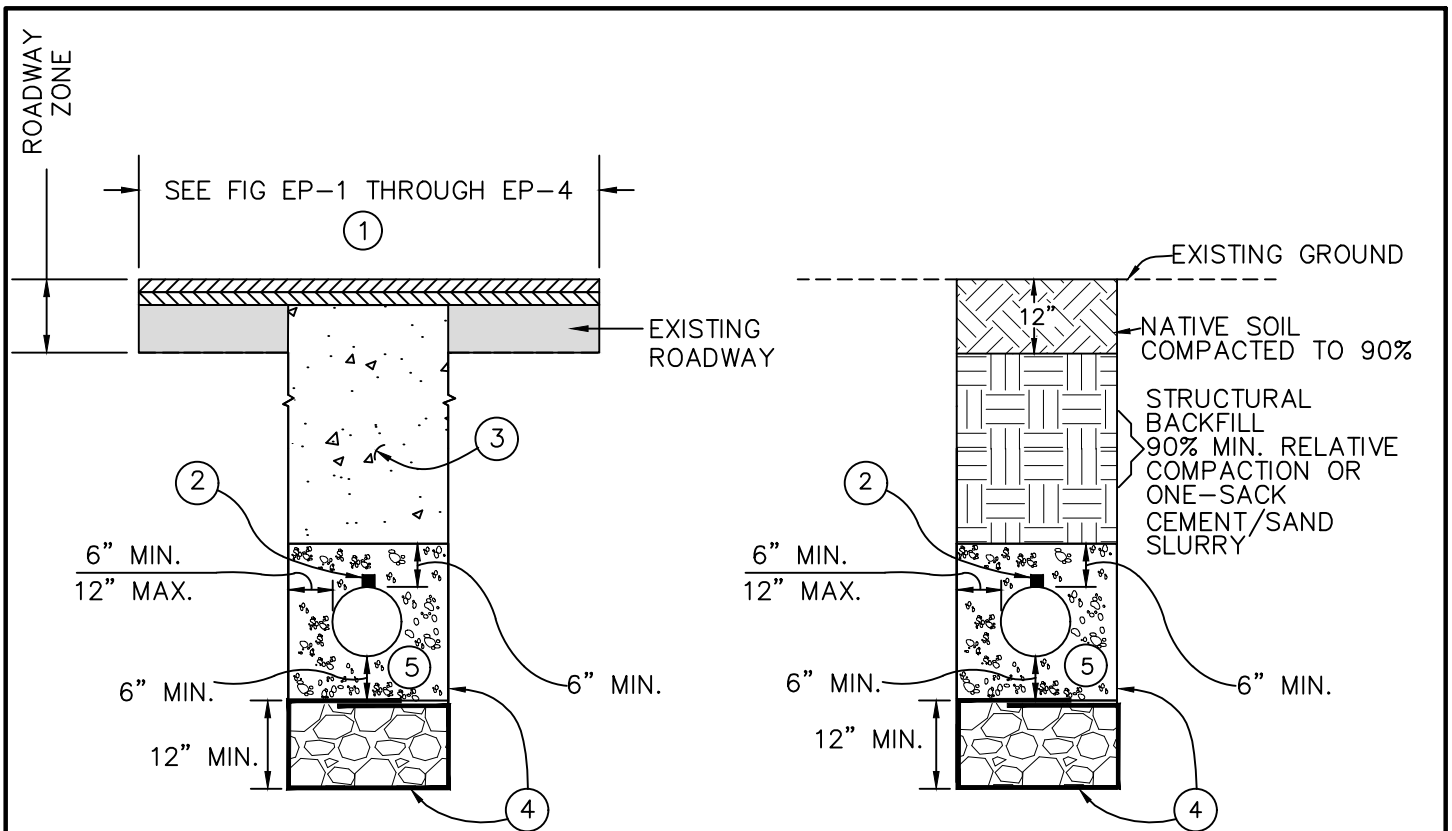


BOX TYPE	NON-TRAFFIC	TRAFFIC
TYPE "16"	CHRISTY B16 BOX W/ B16D LID OR EQUAL	CHRISTY B1017 BOX W/ B1017-JH LID OR EQUAL
TYPE "36"	CHRISTY N36 BOX W/ FL36D LID OR EQUAL	CHRISTY B1730 BOX W/ B1730-51JH LID OR EQUAL

NOTES

1. INSTALL CONDUIT AS SHOWN WHEREVER METER BOXES ARE WITHIN 10' OF OTHER NEW OR EXISTING BOXES.
2. CONDUIT SHALL BE NON-METALLIC, FLEXIBLE, CORRUGATED CONDUIT.
3. WHERE CONDUIT CONNECTS LESS THAN 12 BOXES, CONDUIT SHALL BE 1/2" MINIMUM DIAMETER.
4. WHERE CONDUIT CONNECTS 12 OR MORE BOXES, CONDUIT SHALL BE 1" MINIMUM DIAMETER.
5. ELECTRONICS AND WIRING FOR FLOW METER WILL BE FURNISHED AND INSTALLED BY THE DISTRICT.

**WATER METER BOX INSTALLATION
FIG. W-8**



TRAFFIC AREAS
(3' OR MORE OF COVER*)

NON-TRAFFIC AREAS
(3' OR MORE OF COVER*)

*COVER = TOP OF PIPE TO FINISHED GRADE; SEE NOTE 2 BELOW FOR ADDITIONAL INFORMATION

- ① SEE FIGURE EP-1 THROUGH EP-4 FOR ROADWAY ZONE TRENCH SECTION DETAILS; SS-2 SUPERCEDES EP-1
- ② TRACER WIRE: TRACER WIRE SHALL BE TIED TO ALL WATER LINES AND RUN UP INTO ALL CONNECTING STRUCTURES FOR LOCATING ACCESS. LOCATING WIRE SHALL BE 10 GAUGE MINIMUM, FULLY ANNEALED, HIGH CARBON 1055 GRADE STEEL, HIGH STRENGTH COPPER CLAD STEEL, WITH 21% MINIMUM CONDUCTIVITY, AND AN RHoS COMPLIANT HDPE INSULATED JACKET (APWA UNIFORM COLOR CODE WATER-BLUE).
- ③ ONE-SACK CEMENT/SAND SLURRY BACKFILL.
- ④ SELECT DRAINROCK AND APPROVED FILTER FABRIC IS REQUIRED AS "EXTRA WORK" WHERE SOIL OR GROUND WATER CONDITIONS ARE ENCOUNTERED DURING CONSTRUCTION OR AS CONTRACT WORK WHERE IT HAS BEEN SPECIFIED ON THE PROJECT PLANS. (OVERLAP TOP 12" MIN.)
- ⑤ CLEAN SAND TAMPED UNTIL 95% RELATIVE COMPACTION IN ROADWAYS. (90% RELATIVE COMPACTION ALLOWED OUTSIDE OF ROADWAY)

NOTES:

- 1. IN NON-PAVED, NON-COUNTY MAINTAINED TRAFFIC AREAS, STRUCTURAL BACKFILL MAY BE ALLOWED IF APPROVED BY THE DISTRICT.

WATER MAIN & SERVICE
STANDARD TRENCH BACKFILL
FIG. W-9

PART 6. ENCROACHMENTS

PART 6 - ENCROACHMENTS

Section A – General Encroachment Requirements

1. All work within County right-of-way requires an approved encroachment permit. The standard terms and references that pertain to encroachments within the County maintained road right-of-way system are set forth in the Santa Cruz County Code, Chapter 9.70, “Streets and Roads.”
2. Improvement plan submittals for encroachment permits shall conform the requirements of Part I, General, of this *Design Criteria*.
3. Whenever any work for which an encroachment permit is required by the Encroachment Ordinance has been commenced without first obtaining said permit, a special investigation shall be made before a permit may be issued for such work. An investigation fee, separate from the permit fee, shall be collected whether or not a permit is subsequently issued. The investigation fee shall be equal to the amount of the permit fee required by the Encroachment Ordinance. The payment of such investigation fee shall not exempt any person from compliance with all other provisions of the Encroachment Ordinance nor from any other penalty prescribed by law.
4. Approved work shall be inspected as noted on the permit. The County Encroachment Inspector shall be contacted at least one week in advance for initial site inspection prior to commencement of any approved work, and at least 72 hours in advance for subsequent inspections.
5. Permittee shall be responsible for all costs associated with the requirements of this section, including, but not limited to: road/lane closure requests, traffic control plans, detour signage, grinding existing striping, roadway resurfacing, and restriping.
6. No portion of a County roadway may be closed to public use unless authorized by an encroachment permit. Work shall be planned to minimize disturbance to the general public, and shall only be performed at permitted times and locations. If lane closures or road closures are authorized, permittee shall implement traffic control as permitted, and perform work within the dates and times specified on the encroachment permit. Penalty fees for lane closure before or after designated times shall be enforced. Penalty fees will be assessed for each 10- minute interval (or fraction thereof) for lane closures outside permitted times, penalty fee shall be \$100.00 per interval for first infraction, \$300 per interval for second infraction and \$500 per interval thereafter. Penalty fees will be payable from the permittee to the County of Santa Cruz Public Works.
7. Site signage shall be posted as required by the encroachment permit. Signage shall display at a minimum: impacts to access, working hours, and dates work will occur, additional information to be posted may be required by the encroachment permit. Site signage shall accurately reflect project conditions as approved in the encroachment permit (including but not limited to indicating approved dates of work, working hours, and whether closures or detours will be in effect). Permittee shall be assessed a penalty fee of \$1,000 per day, per site, for failure to post site signage meeting these requirements. Penalty fees will be payable from the permittee to the County of Santa Cruz Public Works.

8. Unless specifically permitted by the County, staging shall not be allowed in the County road right-of-way. The Permittee shall make arrangements for a construction staging area that is in conformance with all County land use and zoning regulations.
9. Certain underground locations within the County road right-of-way contain asbestos-cement pipe (ACP) fragments where special requirements apply, see Design Criteria Part 4 – Sanitary Sewer Design, Section I for locations and requirements.

Section B – Driveways

Construction of a driveway connecting to a County maintained road, alteration of an existing driveway connecting to a County maintained road which substantially changes its alignment or grade, or construction of culverts, ditches, or drains in the County road right of way require an Encroachment Permit. Driveways shall be constructed or modified in accordance with Figures DW-1 through DW- 8 and as described in this section.

1. Driveways shall not interfere with legal encroachments nor create hazards or nuisances, and shall be located to maximize available street parking.
2. A plan and profile drawn to scale showing the following must be submitted for approval prior to the issuance of a driveway permit:
 - a. Existing right-of-way line and property lines
 - b. Existing roadside features and topography (e.g., swales, ditches, culverts, utilities, curb and gutter, sidewalk, etc.)
 - c. Edge of pavement of road
 - d. Existing and proposed ground profiles with elevations and grades
 - e. Typical cross section indicating type and thickness of proposed surface and base material, cross slopes, and drainage facilities.
 - f. Method of handling driveway runoff
3. A common driveway will be allowed only if rights-of-way over all properties are granted to each property owner.
4. Adequate sight distance shall be provided based on the design speed of the road. The minimum sight distance shall be 250 ft for minor local streets, or as required by a traffic engineering report.
5. When more than one driveway serves a given property, the total width of all driveways shall not exceed 70 percent of the frontage for commercial parcels or 50 percent of the frontage for residential parcels. There shall be a minimum of 20 ft of full height curb between driveways on the same parcel.
6. The sideline of any driveway shall not be closer than 10 ft to the intersection curb return.

7. Driveway alignment of less than 60 degrees from the intersected road is not allowed.
8. Gates shall be 20 ft clear from bike lane or 20 ft clear from travel lane if no bike lane.
9. Trees may only be removed to provide vehicular access if no suitable alternative exists. The applicant shall obtain all necessary permits for tree removal work.
10. Engineered plans for a driveway must be submitted upon request by the Director.
11. Subdivision plans shall show a driveway design conforming to these specifications for each lot.
12. The applicant is responsible for the accuracy of all information submitted for the permit.
13. Base rock shall be Class 2 aggregate base, asphalt concrete shall be hot mix Type A, and concrete shall be Caltrans Standard Minor Concrete (5 sack) minimum.
14. The minimum inside turning radius along a driveway shall be 20 ft. Radius may be reduced by 1 ft for every 2 ft of driveway width over 10 ft.
15. An asphalt driveway apron shall be constructed adjacent to the driveway's connection to the County roadway. Apron shall be constructed to the criteria for asphalt driveways noted in this section, and shall extend 15 ft from the edge of County roadway or to edge of road right of way, whichever is greater. Driveway Apron shall not be required for driveways connecting to County roadways with concrete curbs or sidewalks.
16. Water bars shall be required on driveways with culverts sloping toward a County roadway at a slope of 10% or greater, see detail DW-8.
17. Inspections are required prior to placing concrete or asphalt concrete. A final inspection is required upon completion of the permitted work. See Section A regarding inspection scheduling.
18. The Director may disapprove the use of pervious pavements on driveways that slope toward the street, if the department determines that their use could result in the deposit of sediment on the street or could otherwise cause significant problems within the County right-of-way.
19. To encourage stormwater retention and infiltration, base rock or pervious pavements may be used as an alternate surfacing type for driveways outside the County maintained road right-of-way, subject to the following:
 - a. The driveway shall be designed to minimize runoff to the adjoining access road.
 - b. The driveway shall be a minimum of 6 in thick or as required by the appropriate fire agency.
 - c. The driveway shall be cross-sloped to promote sheet flow to a non-erosive vegetated area prior to the runoff being released beyond the property line.

