

DAVIS PUBLIC WORKS

**REVISED** DESIGN STANDARDS

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# DAVIS PUBLIC WORKS DEPARTMENT ENGINEERING DESIGN STANDARDS TABLE OF CONTENTS

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# PART ONE PUBLIC WORKS PLANNING REVIEW AND APPROVAL PROCEDURES

## SECTION I

### DESCRIPTION OF STANDARDS

#### A. PURPOSE

The primary purpose of these Design Standards is to serve as an implementation of the City of Davis General Plan, Municipal Code (including Zoning and Subdivision Ordinances), and other Local and State Rules and Regulations. The secondary purpose is to provide a coherent explanation and description of the Department of Public Works involvement in and requirements for this process.

##### 1. PART ONE - Public Works Planning Review and Approval Procedures

The primary purpose of the PART ONE section of these Design Standards is to describe the involvement of the Public Works Department in the Planning aspects of Development Review. Community Development Department is responsible for implementation of this part of the Development Review process. In general, most of the Public Works comments on a particular proposal will be formulated at the request of Community Development. Public Works personnel will also meet with various Project Owners on an informal basis to directly discuss project impacts and mitigations.

##### 2. PART TWO - Improvement and Design Standards

The PART TWO section of these Design Standards is the mandatory guidelines to be used by all Project Owners and their consultants (Engineers, etc.) in the preparation of Improvement Plans and Maps for facilities which will be owned and maintained by the City of Davis. Privately owned facilities which benefit the general public are also required to be designed in accordance with these Standards.

#### B. DESIGN AND REVIEW RESPONSIBILITIES

The following discussion is intended to give a general description of each Departments' responsibilities and the manner in which the Public Works Department interacts with them during the Development Review process. Any Planning approval required up to and including a Tentative Map is administered by the Community Development Department. Building Permits are also administered by the Community Development Department. Subsequent processing of the required Improvement Plans and Maps after approval of a Tentative Map is administered by Public Works Department.

## **1. City Council**

The City Council is the final approval body for all General Plan Amendments, ReZonings, Tentative Maps, and EIR's. They are also the appeal body for many other minor types of Planning approvals. All Subdivision Maps are approved by the City Council prior to recordation.

## **2. Management Services (City Manager or CM)**

The City Manager is directly responsible to the Council for implementing Council decisions. This department is also indirectly involved in the Development Review process via the management function it performs over all of the other departments. They are responsible for scheduling and coordinating all meetings of the City Council.

## **3. Community Development Department (CDD)**

All applications for General Plan Amendments, Annexations, ReZonings, Tentative Maps, Use Permits, Building Permits and such are submitted to this Department. They collect the application fees, determine the completeness of the applications, determine the level of review required, make the Initial Environmental Determination, coordinate the Planning review process and schedule the required hearings.

Development Review Meetings, involving all City Departments and Public/Private Utilities, are scheduled by CDD on a regular basis to review pending applications. As a result of these meetings, Public Works will review the various applications and prepare a list of comments and/or proposed conditions.

## **4. Public Works Department (PW)**

Public Works provides comments, as requested by CDD, on all types of applications. Review by PW mostly focuses on the elements of the City Infrastructure which is operated and maintained by Public Works (Streets, Bike Paths, Pedestrian Paths, Solid Waste, Wastewater, Storm Drainage, Water, Lighting, Traffic Signals, etc.). Public Works is also responsible for administering the Final Map, Parcel Map and Improvement Plan process for subdivisions with Tentative Maps.

## **5. Finance Department (Finance)**

They play an important role in the tracking of all development impact fees imposed as a result of the various Planning approvals and as required by Municipal Code. Like Management Services, this Department is mostly indirectly involved in the Development Review Process. Plan Checking fees submitted with Improvement Plans and Maps are collected by Public Works and forwarded to Finance. Public Works coordinates with Finance on setting up the correct fee structure for any subdivision. Many of the development impact fees are not due until the issuance of a Certificate of Final Occupancy.

## **6. Parks and Community Services Department (PCS)**

PCS is responsible for operating and maintaining the City's Parks and Greenbelts. PW and PCS are jointly responsible for reviewing and approving Improvements for new Parks and Greenbelts. Many new Parks are constructed under a contract administered by PW.



### **7. Fire Department (Fire)**

Fire is responsible for providing Fire protection and Emergency First Aid response in the City of Davis. Fire is also responsible for providing fire services in adjacent County Fire Districts and Service Areas. They review and approve Fire Hydrant layouts, Fire Alarm facilities (when required), and other related fire facilities on all new projects.

### **8. Police Department (Police)**

Police provides Police services for the City of Davis and is the primary enforcement agency for the criminal provisions in the Municipal Code. They review and approve improvements required by the City Security Ordinance. PW and Police work together on improving and managing the various components of the City's transportation system.

### **9. Davis Waste Removal (DWR)**

DWR is under contract to the City to pick up and dispose of Solid Waste. Their contract is administered by PW. They review and provide comment on solid waste pickup sites for all types of uses.

### **10. Public Utilities (PU)**

PU consists of Pacific Gas and Electric (natural gas and electricity), Pacific Bell (phone), United Cable TV (cable TV), in addition to other regulated Public Utilities and/or Franchisees. PG&E and Pacific Bell are regulated by the State Public Utilities Commission. United Cable TV operates under a franchise to the City of Davis, administered by PCS. These companies generally do not get involved in the review process until Project Improvement Plans are being prepared.

## **C. GOVERNING LAWS, RULES AND REGULATIONS**

This is not a complete list of all Laws, Rules and Regulations, but is meant to discuss the more important ones affecting the Development Review Process. For more complete details of specific requirements, reference should be made to the various Laws, Rules and Regulations.

### **1. STATE LAW**

Many of the City Ordinances are a result of State Law requiring their formulation and adoption (also known as enabling legislation). State Law usually provides a basic guide and enables the City to adopt specific requirements to implement the State Law. The City's Subdivision Ordinance contains specific requirements for the processing of all Tentative Maps, Final Maps, Parcel Maps, and Improvement Plans.

#### **a. General Plan (various Govt Code Sections)**

Each Local Government Entity is required to formulate and adopt a Local General Plan with seven mandatory elements; Land Use, Open Space, Traffic and Circulation, Housing, Conservation, and Safety.

**b. State Planning Act**

This establishes the requirements to adopt a Local Zoning Ordinance to govern the allowable land uses for each parcel in the City.

**c. Subdivision Map Act**

This establishes the requirements to adopt a Local Subdivision Ordinance to govern the division of land for purposes of lease, sale or financing.

**d. Landscaping and Lighting Act**

This establishes procedures and enables the local Agency to form Assessment Districts for installing and maintaining street lighting and landscaping, including parks and greenbelts.

**e. Various Assessment District Bond Acts**

These establish the ability for the local Agency to form Improvement Assessment Districts for the purposes of constructing public improvements, acquiring right of way and levying assessments against benefitting parcels.

**f. Streets and Highways Code**

This governs the acquisition, improvement, abandonment, and use of public right of ways (streets, utilities, etc.) and contains required procedures for use and improvement.

**g. Vehicle Code**

Some of the provisions of this code impact the improvement and use of public streets.

**2. DAVIS GENERAL PLAN**

City of Davis, General Plan, Section 1.2 "NATURE AND FUNCTION OF THE GENERAL PLAN":

"A General Plan for a city functions much as a constitution for a nation. It is a statement of the community's vision of its long-term or ultimate physical form and, desirably, a guarantee of a stable development policy. State law requires each city and county to adopt and maintain a General Plan consisting of seven elements (land use, circulation, open space, safety, conservation, and noise) that must be internally consistent, and consistent with each other and with optional elements, should any be added. City actions, such as those relating to zoning, subdivision approval, housing allocations, and capital improvements must be consistent with the General Plan."



### **3. MAJOR PROJECTS FINANCING PLAN**

This document contains a list of projects and improvements required to provide the desired level of service established by the City General Plan. It is an implementation of the General Plan, via the list of projects and approximate costs, as well as via the adoption of the "Major Projects Fees".

### **4. DAVIS MUNICIPAL CODE**

All City Ordinances are a part of the City of Davis Municipal Code. Various portions, such as the Zoning Ordinance and the Subdivision Ordinance, are often referred to as if they are separate Ordinances, when they are actually part of a greater whole. The Purpose of all Development related Ordinances is to implement the City's General Plan.

### **5. AGENCY STANDARD SPECIFICATIONS**

The intent of Standard Specifications is to clearly define those items which occur with regularity in public works construction. Included with most Standard Specifications are Standard Drawings which provide details of finished components.

#### **a. Public Works**

The Public Works Department Standard Specifications define Public Construction Contract administration procedures, construction materials, and construction methods for publicly owned and maintained improvements. All improvement projects must conform to the Standard Specs, although private development projects do not need to strictly follow the Contract administration procedures.

#### **b. Reference Standards**

The various Standard Specifications reference many other types of standard specifications, such as those by CALTRANS, AWWA (American Water Works Association), ASTM (American Society for Testing of Materials), etc. Most of the Association or Society types of specifications are intended to standardize various materials and components used in public works construction.

#### **c. Parks and Community Services**

The PCS Department Standard Specifications define Parks design requirements, construction materials, and construction methods for publicly owned and maintained Parks improvements. Some of the Parks Improvements and Public Construction Contract administration procedures are defined in the PW Standard Specs. All Parks improvement projects must conform to both PW and PCS Standard Specifications.

#### **d. Building Code**

Although not a Standard Specification, but a portion of the City Municipal Code, the Building Code contains basic construction requirements for various structures by type of construction and use. Non-standard designs must be prepared by an Engineer.

**e. General Engineering Practice**

Most projects have features which may not be adequately defined in any of the City Codes or Standard Specifications. Good sound engineering practice will be used as the basis for the design in these cases. The Engineer will formulate all special or additional specifications required to clearly define the desired product.

**6. DESIGN STANDARDS**

The purpose of the Design Standards is to clearly define the process by which the various public improvements are designed and detailed for construction. Requirements for Improvement Plan and Map arrangements and details are also included.

**a. Public Works**

All Engineers preparing Plans and Maps for review shall adhere to these Design Standards. These Standards are intended to provide procedures and requirements which enable the efficient preparation of Plans and Maps, while maintaining the City's desired level of quality.

**b. Parks and Community Services**

All Landscape Architects and Designers preparing Plans for Parks and Greenbelts shall adhere to the PCS Standard Specifications and to the PW Design Standards. Requirements affecting the finished design exist in both sets of Standards and Specifications.

**c. Building Code**

Although not a Design Standard, the Building Code contains requirements affecting the design of various structures.



## SECTION II

### PLANNING SUBMITTALS

#### A. GENERAL

The general process which is outlined below is a generic process for a typical parcel of land, from annexation into the City and General Plan Amendment, to approval of a Tentative Map. Although very few Project Owners will take their projects through all of these steps, due to changes in ownership, business practices, etc., each project goes through all of them. Many conditions and specific requirements on each project spring from these "earlier" steps and their resulting conditions and mitigations.

#### B. ENVIRONMENTAL REVIEW

Each project, requiring some form of discretionary approval, is subject to Environmental Review, as required by the California Environmental Quality Act (CEQA). Preparation of a project specific Environmental Impact Report (EIR) usually is adequate for addressing all impacts and mitigations.

The Environmental Review process is coordinated by CDD and usually involves the following steps:

**1. Initial Determination**

This document is usually prepared by the Project Owner and reviewed and approved by CDD.

**2. Exempt or Negative Declaration**

This document is issued by CDD if the project is statutorily exempt or has a negative environmental impact or if all mitigations have been adopted via a previous Environmental approval.

**3. Environment Impact Report Required**

This document is prepared by CDD, usually using a private firm under contract, and paid for by the Project Owner. PW reviews and comments on the document as it proceeds through the process. Important milestones in the process are as follows:

- (a) Notice of Preparation and Scoping
- (b) Preparation of Draft EIR
- (c) Public Comment Period
- (d) Preparation of Final EIR
- (e) Certification by Council

The time involved in the Environmental process varies from a minimum of 1 or 2 months for a Negative Declaration to a minimum of 8 months and up to several years for a full EIR. Anyone desiring more information on the Environmental Review process should contact CDD.

## **C. GENERAL PLAN AMENDMENTS AND ANNEXATION**

PW will review General Plan Amendment applications for impacts and mitigations in regard to the requirements of the City's General Plan. An EIR is almost always required for any substantial amendment to the General Plan. The level of review focuses primarily on project-wide impacts or "off-site" impacts for which the mitigations may alter the basic project layout and design. Specific review of interior design details which do not have substantial impacts are left for later in the process (usually Tentative Map and/or Improvement Plans and Maps).

### **1. Land Use Element**

This is the basis for all traffic types of impacts, since it determines the types of uses and the resulting densities of housing. The quantity of uses and locations will also determine the need for the various types of streets. PW uses the locations, types, quantities and densities for the Land Uses as the basis for review based on the requirements of the other Elements.

### **2. Open Space Element**

A portion of the Open Space Element requires Bike Paths in all greenbelts and parks. This Element also contains requirements which affect large drainage ponds and channels. PW reviews the Bike Path circulation scheme and the large drainage features based on the requirements of this Element.

### **3. Transportation and Circulation Element**

This Element governs locations and details of all public streets. It contains specific requirements affecting improvement of various existing Arterials, as well as locations and details of new Arterials. PW reviews the Transportation scheme of a project based on the requirements of this Element. Quite often, a traffic study, prepared by the Project Owner, is required to adequately review the project for compliance with this Element.

This Element also governs the expansion of the City's Sewage, Water and Drainage Systems, as necessary to serve the general public. These Design Standards and the various Standard Specifications are a direct result of these requirements.

### **4. Housing Element**

This Element, in conjunction with the Land Use Element, determines the residential housing patterns and densities used to determine traffic impacts and mitigations.

### **5. Conservation Element**

This Element also has requirements which affect any large drainage ponds or channels, as well as requirements which affect the collection and disposal or recycling of solid waste. A portion of the PW review of the drainage system is based on the requirements of this Element.



## **6. Safety Element**

This Element is the basis for many of the requirements in the City Code, the various Standard Specifications, and these Design Standards, which are required to protect the general public. Areas of concern for PW are Flood Protection and Prevention, Earthquake (as it affects various public works structures), Water supplies for fire fighting purposes, and Hazardous Materials. A portions of the PW review of any project is devoted to the provisions of this Element.

## **7. Noise Element**

This Element concerns the most significant generator of noise in the City, Traffic. Most of the review on this section will be handled by CDD. Any required sound barriers in the public right of way will also be reviewed by PW.

## **D. ZONING (AND REZONING) REQUESTS**

On most projects, the Zoning application (also known as ReZoning or PreZoning) is submitted and reviewed concurrently with any desired General Plan Amendment, since the zoning has to be consistent with the General Plan. PW level of review is very similar to that expended on General Plan Amendments. The most important item of review will be compliance with the General Plan. Substantial non-compliance will trigger a more detailed review.

## **E. TENTATIVE SUBDIVISION MAPS**

The detailed requirements and conditions are formulated at this step in the Planning Approval process. Environmental mitigations are expanded and developed into detailed conditions where appropriate. PW reviews the project for compliance with past practices and current policies and recommends project specific conditions to CDD. In recently approved Tentative Maps these conditions tend to be very numerous. Part of the intended purpose of these Design Standards is to include herein the various design requirements which affect almost all projects and reduce the effort of review at the Planning level.

PW will meet with Project Owners and their consultants in advance of the formal submittal of an application for a Tentative Map. It is desirable for both parties to work out the details of mitigations and proposed conditions prior to preparation and submittal of the Tentative Map. In general, extensive review, such as that required to produce a preliminary list of suggested conditions of approval, will not be provided until an application is submitted and fee arrangements made.

### **1. Compliance with General Plan and Zoning Designations**

All Tentative Maps are required to comply with the General Plan. Since the Tentative Map approval usually grants the right to subdivide land only (exception Vesting Tentative Map), compliance with Zoning is not essential to approval. Prior to obtaining Building Permits, the Project Owner will need to obtain the final Zoning approval. Maps which do not comply with the General Plan cannot be approved per State Law.

## 2. Application Complete

The first step in the review process is for CDD to determine if adequate information has been submitted with the application package to complete processing and schedule the project for a hearing. The City is required by Ordinance and State Law to notify the Project Owner of an incomplete application within a specified time frame. PW participates in this process by reviewing the portions of the proposal which are related to Street, Drainage, Sewer, Solid Waste, Water, Lighting, and Signal Improvements. The general clarity and form of the Tentative Map is also reviewed by PW. PW may request Engineering Design Studies when appropriate to fill in details of important portions of the project and/or City-wide infrastructure.

## 3. Initial Review and Analysis

The project is first formally presented to City Staff at one of the regular Development Review Meetings. The first presentation is usually for the purposes of determining completeness of the application. Subsequent presentations are usually for the purpose of collecting comments from other City Departments and Utilities in order to prepare a Staff Report and hold a Public Hearing on the project. PW generally reviews the project for comment on the following areas:

- (1) Other Required Approvals (EIR, General Plan, Annexation, Zoning)
- (2) General Site Layout and Suitability of Project
- (3) Traffic Circulation
- (4) City Utilities
  - (a) Storm Drainage
  - (b) Sanitary Sewer
  - (c) Water
  - (d) Existing Facilities
- (5) Parks and Greenbelts

## 4. Staff Report

Planning Staff prepares a Staff Report to accompany any presentation of a project proposal to the Planning Commission or City Council. PW contributes a discussion of unique or important features and a suggested list of conditions of approval.

## 5. Planning Commission Recommendations

After hearing public testimony and discussing the project with City Staff and amongst themselves, the Planning Commission makes a recommendation to the City Council for approval with conditions, or denial. All Planning Commission decisions can be appealed to the City Council within certain specified time frames.



**6. City Council Action**

After hearing public testimony and discussing the project with City Staff and amongst themselves, the City Council will make a decision to approve the project with conditions, or deny it, or return the application to staff for more research.

**F. FINAL AND PARCEL MAPS**

After approval of a Tentative Map, the Project Owner works with the Public Works Department to prepare the required Improvement Plans and Final Map or Parcel Map. PART TWO of these Design Standards contains the basic requirements for preparation and submittal of these items.





## SECTION III

### ENGINEERING DESIGN STUDY REQUIREMENTS

#### A. GENERAL

Whenever an Engineering Design Study is required by the City as a condition of, or prior to, a discretionary Planning approval, the required Study shall be prepared, reviewed and approved in accordance with the requirements of this Section. These studies are usually required as a result of the need to fully identify impacts on the existing City infrastructure and recommend mitigations and/or infrastructure improvements.

##### 1. Purpose

This Section is intended to define the minimum information required to be included in an Engineering Design Study or Report. These Studies are usually required to be prepared prior to the various Planning approvals and are for the purposes of clearly defining various elements of a particular type of public improvement, such as, traffic or streets, drainage, sewer, water, etc.

##### 2. Study Items or Improvements

The items which are usually studied are the large "off-site" improvements benefitting all phases of a particular project and/or other projects within the City. In particular, Traffic Studies are usually required to be prepared and submitted prior to completion of the project environmental documentation. Many of the other types of studies may be completed prior to submittal of the first set of Improvement Plans and Maps.

##### 3. Items Excluded from Study

Improvements which are entirely contained within a particular phase and which benefit only that phase are not required to be studied prior to approval of the Tentative Map, except Vesting Tentative Maps. The design requirements contained in PART TWO of these Standards shall be used by the Engineer in satisfying any engineering requirements necessary for approving the Improvement Plans or Maps.

##### 4. Licensed Engineer Requirement

All Engineering Studies are required to be prepared by a registered engineer, appropriately licensed in the State of California. The Study Engineer shall exercise good sound engineering judgement in preparing the study. The study shall include sufficient information for the City, or any interested parties or citizens, to understand all assumptions and the process by which the Study Engineer arrives at the conclusions contained therein. In accordance with State Law, the Study shall be stamped and signed by the preparing engineer.

## 5. City Approval

All Engineering Studies will be subject to review, comment and approval by the Public Works Department. They may also be subject to Environmental review and analysis and subsequent approval by the City Council.

## B. TRAFFIC STUDY REQUIREMENTS

Traffic Engineering Studies are prepared for the purpose of analyzing the impacts of development or improvement on the existing City Transportation System. The City Transportation System is composed primarily of surface streets, but also includes elements such as, pedestrian paths, bike paths & lanes, bus routes, trains, highways, and other means of transportation.

Traffic Studies shall be based on the design criteria contained in PART TWO of the Design Standards. They shall be presented in written format, accompanied by any appropriate drawings, plans or map, essentials to the clear presentation of the material. The study shall clearly list all assumptions and criteria upon which the analysis is based, except that criteria contained in these Design Standards only needs to be summarily quoted. All references other than these Standards shall be listed by Author, Publication Name and Date.

### 1. Engineering Firm Approval

All traffic studies shall be prepared based on General Plan Land Uses and densities. The Public Works Department will approve the Engineering Firm, the scope of work, and the methods of analysis prior to starting the Traffic Study. This is to insure consistency with previously prepared Traffic Studies and the General Plan Traffic Analysis.

### 2. Preliminary Site Plan Review

A Preliminary Project Site Plan indicating Land Uses, with a level of detail equivalent to a Zoning Map, must be submitted for review by PW. This Plan will be used to establish the limits of the study, the streets and intersections analyzed, and any other important study criteria.

### 3. Traffic Study Requirements

In preparing the scope of Work for the Traffic Study the following will be considered and reviewed:

#### a. Proposed Project Environmental Status

If an EIR has not yet been prepared for this project, then the Traffic Study will be included in the Draft EIR. If the Study is a result of an EIR requirement, then it shall comply with the adopted project mitigations.

#### b. Previous Traffic Study(s)

If a previously approved Traffic Study exists for any portion of the study limits, then differences in results will need to be included as part of the scope of the current project Traffic Study.



**c. General Plan, Zoning and/or Tentative Map Applications**

The Study must be based on the proposed project General Plan designations, Zoning and/or Tentative Map configurations, at the maximum allowable densities and uses.

**d. Scope of Study**

The minimum Study analysis must include the following land uses and densities:

(1) Existing Conditions

The Study must generate figures for the Existing Land Uses and densities based on the existing street and transportation configurations. This will be the basis for further comparison of the proposed project impacts on the existing transportation system. The existing traffic loadings shall be based on current traffic counts, either conducted specifically for this Study or as approved by PW.

(2) Existing Plus Project

The Study must generate figures for the Existing Land Uses and densities plus the Proposed Project Land Uses and densities based on the existing street and transportation configurations. This will indicate the amount to which this project will impact the existing transportation system.

(3) General Plan Build-Out Plus Project

The Study must generate figures for the Existing Land Uses and densities plus the full General Plan Build-Out based on the existing street and transportation configurations. This will indicate the amount to which this project and all other proposed future projects will cumulatively impact the existing transportation system.

**e. Street Segments and Intersections Studied**

The following street are those which will be included in the initial analysis of the traffic study. If after performance of the initial analysis and review by PW, it appears that there are other streets impacted, then the Study scope will be revised to include and analyze these other impacted streets or intersections.

(1) Major/Minor Arterial Requirement

In general, the only types of streets which will be analyzed in the Study are Major or Minor Arterials and their intersections, as indicated on the City General Plan.

(2) Adjacent to Project

Each Arterial adjacent to or fronting the project shall be included in the Study. The Arterial shall be divided into segments, beginning and ending at an intersection with another Arterial. The adjacent or fronting intersections shall also be analyzed for turn lane movements and signal or stop sign warrants.

(3) Affected by Project

Arterials reasonably expected to be impacted by the proposed project shall also be included in the Study. These Arterials shall be divided into segments, beginning and ending at an intersection with another Arterial. Their intersections shall also be analyzed for turn lane movements and signal or stop sign warrants.

#### 4. Impacts and Mitigations

The Traffic Study results shall be presented in a neat professionally written form. It shall contain the following information in its presentation of results:

a. Basic Discussion

All of the herein described requirements shall be clearly written out so that minimal reference to other sources of information is required to understand the Study results. Tables and Figures shall be used where necessary to clearly list and itemize all numbers and details of the study assumptions and results.

b. Existing Streets and Intersections

The impacts on the existing transportation system, without the proposed improvements, shall be clearly explained. This will be the basis for comparison of the developed conditions. It will also provide a check against other sources of information, such as the General Plan Traffic Analysis. Provide recommendations, based on this analysis, of the required improvements needed to meet the General Plan and PW requirements for traffic capacity.

c. New Streets and Intersections

The Study shall clearly justify the proposed transportation system improvements and show how they meet the General Plan criteria and policies. Additional improvements required to meet the General Plan criteria and policies, not indicated in the original project assumptions and proposal, shall be clearly detailed. The burden of responsibility for all proposed improvements shall also be clearly detailed. Compare the results of this analysis with the capacities of the proposed General Plan build-out improvements.

### C. UTILITY ENGINEERING STUDY REQUIREMENTS

Utility Engineering Studies are prepared for the purpose of analyzing the impacts of development or improvement on the existing City Utility Systems, including, Water, Sanitary Sewer, and Storm Drainage. Included in these utilities are, domestic water wells and pumps, water storage facilities, control systems, pipes, manholes, fire hydrants, services, drop inlets, drainage channels, storm detention basins, pump stations (drainage and sewer), wastewater treatment facilities, etc.

Utility Studies shall be based on the design criteria contained in PART TWO of the Design Standards. They shall be presented in written format, accompanied by any appropriate drawings, plans or maps, preliminary design calculations, and other items essential to the clear presentation of the material. The study shall clearly list all assumptions and criteria upon which the analysis is based, except that criteria



contained in these Design Standards only need to be summarily quoted. All references other than these Standards shall be listed by Author, Publication Name and Date.

### **1. Approval of Scope of Work**

All Utility Studies shall be prepared based on General Plan Land Uses and densities. The Public Works Department will approve the Engineering Firm, the scope of work, and the methods of analysis prior to starting the Study. This is to insure consistency with previously prepared Studies and any project related General Plan Analysis.

### **2. Preliminary Site Plan Review**

A Preliminary Project Site Plan indicating Land Uses, with a level of detail equivalent to a Zoning Map, must be submitted for review by PW. This Plan will be used to establish the limits of the study, the utility elements analyzed, and any other important study criteria.

### **3. Basic Study Requirements**

In preparing the scope of Work for the Study the following will be considered and reviewed:

#### **a. Project Environmental Status**

If an EIR has not yet been prepared for this project, then the Study will be included in the Draft EIR. If the Study is the results of an EIR requirement, then it shall comply with the adopted project mitigations.

#### **b. Project Discretionary Approvals**

If the project has not yet received required approvals, such as, Zoning, and Tentative Map, then the Study shall be completed and approved prior to these discretionary approvals.

#### **c. Previous Studies**

If a previously approved Study exists for any portion of the study limits, then differences in results will need to be included as part of the scope of the current project Study.

#### **d. General Plan, Zoning and/or Tentative Map Applications**

The Study shall be based on the proposed project General Plan designations, Zoning and/or Tentative Map configurations, at the maximum allowable densities and uses.

#### **e. Scope of Study**

The minimum Study analysis shall include an analysis of the following conditions:

(1) Existing Conditions

The Project Engineer will discuss, although need not analyze in detail, the capacities of the existing Utility System and any excess capacity available for the use of the proposed project. This discussion shall be based on previously prepared Studies or a preliminary analysis where none exist.

This will be the basis for further comparison of the proposed project impacts on the existing Utility systems. Where records exist, the existing capacities shall be based on current information provided by PW. When essential to the analysis, the Project Engineer shall conduct field measurements of the existing configuration, patterns of use and quantities of flow.

(2) Developed Conditions

The Project Engineer will perform a preliminary design analysis of the Utility system for the proposed projects. This analysis will be based on full General Plan build-out uses and densities of this project and any adjacent properties or projects.

f. Minimum Utility Segments Studied

Most Utility Studies will be limited to the major components of a system, such as, water distribution mains, water storage and supply components, sewer trunk mains (capacity > 8"), storm trunk mains (capacity > 24"), sewer lift stations, storm drain pump stations, storm detention facilities, special flood protection facilities required for 100-year storm, and other features as determined by the City Engineer.

(1) On-site trunk facilities

All on-site trunk main facilities shall be included in the Study. In the case of water mains, all 6" and 8" mains shall be included in any network analysis. Any properties which are upstream or adjacent to the project which require the use of the on-site facilities shall be included in the analysis.

(2) Off-site facilities

Existing off-site facilities which are reasonably expected to be impacted by the proposed project shall be included in the Study. Any facilities which are required to be installed off-site shall be included. In the case of water mains, the Project Engineer shall use the City maintained input files for the network analysis.

4. Impacts and Mitigations

The Utility Study results shall be presented in a neat professionally written form. It shall contain the following information in its presentation of results:

a. Basic Discussion

All of the herein described requirements shall be clearly written out so that minimal reference to other sources of information is required to understand the Study results. Tables and Figures shall be used where necessary to clearly list and itemize all numbers and details of the study assumptions and preliminary design results.



**b. Existing System**

Any adverse impacts on the existing system shall be clearly explained. It will also provide a check against other sources of information, such as previous Studies. Provide recommendations, based on this analysis, of any improvements required to maintain the existing levels of service.

**c. Proposed System**

The Study shall clearly justify the proposed system improvements and show how they conform to these Design Standards. Any required changes in the original project proposal shall be clearly detailed. The burden of responsibility for all proposed improvements shall also be clearly detailed. Compare the results of this analysis with the capacities of the proposed General Plan build-out improvements with any previously prepared Study.

**5. Additional Requirements for Water System Studies**

The City has performed an analysis of system-wide impacts of future development on the Water System. The analysis and options for mitigating the impacts of development are contained in the adopted version of the City of Davis Water System Master Plan (Water Master Plan). Copies of this document are available in the Public Works Department for review. The basis for further analysis of a particular project's impacts shall be the various design criteria and parameters discussed in this Water Master Plan and as contained in these Design Standards.

**6. Additional Requirements for Storm Drainage Studies**

The City is currently performing an analysis of system-wide impacts of development on the Storm Drainage System. This document will be the revised Drainage Master Plan. Previous Drainage studies have been conducted and are kept on file in the Public Works Department. The Storm Drainage Design Section in PART TWO contains the most up-to-date list of drainage criteria for the City. The basis for further analysis of a particular project's impacts shall be the various design criteria and parameters discussed in the upcoming revised Drainage Master Plan and as contained in these Design Standards.

**7. Additional Requirements for Sanitary Sewer Studies**

The City is currently performing an analysis of system-wide impacts of development on the Sanitary Sewer System. This document will be the revised Sewer Master Plan. Previous Sewer studies have been conducted and are kept on file in the Public Works Department. The Sewer Design Section in PART TWO contains the most up-to-date list of drainage criteria for the City. The basis for further analysis of a particular project's impacts shall be the various design criteria and parameters discussed in the upcoming revised Sewer Master Plan and as contained in these Design Standards.

# PART TWO IMPROVEMENT AND DESIGN STANDARDS

## SECTION I

### GENERAL REQUIREMENTS AND DEFINITIONS

#### A. PURPOSE OF STANDARDS

The purpose of these Design Standards is to establish standard methods and practices to be applied in the preparation of Improvement Plans and Maps for improvements which are to be dedicated to, and/or used by, the general public in the City of Davis. These standards are being established for the purposes of protecting the health, welfare and safety of the general public.

They shall apply to improvements for new or existing facilities, such as, but not limited to, streets, highways, alleys, drainage, flood control, sanitary sewers, water supply facilities, street lighting, traffic signals, and all related improvements, which are operated and maintained by the City of Davis. They shall also apply to facilities installed within any City right of way and owned and maintained by any Public Utility Company and/or Franchisee, or owned and maintained by any private entity. They establish guidelines to be used in the preparation of Improvement Plans for privately owned and maintained improvements, such as, grading, drainage, flood control, fire protection, sanitary sewers, and related improvements.

#### B. COMPLIANCE WITH DISCRETIONARY APPROVALS

The preparation of all Maps and Plans are subject to the conditions of approval of the Tentative Map and/or other discretionary City approval. An attempt was made to include the portions of the Municipal Code which contain requirements affecting preparation of the Maps and Plans into these Design Standards. Any request for a variance to a requirement which originates in the Municipal Code will require approval of the City Council or as otherwise authorized by the Code.

#### C. REQUIREMENT TO COMPLY WITH DESIGN STANDARDS

These Design Standards, PART TWO, are to be used by all Engineers preparing Improvement Plans and Official Maps for review and approval by the Public Works Department. They are intended to be a guide for the type of methods to be used in analyzing and designing the various physical types of improvements. They are not a definition of general engineering practice or surveying practice in the City of Davis. Each Project Engineer, as the case may be, is still responsible for exercising sound engineering or surveying judgement in the preparation of the project Improvement Plans and Maps.

Any requirements imposed on a project relating to the source of funds shall take precedence over these Design Standards. Sources of funds are limited to State or Federal loan, grant or revenue sharing programs. All other provisions of these Design Standards not conflicting with the State or Federal requirements shall still apply.



## **D. VARIANCES TO DESIGN STANDARDS**

Any request for a variance to these Standards shall be presented to the City Engineer in writing. The request for a variance shall include the reasons for the request and shall justify how the variance provides the same quality of improvement. Variances which pose a threat to the health and safety of the General Public will also require City Council approval. All approvals for a variance will be granted in writing, signed by the City Engineer, or other appropriate City official, Commission, Committee, or Council.

Variance requests shall be submitted with any required Tentative Map or similar discretionary approval. Requests submitted after such approvals may, at the sole option of the City Engineer, require rehearing before the approving City official, Commission, Committee or City Council.

## **E. ENCROACHMENT & UTILITY PERMITS**

The Public Works Department has an Encroachment and Utility Permit program for the improvement of minor items of work and for connection of private facilities to the City utility systems. Application for and issuance of an approved Permit is an acceptable alternative to preparation of a set of Improvement Plans. Processing of a Permit will generally be subject to the appropriate requirements of these Design Standards.

Permits are usually issued when the Developer, Contractor, or other entity desires to reconstruct or improve items such as, but not limited to, driveways, service connections, street lighting, work by Public Utilities, Franchisee, or other responsible public agency, where such work is within portions of a dedicated public right of way or easement. Contact the Public Works Department for the applicability of particular situations to this process.

The items for which Permits are currently being issued are:

- (a) Sidewalk repairs
- (b) Utility Connection
- (c) Driveway construction
- (d) Utility Repairs
- (e) Temporary Fire Hydrant use

## **F. NOTICE OF PROJECT OWNER'S REPRESENTATIVES**

The Project Owner shall notify the Public Works Department of any changes of the Project Engineer and/or Surveyor retained to prepare Maps and Plans for the project. Submittal of various documents, such as, the Tentative Map, Final Map or Parcel Map and Improvement Plans shall serve as constructive notice of the Project Owner's representative. It shall be the responsibility of the Project Engineer to keep the Project Owner informed of the status of the project.

## **G. LIMITATION OF RESPONSIBILITY**

It should be recognized by both the Project Engineer and Project Owner, that informal means of communication will be used during the review process for Maps and Plans. It should also be recognized



that the design and review process is a dynamic procedure and not a static pre-defined formula with certain results. Incomplete communications, partial submittals, inaccurate understandings, discovery of unforeseen conditions, etc., during the Map and Plan review process may require additional work and/or re-work on the part of the Project Engineer. An attempt has been made via the preparation of these Standards to minimize these situations. Except where otherwise approved in writing, the Project Owner and Project Engineer shall bear the full responsibility for any work required to comply with these Standards and as directed by the City Engineer.

## **H. PROFESSIONAL ENGINEER REQUIREMENT**

All Improvement Plans and Official Maps shall be prepared by a California registered Engineer, licensed Land Surveyor, or other licensed design professional, as the case may be, with a valid registration (hereinafter referred to as the Project Engineer). The Project Engineer is responsible for designing the various improvements or performing the mapping in accordance with generally accepted practice and in accordance with these Standards. The Project Engineer shall also prepare all supplemental design information and calculations and shall be responsible for presenting it in a neatly written and well organized format. The design calculations, as required by the various sections, shall be submitted with the initial submittal of the Improvement Plans and Maps.

## **I. SITUATIONS NOT COVERED BY THE DESIGN STANDARDS**

It is recognized that it is not humanly possible to anticipate all situations that may arise or to prescribe standards applicable to all situations. Therefore, any items or situations not described herein shall be designed in accordance with general engineering practice and in accordance with any pertinent reference Design Standards, such as, but not limited to, the Standard Specifications, the CALTRANS Highway Design Manual and/or Traffic Manual, and other industry reference documents.

## **J. ILLEGAL ACTIONS**

All actions, features or designs, which are contrary to, in conflict with, or which do not conform to any State Law, County or City Code or Resolution, conditions of approval, or generally accepted good engineering practice, shall be excepted from City approval, even though such errors, omissions or conflicts may have been overlooked during the City review of the Plans, Maps and other project documents.

## **K. CONSTRUCTION USING APPROVED PLANS**

Approved Plans for all works covered by these Design Standards shall be in the possession of any Construction Contractor prior to commencing work on the improvements. Additional required documents, such as, but not limited to, Subdivision Agreement, Construction Agreement, Maps, Insurance Certificates and Endorsements, easements, dedications, and rights of entry, as the case may be, shall also be fully executed, in the appropriate form, and approved by the City prior to commencing construction work. Any work commenced prior to full approval of all project documents, Plans, and Maps, shall be undertaken at the sole risk of the Construction Contractor and may be summarily rejected at the sole discretion of the Director.



## L. INSPECTION OF CONSTRUCTION WORK

All work which is shown on an approved set of Plans and Maps shall be subject to inspection by the Public Works Department. Each phase or significant item of work shall be inspected and approved by the Inspector prior to proceeding onto the next phase or item of work.

Privately maintained works may also be subject to inspection as determined by the Director. If so required, then Plans will be prepared for review and approval of PW and appropriate fees paid.

## M. DEFINITIONS

Unless the context requires otherwise, wherever in these Design Standards, the following abbreviations and terms, or pronouns in place of them, are used, the intent and meaning shall be interpreted as provided in this Section.

1. **CALTRANS** means the State of California, Department of Transportation.
2. **CALTRANS Standard Plans** means the CALTRANS current edition of the publication with the same title.
3. **CALTRANS Standard Specifications** means the CALTRANS current edition of the publication with the same title.
4. **City** means the City of Davis, Yolo County, California, a municipal corporation, existing under and by virtue of the laws of the State of California.
5. **City Council or Council** means the City Council of the City of Davis.
6. **City Code** means the adopted Municipal Code of the City of Davis, as revised and modified from time to time by the City Council.
7. **City Engineer** means the Director, or duly appointed representative, of the Department of Public Works, City of Davis.
8. **Construction Contractor or Contractor** means a person, firm or other entity, with the appropriate license from the State of California, retained by the Project Owner to perform construction services on a Project. Unlicensed contractors will have no legal standing on a Project.
9. **Consulting Engineer** means any Engineer licensed to practice engineering in the State of California, usually a Civil Engineer, retained for a particular purpose on a Project. Usually also the Project Engineer.
10. **Department** means the Department of Public Works, City of Davis, or a duly appointed representative.

11. **Developer** means the owner of land or person or entity holding the legal right to subdivide or otherwise develop and improve a parcel of land. Also usually means the Project Owner.
12. **Director** means the Director of the Department of Public Works, City of Davis. Also means the City Engineer.
13. **Easement** means a legal document, or encumbrance, recorded in the Yolo County Recorder's Office, granting defined legal rights of use to a legal entity, to install and maintain physical improvements within and across the described parcel of land.
14. **Encroachment Permit** means a permit issued by the Public Works Department for reconstruction or improvement of minor items of work within a public right of way or easement.
15. **General Notes** means the written notes, usually on the first sheet of a set of Improvement Plans, which specify City construction requirements for a particular project.
16. **General Plan** means the adopted City of Davis General Plan, as revised and modified from time to time by the City Council.
17. **Highway Design Manual** means the CALTRANS current edition of the publication with the same title.
18. **Improvement Plans or Plans** means a set of drawings, prepared by a California licensed Engineer, which show the construction details for publicly maintained improvements, for review and approval by the Department of Public Works. Any separate Specific Conditions are considered to be a part of the Plans.
19. **Map** means a Final Map, Parcel Map or other Official Map required for a particular project.
20. **Project or Proposed Project** means a particular Planning application for a Development Project, or a City Capitol Improvement Project, or other Project sponsored by a responsible party or entity.
21. **Project Engineer** means the Consulting Engineer, licensed Architect, or other licensed design professional, retained by the Project Owner to perform specified design tasks on a particular project. The tasks usually include preparation of Maps and Plans.
22. **Project Owner** means the Developer, City, or other Agency or entity which is responsible for obtaining the necessary approvals and preparing the required Improvement Plans and Maps in order to construct a particular project.



23. **Public Utility Easement (P.U.E.)** means an Easement granting rights to Public Utilities, such as, but not limited to, Pacific Gas & Electric Co., Pacific Bell, and United Cable TV, to install and maintain facilities in the described parcel of land.
24. **Site Plans** means the Plans which detail on-site improvements for Multiple Family, Office, Commercial, and Industrial Projects, which Plans are usually not a part of the Improvement Plans.
25. **Soils Report** means a Geotechnical Investigation Report, prepared for a specific purpose, usually project oriented, prepared by a California licensed Engineer.
26. **Special Conditions, Special Provisions or Specific Conditions** means the separate written specifications, bid documents, notices, Construction Contract, etc., prepared for a particular project, which are considered to be a part of the Improvement Plans for that particular project.
27. **Standard Specifications** means the Department of Public Works Standard Specifications as modified and revised from time to time.
28. **Standard Plans** means the drawings which are included with and are a part of the Standard Specifications.
29. **State Department of Transportation** means the State of California, Department of Transportation, or CALTRANS.
30. **Subdivision Ordinance** means the portions of the City of Davis Municipal Code which control the division of land for purposes of lease, sale or finance, as more completely defined therein.
31. **Surveyor** means a California licensed Land Surveyor, retained by the Project Owner, to perform surveying and/or mapping services on a Project. Also the Project Engineer where interpretation dictates.
32. **Traffic Manual** means the CALTRANS current edition of the publication with the same title.
33. **Zoning Ordinance** means the portions of the City of Davis Municipal Code which control the types of uses of individual parcels of land and place additional requirements thereon, as more completely defined therein.





## SECTION II

### IMPROVEMENT PLANS AND MAPS

#### A. GENERAL REQUIREMENT

All Improvement Plans and Maps shall be prepared by or under the direction of a California licensed Civil Engineer or Land Surveyor, as the case may be, with a current registration. The Project Engineer preparing the Plans and Maps shall adhere to the following requirements for the content of Plans and Maps, and ordering of the details contained therein. Deviation from these requirements will usually add additional review time and expense to the plan checking process.

##### 1. MICROFILM REQUIREMENT

All Plans and Maps shall be prepared such that they are suitable for microfilming and subsequent use and reproduction.

Lettering shall generally not be smaller than 1/8" and shall be neat and legible. Care shall be used such that lettering is not bisected by other linework.

All line work shall be black ink or pen and shall be drafted on the front side of the drafting media. Colored pens, pencils and inks which do not microfilm well shall not be used.

##### 2. DRAFTING MEDIA

All Maps submitted for review by the City, which will be recorded with the County Recorder, shall be prepared on a suitable permanent polyester drafting media, with a minimum thickness of 3 mils. All line work, notes and any text shall be a suitable indelible permanent black ink.

Photographically reproduced originals with black linework on permanent polyester drafting media are acceptable.

##### 3. ACCURATE DRAFTING

All information on the Plans and Maps shall be accurately drawn to the indicated scales. Whenever possible, details shall be accurately drawn at a larger scale, which scale shall be indicated under the detail title. Significant deviation from this requirement may lead to the requirement to redraft the offending portions of the Plans and Maps.

#### B. SUBDIVISION MAPS ORGANIZATION AND CONTENT

The basic lot and street layout of the Map shall comply with the approved Tentative Map. Review of the Map for consistency with the approved Tentative Map will be performed by PW and CDD. Minor variances will be reviewed and approved by PW and CDD.

The process and requirements for preparation of Final Maps and Parcel Maps is generally the same. It is recognized that not all of these requirements may apply to Parcel Maps. The City Engineer may waive any requirement which does not apply to a particular Parcel Map.

### 1. Basic Map Requirements

- a. **Original Signatures:** All signatures shall be original using indelible permanent black ink. Colored pens and pencils used for signatures are not acceptable. All stamps shall be original using a quick-drying permanent black ink.
- b. **Map Size:** The map size shall be 18" by 26" with the information generally arranged parallel to the long dimension. All written information shall read from the bottom or the right, except as may otherwise be appropriate.
- c. **Border:** Maps shall have a heavy black 1/8" thick border all around. The border shall be one inch from the sides of the Map.
- d. **Field Survey:** Unless otherwise allowed by Code, all Maps shall be based on a field survey. The allowable error of closure for field work is 1/10,000.
- e. **Map Closures:** The allowable error of closure for calculated distances is 1/20,000. Closures for courses, for which it is impracticable to achieve this requirement, shall close within .01'.
- f. **Lot Numbering on Phased Maps:** The lot numbering of Maps shall commence with 1, on the first phased Map for a Tentative Map, and shall proceed consecutively throughout the Map. Subsequent phased Maps shall commence lot numbering with the last available number from the previous phased Map.
- g. **Lot Numbering Conventions:**

The first phase of a Tentative Map shall commence lot numbering with 1, regardless of the lot numbering shown on the approved Tentative Map. Each subsequent phase of an approved Tentative Map shall commence lot numbering with the next consecutive unused number from the previous phase. Numbers shall not be reused from phase to phase.

- (1) **For-Sale Lots:** Numbered lots shall be used for all for-sale lots on Final Maps. Lettered parcels shall be used on all Parcel Maps.
- (2) **Public Domain Lots:** Lots dedicated to the City of Davis, or other public entity, shall use a letter and number combination to indicate the dedicated lot (for example, A1). All greenbelts shall use the prefix 'G' and a number. All landscape lots shall use the prefix 'L' and a number. All miscellaneous (irrevocable) Offers of Dedication shall use the prefix 'D' ('I') and a number or a future street name.



## 2. Description of Basic Map Sheets

- a. **Cover or Title Sheet:** This sheet shall contain the statements and/or certificates and signatures with acknowledgements of all parties required to sign the map. This sheet (or sheets) shall precede all other sheets in the Map set.
- b. **Boundary Sheet:** Whenever practicable, this sheet shall show the entire subdivision boundary. All dimensional information required to define the boundary shall be shown on this sheet. It shall follow the Cover Sheet in the set. This sheet also serves as the Key sheet if the set has more than 4 sheets.
- c. **Lot Sheets:** If needed, these sheets shall show the individual lots within the subdivision, with each lot being shown in its entirety on one sheet. They shall follow the Boundary Sheet in the set. The lots may be shown on the boundary sheet provided that the scale is adequate to clearly show all dimensioning details of the lots.
- d. **Special Detail Sheets:** If needed, these sheets shall show special details if there is inadequate room on the preceding sheets. The use of a detail sheet due to selection of a map scale for the Boundary or Lot Sheets, which is too small, is not acceptable. Show reference to other sheets.