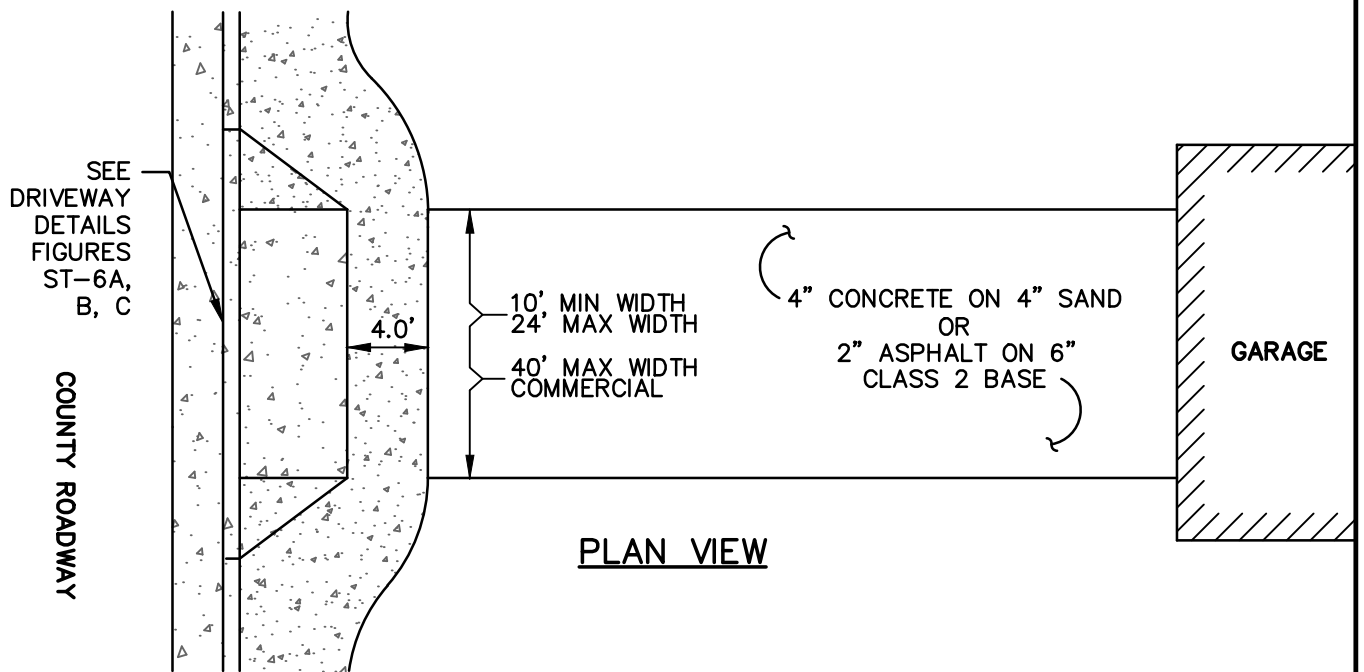
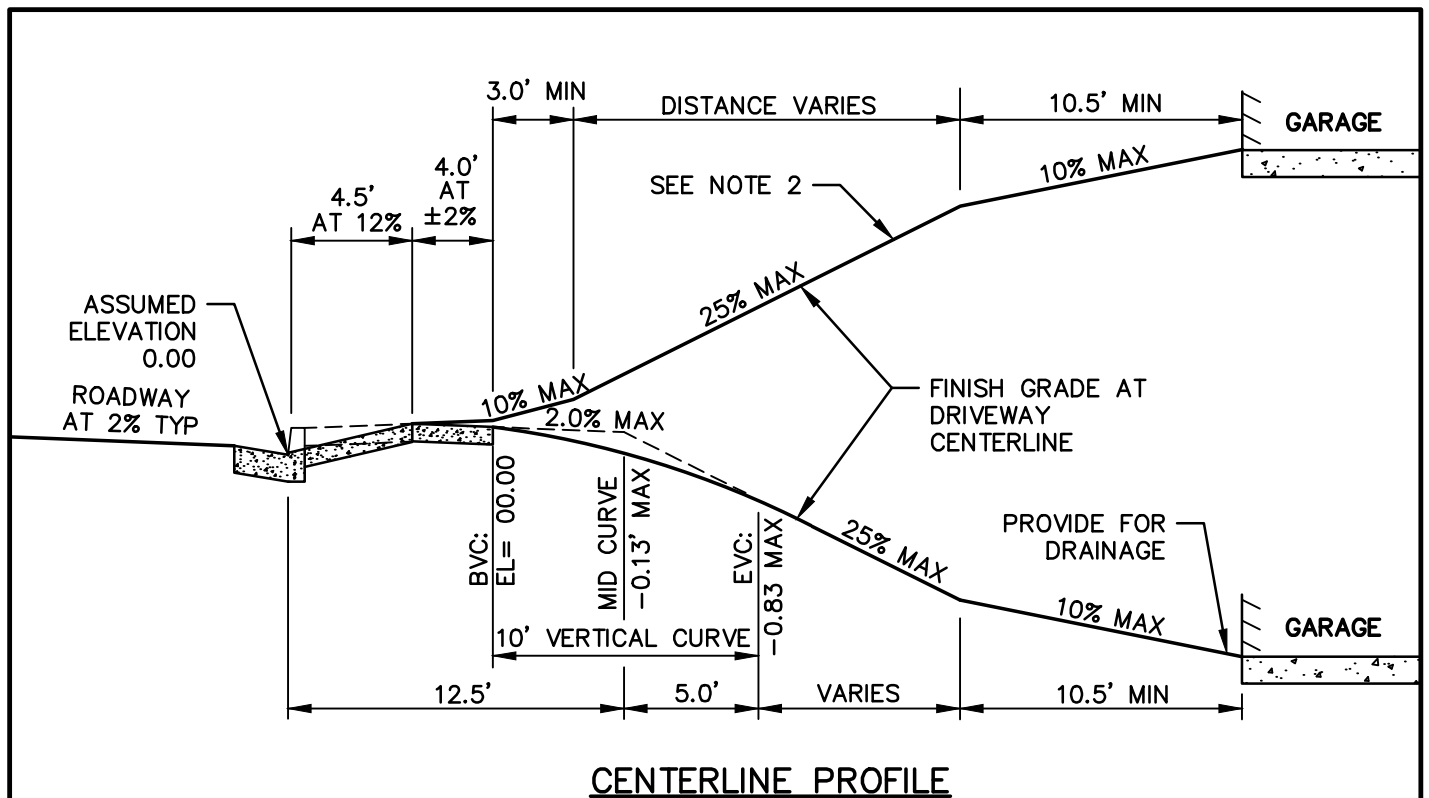
- d. Driveway runoff shall not cause the deposition of sediment onto the accessroad or into downstream drainage conveyances.
- e. A driveway apron shall be constructed if required for driveway type. For all driveways sloping toward a County roadway, a deepened concrete flush curb or other impervious barrier shall be constructed at the pervious driveway/ apron (or curb/ sidewalk) interface to a minimum depth of 4” below pervious driveway base or apron (or curb/ sidewalk) base layer (whichever is deeper) such that water remains entrained in the pervious driveway.

Section C - Utility Trenches

Trench work for all underground utility conduits within County rights-of-way and easements shall be constructed in accordance with Figures EP-1 through EP-9, and as described in this section.

- 1. All underground utilities shall have a minimum cover of 30" from finish grade to top of utility pipe. With authorization from the Director, cover may be reduced to avoid interfering with existing utilities, in this case additional requirements may apply.
- 2. Trench Backfill shall be per Figure EP-1. Within pipe bedding zone the applicable standards of the utility agency may be used, however trench backfill and roadway restoration shall follow the requirements of this section.
- 3. Trenches constructed as part of road improvement projects or land divisions that involve construction of new roads in their entirety may use sand backfill or native material below the new structural section. This standard also applies to service connections, cross trenches, manholes, clean outs, valves, utility boxes, vaults and other structures within the improvement project. A full-time inspector, approved by the Director, shall be on site during all compaction work to observe uniform compaction methods and materials. If an inspector is not provided by the utility company or the County, trench backfill shall be cement/sand slurry. This exception shall not apply to land divisions that involve work on existing roads.
- 4. Steel plate placement and maintenance shall be per Figure EP-6. Temporary trench patching with cold patch material which resists shoving will be allowed for a maximum distance of 100 ft and duration of 5 days. Hot mix asphalt shall be required for temporary trench patching for distances greater than 100 ft or durations longer than 5 days. Temporary patching shall be placed in good workmanship manner such that it is well compacted and flush with roadway. Permittee shall maintain temporary patching in good order throughout the project.
- 5. Trench cap shall be constructed per requirements of EP-2 through EP-4. If trench cap fails to meet required tolerances, corrective action shall be taken as directed by the County. For material or compaction issues, or if trench cap was placed too low, corrective action will likely require removal and replacement of affected sections. For cases where trench cap was placed too high but otherwise meets specifications, profile grinding may be allowed as a repair option at the discretion of the County.

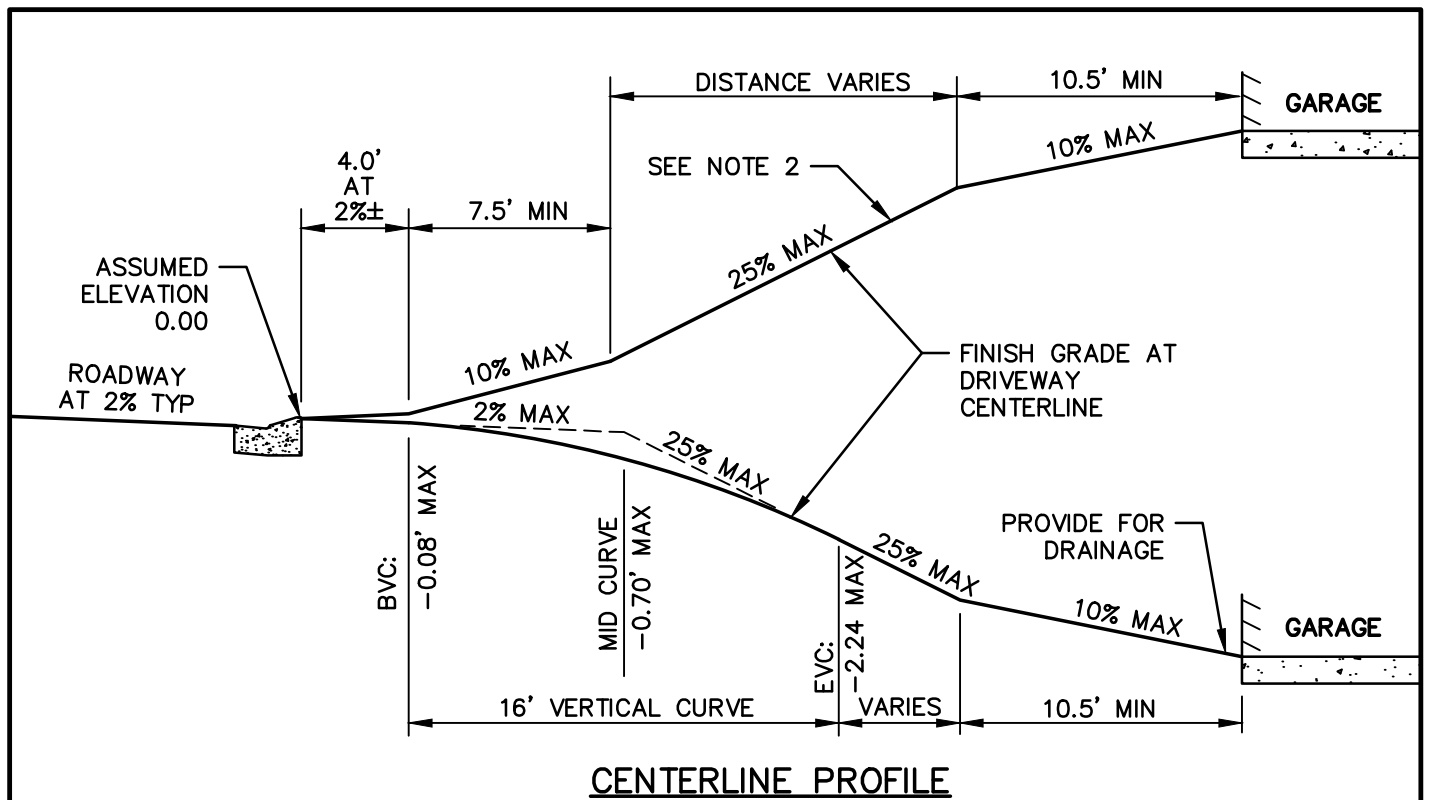
6. Roadway resurfacing shall be required upon completion of trench cap. For trenches less than 500' in length, resurfacing shall consist of fog seal to 1' beyond edge of trench cap. For trenches 500' in length or greater, resurfacing shall consist of a Type II slurry seal applied over the length of the trench to nearest lane line or road edge beyond the trench cap, in the case of single lane roads (roads with no painted centerline) slurry seal shall be applied to entire roadway width along trench alignment. Due to existing road surface conditions, the department may require an alternate resurfacing method in place of type 2 slurry seal, alternate resurfacing method may include microsurfacing, chip seal, cape seal, or asphalt concrete overlay.
7. Roadway resurfacing seal shall extend to the lip of gutter or road edge, and not overlap into the gutter or extend off of roadway. For gutters, in the event that seal extends into the gutter pan more than 1" or a straight uniform line is not maintained, it will be the responsibility of the contractor to remove the excess seal material from gutters using an appropriate method approved by the County. Any drips or runs that spill onto any concrete surface shall be removed the same day the spill occurs; at the completion of removal operations concrete shall be restored to original condition and coloring. For areas without gutters, seal shall extend to the edge of pavement, and shall not spill over to side roads, driveways, or landscaped areas; any seal spilled in this fashion shall be removed as described above.
8. The contractor shall grind existing striping in areas to be sealed prior to seal application, and re-stripe roadway with thermoplastic striping conforming to Caltrans standards upon completion of resurfacing work. Unless otherwise directed by the County, the intent of striping is to replace existing striping in kind. The contractor shall be responsible for making an initial inspection to review and record existing striping in order to replace striping to original layout once resurfacing work is complete. Cat tracking shall be installed and inspected by the County prior to starting the final striping operations. The County reserves the right to alter the striping being replaced.
9. Correctional work may be required due to the condition of the road after project has been completed, at the expense of the permittee. If portions of the County roadway outside project work areas are damaged by project activities, permittee shall be responsible for repairing such damage as directed by the County. Such repairs may include, but are not limited to, grinding and removal of the existing roadway pavement and placement of new asphalt concrete.