## 3. Map Scale

- a. **Subdivision Boundary:** The Map shall not be drawn at a scale smaller than 1"=100'. Smaller scales require special review and approval.
- b. **Lots:** The Map shall be at a scale of 1"=40', 50', or as approved by the City Engineer, to show individual lots for a single-family type subdivision. Reference to details on other sheets is discouraged.

## 4. Map Sheet Contents

- a. **Title Block on All Sheets:** Title Block which shall include: the Subdivision Number; Name; project location by reference to a recorded Map or plat of the United States Survey; "Yolo County, City of Davis"; Engineer's or Surveyor's Name, and City (no address or phone number); Date and Scale. The Title Block shall generally be the same on all the sheets.
- b. **Cover or Title Sheet:** The certificates shall be arranged in the indicated order commencing with the Owner's in the upper left corner of the sheet, and continuing in order to the Recorder's at the lower right corner. The Owner's, Engineer's and City/County statements shall appear on the first sheet. Additional Trustee Statements may appear on a subsequent sheet.

(1) Title Block (@ top center of sheet)

- (2) Owner's Statement, including Dedications, and Acknowledgement
- (3) Trustee's Statement and Acknowledgement
- (4) Engineer's or Surveyor's Statement
- (5) City Engineer's Statement
- (6) City Clerk's Statement
- (7) County Tax Collector's Certificate
- (8) County Recorder's Certificate

**c. Boundary Sheet:** This sheet shall contain the following information:

- (1) Subdivision Boundary shall be shown in a continuous and distinct symbol, such as a 1/10" solid line or equivalent. Use the same symbol on all other sheets.
- (2) Basis of Bearings between two or more existing monuments shown per a recorded map, tied into the California Coordinate System, Zone II, and equation of bearing to true north.
- (3) North Arrow, Map scale, and Title Block.
- (4) Legend which indicates all symbols used on this Map.
- (5) Exterior dimensions of boundary: for straight courses, include bearings and distances; for curved courses include interior angle, radius, length along curve, chord bearing, chord distance, and radial bearings labeled at points of non-tangency. For lines which cross or intersect other lines, show total and incremental distances between other lines.
- (6) References to existing recorded information where substantial discrepancy exists (exceeding normal mapping and surveying accuracy).
- (7) Monumentation:
  - (a) Existing Monuments on the exterior boundary found during the field survey and upon which this Map is based.
  - (b) New Monuments set, or indicated to be set, upon the exterior boundary.
  - (c) Street Monuments set, or indicated to be set, at all street centerline angle points, intersections, center of cul-de-sacs, beginning and ends of curves, for any streets detailed on this sheet.
  - (d) Type and extent of monumentation for any Lots which are shown in their entirety on this sheet.



- (8) City limits lines, Railroad right of way lines, CALTRANS right of way lines, etc.
- (9) Ownership of adjacent properties or Recorded Map reference and adjacent streets and public right of ways.
- (10) Easements of record proposed to remain and all new easements. Also show easements to be abandoned with their abandonment denoted on the map.
- (11) Curve data table on the same sheet, if needed. Curves numbered consecutively starting with the first sheet in the set.
- (12) Indication of subsequent sheet references by use of a distinct line symbol.
- (13) Show any lot information which is appropriate to show on this sheet. Any lots detailed on this sheet must appear in their entirety.

**d. Lot Sheets**

- (1) Subdivision Boundary shall be shown in a continuous and distinct symbol, such as a 1/10" solid line or equivalent. Same as all other sheets.
- (2) Basis of Bearings statement.
- (3) North Arrow, Map scale, and Title Block.
- (4) Monumentation:
  - (a) Existing Monuments on the exterior boundary found during the field survey and upon which this Map is based.
  - (b) New Monuments set, or indicated to be set, upon the exterior boundary.
  - (c) Street Monuments set, or indicated to be set, at all street centerline angle points, intersections, center of cul-de-sacs, beginning and ends of curves.
  - (d) Type and extent of monumentation of Lot Lines.
- (5) City limits lines, Railroad right of way lines, CALTRANS right of way lines, etc.
- (6) Bearings and Distances, or curve information, for all lot lines, right of way lines, center lines, easement lines, etc. For lines which cross or intersect other lines, show total and incremental distances between other lines.

- (7) Curve Dimensions of any horizontal curve, including, interior or central angle, radius, length along curve, chord bearing, chord distance, and radial bearings labeled at points of non-tangency.
- (8) Dimensions of each lot.
- (9) Easements of record proposed to remain and all new easements. Also show easements to be abandoned with their abandonment denoted on the map.
- (10) Curve data table on the same sheet, if needed. Curves numbered consecutively starting with the first sheet in the set.
- (11) Graphical Key Map showing the entire subdivision and all lots which indicates the relationship of this Lot Sheet to any other Lot Sheets. Not needed if there is less than 4 sheets in the Map set.

## C. IMPROVEMENT PLANS ORGANIZATION AND CONTENT

### 1. Standard Title Block

The Project Engineer shall use the same Title Block and border for all sheets in the Plan set. The Title Block shall include the Project Engineer's standard company insignia, Company name, address and phone number, Davis Public Works standard title block and bicycle symbol, Project Name, Subdivision Number, Individual Sheet Title, sheet number (format: Sheet ## of total), revision block, and other signature blocks as needed.

### 2. Basic Plan Requirements

- a. **Ownership of Plans:** The original of the Plans, or suitable reproduction, shall remain the property of the Project Engineer, unless specified elsewhere in the Professional Services Agreement. Suitable reproductions, per Sections II.D.3.f and II.D.3.i, including copies, shall be provided to the City prior to the start of and after completion of construction.
- b. **Original Signatures:** All signatures shall be original using indelible permanent black ink. Colored pens and pencils used for signatures are not acceptable. All stamps shall be original.
- c. **Plan Size and Orientation:** Plans shall be 24" by 36" with the information generally arranged parallel to the long dimension. North shall be up or to the right.
- d. **Plan and Profile Orientation:** The Plan view shall be below the Profile view on these types of sheets. The Plan and Profile shall be oriented parallel to the long dimension of the sheet.



- e. **Sheet Border:** Plans shall have a heavy black 1/8" thick border all around. The border shall be not closer than 1½" from the left edge of the sheet and not closer than ½" from the top, right and bottom edges.
- f. **Title Block Location:** The Title Block shall be placed along the bottom edge or along the lower right edge of the sheet.
- g. **Map Consistency:** All Plans shall be consistent with the accompanying Map.
- h. **Field Survey:** All Plans shall be based on a field survey of the areas included within the scope of work. Survey information shall be extended beyond the limits of work by at least 50' to 100', and as directed by the City Engineer. Elevations and locations of existing aerial and underground facilities shall be determined as required for design purposes.

### 3. Plan Scales

The scales indicated are generally the smallest acceptable scales for the type of Plan. The Project Engineer is encouraged to use the largest scale possible (for purposes of definition: 1"=10' is a larger scale, and 1"=100' is a smaller scale).

- a. **Vicinity Maps:** 1" = 600' per the City Street Maps.
- b. **Key Maps and Site Plans:** 1" = 100' or as approved.
- c. **Plan and Profile Sheets:** 1" = 40' for Site Plans and Grading Plans and horizontal scales on Plan and Profile Sheets. 1" = 2' or 4' for vertical scales on Plan and Profile Sheets.
- d. **Grading Plans:** 1" = 40' or 50', or as approved. More intense detail may require a larger scale.
- e. **Site Plans:** usually 1" = 20', 30' or 40', as needed to clearly show all detail.
- f. **Other Sheets:** Other scales will be reviewed on a case by case basis. The use of larger scales is encouraged in order to maximize clarity of the Plans.

### 4. Description of Basic Plan Sheets

The Improvement Plan set shall consist of the following basic sheets containing the indicated information thereon. An index and vicinity map is required for any Plan set with three or more sheets in the set. The sheets shall be placed in the order in the Plan set as listed below.

- a. **Title Sheet:**
  - (1) Subdivision Name and Number

- (2) Key Map and/or Site Map
- (3) Index of Sheets
- (4) Complete Legend & List of Abbreviations
- (5) Typical Street Sections
- (6) Vicinity Map
- (7) Title Block
  - (a) Project Engineer, Logo, name, address, phone number.
  - (b) Project Name and Subdivision number
  - (c) Davis Public Works Title Block and Logo
  - (d) Revision Block
  - (e) Date
  - (f) Scale(s)
  - (g) Project R.C.E Stamp and Signature
  - (h) Davis PW Approval Block
  - (i) Sheet numbering
- (8) Bench Mark Reference
- (9) Standard Public Works Construction Notes

**b. Grading Plan:**

- (1) Existing Topography at 1' contours and/or spot shots at 50'±, with all pertinent physical features indicated, extended 50' to 100' beyond project boundaries.
- (2) Right of Way and Lot Lines, Street Centerlines, Project Boundary
- (3) Standard Public Works Grading Notes
- (4) Features to be saved and/or removed
- (5) Proposed Grading
  - (a) Pad Elevations
  - (b) Drainage Flow Indications
  - (c) DI Locations
  - (d) Retaining Walls locations
  - (e) Typical Sections
- (6) Finish Grade Statements
  - (a) Relationship of Finish Floor to BFE
  - (b) FEMA Notes



- (7) Project Engineer Statement of constructed grades, signed and dated after grading is completed.
- (8) Retaining Wall locations and details

The Utility Plan and Profiles sheet for any particular street shall be placed so that it precedes the Street Plan and Profile for the same street. All Utilities and Street Plan/Profile sheets shall alternate in this fashion throughout the entire Plan set.

**c. Street Utilities Plan And Profile**

- (1) Typical Plan/Profile Orientation
- (2) Existing Facilities, topo info, sta & elev.
- (3) Plan View
  - (a) Street Name
  - (b) North Arrow & graphic scale
  - (c) Right of Way lines
  - (d) Lot Lines
  - (e) Street Centerline
  - (f) Curb, gutter and walk
  - (g) Street Lights
  - (h) Storm Lines, DI's, MH's (size & direction indicated)
  - (i) Sewer Lines, MH's, FB's (size & direction indicated)
  - (j) Water Lines, Valves, FH's, BO's, angle points
  - (k) Water & Sewer services
  - (l) Curve Data Table (R, Δ, L)
  - (m) CL Stationing
    - i) Labeled @ 100', ticks @ 50'
    - ii) Centerline
    - iii) BC's, EC's, PCC's, PRC's
    - iv) Utility Structures
- (4) Profile View, with background grid (screened or dots, colored lines requires special approval)
  - (a) Existing Ground (labeled)
  - (b) Finished Grade (labeled)
  - (c) Storm Lines, DI's, MH's (sta, elev, size, type, length, slope)
  - (d) Sewer Lines, MH's, FB's (sta, elev, size, type, length, slope)
  - (e) Water Lines, Valves, FH's, BO's, Angle Pt's, (sta, elev, size, type, length, slope)
  - (f) Grade Breaks
  - (g) Slopes (ft/ft ratio)
  - (h) Vertical Curves (sta & elev)
    - i) Beginning and End
    - ii) Point of Intersection of Tangent slopes
    - iii) 25' intervals

- (i) CL Stationing
  - i) 50' intervals (sta & elev)
  - ii) Utility Structures
- (5) Special Notes and Details

The Street Plan and Profiles sheet for any particular street shall be placed so that it follows the Utility Plan and Profile for the same street. All Utilities and Street Plan/Profile sheets shall alternate in this fashion through the entire Plan set.

**d. Street Plan And Profile:**

- (1) Typical Plan/Profile Orientation
- (2) Existing Improvements, topo info, sta & elev
- (3) Plan View
  - (a) Street Name
  - (b) North Arrow & graphic scale
  - (c) Right of Way lines
  - (d) Lot Lines
  - (e) RW, Centerline and/or crown centerline
  - (f) Dimensions to RW, CL, and lip gutter
  - (g) Curb, Gutter and Sidewalk
  - (h) Street Monuments
  - (i) Drainage Inlets
  - (j) Handicap & Bike Ramps
  - (k) Driveways
  - (l) Curve Data Table (R,  $\Delta$ , L) CL, FL, and/or BEW, as approved.
  - (m) CL Stationing
    - i) Centerline
    - ii) Lot Lines
    - iii) BC's, EC's, PCC's, PRC's
    - iv) Drop Inlets
- (4) Profile View, with background grid (screened or dots, colored lines requires special approval)
  - (a) Existing ground (labeled)
  - (b) Finish Centerline (labeled)
  - (c) Finish Gutter Flowline (labeled)
  - (d) Grade Breaks, High pts and Low pts
  - (e) Slopes (+ or - percent)
  - (f) CL Stationing
    - i) 50' intervals (sta & elev)
    - ii) Pavement Centerline (or FC if median) and Gutter
    - iii) BC's, EC's, PCC's, PRC's
    - iv) Drop Inlets



- (g) Vertical Curves (sta & elev)
  - i) Beginning, End
  - ii) Point of Intersection of Tangents slopes
  - iii) High Pts or Low Pts
  - iv) 25' intervals
- (h) Drop Inlets

(5) Special Notes and Details

**e. Miscellaneous Plan and Profile Sheets**

These sheets shall be used as needed and shall contain the appropriate information in accordance with the above requirements.

**f. Joint Utilities Plan (Master Utility Plan)**

This Plan shall follow after the Plan and Profile sheets. The City does not officially approve the details indicated on these sheets, since the design responsibility belongs to various Utility Companies and/or Franchisees.

- (1) Street Right of Way Lines
- (2) Lot Lines
- (3) City Facilities
- (4) Underground Utilities
  - (a) Water
  - (b) Sewer
  - (c) Storm
  - (d) Other
- (5) Street Lighting
- (6) Public Utilities
  - (a) Electric - Primary, Secondary
  - (b) Gas
  - (c) Phone
  - (d) Cable TV
- (7) Typical Trench Sections

**g. Street Lighting Plan**

The information shown on this Plan sheet may be shown on the Utility Plan and Profile Sheets.

- (1) Existing Facilities

- (2) Street Right of Way and CL
  - (3) Lot Lines
  - (4) Other conflicting facilities (storm, sewer, water, joint utilities, etc.)
  - (5) Street Lights (typical details, if needed)
    - (a) Pole height
    - (b) Mast arm length
    - (c) Size of luminaire
    - (d) Type of distribution
    - (e) Photoelectric controller
    - (f) PG&E assigned number
  - (6) Conduit & Conductor
    - (a) Typical section
    - (b) Depth
    - (c) Location
    - (d) Size & length
    - (e) Number of conductors
  - (7) PG&E Service Point(s)
- h. Striping And Signing Plan**
- (1) Right of Way lines
  - (2) Lot Lines
  - (3) Existing Striping, Curbs, Islands (medians), etc.
  - (4) Proposed Curbs, Islands (medians), etc.
  - (5) Existing and proposed Driveways
  - (6) Striping Legend (using CALTRANS conventions)
  - (7) Striping
    - (a) Layout by type
    - (b) Dimensions and/or Stationing
  - (8) Signs
    - (a) Street Name Signs
    - (b) Stops
    - (c) Warning
    - (d) Traffic
    - (e) Barricades



## I. Traffic Signal Plans

A minimum of two sheets shall be used to show the traffic signal design. At least one sheet shall be used for the intersection layout at the largest possible scale. At least one sheet shall be used for all construction notes, equipment schedules, details and other miscellaneous information. When needed, a separate sheet shall be added for the striping and signing details. All signal plans shall always include a separate set of Project Special Provisions.

- (1) Cover Sheet
  - (a) Equipment Schedule (per CALTRANS Std. Plans)
    - i) Signal Pole height
    - ii) Signal Head mounting configurations
    - iii) Street Lights, mounting arm, wattage, etc.
    - iv) Mast arm lengths
    - v) Foundations
  - (b) Signal Heads & mounting type
  - (c) Street Lights (not signal mounted)
  - (d) Miscellaneous Equipment Details
    - i) Pedestrian Push Buttons Details
    - ii) Typical Detector Loop Details
    - iii) Bicycle Push Buttons Details
  - (e) Conduit & Conductor Schedule
    - i) Conduit run
    - ii) Circuit numbers
    - iii) Quantity, Types & Sizes of conductors
    - iv) Sizes of Conduit
    - v) Total number of conductors per conduit run
  - (f) Phase Diagram
  - (g) Service Wiring Diagram
  - (h) PG&E Service Point & Meter location
  - (i) Construction Notes
- (2) Intersection Plan (minimum scale: 1"=20', desirable scale: 1"=10')
  - (a) Right of Way lines
  - (b) Lane configuration, Medians, Curbs, Sidewalks & Bikepaths
  - (c) Crosswalks and Handicap Ramps
  - (d) Existing Improvements
    - i) Lights, Signs, Signals, etc.
    - ii) Overhead Utilities (horizontal and vertical locations)
    - iii) Underground Utilities
  - (e) Signal Configuration
    - i) Signal Poles and Head Orientations
    - ii) Pedestrian Push Buttons
    - iii) Bicycle Push Buttons
    - iv) Separate Street Lights
  - (f) Electrical Configuration
    - i) Controller Location
    - ii) Conduit Runs

- iii) Pull Boxes
- iv) PG & E Service Pedestal and Meter
- (g) Loop Detectors
  - i) Locations, Types, and Nominal Dimensions
  - ii) Advance Loops
  - iii) Bicycle Loops
  - iv) Pull Boxes and Spider Boxes
- (3) Striping and Signing Plan (when needed)

The information included on this plan shall conform to the preceding sub-section with the same title.

#### j. Greenbelt and Parks Plans

Greenbelt and Parks Plans may be a separate Plan set, as approved by the City Engineer.

- (1) Existing Topography at 1' contours and/or spot shots at 50'±, with all pertinent physical features indicated, extend 50' to 100' beyond project boundaries.
- (2) Adjacent Street Right of Way & CL's , Lot Lines, Project Boundary
- (3) Standard Grading Notes and Special Notes
- (4) Features to be saved and/or removed
- (5) Fencing & details
- (6) Lights (typical details, if needed)
  - (a) Pole height
  - (b) Mast arm length
  - (c) Size of luminaire
  - (d) Type of distribution
  - (e) Photoelectric controller
  - (f) PG&E assigned number
- (7) Conduit & Conductor
  - (a) Typical section
  - (b) Depth
  - (c) Location
  - (d) Size & length
  - (e) Number of conductors
- (8) PG&E Service Point(s)
- (9) Irrigation service connection & details
- (10) Proposed Grading



- (a) Elevations
  - (b) Drainage Flow Indications
  - (c) DI Locations
  - (d) Retaining Walls locations
  - (e) Typical Sections
- (11) Project Engineer Statement of constructed grades, signed and dated after grading is completed.
- (12) Retaining Wall details
- k. **Other Plan Sheets (Details)**
- (1) Retaining Wall Details
  - (2) Bicycle Tubes (Under-crossings)
  - (3) Temporary Drainage Facilities
  - (4) Construction Signing Plan
  - (5) Utility Construction Connection Plans

## **D. REVIEW AND APPROVAL PROCEDURE**

The review and approval process for Improvement Plans and Maps will adhere to the following process. In order to achieve the most efficient and timely processing of a set of Plans and Maps for review, the Project Owner, Developer, and/or Project Engineer shall follow these procedures and requirements.

### **1. Preliminary Street and Utility Site Plans**

These Plans are not required for all proposed projects. They are usually submitted with the Tentative Map or other Planning Documents. The various drawings, plans, maps and details included with an approved Engineering Study will generally fulfill this requirement. An approved Tentative Map will also generally fulfill this requirement depending on the nature of the details provided.

When an "approved" Preliminary Plan exists it will be used as the basis for the basic content of the Improvement Plan review.

### **2. Final Map or Parcel Map Submittal**

A complete submittal for review of a Final Map shall comply with the following requirements.

**a. Concurrent Review - Improvement Plans**

Improvement Plans shall be submitted for review at the same time as a Final Map or Parcel Map is submitted. In general, since it takes longer to review Improvement Plans, more time should be allowed for Improvement Plan review than for Final Map or Parcel Map review.

The Final Map or Parcel Map will not be considered approved until the required Improvement Plans are acceptable.

**b. Initial Application**

The initial application submittal shall contain the following information. All of the indicated information is needed to complete the review of the Final or Parcel Map. Complete submittal packages will enable PW to perform an efficient and timely review. Delays in submitting information will also delay the final approval of the Maps. As a minimum, the Application Form, Fee, Approved Tentative Map, Map Copies, Lot Closures and Preliminary Title Report must be submitted in order to commence the plan checking process.

- (1) Application Form: use the form provided by PW.
- (2) Approved Tentative Map: one complete copy of the Tentative Map, signed by CDD, with a complete list of the Conditions of Approval attached as an additional sheet.
- (3) Improvement Plan Submittal: see Section II.D.3.
- (4) Map Checking Fee: approx. \$550 to \$1500 plus \$25 per lot, to be paid upon submittal (the application will be considered incomplete without full payment).
- (5) Copies of Map: 4 copies (more as requested).
- (6) Traverse Closure Calculations: one complete set based on the map dimensions (computer dumps of coordinate geometry calculations are not acceptable).
- (7) Preliminary Title Report: two copies not older than 6 months.
- (8) Utility Letters: copies of letters transmitting copies of Plans and Maps to the Public Utility Companies.
- (9) Soils Report: 2 copies (see Section IV.B.3).
- (10) Dedications and Easements: two copies of legal descriptions of "off-site" easements or dedications to be obtained by the Developer and granted to the City.



- (11) Project Legal Documents: 2 copies of any project related Covenants, Conditions and Restrictions and/or Condominium Plans and related documents.
- (12) Additional Information: any additional information necessary to complete the review of the Maps, as may be required by the Tentative Map Conditions of Approval and/or the Subdivision Ordinance.

**c. Initial Review**

PW will conduct its first review of the Map and prepare one copy of the Map with comments for return to the Project Engineer for their use in making corrections. The Map will also be reviewed by CDD and may need to be reviewed by other City Departments. PW will endeavor to return any comments from other Departments with the first plan check. In general, if the Improvement Plans and Map are substantially complete and in good order, then PW will prepare the Draft Subdivision Agreement for review by the Developer.

**d. Subsequent Reviews**

The Project Engineer shall return the requested numbers of copies of the Map (usually two) and any other requested information to PW for subsequent checking.

**e. Approval by City Council**

The Map will be scheduled for Council approval when all plan checking comments have been satisfactorily addressed by the Project Engineer and/or Developer. Maps which do not comply with all of the Tentative Map conditions of approval will not be scheduled for City Council consideration!

A minimum of two weeks lead time is required to schedule a map for a Council meeting. The following conditions must also be satisfied before a Map will be scheduled for Council approval.

- (1) Compliance with Conditions of Approval: as required by State Law and the Subdivision Ordinance, all conditions must be met prior to approval of a Map.
- (2) Final Subdivision Agreement: this agreement must be in final form and signed by the Developer.
- (3) Liability Insurance: per the Subdivision Ordinance, this requirement must be satisfied and all evidence of insurance approved.
- (4) Project Legal Documents: any other legal documents, such as Conditions, Covenants or Restrictions, and Condominium Plans, must be executed and delivered to the City.
- (5) Map Signatures: the Map must be signed by the Developer or Land Owner, the Trustee on Deed(s) of Trust (if any) and the Project Engineer. The Original of the Map must be delivered to PW.

**f. Recordation of Map**

After approval of the Map by the Council, PW will deliver the original Map to the Title Company to be held in escrow. All of the requirements of the Council approval of the Map must be satisfied prior to issuance of authorization to proceed with recordation of the Map. The Subdivision Agreement contains requirements for Improvement Security, payment of Fees, and execution of any additional documents, such as, but not limited to, dedications, and easements, all of which must be fully executed and delivered to the City or held in escrow at the Title Company.