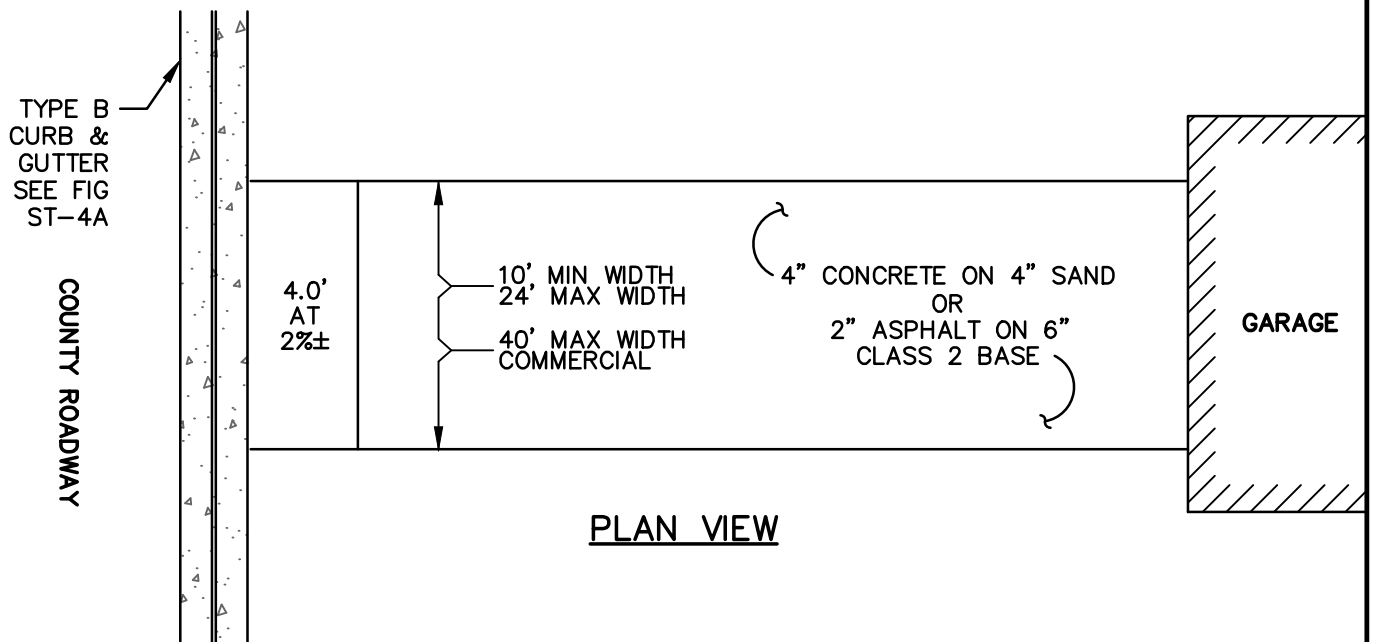
NOTES:

1. SHOW EXISTING GROUND ON PROFILES SUBMITTED FOR APPROVAL.
2. RUNOFF SHALL BE CONTROLLED SUCH THAT IT DOES NOT CAUSE A NUISANCE TO COUNTY ROADWAY.
3. REMOVE EXISTING CONCRETE CURB, GUTTER, AND SIDEWALK PRIOR TO NEW DRIVEWAY CONSTRUCTION. DRIVEWAY DEPRESSION SHALL BE CONSTRUCTED PER FIGURES ST-6A, B, & C. ADJACENT SIDEWALK SECTIONS SHALL BE CONSTRUCTED PER FIGURE ST-4A. MINIMUM SECTION FOR DRIVEWAY DEPRESSION IS 6" CONCRETE OVER 6" AGGREGATE BASE. DOWELS SHALL BE PLACED AT ALL JUNCTIONS WITH EXISTING CONCRETE.

DRIVEWAY WITH TYPE A CURB, GUTTER, & SIDEWALK



CENTERLINE PROFILE

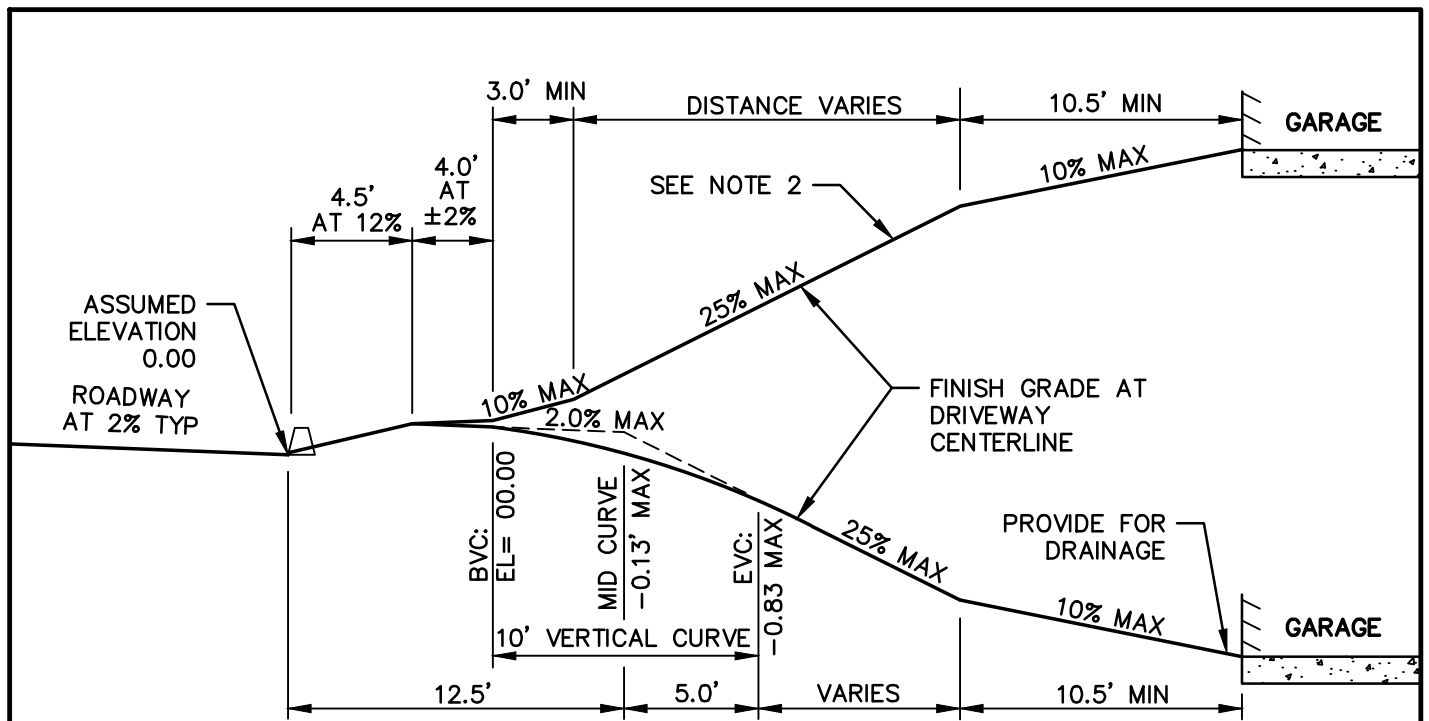


PLAN VIEW

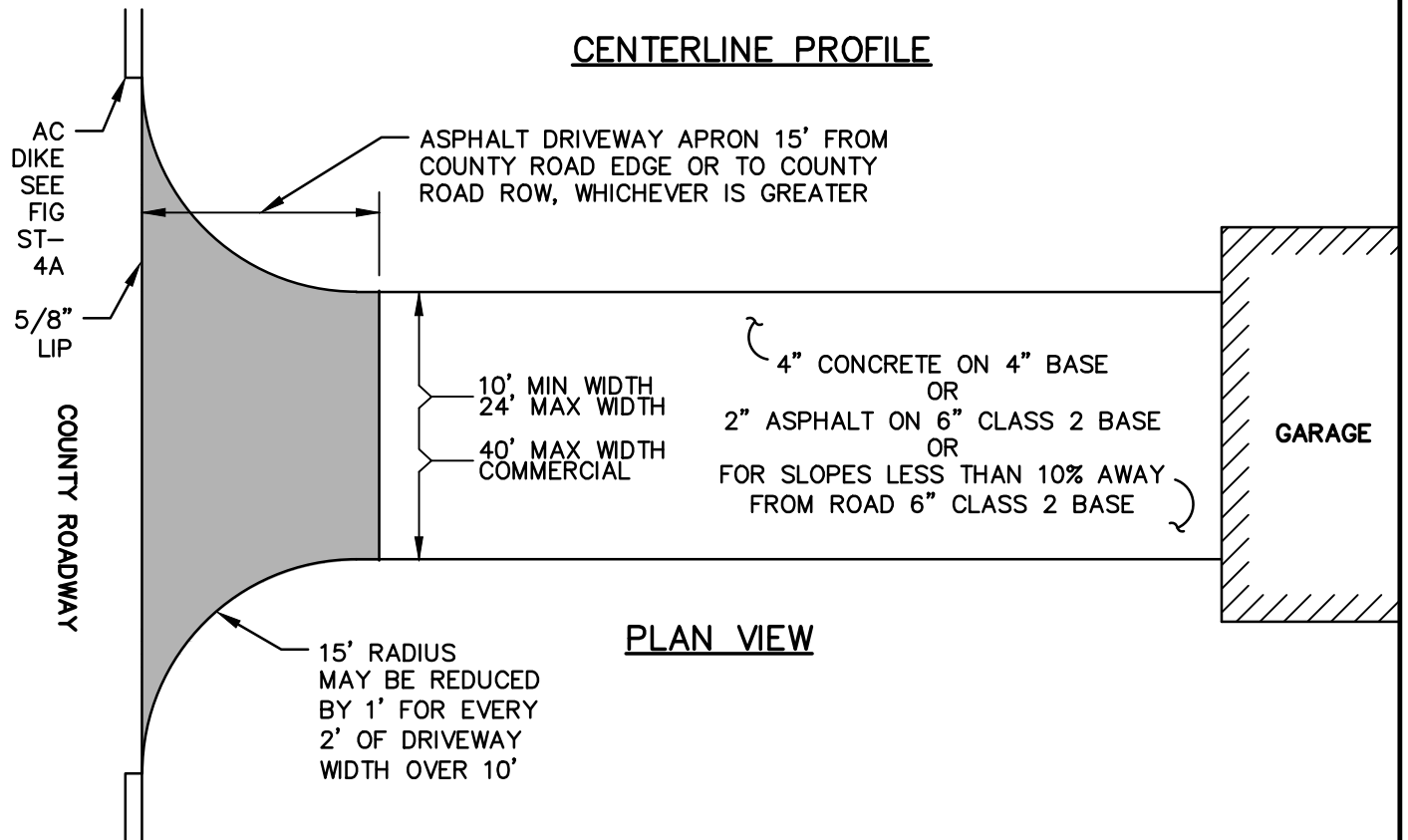
NOTES:

1. SHOW EXISTING GROUND ON PROFILES SUBMITTED FOR APPROVAL.
2. RUNOFF SHALL BE CONTROLLED SUCH THAT IT DOES NOT CAUSE A NUISANCE TO COUNTY ROADWAY.

DRIVEWAY WITH TYPE B CURB & GUTTER



CENTERLINE PROFILE

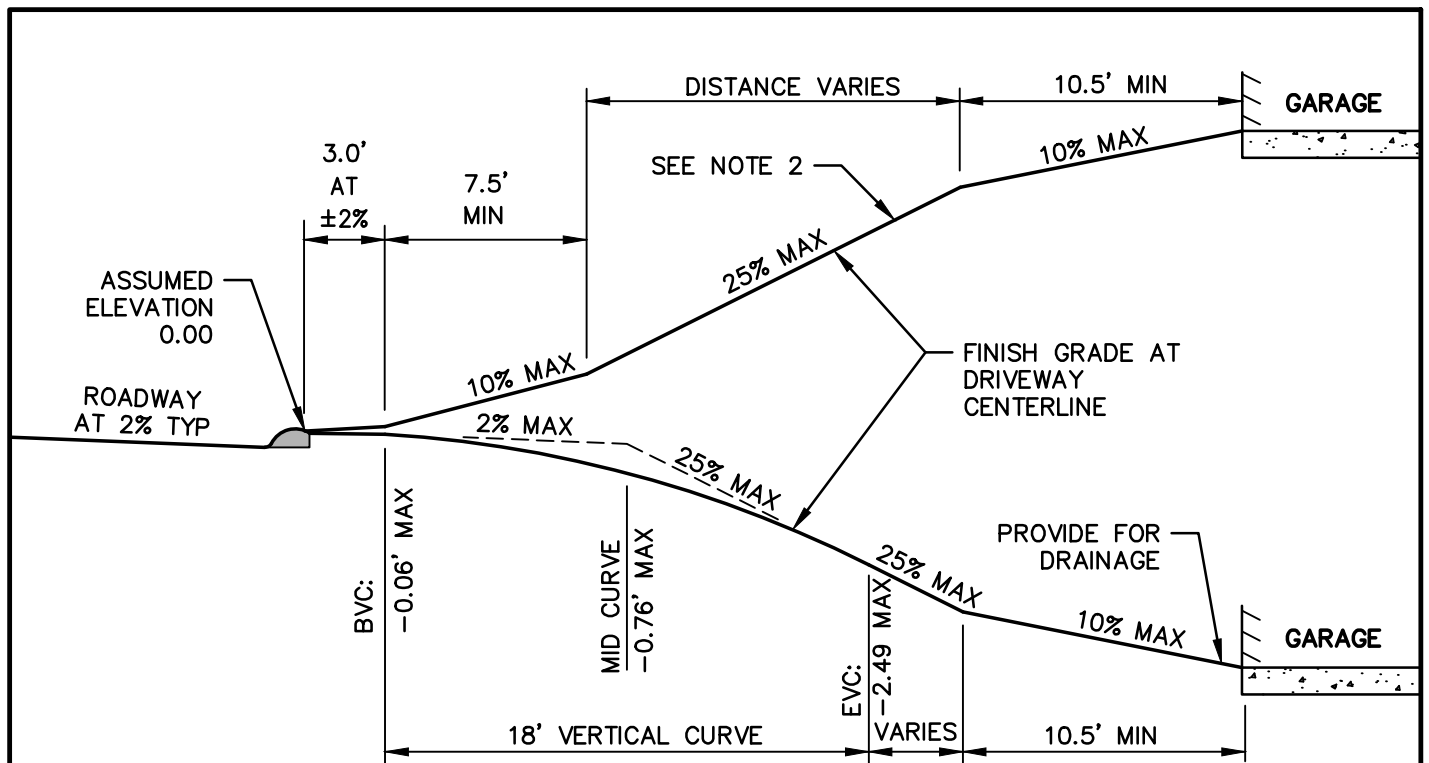


PLAN VIEW

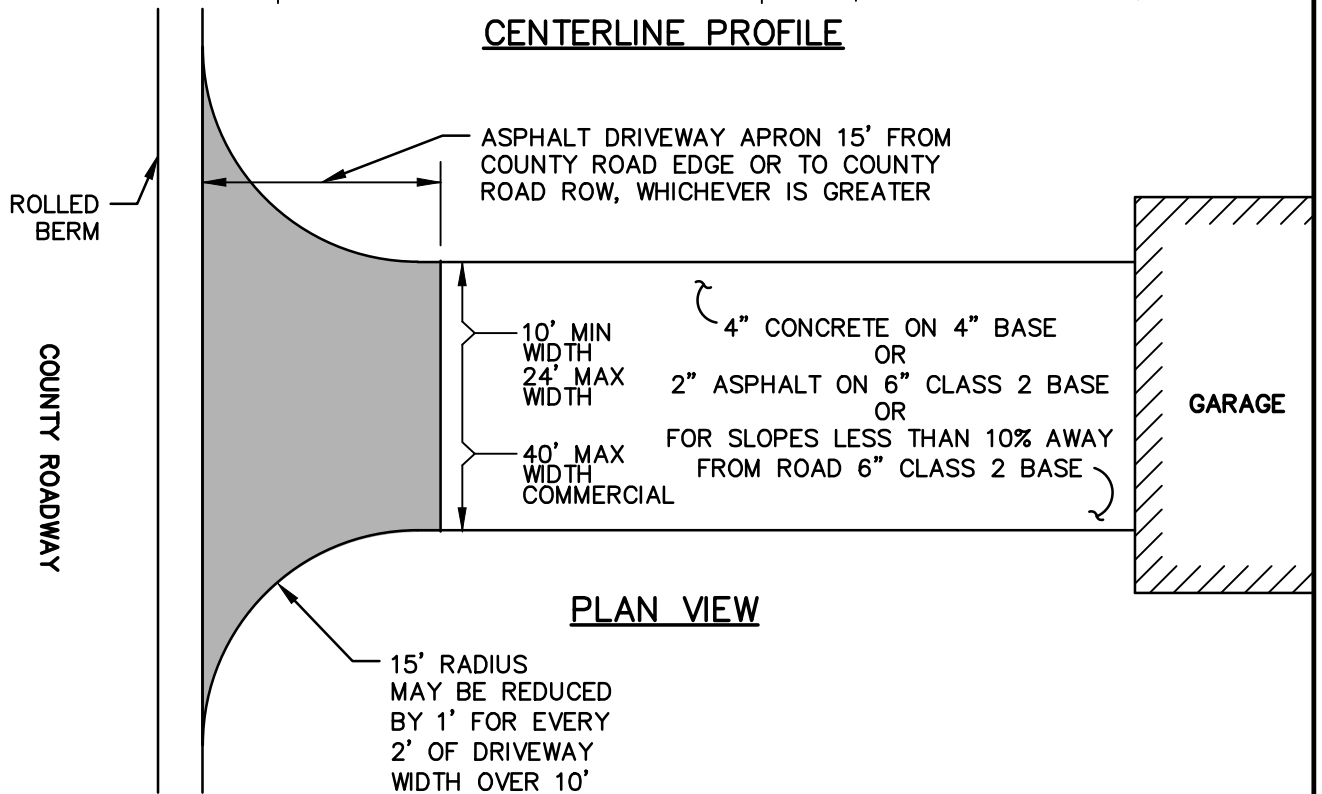
NOTES:

1. SHOW EXISTING GROUND ON PROFILES SUBMITTED FOR APPROVAL.
2. RUNOFF SHALL BE CONTROLLED SUCH THAT IT DOES NOT CAUSE A NUISANCE TO COUNTY ROADWAY.

DRIVEWAY WITH AC DIKE



CENTERLINE PROFILE

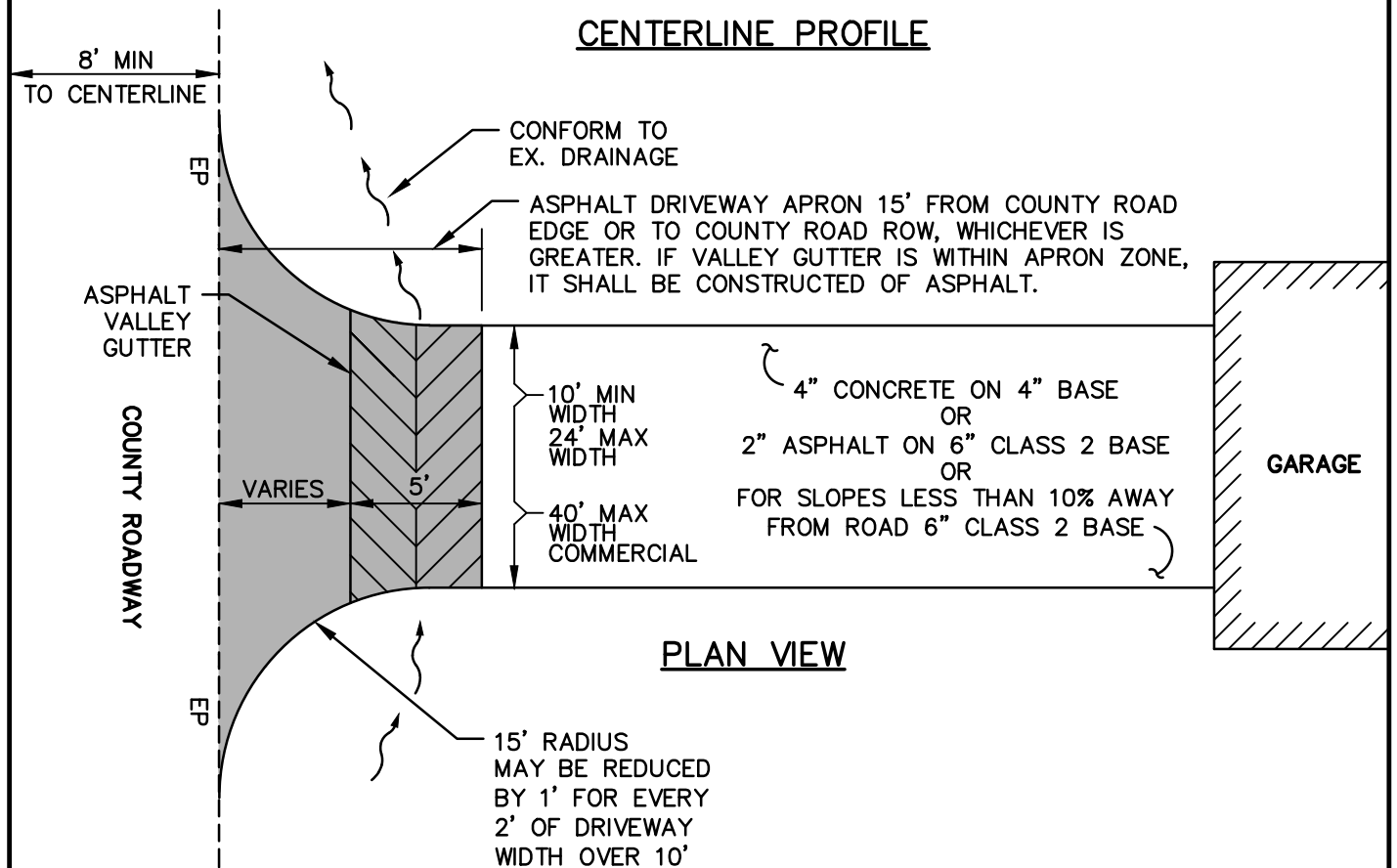
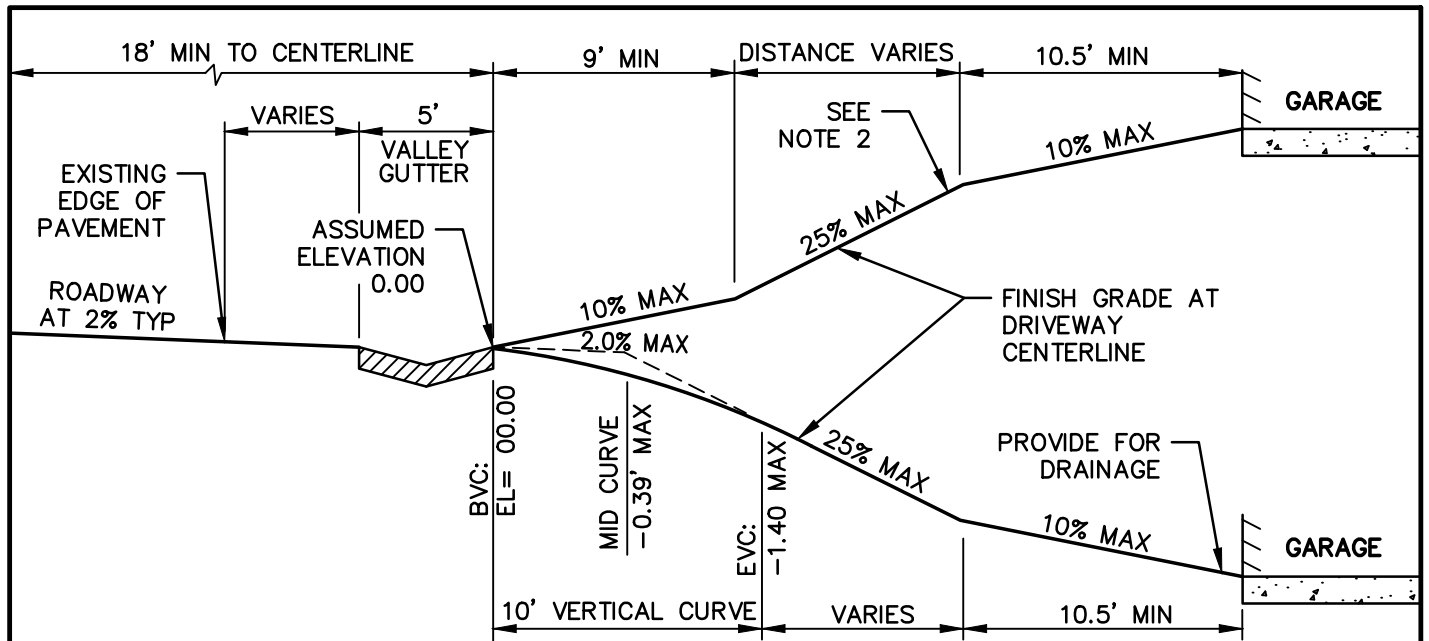


PLAN VIEW

NOTES:

1. SHOW EXISTING GROUND ON PROFILES SUBMITTED FOR APPROVAL.
2. RUNOFF SHALL BE CONTROLLED SUCH THAT IT DOES NOT CAUSE A NUISANCE TO COUNTY ROADWAY.

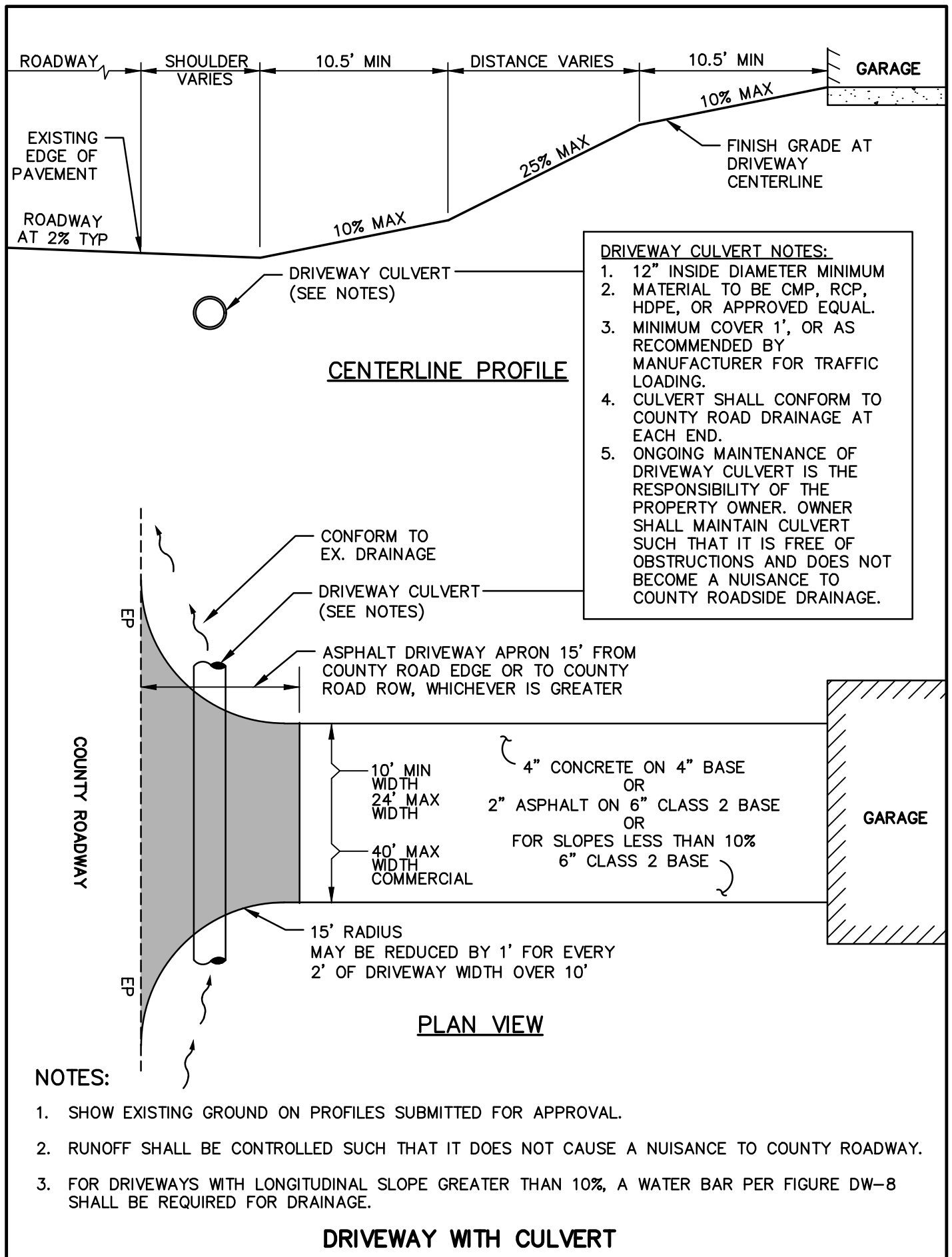
DRIVEWAY WITH ROLLED ASPHALT BERM

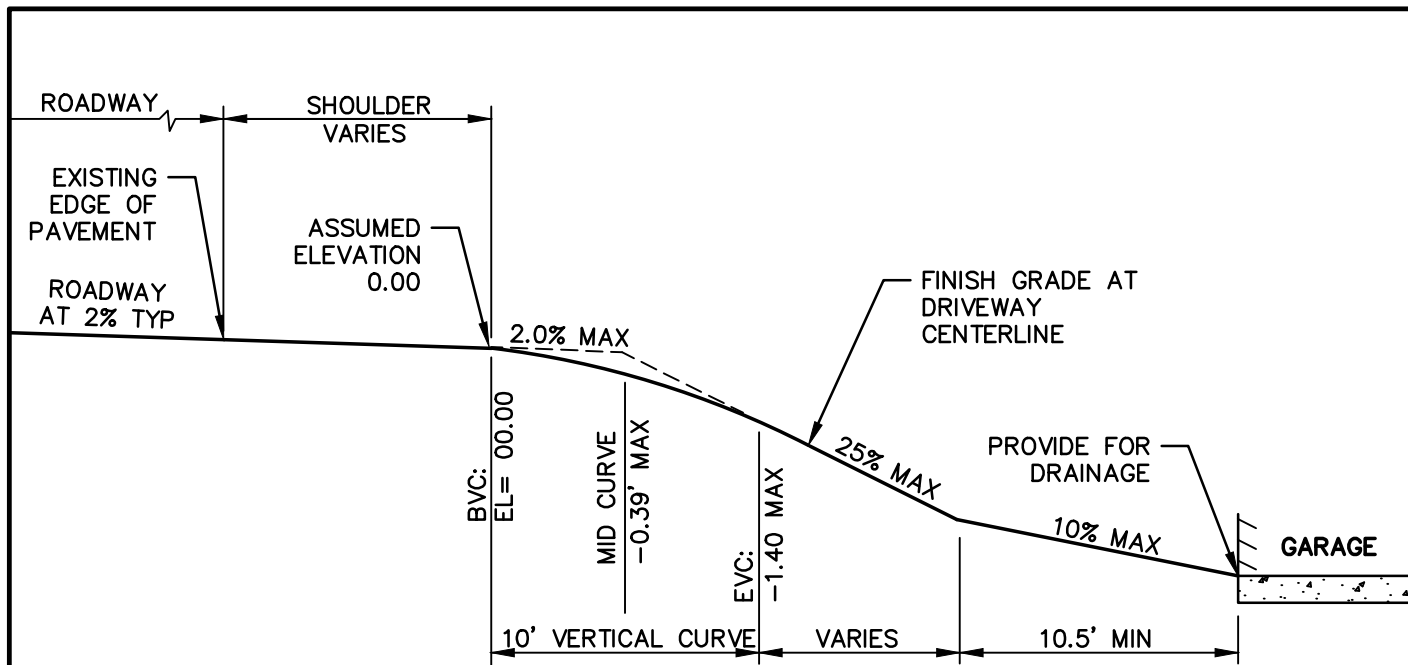


NOTES:

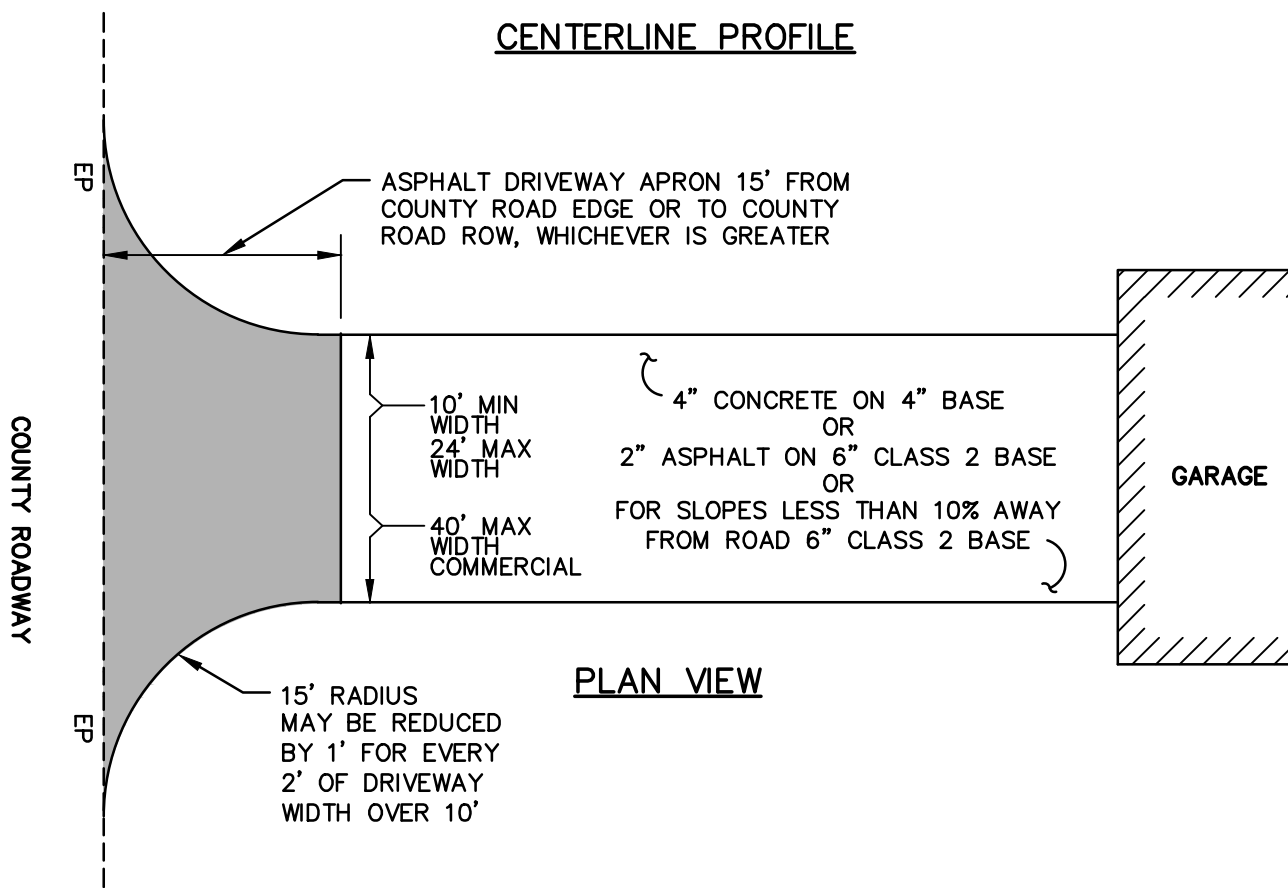
1. SHOW EXISTING GROUND ON PROFILES SUBMITTED FOR APPROVAL.
2. RUNOFF SHALL BE CONTROLLED SUCH THAT IT DOES NOT CAUSE A NUISANCE TO COUNTY ROADWAY.

DRIVEWAY WITH VALLEY GUTTER





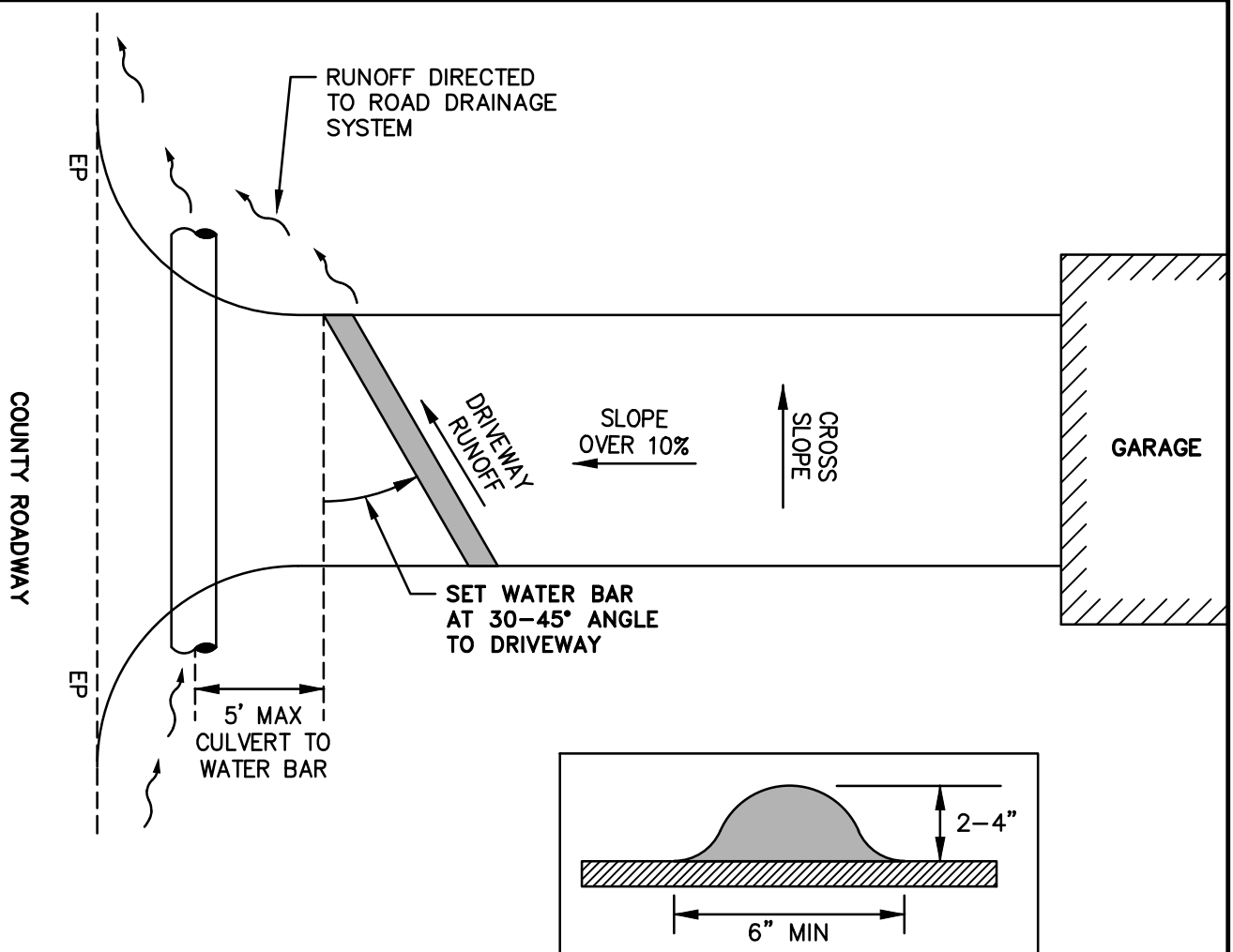
CENTERLINE PROFILE



NOTES:

1. SHOW EXISTING GROUND ON PROFILES SUBMITTED FOR APPROVAL.

DOWNHILL DRIVEWAY WITHOUT ROADSIDE DRAINAGE

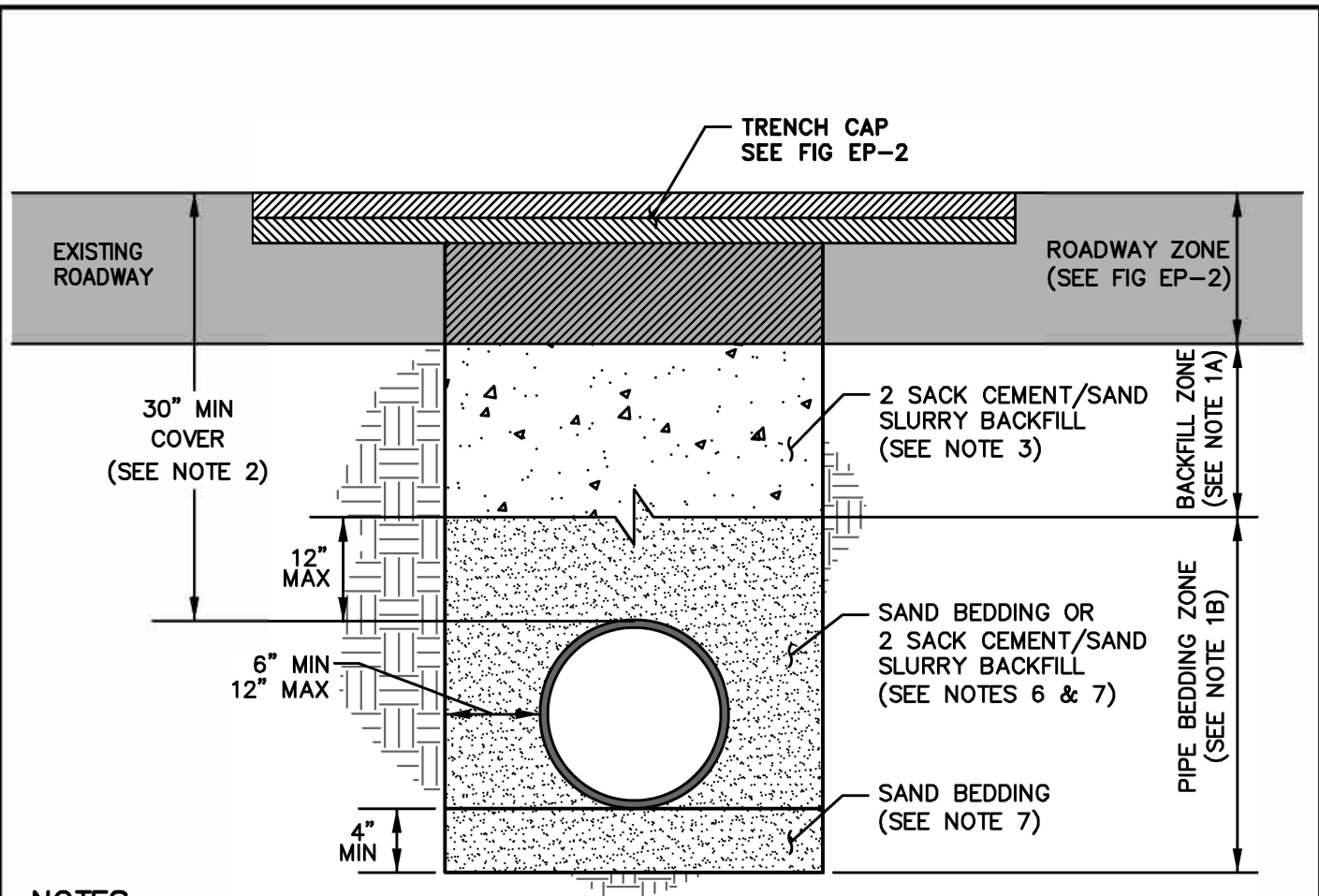


WATER BAR SECTION

NOTES:

1. THE PURPOSE OF THE DRIVEWAY WATER BAR IS TO ENSURE STORMWATER FROM DRIVEWAY WILL BE DIRECTED TO THE COUNTY ROADSIDE DITCH OR OTHER DRAINAGE CONVEYANCE AND NOT CONTINUE INTO THE TRAVELED COUNTY ROADWAY.
2. WATER BARS SHALL BE REQUIRED ON DRIVEWAYS WITH A DRIVEWAY CULVERT AND A LONGITUDINAL SLOPE GREATER THAN 10% DRAINING TOWARD COUNTY ROADS. WATER BARS MAY BE REQUIRED FOR OTHER DRIVEWAY CONFIGURATIONS IF DIRECTED BY THE COUNTY.
3. WATER BAR SHALL MATCH DRIVEWAY MATERIAL. IF WATERBAR IS WITHIN DRIVEWAY APRON ZONE, WATER BAR MUST BE CONSTRUCTED OF ASPHALT.
ASPHALT WATER BARS: SHALL BE CONSTRUCTED OF TYPE A, 1/2" MAXIMUM MEDIUM GRADATION. TACK COAT SHALL BE APPLIED AT A MINIMUM UNDILUTED RATE OF 0.06-GALLONS PER SQUARE YARD TO DRIVEWAY SURFACE ON WHICH WATER BAR IS CONSTRUCTED.
CONCRETE WATER BARS: SHALL BE CONSTRUCTED OF CALTRANS STANDARD MINOR CONCRETE (5 SACK) MINIMUM AND SUFFICIENTLY INTEGRATED WITH DRIVEWAY SO AS NOT TO BE DISLODGED BY TRAFFIC.
4. WATER BAR SHALL BE SITUATED 5' MAX FROM DRIVEWAY CULVERT, SET AT AN ANGLE OF 30-45° TOWARD THE RUNOFF DIRECTION OF THE DRIVEWAY SUCH THAT WATER IS DIRECTED INTO THE COUNTY ROADSIDE DITCH OR DRAINAGE SYSTEM.
5. FOR LONG STEEP DRIVEWAYS, ADDITIONAL WATER BARS MAY BE REQUIRED FOR RUNOFF CONTROL IF DIRECTED BY THE COUNTY.