**3. Improvement Plan Submittal****a. Concurrent Review - Maps**

Improvement Plans shall be submitted concurrently with a Final Map or Parcel Map application, as required by the Municipal Code. In general, since it takes longer to review Improvement Plans, more time should be allowed for Improvement Plan review than for Final Map or Parcel Map review.

The Final Map or Parcel Map will not be considered approved until the required Improvement Plans are acceptable.

**b. Initial Application**

An acceptable or complete Improvement Plan submittal shall contain the following information. All of the indicated information is required to complete the review of the Improvement Plans. Complete submittal packages will enable PW to perform an efficient and timely review. Delays in submitting information will also delay the final approval of the Plans.

- (1) Application Form: use the form provided by PW.
- (2) Plan Checking Fee: based on the estimated Construction Cost, to be paid upon submittal (the application will be considered incomplete without full payment).
- (3) Approved Tentative Map: see Map submittal requirements above, only one copy needs to be submitted for review of each project's Plans and Map.
- (4) Copies of Plans: 4 copies.
- (5) Design Calculations: two copies of each of the following, when required, in the approved form;
  - (a) Hydrology and Hydraulics (Drainage)
  - (b) Drainage Shed Map
  - (c) Water
  - (d) Sanitary Sewer Flows
  - (e) Sanitary Sewer Shed Map
  - (f) Street Lighting



- (g) Structural Sections of Streets
  - (h) Retaining Walls
  - (i) Other details
- (6) Preliminary Construction Cost Estimate: one copy which itemizes all improvements, including Public Utilities, to be secured with the Subdivision Agreement, including:
- (a) Grading, Clearing & Grubbing
  - (b) Streets
  - (c) Storm
  - (d) Sewer
  - (e) Water
  - (f) Lighting
  - (g) Bike Paths
  - (h) Greenbelts
  - (i) Retaining Walls and Fences
  - (j) Other Public Amenities
  - (k) Public Utilities: (cost or evidence of agreement and payment of fees)
    - i) Trenching Cost
    - ii) Electric & Gas
    - iii) Phone
    - iv) Cable TV
  - (l) Construction Staking and Engineering
  - (m) Construction Contingency (5% min. to 10% max.) and Inflation factor
- (7) Soils Investigation Report (See Section IV.B.3)
- (a) Site Investigation with boring and trench logs
  - (b) Grading and Compaction Recommendations
  - (c) Soil Corrosivity Investigation and Recommendations
  - (d) R-value tests
  - (e) Street Structural Sections Recommendations

**c. Application Completeness Review**

Once a submittal is made and the fee paid, PW will perform a completeness review of the information submitted. In general, applications which are lacking significant submittal information, will be returned to the Project Engineer with only a cursory review and request for the required submittal information.

**d. Initial Review of Plans and additional Information**

PW will conduct its first review and prepare one copy of the Plans, along with a copy of the additional information submitted with the application, for return to the Project Engineer for their use in making corrections. The Plans may also need to be reviewed by other City Departments. PW will endeavor to return any comments from the other Departments with the first plan check. In general, if the Improvement Plans and Map are substantially complete and in good order, then the Draft Subdivision Agreement will be prepared for review by the Developer.

**e. Subsequent Reviews**

The Project Engineer shall return the requested numbers of copies of the Plans (usually two) and any other requested information to PW for subsequent checking.

**f. Approval by Public Works**

The Improvement Plans will be approved by the Public Works Director when all comments and concerns have been satisfied by the Project Engineer. Approval of the Plans may precede the Final Map. The originals of the Plans will be delivered to PW for signature by the Director. The Project Engineer will maintain the signed original and send one reproducible paper-based (diaz sepia, reverse reading) original along with the required number of prints.

It is expected that the Joint Utilities Plan will not be ready for construction approval by the City at the time of approval of most of the Plan set. This portion of the Plan set must be in its final form prior to commencement of underground construction. The Project Owner is responsible for arranging with the Utility Companies and/or Franchisees to perform their design work in a timely fashion. The Project Owner should try to obtain Extension Agreements from the Utilities and pay fees as early in the process as possible to avoid delays.

**g. Construction Start**

This sub-section and the following ones are intended to describe the interactions of the plan checking process during construction phases. See Section III for more complete details of the construction procedures.

The Developer may start construction prior to recordation of the Final Map or Parcel Map, provided that the Inspection Fees are paid and the required Insurance is provided prior to the start of construction. In addition, signed copies of the Plans must be in the possession of the City Inspector and Contractor prior to the start of construction.

If the Developer wants to start construction after recordation of the Final Map, then all requirements for the Map must be satisfied prior to the start of construction. The Inspection Fees and Insurance requirements must also be satisfied.

**h. Plan Revisions during Construction**

The Plans shall be revised due to unforeseen conditions discovered during construction. All changes must be approved by the appropriate PW or City representative prior to construction of the changed item.

**(1) Inspector's Authority**

The PW Inspector, and/or other Departmental Personnel, as assigned, are the City's representatives charged with observing the performance of the construction work and responsible for testing of materials.



(a) Minor Changes

The Inspector can authorize certain minor changes in the field. When so authorized, notes of these changes will be kept by the Inspector.

(b) Substantial Changes

The Inspector may also order changes to the Plans for any substantial deviations due to unforeseen conditions. When the Inspector orders changes to the Plans, the Construction Contractor shall stop work on the affected items, and the Project Engineer shall revise the Plans and submit for additional checking and approval of the revision.

(2) Review of Revised Details

PW will review the details of changes in as timely a fashion as possible and return comments by the appropriate means to the Project Engineer. The originals of the Plans shall be delivered to PW for approval of the changes. After the Director initials the changes, the Project Engineer shall deliver new duplicate originals (diazosepia, reverse reading) and copies of the Plans to PW.

i. Record Plans

After completion of all construction, the Project Engineer shall deliver a suitable polyester duplicate original (diazomylar, reverse reading) to PW. PW will use this set to note any minor changes on the Plans authorized by the Inspector during construction.

PW will mark on the duplicate originals other information recorded by the Inspector during construction, such as, locations of utility lines and services, clearances, etc. Once all record information is marked on the Plans, then this set becomes PW official record of the constructed product.





## SECTION III

### CONSTRUCTION PROCEDURES

#### A. GENERAL

The following procedures and requirements shall be followed during the construction phase of a project. The intent of this section is to describe the City procedures which affect the construction process. Any waivers to these requirements will be in writing in the Special Provisions (if any), in the General Notes, or in other official City Document(s).

The Special Provisions or General Notes for a project may impose additional requirements, or repeat some of these requirements.

#### B. REQUIRED DOCUMENTS

The form of any written Agreement, or other document which obligates a Developer of Construction Contractor to perform work, or secures the performance of work, for the City, shall be prepared using the standard City forms. Suitable additional time shall be allowed for review of any non-standard documents by the City Attorney.

The requirement for Improvement Agreements, Bonds, Insurance and payment of fees originate in the Municipal Code. The Standard Specifications, City Resolutions, and other rules and regulations also govern the form and content of these documents. Variance to any standard language or requirements, will require approval of the City Attorney and may also require approval of the City Council.

The following requirements for the various documents shall be satisfied prior to the start of construction. A portion of the requirements in the Subdivision Ordinance relating to Improvement Security may be waived if construction proceeds prior to the filing of a required Map. Any work completed prior to fulfillment of these conditions is performed at the sole risk of the Project Owner or the Construction Contractor, as the case may be.

##### 1. Improvement Agreement

The Improvement Agreement is also commonly referred to as the Subdivision Agreement, or the Construction Agreement (Contract). The purpose of this agreement is to specify the terms for completion of the work and to provide for security to guarantee its completion. This document shall be fully executed by all parties, in the approved form, prior to the start of construction.

##### 2. Improvement Security

The Improvement Security guarantees the completion of the work, provides for payment of materials suppliers and sub-contractors, and provides a warranty guarantee. The form of the Security must be approved by the City Attorney. The amounts and various requirements for Securities are determined by Municipal Code and other State laws, rules and regulations.

**a. Form and Amount of Security**

Approved forms for the Improvement Security are: Letter of Credit; Bond, executed by a Bond firm registered in the State of California; Cash deposit, with approved escrow account and instructions; or other approved document and security. Each project is usually required to provide separate security amounts for the Performance Security (100% of the value of the work), and for the Labor and Material Security (50% of the value of the work). A portion of the Performance Security on Development Projects is required to be cash (\$3,000 or 1%, whichever is greater).

After completion of the work, a Warranty Security (10% of the value of the work) is required. The Performance Security may be reduced to this amount in lieu of providing a separate instrument.

**b. Reduction and/or Increase in Securities**

The amounts of the required Performance Security and Labor and Materials Security shall be increased as the work proceeds to include the additional costs of any changes. This increased amount can be offset by satisfactory completion of portions of the work.

The amount of the Performance Security can be reduced as the work proceeds. The maximum allowable reduction is 90% of the value of the completed work, or not less than the value of the outstanding work, including changes, whichever is greater. The Developer or Contractor is required to make all requests for reduction in the Performance Security. Any such request shall be made not more often than once a month, and shall include an itemized breakdown of the completed work, any authorized partial payments, and complete copies of all construction contracts and change orders, if not already submitted. The City Engineer will review the request, make modifications, and issue an authorization to reduce the Performance Security amount.

The Labor and Materials Security amount cannot be reduced as the work progresses.

**3. Inspection Fee**

Any required Inspection Fees shall be paid in full prior to City inspection of any construction work on a Development Project. Inspection Fees are not required on City Projects.

**4. Insurance**

All evidence of Insurance must be in the approved form prior to the start of construction. Project Owners on Development Projects and Construction Contractors on City Projects must comply with this requirement. Any exceptions require the approval of the City Attorney, and may also require approval of the City Council or the City's Insurer.

**C. PRE-CONSTRUCTION CONFERENCE**

A Pre-Construction Conference will be scheduled by the City, once it appears that all requirements for construction are substantially satisfied. Separate Conferences may be scheduled with the Public Utilities, or other responsible parties, when a distinct and significant portion of the construction work is ready to commence.



The purpose of this conference will be to introduce all of the important personnel which will be monitoring the work and/or responsible for its completion. The inspection and testing schedule will be discussed, as well as other pertinent project related requirements. Official documents may also be delivered to the City by the Contractor or the Project Owner, at this conference.

The following personnel will generally be required to attend. On City Projects, only one PW representative may fulfill the role of City Plan Checker or Engineer, Project Owner and Project Engineer.

**1. City Representatives**

- a. Inspector:** The field personnel assigned to perform inspection services for this project on behalf of the City. May include personnel from other City Departments.
  - b. City Plan Checker or Engineer:** The representative of the City Engineer assigned to perform plan checking services and/or the personnel assigned as contract administrator.
- 2. Project Owner:** The person or entity, whether a Developer of City representative, who retains the Construction Contractor and approves payment.
  - 3. Project Engineer:** The Consulting Engineer responsible for preparation of the Plans.
  - 4. Staking Engineer:** The Engineer or Surveyor responsible for providing Construction Staking services on this project.
  - 5. Contractor:** The Supervisor responsible for overseeing the work and assigning workers and equipment to carry out the terms of the construction contract.
  - 6. Public Utilities:** Appropriate representatives from Pacific Gas & Electric Co., Pacific Bell, United Cable TV, and other Utility Company or Franchisee.
  - 7. Others:** Other persons or parties with an interest in the completion of the work.

**D. CONSTRUCTION INSPECTION**

The following sections shall be communicated to the Construction Contractor by the Project Owner and/or by the Project Engineer. Specific reference to these requirements by note on the Plans is not allowed. Where appropriate, the Project Engineer shall interpret and translate these provisions into requirements on the Plans. The roles of the various parties are defined below.

**1. Project Owner Responsibilities**

The Project Owner is responsible for providing the Contractor with all information pertinent to preparation of a construction bid and subsequent contract. This information may include, although is not limited to: Project Plans; Project Special Provisions; Standard Specifications; Proposal (Bid) Form; Notice(s) to Contractor; Contract Administrative Procedures, including items such as, proposal and contract procedures, scope of work, control of work, control of materials, legal relations and responsibilities,

change orders, partial payment, measurement, and final payment; Security Requirements; Insurance Requirements; and, Sub-Contractor limitations.

On Development Projects, the Project Owner is responsible for preparing all documents which convey any construction requirements not provided for in the PW Standard Specifications or the Project Plans. PW will inspect the work for compliance with the approved Plans but will not formally intervene in disputes between the Developer and Construction Contractor, which disputes arise primarily from interpretations of the construction contract. The Project Owner is responsible for requiring the Construction Contractor(s) to perform the work in accordance with the provisions of the approved Plans, Special Provisions, and other project documents.

## **2. City Responsibilities**

The City will inspect the work for conformance to the Standard Specifications and the approved Plans.

On City Projects, PW will prepare all of the project documents which inform the Contractor of the various City administrative requirements. PW will administer the Contract, order changes in the work, authorize payment, inspect the work, and accept the improvements upon completion.

## **3. Construction Staking**

The Project Owner shall arrange for construction staking in accordance with the requirements of Section X, Construction Staking, of these Design Standards. All staking shall be provided prior to inspection or construction of the item for which the staking is required.

The Project Engineer, performing the staking, will notify PW via phone upon completion of the staking. Cut sheets shall be provided to the Inspector within 24 hours of the completion of staking.

## **4. Contractor Responsibilities**

The Project Owner shall require the Contractor to perform the work in accordance with the approved Plans and Special Provisions. The City will recognize only one General Contractor per job. The relationship of all sub-contractors shall be as described in Section 8-1 of the Standard Specifications.

The Project Owner retains the overall liability and responsibility for Job Site Safety throughout the life of the project. On Development Projects, the Project Owner shall provide evidence of Liability Insurance (General and Automobile) to verify the financial aspect of this obligation. The Project Owner may require the Contractor(s) to also provide similar evidence (to the Owner) prior to commencing work on the project.

PW will observe the construction practices of the Contractor(s) and has the authority to order changes in procedures or stop work.

The Project Owner shall notify PW via phone at least 2 working days prior to starting construction work on the project.



## **E. CHANGED CONDITIONS**

When changed conditions are discovered, the Project owner shall bring it immediately to the attention of the assigned City Inspector.

### **1. City Inspector Notification**

Verbal notification is usually adequate to notify the Inspector of changed conditions. Written follow-up is strongly recommended on items which may add additional time and expense to the performance of the construction work. The Standard Specifications also contain provisions addressing changed conditions.

### **2. Project Engineer Revise Plans**

The Project Owner shall require the Project Engineer to make changes to the Plans and resubmit for review, when a revision to the Plans is essential prior to completion of any items affected by the changed conditions.

### **3. City Review of Changes**

The City will endeavor to review changes in approved Plans at the highest priority in order to minimize the affects of delay on Project costs and completion. Verbal, or other informal methods of communication, may be used by the City to give approval to proceed with the revised Plans.

## **F. PROJECT COMPLETION AND ACCEPTANCE**

Project acceptance will not be considered until all items of work have been completed as shown on the Project Plans, including approved changes. The City will relieve the Project Owner of responsibility for maintenance for any portions of the work required to be opened to use by the general public, when the items are required to be opened prior to completion of the entire project.

### **1. Final Punch List**

The City will prepare a Final Punch List for the convenience of the Contractor when all items of work are substantially complete. This list is intended to be a list of minor corrections required to bring the work into full compliance with the Plans. Otherwise, the Project Owner shall require the Contractor to communicate with the Inspector on a regular basis to discuss the satisfactory completion of the work.

### **2. Notice of Completion**

The Notice of Completion will be prepared by the City upon satisfactory completion of the work and all Final Punch List items. The Notice will be recorded and the improvements are considered complete on this date.

### **3. Release Performance Security**

The Performance Security will be released, or reduced, as requested by the Developer or Contractor, upon filing of the Notice of Completion. The Performance Security cannot be reduced to less than 10% of the secured value, including any changes, until a suitable Warranty Security is substituted in its place.

### **4. Record Plans**

The Project Owner shall require the Project Engineer to deliver a set of reproducible polyester originals (diazomylar, 3 mil., reverse reading) of the Plans to PW. Acceptable duplicate originals shall be delivered to PW prior to filing the Notice of Completion.

### **5. Release Labor and Materials Security**

The Labor and Materials Security will be released in accordance with the provisions of State Law. In General, this means that this Security will be released if no liens or other official notices of claim, are received by the City within 6 months after filing of the Notice of Completion. If a lien or claim is received, then the City will hold a sufficient portion of this Security to guarantee payment of this claim until such time as it is legally resolved.

### **6. Warranty Period**

All Development Projects and many other City Projects are required to guarantee the completed work for a period of 1 year after filing of the Notice of Completion. This guarantee shall take the form of a Warranty Security similar to the Performance Security in form and content. It shall be in the amount of 10% of the Performance Security. The City will review the constructed work prior to completion of the 1 year time period and will require the Project Owner to correct any construction deficiencies.

In the event that the deficiency is due to inadequate or incomplete engineering design, then the Project Engineer shall revise the Plans to correct the problem. A revised design will extend the warranty period for 1 year after completion of the construction work.

The Warranty Security will not be released until all deficiencies are satisfactorily corrected.



## **SECTION IV**

### **SITE AND GRADING IMPROVEMENTS DESIGN**

#### **A. PURPOSE**

This section shall apply to all types of Development Projects, including but not limited to, Subdivisions, Multiple Family Housing, Commercial, Office, and Industrial, in the preparation of the Site Improvement Plans and Grading Plans for privately owned and maintained facilities.

##### **1. Discretionary Approvals**

All discretionary approvals shall have been approved, unless exception is granted by the City Council, prior to application for review of Site Plans.

##### **2. Building Permit Application**

All Site Plans, excepting Subdivision Grading Plans, are submitted with the Architectural Plans upon application for Building Permit. The Building Permit application and fees are then processed by CDD. During the review process, the Site Plans are referred to PW and comments returned to the Project Engineer via CDD.

#### **B. GRADING DESIGN REQUIREMENTS**

The Project Engineer shall comply with the following requirements in the preparation of Grading Plans for the project. The Building Permit review step is not required for Subdivision Grading Plans. Approval for Grading associated with individual house construction will not be issued until after application for a Building Permit.

##### **1. Building Permit Review**

All Grading design shall be subject to the provisions contained in the adopted City Building Code. Grading review of Building Permit applications for single family homes and other minor structures will be referred to Public Works at the discretion of the Building Department.

##### **2. Subdivision Plan Review**

A Grading Plan is required to be prepared for all projects which require a Final Map or Parcel Map. The Grading Plan shall be a part of the required Improvement Plan set. The Grading Plan will be reviewed concurrently with the Plans. Two copies of the Preliminary Geotechnical Investigation Report shall accompany the initial application, one copy of which will be forwarded to the Building Division of CDD for their records.

### 3. Preliminary Geotechnical Investigation Report

This Report shall be prepared by a California licensed Civil Engineer, Geotechnical Engineer or Engineering Geologist. It shall be based on an on-site investigation of the subsurface soils. The results shall be presented in written format, accompanied by any appropriate drawings, plans or map, essential to the clear presentation of the material. All references to other reports or work shall be listed by Author, Publication Name and Date.

#### a. Basic Content of Report

For all soils with distinctly different engineering properties, the Report shall contain the following information:

- (1) In-situ Properties
  - (a) Soil Profiles at Borings/Excavations
    - i) Changes in soils strata
    - ii) Soils types per the Unified Soil Classifications
    - iii) Water table
    - iv) Sample locations
  - (b) Density
  - (c) Moisture Content
  - (d) Sieve Analysis
  - (e) Compressive and Shear Strength
  - (f) Shrink/Swell Potential (clay content)
  - (g) Significant Seismic properties
  - (h) Optional Tests (when needed or ordered by City Engineer)
    - i) Plasticity Index
    - ii) Sand Equivalent
    - iii) Specific Gravity
    - iv) Tri-axial Shear
    - v) Consolidation
    - vi) Permeability
- (2) Engineering Recommendations
  - (a) Compaction Testing (at least 4 samples per test)
    - i) Plot of Dry Density vs. Moisture Content
    - ii) Optimum Moisture Content
    - iii) Maximum Dry Density
  - (b) Foundation recommendations
    - i) Allowable loads (normal & seismic)
    - ii) Differential settlements
    - iii) Subgrade preparation
  - (c) Soil Corrosivity for DI Water Mains
  - (d) R-value
  - (e) Retaining Walls
    - i) Active loading (normal & combined wind/seismic)
    - ii) Sliding resistance (friction and shear)



- iii) Passive resistance
- (f) Optional recommendations (when needed or ordered by City Engineer)
  - i) Lime-treated subgrade
  - ii) Retaining Walls

#### **b. Test Borings and Excavations**

A complete set of Boring and/or Excavation Logs shall accompany the report. The Logs shall be presented in a graphical context, drawn to scale, including information which details the various types of soils encountered and properties which are significant, in the opinion of the investigating Engineer, described and noted by depth and location. A Site Plan shall also accompany the Report which shows the approximate locations of the Test Borings and Excavations.

Test boring locations shall be determined by the investigating Engineer such that they provide a representative sampling of the engineering properties of the soils. Borings shall be spaced at approximate intervals not to exceed 250 feet, and not less than 4 for any particular Report. The minimum depth of investigation shall be approximately 12 feet. At least one of every five test borings shall extend to 35 feet.

#### **c. Grading Recommendations**

The Report shall contain recommendations for grading procedures to satisfy the provisions of the Building Code in regard to foundation preparation and the Standard Specifications in regard to street excavations and embankments. The Geotechnical Engineer shall make recommendations which minimize the amount of expected settlement or other deleterious movement or behavior of the ground after completion of grading operations.

The investigation to determine the grading recommendations shall be based on compaction testing of the on-site soils. The Geotechnical Engineer shall perform compaction test at differing moisture contents to determine the optimum moisture content to achieve the maximum relative compaction. One set of tests shall be prepared for each soil type with distinctly different engineering characteristics. The Report shall present a recommended optimum moisture content and minimum relative compactions for the various types of uses. All compaction testing shall be based on method ASTM D-1557 (Modified Proctor).

#### **d. Soil Corrosivity**

The Geotechnical Engineer shall investigate the properties of the soil in regard to corrosion of Ductile Iron Water Pipe. The soil corrosivity investigation shall conform to the provisions of AWWA Designation C-105, Appendix A, *Notes on Procedures for Soil Survey Tests and Observations and Their Interpretation to Determine Whether Polyethylene Encasement Should Be Used*. The Report shall contain the results of tests for Resistivity, pH, Redox potential, Sulfides, and Moisture and shall be tabulated and evaluated per Table A.1 *Soil-Test Evaluation* of said Appendix.

Soils samples shall be tested at intervals of 500 feet along the approximate alignment of any proposed water mains. The samples shall be taken at the approximate depths of the installed mains.

**e. Resistance R-value tests**

The properties of the site soils shall be tested for Resistance "R" values per California Test method 301, or an approved equivalent.

Soils samples shall be tested at intervals of 500 feet along the approximate alignment of any proposed streets. The samples shall be taken at the approximate depths of the future street subgrade.

**f. Retaining Wall Design Criteria**

When retaining walls may be required, the Report shall contain recommendations for passive and active soil loading conditions, as well as other criteria which will impact the design. The Report shall contain sufficient information to enable PW to review the design of the types of retaining walls required for the project.

**4. Building Pads**

Building Pads shall be created for all Subdivision projects for which a set of Plans are required. The limits of the Pads and their elevations shall be shown on the Grading Plans.

**a. Minimum Elevation**

Per City Code, the Project Engineer shall design the project so that the minimum elevation of the Building Pad is not less than one foot above the Base Flood Elevation as shown on the current Flood Information Rate Map (FIRM), Federal Emergency Management Agency (FEMA). The Project Engineer should check with PW to determine if there are any Letters of Map Revision (LOMR) or Amendment (LOMA) affecting their project. In accordance with City Code, the Developer is responsible for processing any desired Letters of Map Revision or Amendment through the City and FEMA.

**b. Minimum Compaction**

The minimum compaction in all street areas shall be as required in the Standard Specifications. The minimum compaction under all future buildings, for which building pads are being constructed, shall be 90% relative density, as determined using ASTM Designation D-1557 (Modified Proctor).

**c. Drainage**

Drainage improvements shall be provided to move storm water runoff away from all proposed Buildings and Building Pads. Drainage away from Buildings shall comply with the provisions of the City Building Code. Drainage swales, or other physical improvements, such as, underground pipes and inlets, shall be provided at the edges of all Pads. The swales shall be graded at a minimum slope of 1% from the back edge of the sidewalk to the farthest reaches of the existing or proposed parcel of land. Whenever possible, the drainage from any proposed or existing lot shall be designed so that it does not cross lot lines before arriving at a public right of way or easement.

When due to lot arrangements, the drainage needs to cross another lot line before arriving at a public right of way or easement, then private drainage easements shall be created to contain a concrete or



asphalt lined ditch. The details of the design and easements, including provisions for maintenance, shall be subject to review by PW. All easement and maintenance documents shall be recorded in the Yolo County Records.

## **C. SITE IMPROVEMENT DESIGN REQUIREMENTS**

The Project Engineer shall prepare a Site Plan which details the on-site improvements, such as, but not limited to, grading, access driveways, parking areas, building locations, pedestrian access, bike access, drainage improvements, sanitary sewer and water improvements when they serve more than one building, water mains and fire hydrants for fire protection purposes, and other related improvements which serve the general public.

### **1. On-site Utility Maintenance**

All on-site utilities shall be privately owned and maintained. When the on-site utilities cross lot or parcel lines, then suitable easement and maintenance documents shall be prepared and reviewed by PW. All such documents shall be recorded in the Yolo County Recorders Office.

### **2. Site Grading Plan and Site Utility Plan**

At the option of the Project Engineer, the Site Plan may be divided into two types of Plans: a Site Grading Plan which shows grading, buildings, and parking; and, a Site Utility Plan which shows the various on-site utilities.

### **3. Frontage or Public Improvements**

A separate set of Improvement Plans shall be prepared and submitted to PW whenever there are substantial frontage or other public improvements.

### **4. On-site Traffic and Circulation**

The traffic circulation and parking shall be designed in accordance with the provisions of the City Code, such as, but not limited to, Zoning Ordinance, any discretionary approvals, and these Design Standards. The design shall provide for emergency vehicle access (Police and Fire), parking, DWR access, handicap access and parking, truck access, etc.

### **5. Private Water System**

In accordance with City Code, all use of water from the public system shall be monitored by installation of water meters. On projects other than single-family residential, separate meters are required for landscape purposes. The Developer may install private meters downstream of the City Meter to monitor use by individual buildings or units.

**a. Fire Hydrant Locations**

An on-site fire system, which has on-site Fire Hydrants, shall be designed in accordance with these Design Standards. All Fire Hydrant locations shall be reviewed and approved by the Fire Department. The on-site fire system shall be privately owned and maintained.

This system may be separated from the domestic water or landscaping systems. This fire system does not need to be metered except for the installation of a required back-flow and detector check device at the City connection(s). Per City Code, a full-size meter may be required at a later date if there is an unauthorized use of water.

A system of looped fire mains shall be provided when more than one hydrant is served by any section of pipe. The materials and construction up to and including the detector check device shall conform to PW Specifications. All fire hydrants, including lateral and shut-off valve, except pipe materials, shall conform to the Standard Specifications. All other pipe materials in the on-site system are not required to conform to the Standard Specifications.

The Project Engineer shall clearly detail all construction requirements on the Plans. This shall include details for construction of the fire system if the materials and construction differ from the Standard Specifications.

**b. Cross-Connection Control (Back Flow Prevention)**

All on-site water supply systems shall be connected to the City system using an appropriate Back Flow Prevention Device. The back flow device shall be attached immediately downstream of the water meter and shall be privately owned and maintained.

**6. Private Sanitary Sewer**

All on-site sanitary sewer systems shall be designed in accordance with the City Building Code and shall be privately owned and maintained. If the Developer desires to install to less than the Building Code requirements, then the design shall comply with all requirements for a public main, except for ownership and maintenance. Any such mains shall be designed to these Standards shall be inspected by PW and a fee paid to PW for this purpose.

**7. Private Storm Drainage**

All on-site storm drainage shall be designed in accordance with these Design Standards, except that the system shall be privately owned and maintained. Inlets other than the City standard may be used provided that they are suitable for the application. All inlets in parking areas shall be designed for truck loading. Inlets shall generally be spaced not further than 500 feet apart.

Positive drainage shall be provided away from all buildings using swales and/or drainage inlets and underground pipes. The minimum slope for these swales shall be 1%.



## **8. Existing Adjacent Improvements**

All existing improvements in the public right of way or easements shall be protected from damage and maintained in a good workable conditions. The Developer shall obtain an encroachment permit to construct any minor improvements such as driveways and service connections.

### **a. Sidewalk replacement**

Whenever sidewalk adjacent to a project is significantly damaged or in disrepair, although such damage or disrepair was not caused by the Developer or Contractor, it shall be replaced with new sidewalk prior to issuance of a Certificate of Occupancy.

## **D. EROSION CONTROL**

These requirements apply to the Developer, Project Engineer, Project Architect, and Contractor(s) working on a project. The Developer or Project Owner is responsible for conveying these various requirements to the Construction Contractor.

### **1. Permanent Erosion Control Design**

The project designers shall design the grading and landscaping improvements to provide control of erosion and to prevent the off-site transport of silt and other deleterious substances due to storm water runoff.

Consideration shall be given to the time of year in establishing the construction schedule. Permanent landscaping improvements shall be installed so that it is 95% effective in preventing erosion prior to the start of the winter rainy season.

### **2. Summer Construction Erosion Control Practices**

The Developer and/or Contractor shall prevent the off-site transport of dust, dirt or any other deleterious substances during the construction period, including times when the contractor is not actively working on-site.

Spills of construction materials, and/or mud and dirt tracked off the site by construction delivery vehicles shall be cleaned up on a regular basis by the Contractor.

### **3. Winter Construction Erosion Control Practices**

If construction is anticipated to continue through the rainy season, then the Developer and/or Contractor shall be responsible for preventing the off-site transport of silt or other deleterious substances due to storm water runoff.

Upon completion of the on-site grading, the contractor shall seed all sloped areas subject to erosion, provide intermittent silt traps in swales or drainage paths as needed, and provide silt traps where any storm water enters the underground pipe system. Every effort shall be made to prevent heavily silt-laden storm runoff from entering the City drainage system.

The Contractor shall also clean the tires of all construction vehicles leaving the site to prevent the tracking of mud and dirt onto existing City Streets. Cleaning and washing of City Streets adjacent to the site of work shall be performed on a regular basis. The washing of large quantities of mud and dirt into the City drainage system is not allowed.



## SECTION V

### TRANSPORTATION SYSTEMS DESIGN

#### A. GENERAL

The intent of this section is to describe the most common practices in the City of Davis in regard to street, bicycle and pedestrian systems design and improvement. Almost all significant transportation elements (Arterials and Bike Paths) are reviewed during the approval of a General Plan, Zoning and Tentative Map for a project. In order to adequately study, analyze and review most street arrangements, they are reviewed during the preparation of the Environmental documents for the project.

Street lighting is required on all Public Streets, Pedestrian Ways and Bike Paths. Traffic Signals are required on many Arterials. Refer to the Sections on Street Lighting and Traffic Signal Design for these requirements.

##### 1. Reference Design Manuals

It is recognized that it is not possible to fully cover the subject of street design within these Design Standards. Therefore we have referenced other pertinent documents when available. We have repeated some of the more pertinent sections out of these reference documents, mostly for convenience. The Project Engineer shall refer to these other documents for details which may not appear herein or which may have been duly revised and adopted. The reference manuals are listed in the general order of precedence.

- (a) General Plan
- (b) Municipal Code
- (c) Project EIR, Traffic Study, and Discretionary Approvals
- (d) PW Standard Specifications
- (e) PW Design Standards (except where waivers are granted during project approval)
- (f) CALTRANS Highway Design Manual
- (g) CALTRANS Traffic Manual

##### 2. Preliminary Site Plan Approval

All transportation system arrangements require approval of a Preliminary Site Plan before the Project Engineer begins preparation of the Improvement Plans. An approved Tentative Map will generally suffice as a Preliminary Site Plan. The transportation system arrangement will be reviewed during the Public Works review of the various planning applications.

##### 3. Types of Streets

The following streets are defined in the General Plan. See the Typical Street Sections in the Appendices for details of the specific sections. The following generally describes the applications for each type of street.

**a. Major Arterial**

A fully improved four lane street serving large portions of the City, which functions as a distributor to and from Highways and other County Roads. Locations and alignments are defined in the General Plan. Direct access is usually restricted to large commercial and industrial users. Changes in locations and design sections are studied during the Project Environment Review Process and usually require completion of a Traffic Study.

**b. Minor Arterial**

A fully improved two lane street with a center two-way turn lane which functions as a distributors to and from Major Arterials. Locations and alignments are defined in the General Plan. Direct access is usually restricted to large commercial and industrial uses. Changes in locations and design sections are studied during the Project Environment Review Process and usually require completion of a Traffic Study.

**c. Collector**

A fully improved two lane street with all lanes fully delineated serving neighborhoods as a convenient connector to nearby Arterials. Usually the smallest street classification of street which connects to an Arterial. Usually the largest street classifications which has direct access to residential uses.

**d. Modified Local**

A fully improved street in residential areas which connects other locals to a Collector or Minor Arterial.

**e. Local**

A fully improved street in residential areas which connects to another local or collector. Usually serves less than 50 single-family homes or the equivalent. Also a cul-de-sac which is longer than 450 feet in length.

**f. Cul-de-Sac and Other Standard Streets**

A small fully improved street in residential areas, which is less than 450 feet in length, ending in a standard cul-de-sac type of turn-around.

Special street designs with minimal concrete curb, gutter or sidewalk for application in areas with large size lots or less than 10 dwelling units. Special street designs require approval of the City Council. Minimum paved width is 20 feet with concrete borders and buffers to adjacent uses.

**g. Bike Paths**

An improved off-street facility for transporting pedestrian and bicycle traffic. Usually placed adjacent to all Major Arterials, within Greenbelts and through Parks. City-wide alignments are shown in the General Plan.



#### **h. Private Roads**

Small privately owned and maintained streets which serve more than 3 and less than 10 single-family lots (or the equivalent). Minimum paved width is 20 feet.

#### **i. Common Driveways**

Common Driveways which are privately owned and maintained which serve up to 3 single-family lots. Usually used for flag lots. Minimum paved width is 15 feet.

### **4. Elements of Streets**

The following lanes shall be used as defined in the General Plan to provide for moving vehicular, bicycle, and pedestrian traffic within the City of Davis.

- a. Travel Lanes:** lanes primarily designed to carry vehicular traffic. May or may not be delineated with striping.
- b. Median or Island:** a landscaped center island on Major Arterials between vehicular lanes, with paved turn lanes at intersections.
- c. Two-way turn lane:** a paved center turn lane for the use of left turning and merging traffic on Minor Arterials.
- d. Turn lane:** a lane marked for left or right turning vehicles only. Either uniform width or tapered to also provide for acceleration (speeding up and slowing down) and merging of traffic.
- e. Free-right turn:** a combination of merge lane taper and an island on Major Arterials at all intersections to provide for minimal delays to right turning traffic.
- f. Bicycle Lanes (On-street):** lanes immediately adjacent to the outside travel lane for the purposes of carrying bicycles.
- g. Parking Lanes:** paved area on the street immediately adjacent to the concrete curb for the purposes of parking vehicles.
- h. Transit Turnouts:** paved areas for the sole purpose of bus stops, including area for shelter/bench and bike parking.
- i. Pedestrian Way:** improved paths, such as sidewalks and bike paths, for the use of pedestrian traffic. Bicycle traffic may be allowed to share the same facility.
- j. Bike Paths:** paths which are outside of the paved street section and/or within Parks, Greenbelts or easements, for the purposes of bicycle and pedestrian traffic.

## B. HORIZONTAL ALIGNMENT REQUIREMENTS FOR STREETS

The following requirements shall be used in the design of the horizontal alignment of public and private streets and bike paths.

### 1. Section Requirements

The geometric cross-section of the street shall conform to the General Plan and as otherwise approved by the City Council. Street sections and elevations shall be symmetrical about the street centerline. Non-symmetrical street sections require special approval of the City Engineer. See the Standard Street Section Details in the Appendices.

### 2. Design Speed and Sight Distance

All features of the street improvement and design shall be based on the following minimum requirements. Deviation from these requirements will require review by the City Traffic Engineer, the Safety Advisory Commission and approval by the City Council. The design speed shall be at least 5 mph greater and preferably 10 mph greater than the posted speed limit.

Minimum Design Speeds and Sight Distances		
Street Classification	Minimum Design Speed	Minimum Stopping Sight Distance
Major Arterial	45 mph	360 feet
Minor Arterial	40 mph	300 feet
Collector	35 mph	250 feet
Modified Local	30 mph	200 feet
Local	30 mph	200 feet
Cul-de-Sac, etc.	25 mph	150 feet
Rural	20 mph	125 feet
Bike Path	20 mph	125 feet
Private Street	20 mph	125 feet

### 3. Curves

Horizontal curves shall be used to provide a change in horizontal alignment. Minor directional changes may be accommodated at intersections, subject to PW review.



**a. Curve Radii and Design Speed**

The minimum horizontal curve radii shall be designed using the CALTRANS Highway Design Manual and the street design speed and in accordance with the following table.

Minimum Horizontal Curve Criteria	
Street Classification	Minimum Curve Radii
Major Arterial	700 feet
Minor Arterial	550 feet
Collector	425 feet
Modified Local	300 feet
Local	300 feet
Cul-de-Sac	200 feet
Rural	125 feet
Bike Path	50 feet
Private Street	50 feet

**b. Tangents**

Tangents between horizontal curves shall be provided on all streets. The minimum tangent length shall be 150 feet on Arterials and 50 feet on other streets. Tangent lengths may be reduced for curve radii larger than the minimum required, subject to approval by PW.

**4. Intersections**

**a. Basic Layout Criteria**

The following table shall be used as a guide in determining the various improvements to be installed at each type of intersection. Where two dissimilar types of streets intersect, the requirements for the larger capacity facility shall determine the minimum design criteria.

Basic Intersection Requirements					
Street Classification	Intersection spacing	Turn Lane provisions	Free Right provisions	Merge Lanes provisions	Stop Control provisions
Major Arterial (special approval)	1000 ft	left	Yes	Yes	Signals
Minor Arterial (special approval)	500 feet	two-way	@ Major Arterials	@ Major Arterials	Signals or Stop
Collector	300 feet	no	no	no	Stop
Locals and Cul-de-Sacs, etc.	200 feet	no	no	no	As needed
Bike Paths	Mid-block or corners	n/a	n/a	n/a	As needed
Private	100 feet	no	no	no	As needed
Driveways	50 feet	no	no	no	no

**b. Truck turning movements**

All intersections shall be designed to provide for turning movements of legal highway trucks. The standard turn movement templates prepared by CALTRANS shall be used to verify the ability of trucks to negotiate the various turns. U-turn movements may be prohibited by placement of appropriate signs.

**c. Sight Distances**

Visual sight clearances shall be provided for a stopped car at an intersection equivalent to the stopping sight distance of the intersecting street. The sight clearances shall allow a stopped car to see approaching traffic on the intersecting street for the required distance.



**d. Corner Radius Requirements**

The minimum radii requirements at intersection corners shall be as follows:

Radius Requirements at Corners		
Street Classification	Minimum Radius @ Curb line	Minimum Radius @ Right of Way
Major Arterials	90 feet	85 feet
Minor Arterials	35 feet	30 feet
Collectors	30 feet	25 feet
Locals and Cul-de-Sacs, etc.	25 feet	20 feet
Bike Paths	20 feet	No curve, chord line for radius of 20 feet

**5. Turn-arounds**

An approved turn-around shall be provided at the ends of all public streets, whether the end is temporary or permanent. The standard cul-de-sac design shall be used whenever feasible. Acceptable alternates shall provide for turning movements of the City Fire Trucks and other over the road highway vehicles. See the attached drawings for details.

**6. Driveways**

A driveway shall be provided for connection of any on-site roadway or parking area to a public street. All driveways shall be designed to meet handicap accessibility requirements.

Driveway Requirements		
Type of Use	Minimum-Maximum Width	Driveway Type (See Std Plan 301-4)
Industrial	35-45 feet	Special Design for Trucks, or Heavy
Commercial	25-45 feet	Heavy
Multiple Family	20-35 feet	Medium or Heavy, depending on # of units
Residential	12-30 feet	None in std. roll curb or Light in vertical curb
Bicycle Paths	8-12 feet	Light in all std. curbs

## 7. Transitions

All transitions where a lane is dropped shall be smoothly tapered to allow traffic to safely merge into the remaining lane of traffic. The required transition distance shall be determined by multiplying the design speed by the horizontal transition distance. The minimum transition distance on any street shall be 90 feet. The curb alignment for turn lane transitions shall follow the CALTRANS standard tapers.

## C. VERTICAL ALIGNMENT (GRADE) REQUIREMENTS FOR STREETS

### 1. Basic Criteria

All streets shall be designed to meet in accordance with the design speed and sight distance requirements of Section V.B.2.

### 2. Slopes

The minimum slope for concrete curb and gutter shall be 0.35% on tangents and sections where the radius is greater than 100 feet. When the radius of a curved section of curb and gutter is less than 100 feet, the minimum slope shall be 0.50%. Slopes above 6% will require special approval of the City Engineer.

### 3. Vertical Curves

A vertical curve shall be provided whenever the change in grade exceeds 2%. The minimum length of vertical curve shall be 100 feet on Arterials and Collectors and shall be 50 feet on locals and smaller. Curve length shall be designed based on stopping sight distance and design speed for sag or crest curves per the CALTRANS Highway Design Manual.

### 4. Cross-slopes

The street grades and elevations shall be designed to provide good positive runoff of rainfall throughout the entire section.

#### a. New Construction: Full or Half Street Section

The design pavement cross slope shall be 2.00% from centerline to gutter lip. This cross slope may be decreased to 1.50% at intersections. Increases in the design cross slope above 2.00% requires special approval of the City Engineer.

#### b. Construction adjacent to Existing Streets

The design pavement cross slope shall be a minimum of 1.50% and a maximum of 4.00%, from the conform point on the existing pavement to the lip of gutter. The existing pavement shall be overlaid with new pavement and/or removed and replaced with new pavement as needed to meet these requirements. Increased or decreased slopes require special review and approval of the City Engineer.



Cross-sections shall be provided at a minimum interval of 25 or 50 feet, as required, to verify the design cross slopes. The cross-sections shall show: existing pavement grades, elevations; existing adjacent ground elevations; proposed pavement grades, elevations, conform point; proposed curb and gutter elevation; and station of section. Cross-sections need not be a part of the Plan set and may be a separate document.

## **5. Transitions**

Transitions shall be designed to provide a smooth ride at the posted speed. New pavement shall be matched so that the finish surface is flush with existing pavement. Abrupt vertical transitions and feathering of pavement (gradually decreasing pavement thickness) to achieve a smooth transition is not allowed. The existing pavement shall be planed when necessary to provide a minimum pavement thickness of 2 inches at the conform point.

## **D. PEDESTRIAN AND HANDICAP ACCESSIBILITY**

All public and private street designs shall be designed to provide pedestrian and handicap access. A handicap accessible pedestrian path shall be provided on each side of all fully improved public streets. Any deviation from handicap accessibility requirements requires approval of the City Engineer and may also require other City approvals.

In residential areas, alternate locations of pedestrian ways not adjacent to the street may be acceptable. All such alternate locations require review by the City Traffic Engineer, the Safety Advisory Commission and approval of the City Council.

Handicap ramps shall be provided at all corners, intersections and other locations where a handicap person is expected to cross the street. Ramps shall be provided on both sides of the street more or less directly opposite each other. All delineated crossings with handicap ramps shall be perpendicular to the street centerline.

## **E. STREET STRUCTURAL SECTION**

All public streets and bike paths shall be designed to provide a useable minimum life of 20 years. The Project Engineer shall include all anticipated construction traffic in the calculation of design life of street facilities.

### **1. Basic Design**

All street structural sections shall be designed using the CALTRANS Highway Design Manual methods for Asphalt Concrete Pavement.

The R-value shall be determined by the Project Geotechnical Engineer based on testing of the on-site soils. The design Traffic Index shall be based on the Average Daily Traffic volumes, including Truck Traffic, per any approved Traffic Study, or based on the following table, whichever is greater.

Traffic Index Requirements	
Street Classification	Minimum Traffic Index
Major Arterials	9.0
Minor Arterials	7.0
Collectors	7.0
Modified Locals	6.0
Locals	5.0
Cul-de-Sacs, etc.	4.5
Private	4.0

**2. Underdrains**

The Project Geotechnical Engineer shall report on the ability of the subsurface soils to rapidly carry away drainage water which may leach into the ground. Streets in areas with soils with very low soil permeability will require the use of street underdrains. Areas of the City in which underdrains are required are: all areas West of Highway 113 (Aspen, Stonegate, Evergreen, etc.), and Covell Park subdivisions (including Northstar).

**F. LANDSCAPING REQUIREMENTS**

The medians and other bare ground areas of all new Streets shall be fully landscaped with irrigation. The landscaping shall meet City requirements for low water use and durability. The minimum width of any landscape area shall be 4 feet.

In medians, a suitable 2 feet wide buffer, such as decomposed granite, shall be provided between the landscaped area and the median curb. The median landscaped areas shall be edged with wood headers, such as are used along the edges of bike paths.

All median landscaping will be subject to the review of PCS.

**G. BICYCLE PATH DESIGN**

All Bicycle Path design shall conform to the requirements contained in the CALTRANS Highway Design Manual, Chapter 1000, "Bikeway Planning and Design", and to the requirements of these Design Standards.

A Class I Bikeway, as defined in the CALTRANS Highway Design Manual, is equivalent to the City's Bike Path requirements.



A Class II Bikeway, as defined in the CALTRANS Highway Design Manual, is equivalent to the City's Bike Lane requirements.

A Class III Bikeway, as defined in the CALTRANS Highway Design Manual, is generally not defined within this document. All City Streets are considered to serve as acceptable routes for bicycle traffic.

## 1. Bike Path Design Requirements

Situations not covered within these Design Standards shall refer to the CALTRANS Highway Design Manual. Any such situations also require the special review and approval by PW.

### a. Horizontal Alignment

The minimum centerline curve radius on Bike Paths shall be the minimum necessary to provide for smooth passage of Emergency Vehicles. At intersections with other paths, the minimum radius along the edge of path shall be 20 feet.

### b. Width

The minimum paved width for Bike Paths shall be 10 feet, except in separation structures the allowable width shall be 12 feet clear between rails or walls of the structure, whichever is less. A minimum horizontal clearance of 2 feet shall be provided to any obstruction.

### c. Vertical Clearance

The minimum vertical clearance to any overhead obstruction shall be 8 feet measured from the finish pavement grade.

### d. Vertical Alignment (Grade)

The maximum allowable slope, parallel to the path direction, shall be 4.9%. Any change in grade exceeding 2% shall be accomplished using a vertical curve. Paths may be constructed at no slope provided that there is adequate drainage.

### e. Cross-Slope and Drainage

The design cross-slope on new paths, perpendicular to the path direction, shall be 2.00%. The paths shall be sloped all to one side to allow for drainage. Suitable drainage improvements shall be provided in the vicinity of the path to carry away all storm drainage flows. Storm flows from the 10-year design storm shall not encroach onto the path.