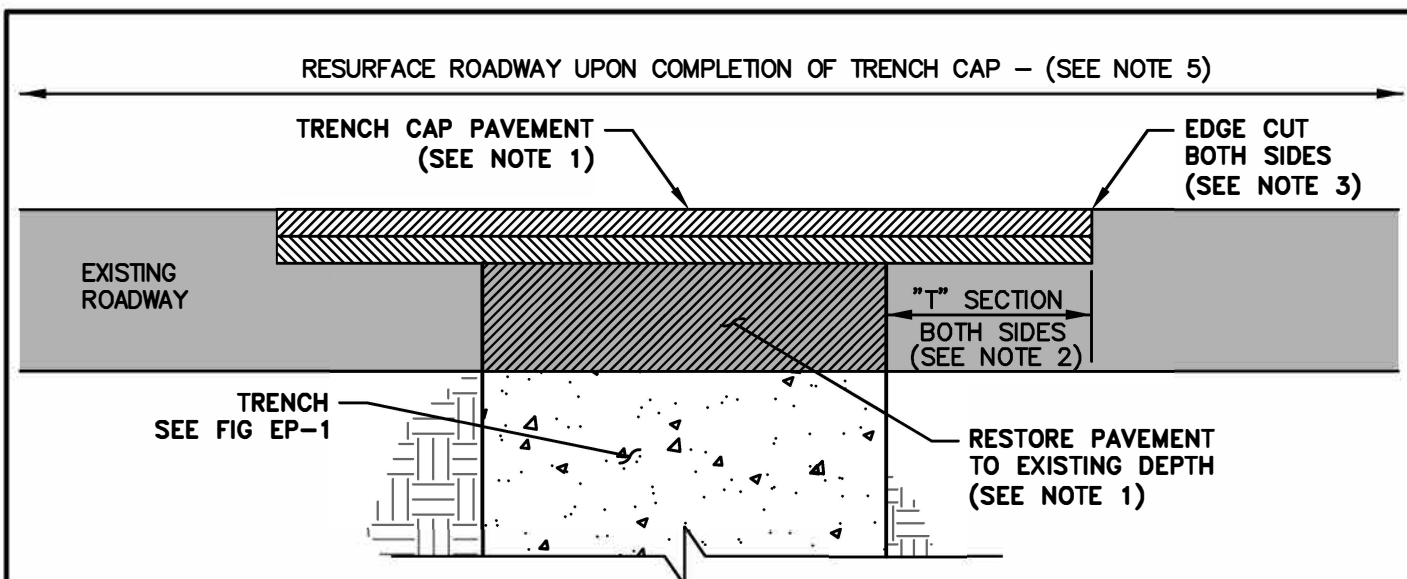
DRIVEWAY WATER BAR



NOTES:

1. TRENCH ZONES:
 - A. WITHIN BACKFILL ZONE, THIS AND OTHER COUNTY EP DETAILS SHALL GOVERN.
 - B. WITHIN PIPE BEDDING ZONE, APPLICABLE STANDARDS OF THE UTILITY AGENCY MAY BE USED IN PLACE OF THIS DETAIL.
2. ALL UNDERGROUND UTILITIES SHALL HAVE A MINIMUM COVER OF 30" FROM FINISH GRADE TO TOP OF UTILITY PIPE. WITH AUTHORIZATION FROM THE DIRECTOR, COVER MAY BE REDUCED TO AVOID INTERFERING WITH EXISTING UTILITIES, IN THIS CASE ADDITIONAL REQUIREMENTS MAY APPLY.
3. BACKFILL ZONE UNDER ROADWAYS SHALL CONSIST OF 2 SACK CEMENT/ SAND SLURRY BACKFILL, 1 SACK CEMENT/ SAND SLURRY MAY BE ALLOWED UNDER ROADWAYS AT THE DISCRETION OF THE COUNTY.
4. SPECIAL CONDITIONS (SUCH AS SAND ENCASEMENT) MAY BE REQUIRED WITHIN THE BACKFILL ZONE AT LOCATIONS WHERE THE TRENCH CROSSES OTHER UNDERGROUND UTILITIES. IN SUCH CASES, CROSSING SHALL BE CONSTRUCTED TO COMPLY WITH THE STANDARDS OF THE UTILITY BEING CROSSED.
5. BACKFILL ZONE OUTSIDE OF ROADWAYS MAY USE ENGINEERED FILL IN LIEU OF SLURRY, ENGINEERED FILL SHALL BE COMPACTED TO 90% MINIMUM RELATIVE COMPACTION, AND GROUND AT TOP OF TRENCH SHALL BE RESTORED TO PRE-PROJECT CONDITIONS OR AS OTHERWISE DIRECTED BY THE COUNTY.
6. 2 SACK CEMENT/SAND SLURRY SHALL BE MIXED IN A TRANSIT MIXER (CERTIFICATION TAGS REQUIRED) AND CONSIST OF 188 LB OF CEMENT FOR EACH CUBIC YARD OF MATERIAL.
7. SAND BEDDING SHALL CONSIST OF CLEAN SAND COMPACTED TO 95% RELATIVE COMPACTION MAY BE USED FOR PIPE BEDDING AND ENCASEMENT WITHIN PIPE BEDDING ZONE.
8. ANY EXCEPTIONS TO THIS DETAIL MUST BE APPROVED BY THE DIRECTOR.

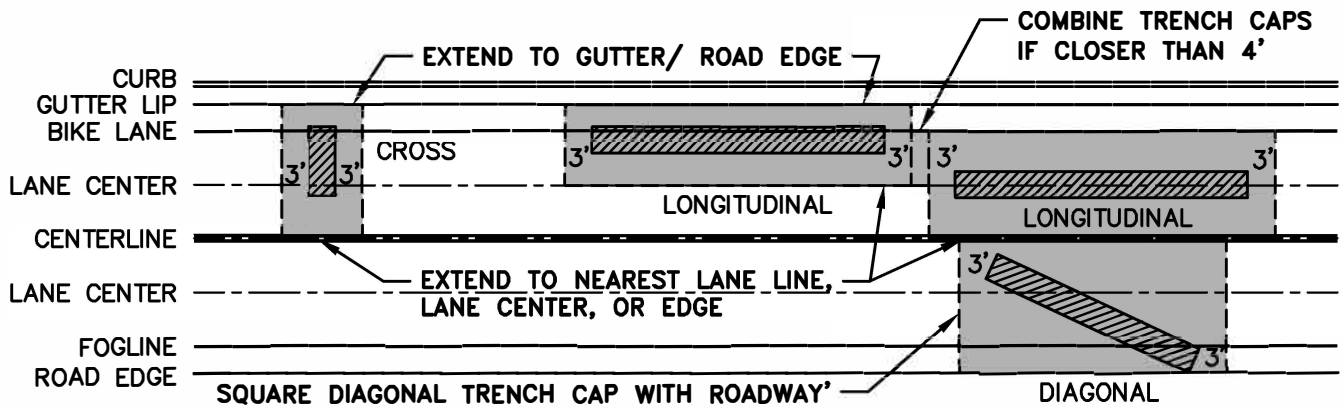
TRENCH SECTION



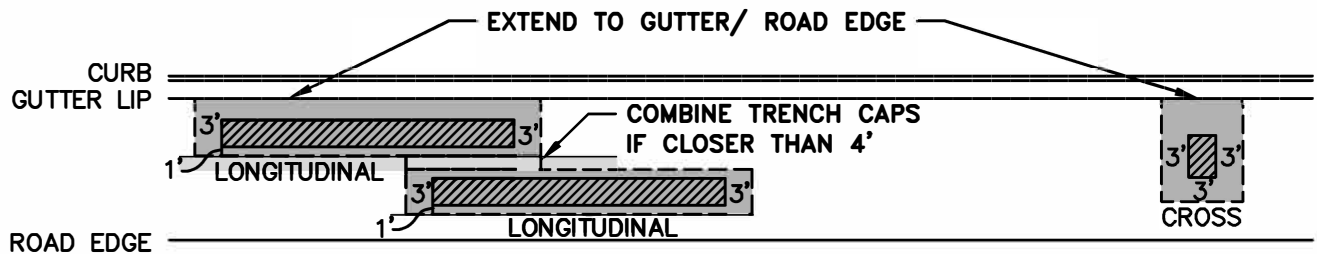
NOTES:

1. TRENCH PAVEMENT SECTION REQUIREMENTS:
 - A. ASPHALT PAVED ROADS – TRENCH CAP SHALL CONSIST OF 4" AC, TYPE A, 1/2" MAXIMUM MEDIUM GRADATION, PLACED IN 2" LIFTS. IF EXISTING PAVEMENT DEPTH IS GREATER THAN 4", ADDITIONAL ASPHALT SHALL BE PLACED IN TRENCH TO MATCH EXISTING PAVEMENT SECTION THICKNESS. TACK COAT SHALL BE APPLIED AT A MINIMUM UNDILUTED RATE OF 0.06–GALLONS PER SQUARE YARD TO ALL CONTACT SURFACES TO RECEIVE ASPHALT PAVING, INCLUDING EXISTING PAVEMENT BELOW TRENCH CAP, SIDES OF TRENCH CAP, AND BETWEEN LIFTS OF ASPHALT PAVING.
 - B. CONCRETE PAVED ROADS – TRENCH CAP SHALL CONSIST OF 6" CONCRETE, 6 SACK 3000 PSI, REINFORCED WITH #4 REBAR SPACED AT 24" ON CENTER BOTH WAYS. REPLACEMENT SHALL OCCUR TO NEAREST EXISTING PANEL SEAM. IN NO CASE SHALL CONCRETE BE REPLACED WITH ASPHALT.
 - C. GRAVEL ROADS – PLACE MINIMUM 6" OF COMPACTED CLASS 2 AB AT TOP OF TRENCH, NO T–SECTION REQUIRED.
2. TRENCH CAP MINIMUM T–SECTION WIDTH SHALL BE 1' BEYOND TRENCH EDGE FOR LONGITUDINAL TRENCHES (RUNNING PARALLEL WITH ROADWAY) AND 3' BEYOND TRENCH EDGE FOR CROSS TRENCHES (RUNNING ACROSS ROADWAY). DIAGONAL TRENCHES SHALL HAVE TRENCH CAP SQUARED WITH ROADWAY. THE REQUIRED WIDTH MAY BE GREATER THAN THESE DIMENSIONS BASED ON ROADWAY ALIGNMENT REQUIREMENTS NOTED IN FIGURE EP–3.
3. EXISTING PAVEMENT SHALL BE CUT TO PRODUCE A STRAIGHT VERTICAL FACE AGAINST WHICH TO BUTT THE TRENCH CAP PAVEMENT. FOR TRENCHES IN ROADS WITH AN EXISTING ASPHALT SECTION GREATER THAN 4", TRENCH CAP CUT SHALL BE ACHIEVED BY GRINDING ONLY. SAWCUTTING MAY BE USED IF EXISTING PAVEMENT SECTION IS 4" OR LESS, HOWEVER CUTS SHALL BE SQUARE TO TRENCH CAP AND SHALL NOT EXTEND BEYOND CORNER OF CAP (NO OVER CUTS).
4. TRENCH CAP SHALL BE CONSTRUCTED FLUSH WITH ADJACENT PAVEMENT PER FIG EP–4. IF TRENCH CAP FAILS TO MEET REQUIRED TOLERANCES, CORRECTIVE ACTION SHALL BE TAKEN AS DIRECTED BY THE COUNTY. FOR MATERIAL OR COMPACTION ISSUES, OR IF TRENCH CAP WAS PLACED TOO LOW, CORRECTIVE ACTION WILL LIKELY REQUIRE REMOVAL AND REPLACEMENT OF AFFECTED SECTIONS. FOR CASES WHERE TRENCH CAP WAS PLACED TOO HIGH BUT OTHERWISE MEETS SPECIFICATIONS, PROFILE GRINDING MAY BE ALLOWED AS A REPAIR OPTION AT THE DISCRETION OF THE COUNTY.
5. RESURFACING REQUIREMENTS:
 - A. FOR TRENCHES LESS THAN 500': APPLY FOG SEAL 1' BEYOND EDGE OF TRENCH CAP.
 - B. FOR TRENCHES 500' OR GREATER: APPLY TYPE 2 SLURRY SEAL OVER LENGTH OF TRENCH, WIDTH OF SEAL TO BE TO THE NEAREST LANE LINE OR ROAD EDGE BEYOND TRENCH CAP. FOR SINGLE LANE ROADS, SLURRY SEAL SHALL BE APPLIED TO THE ENTIRE ROAD WIDTH ALONG TRENCH ALIGNMENT.
DUE TO EXISTING ROAD SURFACE CONDITIONS, THE DEPARTMENT MAY REQUIRE AN ALTERNATE RESURFACING METHOD IN PLACE OF TYPE 2 SLURRY SEAL, ALTERNATE RESURFACING METHOD MAY INCLUDE MICROSURFACING, CHIP SEAL, CAPE SEAL, OR ASPHALT CONCRETE OVERLAY.
6. ANY EXCEPTIONS TO THIS DETAIL MUST BE APPROVED BY THE DIRECTOR.