### f. Minimum Section

The minimum structural section shall be 3 inches of Class B Asphalt Concrete on compacted sub-grade, per Standard Drawing 301-7.

**g. Lighting**

Standard Post-Top Luminaires shall be provided for all Bike Paths. Minimum size and spacing is 14 feet, in height, 70 Watt HPSV, at intervals not to exceed 135 feet. Lights shall also be provided near all Path intersections and connections to adjacent streets. The center of the light post shall be placed 1 foot from the edge of the path.

**2. Bike Lane Design Requirements**

A separate Bike Lane shall be provided on all Arterial and Collector type streets, one for each direction of travel. The Bike Lane shall be immediately adjacent to the outside Travel Lane. The Bike Lanes shall be delineated (striped) if there is also an adjacent on-street parking lane. Bike Lanes are considered to be shared lanes with motorized vehicular traffic on all other classifications of streets.

**a. Width**

The minimum width for Bike Lanes shall be 8 feet, except where the Bike Lane is adjacent to a Parking Lane, then the minimum width shall be 7 feet. Depending on the availability of right of way in improvement projects on existing streets, special approval may be granted for a narrower width.

**b. Clearance**

The minimum vertical clearance to any overhead obstruction shall be that required for the street.

**c. Vertical Alignment (Grade)**

The maximum allowable slope shall be the same as for Streets.

**d. Cross-Slope**

The maximum allowable cross-slope, perpendicular to the lane direction, shall be 5.00%.

**e. Minimum Section**

Provide the minimum structural section as required for the street design.

**f. Lighting**

Provide standard street lighting.

**g. Delineation (Striping)**

All Bike Lanes adjacent to on-street parking shall be delineated with a stripe between the bike lane and adjacent traffic lane. See Section V.H, Delineation and Striping for details.



### 3. Intersections and Street Connections

All Bike Paths shall be connected to the City Street system at regular intervals as approved by PW and/or as required by the General Plan and other project documents or approvals.

#### a. Bike Path Connections - Arterials

If the Bike Path makes a grade crossing of an Arterial, it shall be accomplished at an intersection with a Traffic Signal. The bike/pedestrian traffic shall utilize the bike/pedestrian features provided at the signalized intersection to cross the Arterial Street.

Other connections which originate along an Arterial shall use the standard ramp to provide for access to the adjacent on-street Bike Lane.

#### b. Bike Path Connections - Other Streets

Bike Paths shall be connected to Collector and Local streets using the standard bike ramp. The ramp shall be located where it does not conflict with other traffic movements. Mid-block connections are discouraged due to the conflict of bike traffic entering the street at a right angle to street traffic.

### 4. Grade Separations (Above or Below Ground)

Bicycle Path Grade separations structures shall be provided as indicated in the City General Plan and at the locations specified by the City Engineer, or as may be required in the Project approvals. All design details of grade separations require approval of the City Engineer. In addition, review by the Traffic Safety Commission may also be required.

The type of structure, above street level (bridge) or below street level (tunnel) shall be determined by the interactions of factors, such as, but not limited to, economics of construction, right of way availability, interference with other utilities and improvements, public safety, etc.

Experience has shown that tunnels are generally the most economical means of crossing other transportation features. All tunnel design shall conform to the details shown on the attached Standard Plan. Although specific requirements are not included herein for bridges, the applicable portions of the tunnel criteria shall be applied to bridge crossing design. The remainder of this section is devoted to tunnel crossing design criteria.

#### a. Horizontal Alignment

The Bicycle Path crossing alignment shall generally be placed perpendicular to the centerline of the street, highway or railroad being crossed. The termination points for the crossing shall be located in greenbelts or parks. The minimum greenbelt or park width at the crossing location is 100 feet.

Parking lanes and two-way turn lanes on streets which cross a tunnel may be dropped over the tunnel. Adequate transition distances shall be provided in accordance with these Standards. Parking lanes cannot be eliminated for land uses with high parking demands. Two-way turn lanes cannot be eliminated if there is insufficient transition distance to the nearest intersection(s).

**b. Clearances**

The total nominal clear area shall be 8 feet high and 12 feet wide. A minimum clear area of 8 feet wide and 8 feet high shall be provided for the use of bicyclists and pedestrians. All lighting fixtures or other physical improvements shall be placed outside of this 8'x8' clearance zone. At least 2 feet horizontal clearance shall be provided along each side of the path. Minor intrusions (lighting fixtures, structural fillets, etc.) into the horizontal clearance zones alongside the path are acceptable.

**c. Sight Distance**

A minimum stopping sight distance of 140 feet shall be provided on all sloped approaches to the crossing structure. The sight distance shall be measured from the ends of underground tunnels. The path alignment on tunnels shall allow an approaching cyclist to see through the tunnel to the other end from a point 140 feet away from the end of the tunnel.

**d. Slope Requirements**

The grade of the path shall not exceed a slope of 4.9%, whether ascending or descending. The path, within the confines of the structure, shall be designed with a cross slope of 2% for Asphalt Concrete and 1% for Portland Cement Concrete. The cross slope on tunnels shall drain all to one side. The tunnel shall also be sloped to drain towards the ends.

**e. Lighting**

Surface mounted lights shall be provided within tunnels. All tunnel lighting shall be dual 6' fluorescent tubes with impact resistant covers. The lighting fixtures shall be housed in wire mesh cages. Conduits shall consist of 3/4" rigid tubing flush mounted to wall.

Standard street or post-top bike path lights shall be used on bridges.

**f. Slopes and Retaining Walls**

Retaining walls will not be allowed adjacent to the Bike Path as it descends to the structure entrance. The ground slope around the descending path shall not exceed a ratio of 2½:1 (horizontal:vertical). Retaining walls and the break point for slopes shall be located at least two feet away from the bike path.

**g. Wing Walls**

Wing walls shall be provided at the ends of the tunnel. The interior angle between the approaching path and the wing portions shall be at least 45°.

**h. Safety Fencing**

Steel cable fencing shall be provided continuously along the tops of any walls which exceed a height of two feet. Any fencing adjacent to the back edge of sidewalk shall conform fully to the requirements of the Uniform Building Code for railing.



**i. Drainage**

Adequate drainage facilities, including any required pump stations, shall be provided to prevent storm water runoff from entering the tunnel. Drainage water will not be allowed to drain through the structure, but shall be collected via a pipe system at either end.

**j. City Water Main**

City water mains shall cross over or around the tunnel, but may not go underneath it. Sand bedding shall be provided between the water main and the tunnel when there is less than 12 inches of clearance. A 6" concrete cap shall be provided over the water main when there is less than 24 inches of clearance to finish grade or it is within the road structural section. The preferred alignment for water mains is in the street.

**k. City Sewer and Storm Drains**

City sewer and storm mains may cross under the tunnel. At least 12 inches of clearance shall be provided between the main and the structure. Smaller clearances will require special designs to prevent breakage of the sewer or storm main caused by movement of the structure.

**l. Joint Trench Utilities**

Joint trench utilities, such as PG&E, PacBell, and CATV, shall cross over the tunnel. Steel conduits shall be provided to carry the cables and pipes installed by the utilities. A 6" concrete cap shall be provided over the steel conduits. The conduits shall be extended beyond the structure to return the cables and pipes to the design utility trench section.

**5. Landscaping adjacent to Bike Paths**

Landscaped areas with irrigation shall be provided adjacent to all Bike Paths. Bike Paths in Greenbelts and Parks fulfill this requirement via the landscaping improvements provided. Bike Paths adjacent to streets shall have a minimum 5 feet wide landscape buffer between the Path and the Street. A minimum 5 feet wide buffer shall also be provided between the Bike Path and the street right of way line.

The landscaping shall meet City requirements for low water use and durability. The minimum width of any landscape area shall be 4 feet. All median landscaping will be subject to the review of PCS.

## **H. DELINEATION AND SIGNING**

Delineation (Striping and messages or legends) and signing shall be provided on all streets, whether public or private. All striping and signing shall comply with applicable Federal, State and Local, Laws (including Ordinances and Codes) rules and regulations.

The preliminary layout for all striping and signing will be subject to the review of the City Engineer and may be subject to review by the Safety Advisory Commission.

### 1. City of Davis Legends

All legends and messages shall be placed on the pavement using the City of Davis standard templates. As provided in the Standard Specifications, these templates can be borrowed by Contractors. The Project Engineer shall check with PW to determine differences in dimension from the CALTRANS standards.

### 2. Standard Signs and Stripes

All signs and striping patterns shall conform to the CALTRANS Traffic Manual, except where otherwise modified. The standard sign and striping detail numbers used on the Plans shall be the same as assigned in the Traffic Manual.

### 3. Installation of Signs

All signs on development projects will be installed by the Contractor. Signs on City projects may be installed by PW, as determined by the City Engineer.

### 4. Striping and Signing Requirements

The following table lists signing and striping requirements for the various types of streets.

Minimum Striping and Signing Requirements			
Sign and Stripe Combination	CALTRANS References	Type of Street	Comments on Usage
Yellow Centerline	Detail 2 Detail 1	Arterials Collectors	Use as required for centerline stripe.
Double Yellow Centerline	Detail 22 Detail 21	Arterials Collectors & ↓	Use as required for centerline stripe.
Two-way left turn lanes	Detail 32 Detail 31	Arterials Collectors & ↓	Use when there is a two-way left turn lane. Change to double yellow for turn pockets at intersections.
Lane lines	Detail 9	Arterials	Use as lane line on multi-lane Arterials.
Bike Lane lines	6" solid white	Arterials & Collectors	Use to delineate bike lane when between thru-lane and parking. Change to skip pattern at intersections.
Bike Lane lines	6" skip white	Arterials and Collectors	Use at approach to all intersections. Pattern: 96' of 12' solid, 4' skip.
Crosswalks	12' solid white, 10' apart.	All streets	Place crosswalks at all signalized intersections and as required. Use crosswalks at school crossings and bike path crossings.



Minimum Striping and Signing Requirements			
Sign and Stripe Combination	CALTRANS References	Type of Street	Comments on Usage
Stop Sign Stop Bar (Street Name Sign)	R1 (24" std) 12" White	All	Placed on intersecting streets at intersections with "Through Streets" and as required by Code. Street name sign is the only other sign which may be mounted on the same pole with the stop sign.
Stop legend	City "STOP"	Arterials and Collectors	Stop legend is 8' from stop bar.
Yield Sign	R1-2	Arterials	Place on near side of handicap ramp and sidewalk at "Free-right" turns at intersections with Arterials
Bike Lane Signs Bike lane legend	R81 City "BIKE LANE" & 1	Bike Lanes	Place at the beginning and end of bike lanes, and at all intersections. Install at intervals of 400' ± along bike lane.
End Bike Lane	R81/R81B	Bike Lanes	Place sign at end of bike lane.
Fire Hydrant markers	Blue reflector	All fire hydrants	Place 1' right or left of centerline toward fire hydrant. Place 1' right of left edgeline in streets with medians.
Street Name Signs	City Standard	All intersections	At signalized intersections, place on each signal pole. At other arterial & collector intersections, place at diagonally opposed corners. All local and smaller intersections get one sign.
Speed Limit Signs	R2 (24"x30") R2-4 & R3	All Streets as required	Speed limit signs are placed at changes in speed zones at generally near each arterial intersection.
No left, right, or U-turn signs	R16, R16B R17, R17B R19, R34, R34A, R73-3	All Streets	Used as needed to notify traffic of prohibited movements. No U-turn signs required at all arterial intersections with free-right turns. Use R73-3 on signal mast arms at intersections.
No Parking signs Red painted curb	R26, R28 R30 to R30B	All streets	Used as needed to indicate no parking zones. Face and top of curb are painted red. Red curb is also required at fire hydrants.
Radar warning & Speed Limit	R48 (30") R2 (36"x45")	All streets	Placed at City limits for approaching traffic.

Minimum Striping and Signing Requirements			
Sign and Stripe Combination	CALTRANS References	Type of Street	Comments on Usage
Handicap sign and painted legends	R99 Blue wheelchair symbol	Handicap parking	Use at all handicap parking spaces. Place sign and painted legend.
Pavement Transition Arrow legends	W11 (24")	At lane drops	Use where a thru-lane is merged with an adjacent lane. Place sign at beginning of merge. Place 3 arrows evenly spaced.
Signal Ahead Sign	W41 (36") City "A"	All streets	Use on all streets at the approach to the first signal along the street. Subsequent signals do not require this sign. Use at approaches to City from county.
Railroad sign	W47/W48	All railroads	Place at approaches to all railroad crossings.
School Zones	W63/W65 W65/R2/R72 W65-1 W66/W66A W64	At Schools	Place appropriate signs as authorized by Council to delineate school zones.
Stop Ahead legend	City Std.	All streets	Use as directed.
Turn Arrows	City Std.	All Streets	Use as directed in turn lanes.
Thru Arrows	City Std.	All streets	Use as directed to indicated thru-lanes at intersections.
Left Turn Pockets	City Std. Left Arrows, "Left Turn Only", 8" stripe, 12" stop bar.	At intersections	Use as directed to indicated left turn lane at intersections. Minimum length is 90'. Use crosswalk of stop bar, place 8" stripe to separate pocket from adjacent thru-lane. Use double yellow to separate adjacent opposing lane.
Other Signs, Stripes and Legends	Per Traffic Manual	All streets	Use signs, stripes and legends as directed by City Engineer and in accordance with the Traffic Manual.



## 5. Mounting Details

All signs shall be mounted so that the lower edge is at least 7 feet above the finish grade. The signs shall be placed so that they are 2 feet horizontally away from the edge of pavement or traveled way. No more than two signs may be mounted on one pole, except for matched sets. The preferred location for signs is on street light poles, in which case three signs may be mounted on the same street light. Street name signs at signalized intersections shall be mounted on the signal mast arm so that they face oncoming traffic.





## SECTION VI

### STORM DRAINAGE DESIGN

#### A. GENERAL

The Project Engineer will present all design information and calculations in a neatly written and well organized format. The design calculations shall be submitted with the initial submittal of the Improvement Plans. All design calculations shall be appropriately titled, dated, stamped and signed by the Project Engineer.

##### 1. Yolo County Flood Control and Water Conservation District (Yolo Flood)

Yolo Flood will also review and approve any facilities or improvements to be constructed outside of the City Limits or within one of their easements or facilities. Additional copies of the Plans and calculations shall be submitted directly to Yolo Flood, with a copy of the Transmittal Letter sent to PW. A signature block shall be provided on the Plan sheets to indicate approval by Yolo Flood.

##### 2. Acceptable Storm Discharges

The City Storm System is designed to convey clean storm water runoff. All runoff containing any toxic substances or any human wastes shall not be discharged into the storm system, onto public streets or onto any lands tributary to the City maintained drainage system. All such wastes shall be appropriately pre-treated, as required, and discharged to the City Sewer System.

##### 3. Computer Design Aids

The Public Works Department has prepared several different computer spread sheets on Lotus® and SuperCalc® for storm system design purposes. Disc copies of these sheets will be provided to the Project Engineer at no charge. Copies are provided on the condition that the Project Engineer assumes all risk and responsibility for their use and application.

##### 4. Design Storm Requirements

All development projects shall be designed to provide protection against flooding in accordance with the criteria contained in this section. All projects shall also comply with the Flood Damage Prevention Standards of the Municipal Code.

###### a. 10-year Storm Design Criteria

The storm drainage conveyance system for all drainage sheds with an upstream area which is equal to or less than 160 acres shall be designed to contain the flows from the 10-year Storm. All flows shall be based on the City's version of the modified Rational Method as defined herein.

**b. 25-year Storm Design Criteria**

The storm drainage conveyance system for all drainage sheds with an upstream area which is greater than 160 acres and equal to or less than 640 acres shall be designed to contain the flows from the 25-year Storm. All flows shall be based on a computerized modeling routine such as HEC-1. The flows shall be routed using the modeling routine. The hydraulic performance of the system shall be analyzed and designed using a computerized modeling routine such as HEC-2. Modeling routines which are substantially equivalent require approval of the City Engineer prior to their use.

**c. 100-year Storm Design Criteria**

The storm drainage conveyance system for all drainage sheds with an upstream area which is greater than 640 acres shall be designed to contain the flows from the 100-year Storm. All flows shall be based on a computerized modeling routine such as HEC-1. The flows shall be routed using the modeling routine. The hydraulic performance of the system shall be analyzed and designed using a computerized modeling routine such as HEC-2. Modeling routines which are substantially equivalent require approval of the City Engineer prior to their use.

**5. Storm Shed Map**

The Project Engineer shall prepare and submit copies of a Storm Shed Map which indicates all of the drainage sub-areas used for the calculations. The map for the onsite areas shall be the same scale as the Project Grading Plan. Each sub-area shall be labeled using a numbering system which assigns a letter for each distinct storm drain line and a number for each sub-area connected to that line (1-A, 2-A, 3-A, ... , 1-B, 2-B, etc.). The limits of all assumed land uses shall be clearly labeled and shall indicate the Rational Method C-value or SCS Method CN-value. All features of the conveyance system shall be shown, including pipe size, type, flow direction, design slope ( $s_d$ ), hydraulic slope ( $s_h$ ), and design flow ( $Q_d$ ). Design information shall be indicated at each inlet, including design flows thru, in and out ( $Q_{di}$ ,  $Q_{di}$ ,  $Q_{do}$ ), and design water surface ( $W_{sd}$ ). Localized flooding locations for 100-year storm water runoff and any overland flow routes shall be indicated. The escape route for storm flows which exceed the 100-year storm shall be indicated.

**B. DESIGN RUNOFF**

All storm drainage design shall be based on the runoff calculated using the following methods. All calculations shall be presented substantially in accordance with the Sample Calculations at the end of this Section. Deviation from these methods and requirements must be approved by the City Engineer.

**1. Davis Modified Rational Method**

The Rational Method of calculating runoff shall be used for all portions of storm drainage systems which are smaller than 640 acres. The City of Davis method of calculating runoff is an adaptation of the Yolo



County Basic Hydrology and Drainage Design Procedure (hereinafter referred to as the Yolo County method). Equation (A) shall be used to calculate runoff.

**Equation (A) Rational Formula for Storm Runoff Calculation**

$$Q_t = C \times I \times A \times F \times G$$

*Q* = Design Storm Runoff for Recurrence Interval *t* (cubic feet per second)

*C* = Composite Runoff Coefficient

*I* = Intensity of *T*-yr Design Storm (inches per hour)

*A* = Upstream Sub-Basin Tributary Area (acres)

*F* = Frequency Factor (1.00 for 10-yr & 100-yr Storms)

*G* = Geographic Factor (1.00 for Davis)

**a. Frequency Factors**

The design intensities of 10-year and 100-year storms shall be used with a frequency factor of 1.00 when calculating flows for these storm events. The design intensity for the 10-year storm shall be used with the following frequency factors when calculating flows for events other than the 10-year and 100-year storms.

Frequency Factors					
2-year Storm	5-year Storm	10-year Storm	25-year Storm	50-year Storm	100-year Storm
0.63	0.83	1.00 (Use 10-yr design intensity)	1.18	1.33	1.00 (Use 100-yr design intensity)

**b. Runoff Coefficients**

The Project Engineer shall verify that the selected coefficient is appropriate for the land use. Runoff coefficients for selected land uses and the 10-year and 100-year storms are listed in the following table. Coefficients for land uses other than those listed shall be calculated by figuring the weighted average of the amount of impervious area and the amount of landscaped area in the tributary area. The City Engineer will review and approve all runoff coefficients for uses not listed.

Runoff coefficients for storm events other than the 10-year and 100-year storm shall be modified using Figure 1.

The following table lists coefficients for land use vs 10-year and 100-year storm:

Runoff Coefficients for Land Use		
General Plan Land Uses	10-year Runoff C	100-Year Runoff C
Impervious	0.95	0.99
Core Commercial Area	0.80	0.93
Office/Commercial	0.75	0.90
Multiple Family	0.55	0.70
Single Family	0.45	0.60
School	0.35	0.50
Parks	0.25	0.40
Farm Land	0.25	0.40
Other	Weighted Average	Weighted Average

**c. Time of Concentration**

The Time of Concentration shall be based on the amount of time it takes runoff to travel from the farthest portions of a drainage basin to the point of concentration. It shall be based on the sum of overland flow, or starting time, channel or gutter flow and pipe flow. Engineering judgement shall be used in selecting an appropriate starting time of concentration.

The starting times of concentration generally need not be less than those listed in the following table.

Starting Times of Concentration	
Land Use by Type	Minimum times
Residential sub-areas (10,000 ft <sup>2</sup> lots and smaller)	10-15 minutes
Residential sub-areas (1/4 acre lots and larger)	15-20 minutes
Commercial and Office sub-areas	10-15 minutes
Industrial sub-areas	10-15 minutes
Parking lots	5-10 minutes
Landscaping	15-30 minutes



**d. Rainfall Intensity**

The Rainfall Intensity for the design storm shall be based on rainfall records for the Davis area. These records are published by the State of California, Department of Water Resources. The Public Works Department has compiled these records in Figure 2 and Figure 3.

**2. Other Methods of Analysis**

Other methods, such as, the U.S. Soil Conservation Service (hereinafter referred to as SCS methods), or the various methods prepared by the Army Corps of Engineers (known by HEC-## designations), shall be used for analysis of major sub-area portions of storm drainage systems when the entire system is larger than 640 acres. The details of application of the other methods requires special approval of the City Engineer.

**a. SCS - Volume of Runoff**

When the volume of runoff needs to be calculated, such as in the design of a detention basin facility with a very limited outlet, then it shall be calculated in accordance with Section 4, Hydrology, of the SCS National Engineering Handbook, latest edition, or the approved equivalent. The soils types shall be based on the Soil Survey of Yolo County, by SCS, dated June 1972.

**b. SCS TR-55**

When the peak flow vs time (hydrograph) needs to be calculated, it shall be based on SCS method TR-55, or the approved equivalent. The design storm shall be based on the Davis area rainfall records.

**c. HEC Programs (Corps of Engineers)**

The preferred method for determining the rainfall excess is the SCS Curve Number method. Other methods may be used, provided that calibration of the model against measured storm flows is performed. All elements of a project storm system shall be modeled and the flows routed to determine the storm water hydrograph at significant points in the system. All storm water routing shall be verified by performing hydraulic calculations using HEC-2 or similar approved programs.

**d. Presentation of Data**

All data shall be presented with a written report which outlines the basic process used, including any assumptions not covered herein. Detailed computer print-outs shall be included with the report, including all input information.

**C. CONVEYANCE FACILITIES DESIGN**

All Projects shall be designed with stormwater conveyance facilities which safely convey the 10-year storm flows. All Projects shall be designed in accordance with the Municipal Code to provide flood protection for the 100-year storm. The Project Engineer shall provide calculations which indicate compliance with the following criteria. All Modified Rational Method calculations shall substantially comply with the Sample

Calculations at the end of this Section. The following requirements shall be considered to be additive if a project is required to comply with sub-section 3, it shall also comply with sub-sections 1 and 2.

### **1. Grade Line Calculations**

The use of the term "hydraulic grade line" shall mean the actual water surface or the elevation of the kinetic energy grade line, whichever is higher.

The hydraulic grade line and energy grade line in the conveyance system shall be calculated for the required design storm. The design storm water surface at structures and flows in pipes shall be indicated on the Improvement Plans.

Suitable factors shall be used to account for losses due to the effect of: inflow and outflow losses through structures; changes in the direction of flow; substantial changes in flow velocity; changes in pipe size or slope; and any other physical feature or flow characteristic which impacts the hydraulic grade line.

### **2. 100-year Storm Flows Design**

The hydraulic grade line of the 100-year storm shall be lower than the elevation of the finish floor for any residential structures, including any appurtenant electrical, mechanical, or plumbing which may be damaged by flood waters. The 100-year excess which cannot fit in the enclosed system shall be safely routed overland through and/or around the project to an acceptable storm drain facility, while maintaining the required clearance to pads. It may also be stored within the street areas for short periods of time. The Project Engineer shall provide written evidence of the ability of the project to safely withstand the effects of a 100-year storm event.