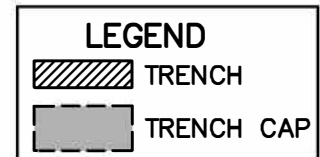
TRENCH CAP SECTION



TYPICAL MULTI-LANE ROAD



TYPICAL SINGLE LANE ROAD



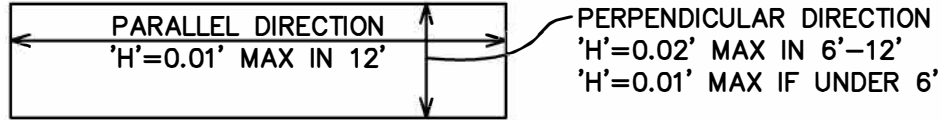
NOTES:

1. REFERENCE DIAGRAMS ABOVE REPRESENT TYPICAL ROADWAY SCENARIOS, FIELD CONDITIONS MAY VARY.
2. TRENCH CAP MINIMUM T-SECTION WIDTH SHALL BE 1' BEYOND TRENCH EDGE FOR LONGITUDINAL TRENCHES (RUNNING PARALLEL WITH ROADWAY) AND 3' BEYOND TRENCH EDGE FOR CROSS TRENCHES (RUNNING ACROSS ROADWAY). DIAGONAL TRENCHES SHALL HAVE TRENCH CAP SQUARED WITH ROADWAY. THE REQUIRED WIDTH MAY BE GREATER THAN THESE DIMENSIONS BASED ON ROADWAY ALIGNMENT REQUIREMENTS NOTED IN THIS DETAIL.
3. TRENCH CAP SHALL EXTEND 3' BEYOND END OF TRENCH, OR TO NEAREST LANE LINE, LANE CENTER, OR ROAD EDGE IF LESS THAN 3'.
4. TRENCH CAP SEAMS SHALL EXTEND TO NEAREST LANE LINE, LANE CENTER, OR ROAD EDGE. THIS CONDITION SHALL NOT APPLY TO SINGLE LANE ROADS, HOWEVER TRENCH CAP SHALL BE EXTENDED TO ROAD EDGE IF CLOSER THAN 2', AND PLACEMENT OF SEAM IN VISIBLE WHEELPATH SHALL BE AVOIDED. IN NO CASE SHALL A LONGITUDINAL TRENCH CAP SEAM BE PLACED IN A WHEEL PATH OR A BIKE LANE.
5. IF SEPARATE TRENCH CAPS ARE CLOSER THAN 4', TRENCH CAPS SHALL BE COMBINED.
6. IF PAVEMENT IS DAMAGED BEYOND STANDARD TRENCH CAP LIMITS DUE TO PROJECT ACTIVITIES, OR DUE TO EXISTING TRENCH SETTLEMENT OF THE UTILITY UNDERGOING WORK IN THIS PROJECT, TRENCH CAP SHALL BE EXTENDED TO INCLUDE THE DAMAGED AREA. IF PROJECT IS REPLACING AN EXISTING UTILITY IN THE SAME GENERAL LOCATION, NEW TRENCH CAP SHALL REPLACE THE ENTIRETY OF THE ORIGINAL TRENCH CAP.
7. TRENCH CAP LAYOUT SHALL BE INSPECTED AND APPROVED BY COUNTY PRIOR TO GRINDING OR SAWCUTTING.

TRENCH CAP LAYOUT

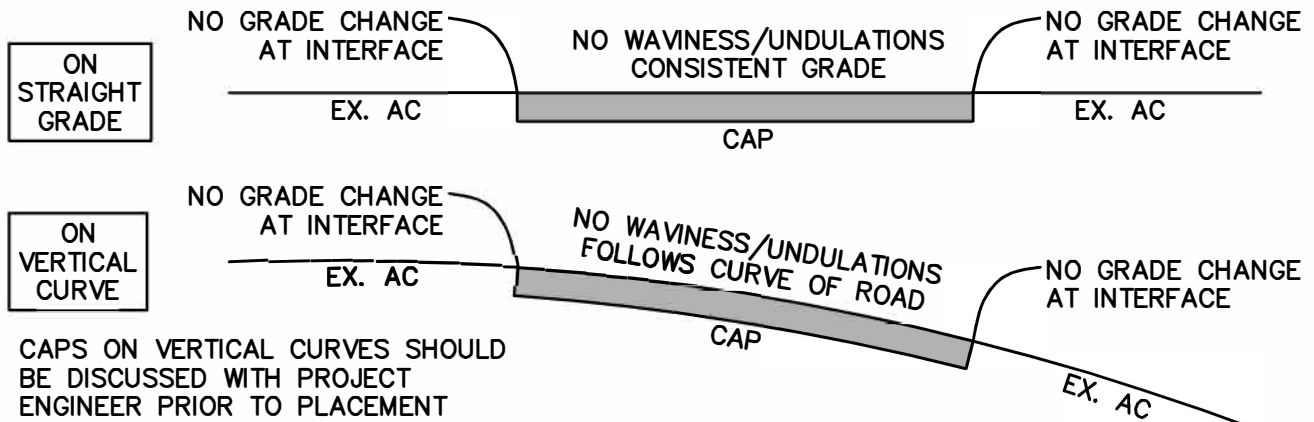
ASPHALT TRENCH CAP TOLERANCE MEASUREMENT:

1. PER CALTRANS SPECIFICATIONS, A 12' STRAIGHT EDGE IS TO BE USED FOR TOLERANCE MEASUREMENT, CAP AND ALL INTERFACES WITH EXISTING AC SHALL MEET TOLERANCES.
2. FOR THE PURPOSES OF THIS EXHIBIT, 'H' INDICATES GRADE DIFFERENCE (RAISE OR DROP) 'H' SHALL NOT EXCEED:
 - * PARALLEL WITH ROAD: 0.01' MAX (1/8"±) IN 12'
 - * PERPENDICULAR WITH ROAD: 0.02' MAX (1/4"±) IN 12' OR 0.01' (1/8"±) FOR ANY DIMENSIONS UNDER 6'

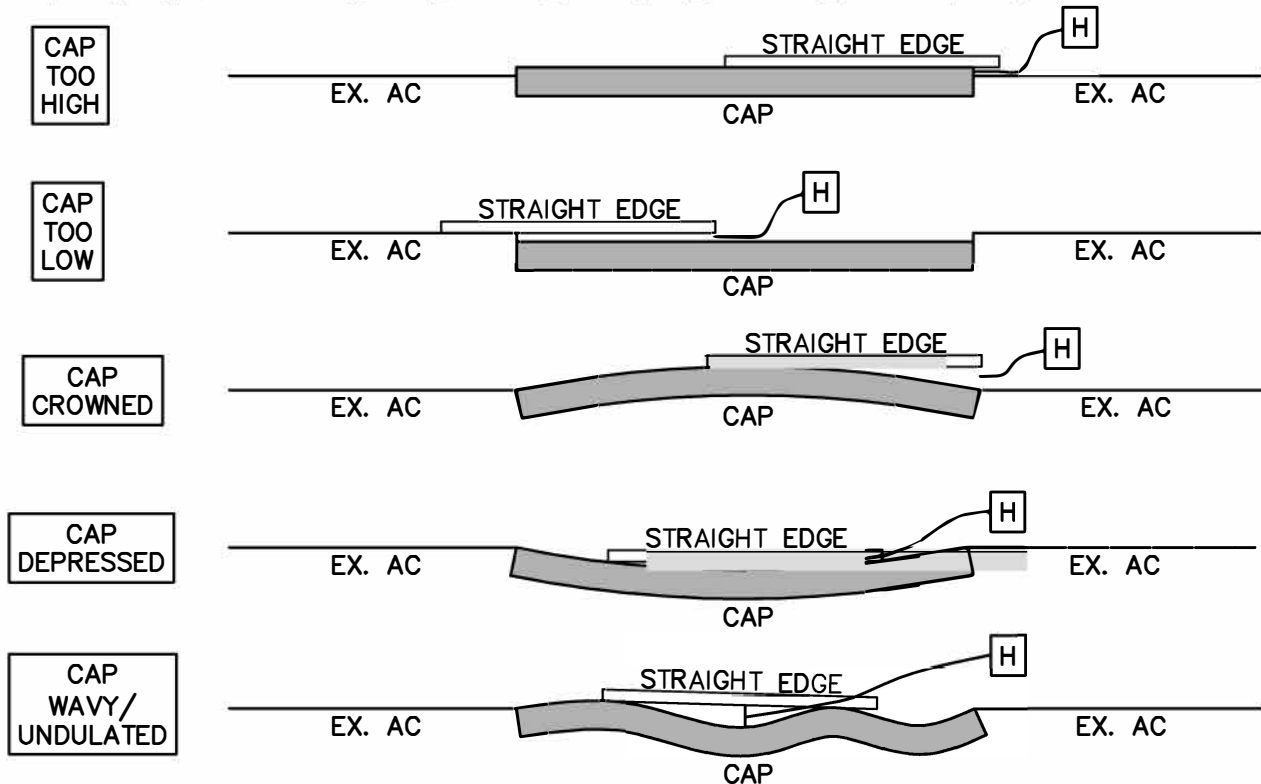


TIP: IF CAP CAN BE HEARD OR FELT WHEN DRIVING OVER INTERFACE, CAP IS OUT OF SPEC.

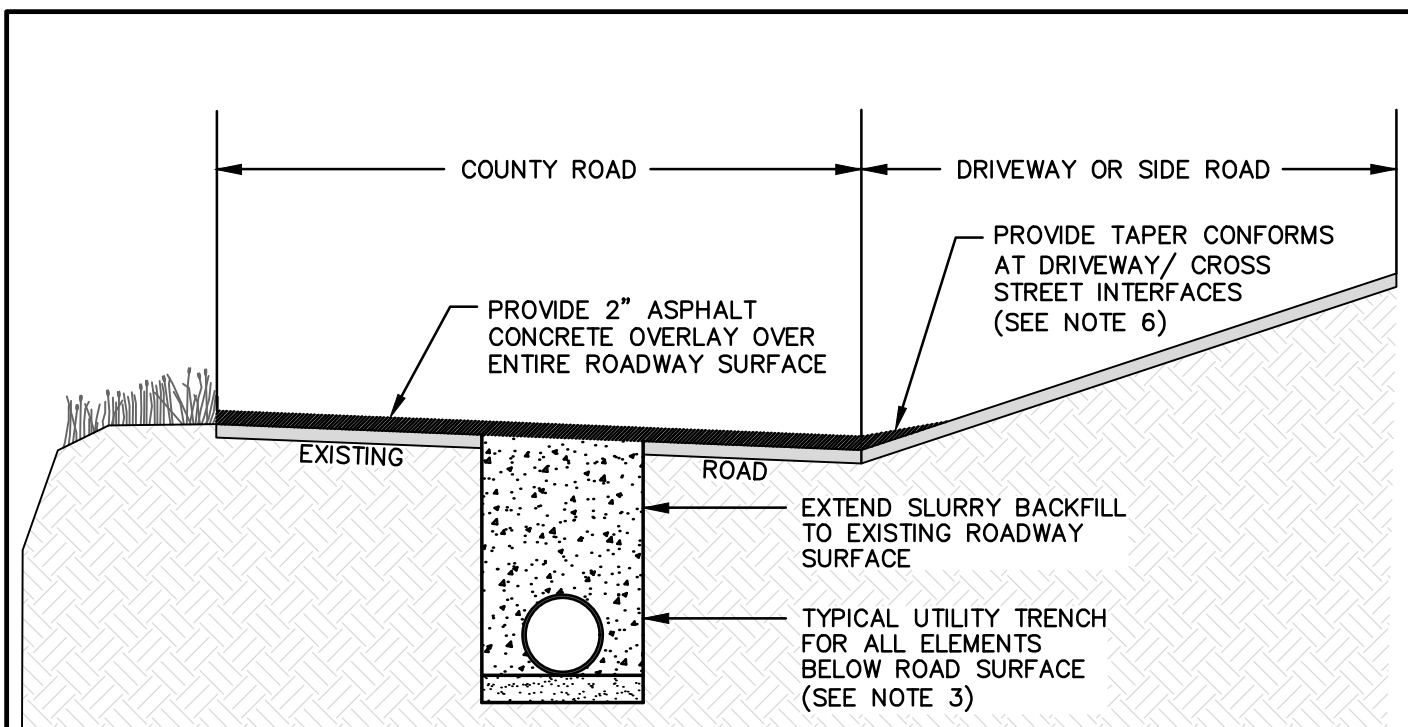
EXAMPLES OF CORRECTLY DONE TRENCH CAPS:



EXAMPLES OF INCORRECTLY DONE TRENCH CAPS ('H' EXCEEDS TOLERANCES):



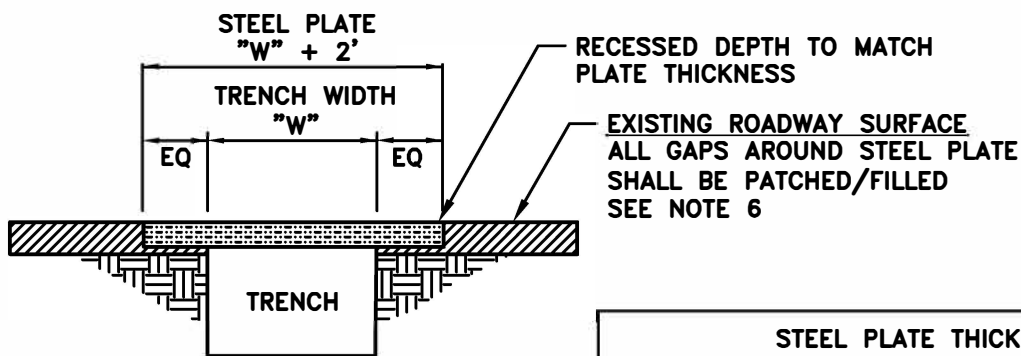
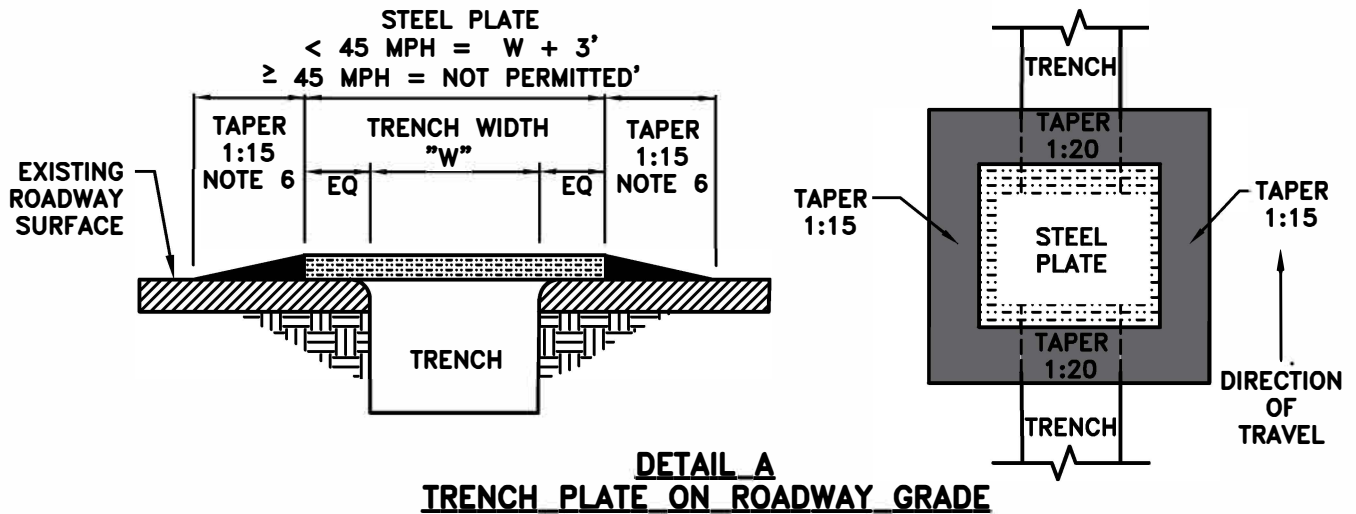
TRENCH CAP TOLERANCES