### **3. Enclosed Conveyance Systems (Pipe)**

An enclosed system is preferred when the design storm peak flow is less than or equal to 100 cfs. The hydraulic grade line for the design storm peak flow shall not be higher than the finish elevation of the ground surface. It shall also be lower than the rim of manholes and lower than the gutter flow line at drainage inlets.

### **4. Open Conveyance Systems (Channels and Ditches)**

An open conveyance system may be used when the design storm peak flow exceeds 100 cfs. The hydraulic grade line of the design storm peak flow shall be at or below the top of bank of the open conveyance facility. The water surfaces in any appurtenant piped conveyance systems shall be at or below the top of the structure (manhole rim or gutter) if it is designed for these peak flows.



**5. Manning's Formula**

Manning's Formula, Equation (B), shall be used to determine the design parameters such as, capacity, slopes, velocity, hydraulic grade line, kinetic energy grade line, etc.

Equation (B) Manning's Formula

$$Q = \frac{1.486 \times R^{2/3} \times S^{1/2} \times A}{n}$$

- Q=Peak Flow (cfs)
- R=Hydraulic Radius (ft)
- S=Slope (ft/ft)
- A=Cross-sectional Area (ft<sup>2</sup>)
- n=Manning's n

Manning's "n" for use in Equation (B), shall be based on the values listed in the following table.

Manning's "n" for Storm Drainage Pipes	
Type of Pipe Material	Manning's "n"
Ductile Iron Pipe	0.013
Concrete Pipe up to 60" diameter (good quality)	0.013
Concrete Pipe up to 60" diameter (poor quality)	0.015
Concrete Pipe 60" and larger	0.012
Plastic Pipe (PVC, ABS, etc.)	0.010
Corrugated Steel Pipe, annular, unpaved	0.024
Corrugated Steel Pipe, annular, 100% paved	0.012
Corrugated Steel Pipe, helical, unpaved, (2-2/3" x 1/2" corrugations)	12" = 0.011 <sup>1</sup> 18" = 0.013 <sup>1</sup> 24" = 0.015 <sup>1</sup> 36" = 0.018 <sup>1</sup> 48" = 0.020 <sup>1</sup> 60"+ = 0.021 <sup>1</sup>
Corrugated Steel Pipe, helical, 100% paved, (2-2/3" x 1/2" corrugations)	0.012

Note 1: Do not interpolate for intermediate sizes of pipes. Use the highest listed values adjacent to the desired range.

Manning's "n" for all types and sizes of pipe, and for situations not covered herein, shall be approved by the City Engineer. Manning's "n" for the sizes and types of corrugated steel pipe not listed shall be based on the values as listed in the *Handbook of Steel Drainage and Highway Construction Products*, American Iron and Steel Institute. Manning's "n" for other unlisted pipe materials shall be based on publications of the appropriate Pipe Manufacturer's Association or *King's Handbook of Hydraulics*, McGraw-Hill.

**6. Minimum Velocity**

All new storm systems shall be designed to achieve a velocity of 2.5 feet per second when flowing 40% full or greater. All pipes flowing less than 40% full shall be designed to achieve a minimum velocity of 2.0 feet per second.

**7. Minimum Sizes - Streets**

The minimum size of storm line in public streets shall be 15 inches in inside diameter. The minimum size lateral from a street drainage inlet to a manhole shall be 12 inches in inside diameter.

**8. Pipes in Parks and Greenbelts**

Plastic Pipes for use in City Parks and Greenbelts shall meet the following criteria:

Plastic Storm Drain Pipe Criteria			
Pipe Diameter	Maximum Shed Area	Minimum Slope	Special Constraints
6"	0.5 Ac.	1.0%	Only allowed on last upstream section of storm drain. Minimum velocity not required.
8"	2.0 Ac.	0.5%	Minimum velocity required.
10"	5.0 Ac.	0.35%	Minimum velocity required.
12"	None	0.25%	Maximum size of plastic pipe which is allowed. Maximum area is only limited by capacity of pipe.

If sizes larger than 12" are required, then they shall conform to the requirements for pipe in streets.

**D. DETENTION FACILITIES DESIGN**

Detention Facilities shall be used, as required, to reduce and/or eliminate any impact due to development on downstream properties. All detention facilities shall be designed to provide protection for the 100-year storm.

Detention facilities shall be owned and operated by the City of Davis. The land encumbered by the detention facility shall be dedicated in fee to the City.



### 1. Capacity

All detention facilities shall be designed to safely store the flow from the critical 100-year storm event. A freeboard of 1 foot shall be provided to the lowest top of bank. The water surface in the facility during overflow conditions shall not be higher than the lowest residential finish floor in the tributary area.

### 2. Fencing

Fencing shall be provided around the detention facility to discourage human trespass and to prevent the intrusion of domestic pets. The minimum elevation for this fence shall be the 10-year water surface. The fence shall be a 5 feet in height chain link, painted a non-intrusive color.

### 3. Outlet Facilities

The Outlet Facilities shall be designed to discharge the maximum allowable flow based on project conditions. Outlet discharge capacity will be determined on a case by case basis and will require approval of the City Engineer and Yolo Flood. Suitable backup systems and/or redundant pumping capability shall be provided in order to assure reliable operation. All pumping facilities shall be connected to the City SCADA system.

### 4. Erosion Control

Erosion Control measures shall be developed and implemented for the detention facility. This shall include measures which prevent erosion due to wind generated waves and runoff from rainfall. The maximum slope of all banks or levees subject to inundation shall be a maximum of 3 (horizontal) : 1 (vertical). All slopes shall be protected by hydro-seeding or the equivalent.

An access road, minimum width 12 feet, shall be placed along the top of all levees (banks) and shall be covered with 4 inches of Aggregate Base or a standard City bike path. An access road shall be provided to the floor of the detention facility, which shall be at least 12 feet wide and shall not exceed a 10% slope.

### 5. Wildlife Enhancement

A Wildlife Enhancement and Landscaping Plan shall be developed for all detention facilities. This plan shall be prepared by an appropriately licensed and qualified firm or individual. This plan shall detail the number, size and species of plants to be used in planting within the facility, as well as the method of providing water to maintain the wildlife and vegetation. This plan shall be submitted, reviewed and approved by the Public Works Department and Parks and Community Services Department.

### 6. Wildlife Area Posting

The detention facility shall be posted as a wildlife area with permanent signs at appropriate intervals.

### 7. Construction Access

All construction firms and workers will be required to minimize their impact on any existing detention facility. Only personnel and equipment working in the facility area will be allowed access. Temporary fencing shall be installed to prevent any unauthorized access.

## **E. STRUCTURES AND APPURTENANCES**

### **1. Manholes**

Manholes shall be placed at intervals not to exceed 500 feet and at the intersections of all main lines. A drop of 0.10 feet through the manhole is required when the deflection angle between the inlet and outlet line(s) exceeds 45°. The deflection angle through a manhole shall not exceed 90°.

The invert of an incoming line shall not be higher than 12 inches above the crown of the largest pipe. In general, when the incoming line is smaller than the outgoing line, the crown of the incoming line shall not be lower than the crown of the outgoing line. The crown of minor lines shall match the crown of main lines, when feasible. In no case, shall the invert of the minor line be lower than the springline of the main line. All storm laterals which connect to a main line which is 30 inches in inside diameter or smaller, shall be connected to main lines at a manhole.

### **2. Drop Inlet Substitution for Manhole**

A standard City Drop Inlet with a manhole base may be substituted for a manhole provided that the inlet and outlet pipes are not larger than 24 inches in inside diameter. The inlet top shall be mounted on an appropriate "flat-top" slab.

### **3. Manhole Access Roads**

All weather access shall be provided to all manholes not in the public street right of way. The minimum width for an acceptable access road shall be 12 feet. The minimum width for the storm drain and access easement shall be 15 feet. Details of the access road design are subject to review and approval of the City Engineer.

### **4. Drop Inlets**

City Standard Drop Inlets shall be used to pick up all storm water runoff in the street area. Inlets shall be spaced so that the longest gutter flow length from summit to inlet does not exceed 500 feet, or such that the 10-year peak storm flow does not encroach into the nearest travel lane, or such that the depth of the 10-year peak flow is not higher than the top of curb.

The minimum fall from an inlet to a manhole shall be 0.2 feet.

The maximum depth of a drop inlet shall be 4.5 feet from the flow line of the gutter to the invert of the inlet. Inlets may be deeper if they are constructed with a manhole type base, although the inlet portion shall not exceed 24 inches in height, excluding the top slab thickness.

### **5. Special Structures**



All special structures shall be designed and detailed on the plans. Special consideration shall be given to earth loads and traffic loads. Any manhole which exceeds the dimensions of the City standard designs shall be considered a special structure. Special Manhole designs shall be prepared by the Project Engineer when the trunk storm line size exceeds 48 inches in inside diameter.

## **6. Private Connections**

The maximum amount of area which will be allowed to drain across the sidewalk into the public street right of way shall not exceed 10,000 square feet in residential areas and shall not exceed 5,000 square feet in office, commercial or industrial type areas. Any drainage exceeding these limitations shall be collected via an underground pipe system and connected to a defined drainage system, whether public or private.

The minimum size of private service shall be 12 inches in inside diameter and shall connect to the system at a drop inlet or manhole.

Small drains through the curb and under the sidewalk will be acceptable. The Project Engineer shall prepare and show details of this type of drain on the Plans. The drain shall be capable of passing the 10-yr storm flows without overtopping the sidewalk. Provisions shall be made to prevent debris such as leaves from interrupting the function of the drain.

All private service connections shall be sized and designed to convey the peak 10-year flows as calculated in accordance with this Standard.

## **F. ALIGNMENT REQUIREMENTS**

The horizontal and vertical alignment for storm drainage lines shall be designed in accordance with the following provisions.

### **1. Mains in Streets**

The preferred location for all storm mains is in the public street right of way. The Storm line shall be placed 6 feet right or left of the centerline of the street, opposite the sewer main. At least 5 feet of horizontal clearance shall be provided between the storm line and any parallel underground utility.

In streets with median curbs, the storm main shall not be located within the median area, except for perpendicular crossings. The storm line shall be placed in the center of the lane adjacent to the island curb.

### **2. Mains in Easements**

The minimum size easement shall be 10 feet wide with the main centered in the easement, if there are no manholes or inlets within the easement. If there are manholes or inlets within the easement then additional width shall be added, but not less than 12 feet total, to accommodate an access road. The access road need only extend to any inlets or manholes within the easement. Additional width shall also be added to the easement when the storm main is deeper than 10 feet and/or when the storm main is

larger than 24 inches in inside diameter, or when other parallel underground utilities share the same easement.

### 3. Horizontal Curves

Horizontal curves will be allowed provided that the total angle of curvature does not exceed 90° between structures. The minimum allowable curve radii shall be calculated using Equation (C).

**Equation (C) Horizontal Curve Formula for Storm Drainage Pipe**

$$\text{Radii} = \frac{57.3 \times \text{Length (ft)}}{\text{Allowable Deflection (°)}}$$

The allowable joint deflection shall be 80% of the manufacturers recommended maximum deflection.

### 4. Services

Storm services shall be located near the corners of the lot. The preferred location is 10 feet right or left of the lot corner. Services shall be provided at a spacing not to exceed 500 feet and shall connect to a drop inlet or a manhole. The service shall generally extend at a right angle from the main to the lot. Services shall enter the main or a manhole at a deflection angle not to exceed 90°.



**5. Minimum Cover**

The required depth of cover for all storm drain pipes shall be determined based on the strength of the pipe, soil loads, and traffic loads, including any impact factors. The minimum depth of cover shall be 12 inches below the flow line of the adjacent gutters. The following table lists the minimum allowable cover:

Minimum Cover for Storm Pipes			
Pipe Material	ASTM Designation, & Class	Street Min.	Off-Street Min.
Plain Concrete (CP)	C-14, Class II	2.25 ft.	1 ft.
Plain Concrete (CP)	C-14, Class III	2.00 ft.	1 ft.
Cast in Place Concrete (CIPCP)	None, See Std. Specs.	1.0 ft.	0.5 ft.
Reinforced Concrete (RCP)	C-76, Class I	2.25 ft.	1 ft.
Reinforced Concrete (RCP)	C-76, Class II	2.00 ft.	1 ft.
Reinforced Concrete (RCP)	C-76, Class III	1.50 ft.	1 ft.
Reinforced Concrete (RCP)	C-76, Class IV	1.00 ft.	0.5 ft.
Reinforced Concrete (RCP)	C-76, Class V	0.50 ft.	0.5 ft.
Asbestos Cement (ACP)	C-663, Class III	1.50 ft.	1.0 ft.
Asbestos Cement (ACP)	C-663, Class IV	1.00 ft.	1.0 ft.
Asbestos Cement (ACP)	C-663, Class V	1.00 ft.	1.0 ft.
Vitrified Clay Pipe (VCP)	C-700, Extra Strong	2.00 ft.	1.0 ft.
Polyvinylchloride (PVC) (8" to 12")	D-3034, SDR 35	Not Allowed	1.0 ft.
Corrugated Steel or Aluminum (CMP)	Steel: AASHTO M-36 Alum: AASHTO M-196	1.00 ft.	1.0 ft.
			1.0 ft.

The Project Owner assumes full responsibility for providing adequate cover and protection for the pipe during construction activities.

**6. Clearance Requirements to Other Utilities**

The storm facilities shall generally be located higher than sewer utilities, and lower than water and other facilities.

**a. Clearances to Water Facilities**

Storm facilities shall be installed at least 12 inches below all parallel or crossing water mains and services.

The vertical clearance may be reduced provided that the storm pipe material is Ductile Iron. The Ductile Iron Pipe shall conform to all of the requirements for pressure water pipe in the City Standard Specifications. Whenever the storm main crosses a water main or service with less than the required clearance, the minimum pipe length shall be 18 feet and shall be centered on the water main or service.

Storm facilities shall be installed with at least 10 feet of horizontal clearance to all water mains or services. Any reduction in horizontal clearance requires the approval of the City Engineer.

**b. Vertical Clearance to Other Utilities**

A vertical clearance of not less than 12 inches shall be maintained between all storm mains and all crossing utilities.

A vertical clearance of not less than 6 inches shall be maintained between all private storm services and all crossing utilities.

The vertical clearances required above may be reduced provided that Ductile Iron Pipe is used for storm, sewer and/or water pipes at the utility crossing. The minimum pipe length shall be 10 feet and shall be centered on the crossing utility.

**c. Horizontal Clearance to Other Utilities**

A horizontal clearance of not less than 5 feet shall be provided between all storm facilities and all other parallel utilities or structures.

**7. Storm Drain Clearance to Water Wells**

New Storm Drain Pipes shall not be placed closer than 50 feet to any proposed or existing public water well or operating domestic water well.

## **G. OTHER CONSIDERATIONS**

The Project Engineer shall design the drainage facilities for all types and conditions of use which can be reasonably expected during the life of the facilities. The minimum design life for all passive or non-mechanical items shall be 50 years. The minimum design life for all moving or mechanical items shall be 20 years. The longest possible design life shall be provided for any item or facility whenever it can be reasonably and practically attained.

**1. Connections to the Existing System**

All projects shall connect to the existing system at the locations specified by the City Engineer. When required by the City Engineer, the Project Engineer shall verify the capacity of downstream portions of the existing City Storm Drainage system. The Project Engineer shall specify on the Plans the methods and



procedures to be used in tapping into the existing system. All connections to the existing system shall be designed to minimize disruptions in service to existing users.

**2. Future Expansions of the System**

When a project is to be followed by subsequent phases of a multi-phase project, the Project Engineer shall provide facilities to expand the system beyond the phase boundaries. Storm Drainage mains, and/or other types of conveyance facilities, shall be extended beyond the edge of pavements to minimize disruption of traffic or disturbance of existing improvements.

**3. Trench Loading**

All storm facilities shall be designed to withstand the imposed loads of trench backfill and traffic.

**4. Corrosion Control**

The minimum design life for any storm drain facility is 50 years. Consideration shall be given to choosing materials and methods which provide the longest life. Metal pipes and similar materials shall not be used in soils which are corrosive by their nature. Soils which are rated 10 or higher when tested in accordance with the methods in Section VIII.H.4., shall be considered to be corrosive. All miscellaneous iron work shall be hot-dip galvanized or shall be stainless steel.