NOTES:

1. THIS DETAIL IS MEANT FOR SPECIAL CIRCUMSTANCES WHERE THE EXISTING CONDITION IS A SINGLE LANE ROAD WITHOUT CURB & GUTTER. THIS DETAIL SHALL ONLY BE USED IF DIRECTED BY THE COUNTY, STANDARD TRENCH PAVING DETAILS (FIGURES EP-2 & EP-3) SHALL OTHERWISE APPLY.
2. FOR ROAD SECTIONS WHERE THIS DETAIL IS APPLIED, PAVEMENT LIFE PERFORMANCE WARRANTY OVER THAT ROAD SECTION SHALL BE WAIVED FOR THE UTILITY AGENCY PERFORMING THIS WORK, THIS WAIVER TO REMAIN IN EFFECT AS LONG AS THE ROADWAY REMAINS UNDISTURBED BY THE UTILITY AGENCY. SHOULD THE UTILITY AGENCY EXCAVATE INTO SOME PORTION OF THIS SECTION OF ROADWAY AT A FUTURE TIME FOR WORK ON THEIR FACILITIES, PAVEMENT LIFE PERFORMANCE WARRANTY WAIVER WILL BE VOIDED FOR ANY AFFECTED PORTIONS.
3. FOR ALL TRENCH ELEMENTS BELOW EXISTING ROAD PAVEMENT, SEE FIGURE EP-1. FOR ALL ELEMENTS ABOVE EXISTING ROAD PAVEMENT, THIS DETAIL SHALL SUPERCEDE TRENCH PAVING DETAILS EP-2 AND EP-3..
4. SAND-CEMENT SLURRY BACKFILL SHALL EXTEND TO SURFACE OF EXISTING ROADWAY.
5. FULL WIDTH OF ROADWAY SHALL BE PAVED WITH 2" OF TYPE A HOT MIX ASPHALT, 1/2" MAXIMUM MEDIUM GRADATION.
6. TAPER CONFORMS SHALL BE PLACED AT ALL EXISTING DRIVEWAYS, CROSS STREETS, AND AT STOP/START OF WORK. SEE FIGURE ST-10, DETAIL B.
7. PERMITTEE SHALL NOTIFY THE COUNTY PRIOR TO CONSTRUCTING ASPHALT PAVEMENT UPON COMPLETION OF SLURRY BACKFILL, AS COUNTY MAY ELECT TO PERFORM SELECT BASE REPAIRS ON ROADWAY PRIOR TO PAVING.

SINGLE LANE ROAD TRENCH

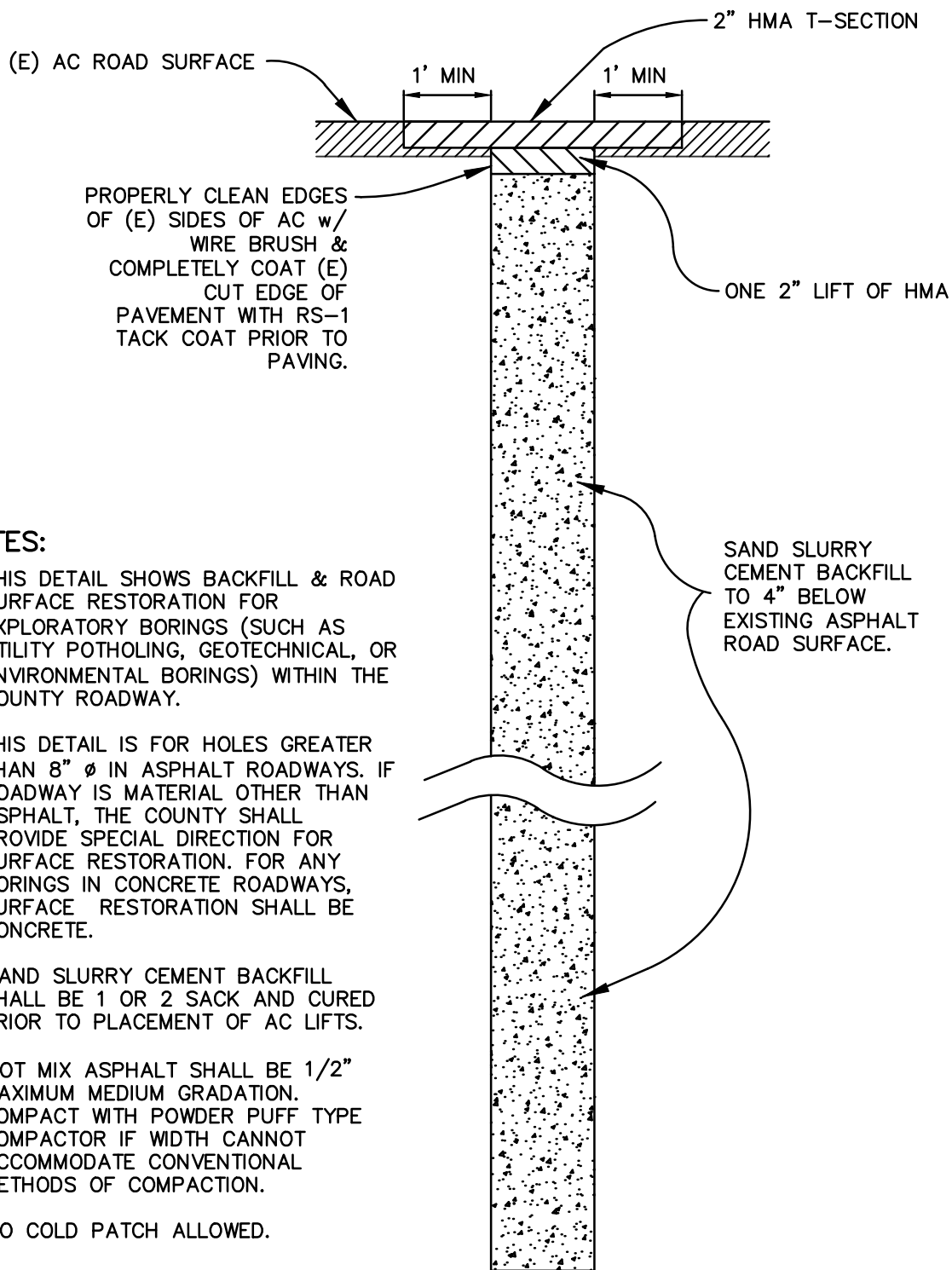


STEEL PLATE THICKNESS	
"W"	MIN. THICKNESS (INCHES)
0'-2'	3/4
2.1' - 4'	1
> 4'	CALCULATIONS REQUIRED BY REGISTERED CIVIL ENGINEER

NOTES:

1. DETAIL A IS ONLY PERMITTED WHEN SPEEDS ARE LESS THAN 45 MPH AND DURATION IS LESS THAN 7 DAYS, UNLESS APPROVED BY THE COUNTY
2. ALL TRENCHES SHALL BE ADEQUATELY SHORED TO SUPPORT TRAFFIC LOADS
3. NO MORE THAN 300 LINEAR FEET OF STEEL PLATES ARE ALLOWED AT ONE TIME
4. PROVIDE ADVANCED WARNING SIGNS (UNEVEN PAVEMENT- C46(CA); OR STEEL PLATE AHEAD SIGN- W8-24) PER THE LATEST EDITION OF THE "CALIFORNIA MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES"
5. STEEL PLATES SHALL BE SKID RESISTANT AND ABLE TO WITHSTAND TRAFFIC LOADS
6. TACK WELDING, PINNING, SHIMS, WEDGES, ETC. MAY BE REQUIRED BY THE COUNTY TO REDUCE NOISE AND ELIMINATE MOVEMENT
7. MATERIAL FOR TAPERS/GAPS SHALL BE BASED ON DURATION OF PLATING:
 - < 7 DAYS: COLD PATCH MATERIAL WHICH RESISTS SHOVING
 - > 7 DAYS: HOT MIX ASPHALT

TEMPORARY STEEL PLATES



NOTES:

1. THIS DETAIL SHOWS BACKFILL & ROAD SURFACE RESTORATION FOR EXPLORATORY BORINGS (SUCH AS UTILITY POTHOLING, GEOTECHNICAL, OR ENVIRONMENTAL BORINGS) WITHIN THE COUNTY ROADWAY.
2. THIS DETAIL IS FOR HOLES GREATER THAN 8" ϕ IN ASPHALT ROADWAYS. IF ROADWAY IS MATERIAL OTHER THAN ASPHALT, THE COUNTY SHALL PROVIDE SPECIAL DIRECTION FOR SURFACE RESTORATION. FOR ANY BORINGS IN CONCRETE ROADWAYS, SURFACE RESTORATION SHALL BE CONCRETE.
3. SAND SLURRY CEMENT BACKFILL SHALL BE 1 OR 2 SACK AND CURED PRIOR TO PLACEMENT OF AC LIFTS.
4. HOT MIX ASPHALT SHALL BE 1/2" MAXIMUM MEDIUM GRADATION. COMPACT WITH POWDER PUFF TYPE COMPACTOR IF WIDTH CANNOT ACCOMMODATE CONVENTIONAL METHODS OF COMPACTION.
5. NO COLD PATCH ALLOWED.

ROADWAY RESTORATION FOR EXPLORATORY BORINGS (LARGE)

(E) AC ROAD SURFACE

PROPERLY CLEAN EDGES
OF (E) SIDES OF AC w/
WIRE BRUSH &
COMPLETELY COAT (E)
CUT EDGE OF
PAVEMENT WITH RS-1
TACK COAT PRIOR TO
PAVING.

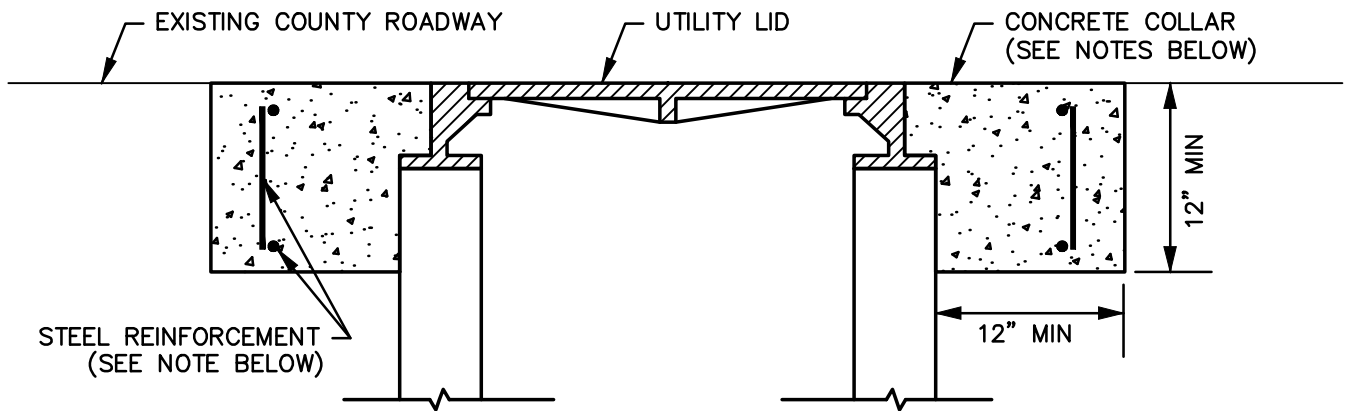
TWO 2" LIFTS OF HMA

SAND SLURRY
CEMENT BACKFILL
TO 4" BELOW
EXISTING ASPHALT
ROAD SURFACE.

NOTES:

1. THIS DETAIL SHOWS BACKFILL & ROAD SURFACE RESTORATION FOR EXPLORATORY BORINGS (SUCH AS UTILITY POTHOLES, GEOTECHNICAL, OR ENVIRONMENTAL BORINGS) WITHIN THE COUNTY ROADWAY.
2. THIS DETAIL IS FOR 8" ϕ OR SMALLER HOLES IN ASPHALT ROADWAYS. IF ROADWAY IS MATERIAL OTHER THAN ASPHALT, THE COUNTY SHALL PROVIDE SPECIAL DIRECTION FOR SURFACE RESTORATION. FOR ANY BORINGS IN CONCRETE ROADWAYS, SURFACE RESTORATION SHALL BE CONCRETE.
3. SAND SLURRY CEMENT BACKFILL SHALL BE 1 OR 2 SACK AND CURED PRIOR TO PLACEMENT OF AC LIFTS.
4. HOT MIX ASPHALT SHALL BE 1/2" MAXIMUM MEDIUM GRADATION. COMPACT WITH POWDER PUFF TYPE COMPACTOR IF WIDTH CANNOT ACCOMMODATE CONVENTIONAL METHODS OF COMPACTION.
5. NO COLD PATCH ALLOWED.
6. "PLUG-R" TYPE PLUS OR APPROVED EQUAL MAY BE USED FOR HOLES BELOW 2" ϕ .

ROADWAY RESTORATION FOR EXPLORATORY BORINGS (SMALL)



NOTES:

1. THIS DETAIL SHALL APPLY TO MANHOLES, VAULTS, VALVE BOXES, MONUMENT WELLS, OR ANY OTHER UTILITY LID STRUCTURES LOCATED WITHIN COUNTY MAINTAINED ROADWAYS. EXCEPTIONS MUST BE APPROVED BY THE COUNTY.
2. CONCRETE COLLAR SHALL BE ROUND FOR CIRCULAR UTILITY LIDS AND RECTANGULAR FOR RECTANGULAR LIDS.
3. CONCRETE COLLAR SHALL EXTEND TO BE FLUSH WITH ADJACENT ROADWAY SURFACE, NO ASPHALT SHALL BE PLACED OVER TOP.
4. CONCRETE SHALL USE TYPE III HIGH-EARLY STRENGTH CEMENT WITH A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 5000 PSI.
5. BROADCAST 1 LB OF LAMPBLACK PIGMENT ON CONCRETE SURFACE DURING CURE TO ACHIEVE DARKENED APPEARANCE.
6. CONCRETE COLLAR SHALL BE PROTECTED FROM TRAFFIC USING TRENCH PLATES OR OTHER ACCEPTABLE MEANS. CONCRETE SHALL NOT BE REOPENED TO TRAFFIC UNTIL A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI HAS BEEN ACHIEVED.
7. CONCRETE SHALL BE REINFORCED HORIZONTALLY WITH #4 REBAR HOOP AROUND GRADE RING AT TOP & BOTTOM, AND VERTICALLY WITH #4 REBAR TIES SPACED AT 12". REBAR SHALL BE KEPT A MINIMUM OF 2" CLEAR FROM ALL EDGES.

UTILITY LID PAVING