Figure 1 Runoff Coefficient vs Rainfall Frequency

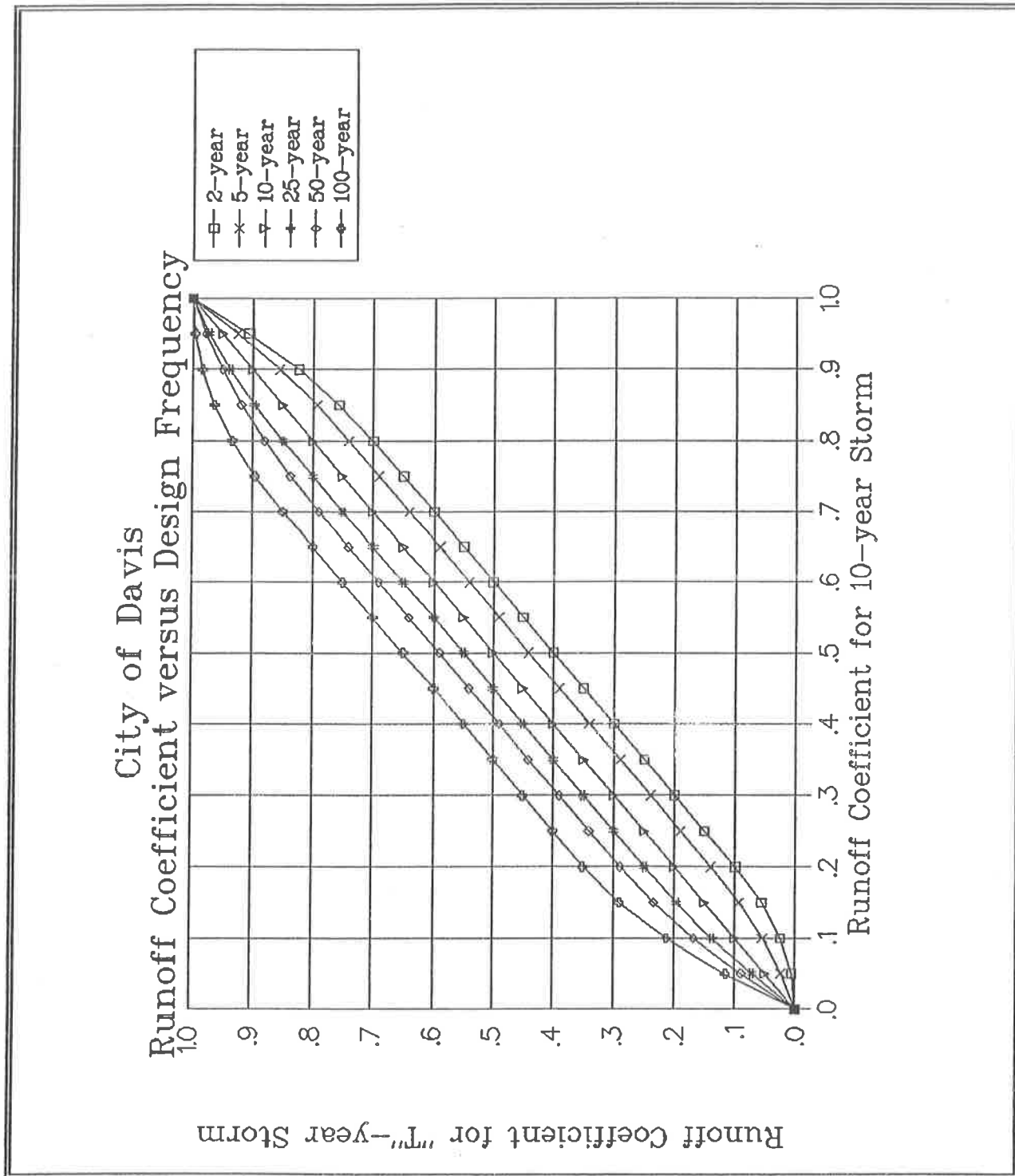




Figure 2 Rainfall Intensity (minutes) vs Duration

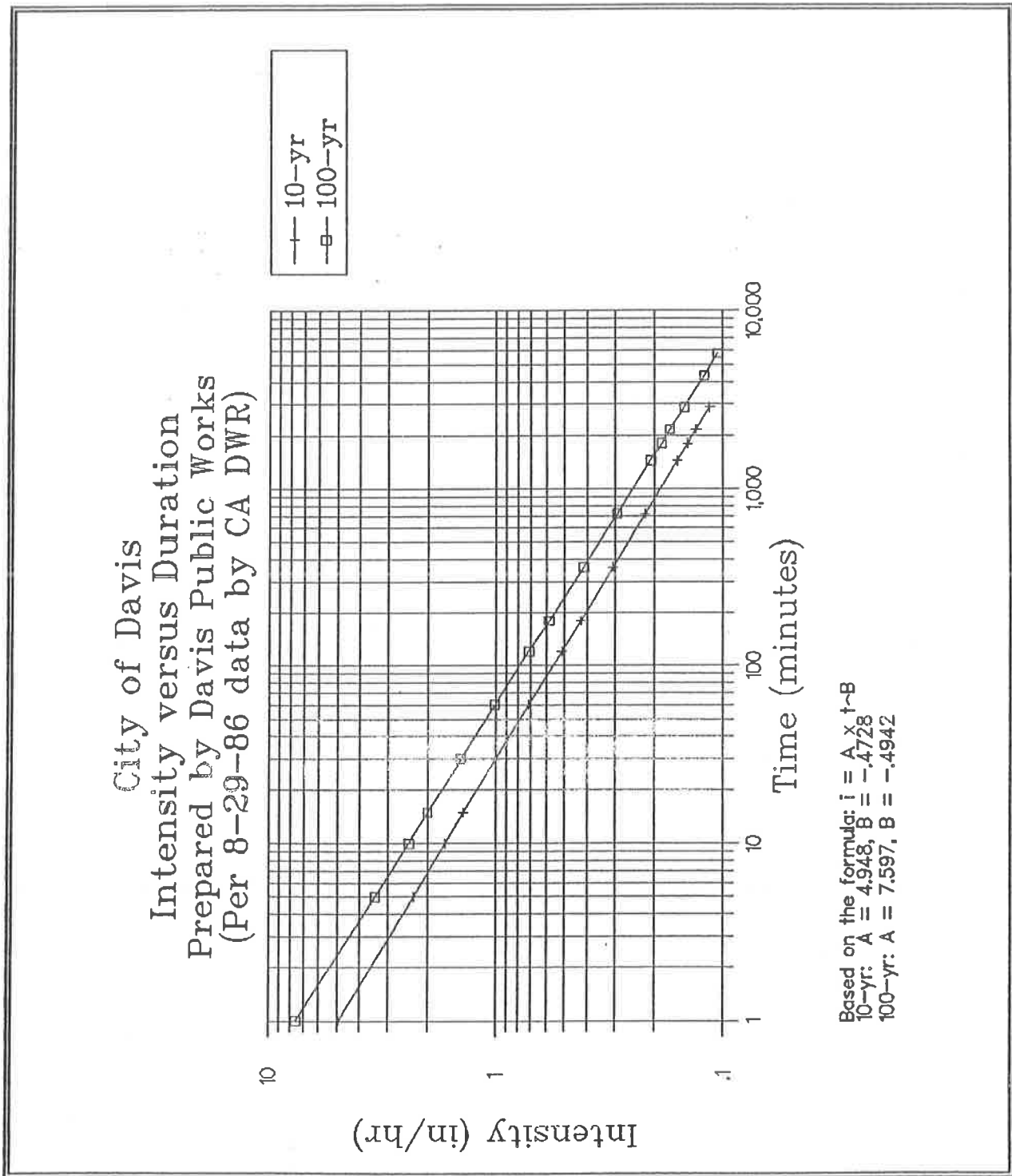
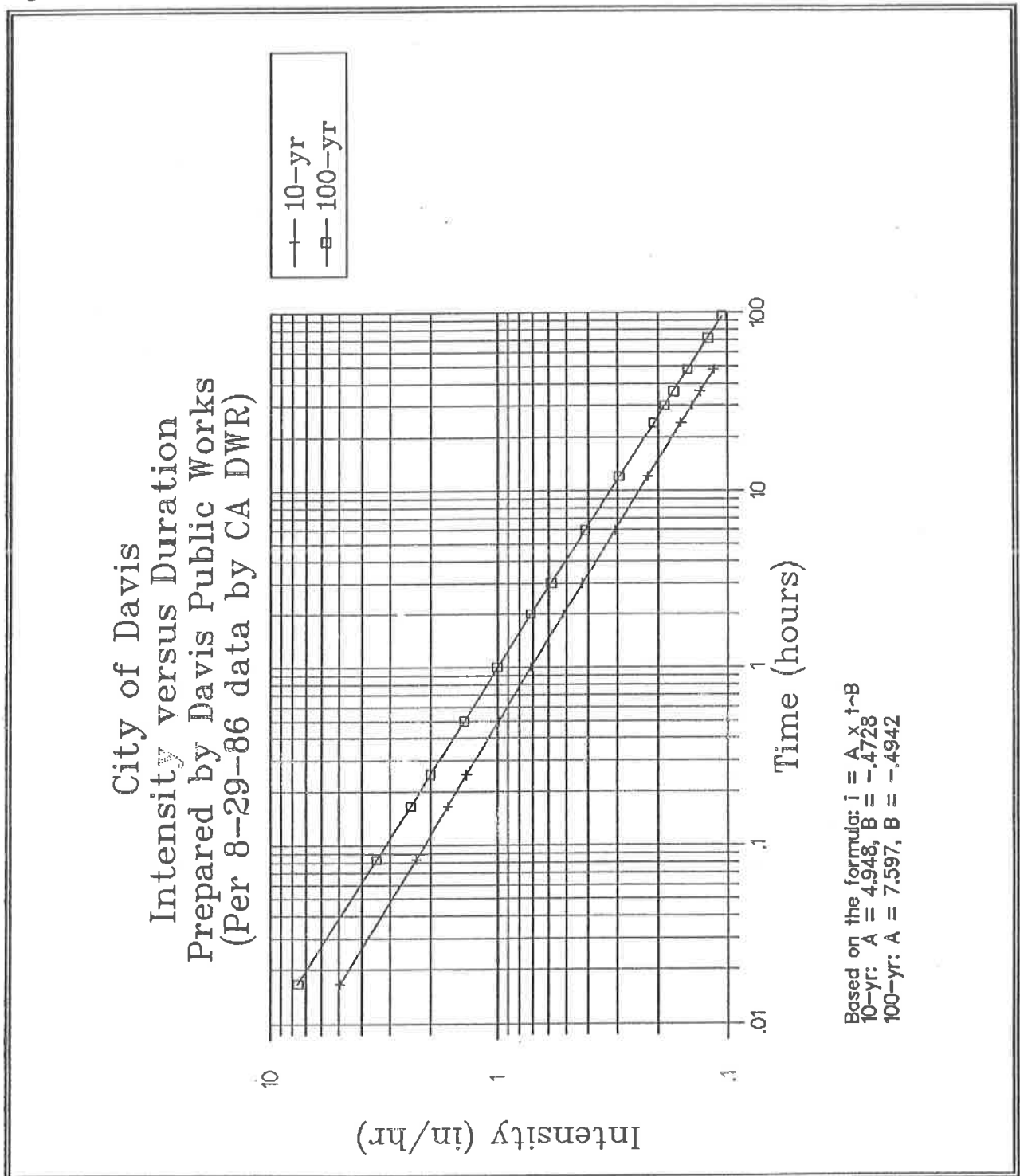


Figure 3 Rainfall Intensity (hours) vs Duration







# Davis Public Works Design Standard Storm Design

## SAMPLE DAVIS HYDROLOGY (RUNOFF) CALCULATIONS

Average Annual Precipitation =	17	Inches					
Minimum Time of Concentration =	15	Minutes					
<b>C-values: Off/Comm M-Fam S-Fam School Open/Park F G</b>							
2-year:	.650	.450	.350	.250	.150	.63	1.00
10-year:	.750	.550	.450	.350	.250	n/a	1.00
100-year:	.900	.700	.600	.500	.400	n/a	1.00
%Imp:	66.67%	40.00%	26.67%	13.33%	.00%		

### Sample Storm Line A

Area	Off. Comm.	Multi Family	Single Family	School	Open Space	10-year $\Sigma CxA$ sub-total	Tc (min)	Intensity (in/hr)	Flow (cfs)	100-year $\Sigma CxA$ Sub-total	Intensity (in/hr)	Flow (cfs)
A-1	5.00	.00	.00	.00	.00	3.75	15.6	1.35	5.1	4.50	1.95	8.8
A-2	.00	5.00	.00	.00	.00	2.75	19.7	1.21	7.9	3.50	1.74	13.9
A-3	.00	.00	5.00	.00	.00	2.25	21.7	1.15	10.1	3.00	1.66	18.3
A-4	.00	.00	.00	5.00	.00	1.75	10.50	1.10	11.6	2.50	1.58	21.3
A-5	.00	.00	.00	.00	5.00	1.25	11.75	1.05	12.3	2.00	1.50	23.2
<b>TOTALS</b>	<b>5.00</b>	<b>5.00</b>	<b>5.00</b>	<b>5.00</b>	<b>5.00</b>	<b>11.75</b>	<b>Peak Q =</b>	<b>12.3</b>	<b>12.3</b>	<b>15.50</b>	<b>Peak Q =</b>	<b>23.2</b>
Impervious	3.33	2.00	1.33	.67	.00	.470				.620		
						$\Sigma$ Area =	25.00			$\Sigma$ Area =	25.00	

### Sample Storm Line B

Area	Off. Comm.	Multi Family	Single Family	School	Open Space	10-year $\Sigma CxA$ Sub-total	Tc (min)	Intensity (in/hr)	Flow (cfs)	100-year $\Sigma CxA$ Sub-total	Intensity (in/hr)	Flow (cfs)
B-1	1.00	2.00	3.00	4.00	5.00	5.85	15.0	1.38	8.0	8.10	1.99	16.1
B-2	5.00	4.00	3.00	2.00	1.00	8.25	17.7	1.27	17.9	10.50	1.84	34.2
A-1,5	10.00	8.00	6.00	4.00	2.00	16.50	20.7	1.18	36.2	21.00	1.70	67.3
B-3	1.00	2.00	3.00	4.00	5.00	5.85	24.0	1.10	40.1	8.10	1.58	75.3
B-4	5.00	4.00	3.00	2.00	1.00	8.25	27.7	1.03	46.0	10.50	1.47	85.7
B-5	1.00	1.00	1.00	1.00	1.00	2.35	31.7	.97	45.4	3.10	1.38	84.4
<b>TOTALS</b>	<b>23.00</b>	<b>21.00</b>	<b>19.00</b>	<b>17.00</b>	<b>15.00</b>	<b>47.05</b>	<b>Peak Q =</b>	<b>46.0</b>	<b>46.0</b>	<b>61.30</b>	<b>Peak Q =</b>	<b>85.7</b>
Impervious	15.33	8.40	5.07	2.27	.00	.495				.645		
						$\Sigma$ Area =	95.00			$\Sigma$ Area =	95.00	

Davis Public Works Design Standards DESIGN

Sample Time of Concentration Calculations

Sample Storm Line A

Area	Overland Flow		Channel/Gutter Flow		Pipe Flow		Σtc
	Dist	n Slope tc	Dist	Vel tc	Dist	Vel tc	
Start	100	.4	300	3.0	50	2.5	15.6
MH	100	.4	400	1.5	250	2.5	19.7
MH	100	.4	400	1.5	300	2.5	21.7
MH	100	.4	400	1.5	350	2.5	24.0
MH	100	.4	400	1.5	400	2.5	26.7

Sample Storm Line B

Area	Overland Flow		Channel/Gutter Flow		Pipe Flow		Σtc
	Dist	n Slope tc	Dist	Vel tc	Dist	Vel tc	
Start	100	.05	400	1.5	350	2.5	15.0
MH	100	.20	400	1.5	400	2.5	17.7
MH	100	.20	400	1.5	450	2.5	20.7
MH	100	.20	400	1.5	500	2.5	24.0
MH	100	.20	400	1.5	550	2.5	27.7
MH	100	.20	400	1.5	600	2.5	31.7

Davis Public Works Design Standards PART TWO, STORM DESIGN

SAMPLE DAVIS HYDRAULIC CALCULATIONS

Sample Storm Line B

Jct Desc	K	System Parameters					Hydraulic Values - Full Flow					Inlet Elev	Above Crown	Below Surface	
		FL	L	So	Q	D	n	Sf	Vel	V <sup>2</sup> /2g	L*Sf				HGL
End		90.00										96.00	98.00	N/A	-2.00
B-5	-.01	92.00	600	.333%	45.4	48	.015	.133%	3.6	.20	.80	96.80	99.00	.80	-2.20
B-4	.06	94.00	550	.364%	46.0	42	.015	.279%	4.8	.36	1.53	98.35	100.00	.85	-1.65
A-1,5	.05	98.00	500	.800%	40.1	36	.015	.482%	5.7	.50	2.41	101.00	104.00	.00	-3.00
B-3	.25	100.00	450	.444%	36.2	36	.015	.391%	5.1	.41	1.76	103.00	106.00	.00	-3.00
B-2	.28	102.00	400	.500%	17.9	30	.015	.255%	3.7	.21	1.02	104.50	108.00	.00	-3.50
B-1	.50	103.00	350	.286%	8.0	24	.015	.168%	2.6	.10	.59	105.14	109.00	.14	-3.86

Sample Storm Line A

Jct Desc	K	System Parameters					Hydraulic Values - Full Flow					Inlet Elev	Above Crown	Below Surface	
		FL	L	So	Q	D	n	Sf	Vel	V <sup>2</sup> /2g	L*Sf				HGL
Line B		98.50										101.00	104.00	N/A	-3.00
A-5	.10	100.00	400	.375%	12.3	30	.015	.120%	2.5	.10	.48	102.50	104.00	.00	-1.50
A-4	.20	102.00	350	.571%	11.6	24	.015	.347%	3.7	.21	1.21	104.00	106.00	.00	-2.00
A-3	.25	104.00	300	.667%	10.1	21	.015	.541%	4.2	.27	1.62	105.75	108.00	.00	-2.25
A-2	.50	105.00	250	.400%	7.5	18	.015	.745%	4.4	.31	1.86	107.76	109.00	1.26	-1.24
A-1	1.00	106.00	200	.500%	5.1	15	.015	.817%	4.1	.26	1.63	109.66	110.00	2.41	-.34



## SECTION VII

### SANITARY SEWER DESIGN

#### A. GENERAL

The Project Engineer shall present all design information and calculations in a neatly written and well organized format. The design calculations shall be submitted with the initial submittal of the Improvement Plans. All design calculations shall be appropriately titled, dated, stamped and signed by the Project Engineer.

##### 1. COMPUTER DESIGN AIDS

The Public Works Department has prepared several different computer spread sheets using Lotus® and SuperCalc® for sewer design. Disc copies of these sheets will be provided to the Project Engineer at no charge. Copies are provided on the condition that the Project Engineer assumes all risk and responsibility for their use and application.

#### B. DISCHARGE REQUIREMENTS

All users connecting to the City sanitary sewer system shall comply with the prohibitions on discharge of substances into the sanitary sewer system contained in Article III, Chapter 23, "Sewers and Sewage Disposal," of the Municipal Code. A summary of the Code requirements is contained in the Appendices to these Standards.

In general, the City sewer system is designed to convey and treat the waste from residential type uses or uses that are substantially equivalent. Waste discharge from most Commercial uses, such as Professional Offices and Retail, may also be acceptable. All industrial users are required to fill out a questionnaire and may be required to apply for a significant industrial user permit to connect to the City sewer system.

##### 1. Permits

All users are required to obtain permits to connect to the City sewer system and discharge wastewater. Each user is classified according to the following sections and shall follow the requirements contained therein.

##### a. Single-Family Residential Permits

Individual Single-Family Residential permits are not issued for each unit. Prior to connection, the Map shall be recorded, connection fees shall be paid, public improvements shall be accepted by the City, and a Building Permit shall be issued by CDD. Each user shall connect to the service shown on the approved Plans. Any user which desires to install a new service or alter the existing service shall apply for and obtain a Utility Connection Permit from PW.

**b. Multiple-Family Permits**

Permits for this use will be issued after application for a Building Permit and payment of all connection fees. Each user shall apply to PW for a Utility Connection Permit.

**c. Retail, Office, Commercial and Industrial Permits**

Permits for these uses will be issued after application for a Building Permit. The connection fees for these uses are paid at recordation of any Map creating the lots or at application for a Building Permit, whichever is sooner. Each type of use shall submit information on the projected wastewater generation rates for review by PW. Each user shall apply to PW for a Utility Connection Permit. All non-typical uses are required to fill out a discharge questionnaire. Any significant pollutants, toxic materials or large wastewater flows, will classify the user as a Significant Industrial User.

**d. Significant Industrial User Permits**

See the Appendices for the permit application requirements and definition of a Significant Industrial User.

**C. FLOW RATES BY TYPE OF USE**

The following flow rates shall be the basis for all sewer systems collection and conveyance facilities. Where possible, they are based on City records of flow, including reasonable increases to insure a conservative design.

**1. Single Family Residential**

Single Family Residential uses include single family lots, duplex lots, triplex lots, fourplex lots, and mobile home parks. Any condominium project in which 50% of the units are three bedroom or larger shall be considered single family for the purposes of calculating flow rates.

The Single Family average daily dry weather flow rate shall be 110 gallons per capita per day. All Single Family units shall be assumed to have 3.0 persons per unit.

**2. Multiple Family Residential**

Multiple Family Residential uses consist of residential uses not encompassed by the Single Family definition.

The Multiple Family average daily dry weather flow rate shall be 110 gallons per capita per day. All Multiple Family units shall be assumed to have 2.1 persons per unit.

**3. Retail and Commercial uses**

The average daily dry weather flow rate for Retail and Professional Office uses, except medical offices and clinics, shall be 15 gallons per employee per day.

**4. Industrial uses**

The average daily dry weather flow rate shall be based on a complete description of the proposed use. The design flow rate shall be at least 10% more than the actual projected rate. All Industrial design flow rates require approval of the City Engineer.

**5. Table of Wastewater Flow Rates**

The average daily dry weather design flow rate shall not be less than those listed in the following Table:

Land Uses and Wastewater Generation Rates			
Description of Source	Type of Use	Unit	Design Flow (gallons)
Auto Service Station	Commercial	Employee	15
Auto Service Station	Commercial	Auto	11
Bar	Commercial	Customer	2
Bar	Commercial	Employee	15
Country Club	Recreation	Member	55
Hospital	Industrial	Bed	175
Hospital	Industrial	Employee	15
Hotel	Commercial	Employee	15
Hotel	Commercial	Guest	55
Industrial Offices	Commercial	Employee	15
Laundry (self-serve)	Commercial	Machine	600
Laundry (self-serve)	Commercial	Wash	55
Motel	Commercial	Employee	15
Motel	Commercial	Guest	35
Motel with kitchens	Commercial	Guest	55
Office (Typical)	Commercial	Employee	15
Residential, Single-Family	Residential	Unit	330
Residential, Multiple-Family	Residential	Unit	230
Restaurant	Commercial	Meal	4
Retail (Typical)	Commercial	Employee	15
Retirement Home	Industrial	Employee	15



Land Uses and Wastewater Generation Rates			
Description of Source	Type of Use	Unit	Design Flow (gallons)
Retirement Home	Industrial	Resident	110
School	Industrial	Student	11
School with Cafeteria	Industrial	Student	16
School with Cafeteria and Gym	Industrial	Student	21
Shopping Center	Commercial	Employee	15
Shopping Center	Commercial	Toilet	550
Theater	Commercial	Seat	3

**6. Miscellaneous Uses**

Uses for which it appears that the information listed above is not applicable, will be determined based on wastewater generation and use patterns. This information may include, but is not limited to, analysis of manufacturing processes, analysis of employee and patron use patterns, Code requirements, potential for accidental discharges, suitable factors to provide a conservative design, etc.,. These flow rates are subject to special approval of the City Engineer.

**D. LAND USES AND DENSITIES**

The above flow rates for the various uses shall be applied to the Land Uses as contained in the General Plan. They shall be applied at the maximum allowable densities regardless of the approved or proposed uses.

**1. Single Family**

All Single Family uses will be calculated at the maximum allowable densities based on the current version of the City's General Plan (4.2 units per gross acre). If applicable, the General Plan Density bonus (up to 25%) allowed for affordable housing units shall also be included in this density calculation.

**2. Multiple Family**

All Multiple Family uses will be calculated at the maximum allowable densities based on the current version of the City's General Plan (30 units per gross acre - Core area, 15 units per gross acre - All other areas). If applicable, the General Plan Density bonus (up to 25%) allowed for affordable housing units shall also be included in this density calculation.

**3. Retail, Commercial and Industrial Uses**

The density of Retail and Professional Office uses shall be calculated by assuming 1 employee per 250 square feet of floor area. The floor area coverage shall be based on the Final Development Plan and/or approved Zoning. In the absence of the above, the waste water generation may be estimated using the following values:

Floor Area Coverage by Land Use Type		
Land Use	Core Area	Other City
Retail	100%	25%
Office	100%	35%
Industrial	N/A	40%
Business Park	N/A	35%
Service Commercial	N/A	40%

If the waste water flows are estimated using the above values, then the Project Engineer shall verify system capacity, with the uses based on the approved Building Plans, prior to hook up to the system.

**E. PEAKING FACTORS**

The flows generated from the above flow rates and land uses/densities shall be used in conjunction with the Peaking Factors to calculate the peak flows in the sewer system. The Peaking Factor shall be figured using one of the following methods.

**a. Formula**

The Peaking Factor shall be calculated based on the average daily dry weather flow using Equation (D).

**Equation (D) Peaking Factor for Sewer Flows**

$$PF = 7.67 \times ADDF^{-0.093}$$

*PF = Peaking Factor*  
*ADDF = Average Daily Dry Weather Flow (Gallons)*

**b. Graph**

Figure 4 is based on the above formula.

## F. INFILTRATION/INFLOW ALLOWANCE

An Infiltration and Inflow allowance shall be added to the peak sewer flows to figure the design flow in the sewer system. The Infiltration/Inflow allowance for all new development areas shall be 600 gallons per gross acre per day. The area of streets and lots in all residential and commercial areas shall be included in the gross area. Areas such as parks and greenbelts which do not contain sewer facilities may be excluded from the gross area.

## G. PIPE AND CONVEYANCE SYSTEM DESIGN

All sewer system pipes and conveyance facilities shall be sized and designed in accordance with the following criteria and formulas. All gravity sewer systems shall convey the design flow without surcharging any portion of the pipe system.

### 1. Design Flows

The flow for hydraulic design of the system shall be based on the Peak Wet Weather Flow and shall be calculated using Equation (E).

Equation (E) Formula for Calculating Sewer Design Flow

$$PWWF = ADDF \times PF + II$$

*PWWF* = Peak Daily Wet Weather Flow (Gallons)  
*ADDF* = Average Daily Dry Weather Flow (Gallons)  
*PF* = Peaking Factor  
*II* = Infiltration and Inflow Allowance (Gallons)

### 2. Manning's Formula

Manning's Formula (Equation (F)) shall be used to determine the design parameters such as, capacity, slopes, velocity, etc. Manning's "n" for vitrified clay sewer pipe shall be 0.013. Other pipe materials require special approval.

Equation (F) Manning's Formula

$$Q = \frac{1.486 \times R^{2/3} \times S^{1/2} \times A}{n}$$

*Q* = Peak Flow (cfs)  
*R* = Hydraulic Radius (ft)  
*S* = Slope (ft/ft)  
*A* = Cross-sectional Area (ft<sup>2</sup>)  
*n* = Manning's n



**a. Variation of Manning's "n" with Depth**

The variation of Manning's "n" with depth does not need to be considered for most normal design situations. Manning's "n" shall be appropriately adjusted for variation with depth whenever a Project Engineer is proposing to design a system which does not meet the minimum criteria for slope or velocity. It shall also be adjusted for depth of flow whenever flow monitoring results are being analyzed for hydraulic performance. The *Clay Pipe Engineering Manual, National Clay Pipe Institute*, contains information on the variation of Manning's "n" vs depth.

**3. Minimum Velocity**

All new sewer systems shall be designed to achieve a velocity of 2.0 feet per second when flowing 40% full or greater. All pipes flowing less than 40% full shall be designed to achieve a minimum velocity of 1.8 feet per second. Minimum size mains with limited upstream connections may be exempted from this requirement. Although, every effort shall be made to provide the highest velocity possible.

**4. Minimum Sizes**

The minimum size of sewer main shall be 6 inches in inside diameter. The minimum pipe slopes shall be as listed in the following table:

Minimum Pipe Sizes and Slopes	
Pipe Diameter	Minimum Slope
6"	0.0050
8"	0.0035
10"	0.0025
12"	0.0020
> 12"	as approved

The minimum slopes for pipe sizes not listed shall be approved by the City Engineer.

**5. Oversizing of Sewer Mains**

Oversizing of sewer mains to meet slope constraints in a project is not allowed. Pipes designed to be laid at less than the minimum slope require special approval of the City Engineer. When design constraints require a lesser slope than those listed above, preference shall be given to using the smaller size pipes at less than minimum slopes. Particular attention shall be paid to preventing excessive sedimentation and to preventing generation of sulfides in flatter than minimum pipes.

## 6. Maximum Slopes

The maximum allowable slope for a sewer main shall be 10.00%. A drop manhole shall be used when the design requires a steeper slope. Slopes which prevent separation of the liquids and solids in the waste stream shall be given preference over steeper slopes.

The maximum slope for sewer services may exceed this slope provided they are constructed in accordance with Standard Plan 201-4.

## H. STRUCTURES AND APPURTENANCES

All structures and appurtenances shall be designed and placed in accordance with the following requirements.

### 1. Pipe Materials

Vitrified Clay Sewer Pipe shall be used on all sewer mains and services, unless shallow cover requires the use of Ductile Iron Pipe. Ductile Iron Pipe, conforming to the City requirements for water pipe, shall be used in areas with shallow cover. The use of any other types of materials will be subject to special approval by the City Engineer.

### 2. Sewer Manholes

Manholes shall be placed at intervals not to exceed 500 feet and at the intersections of all main lines. A drop of 0.10 feet through the manhole is required when the deflection angle between the inlet and outlet line(s) exceeds 45°. The deflection angle of a main or service into or through a manhole shall not exceed 90°.

A drop manhole shall be used when the vertical drop between the invert of the inlet main or service and the crown of the outlet main exceeds 12 inches.

All manholes shall be designed or placed to prevent storm water inflow through the top of the manhole.

The crowns of any inlet mains or services shall not be placed lower than the crown of the outlet main.

Sewer services shall be connected to trunk lines at a manhole.

An all weather access road shall be provided to all manholes outside of the public street right of way. The minimum width for the access road shall be 12 feet. Details of the access road design are subject to review and approval of the City Engineer.

### 3. Flusher Branches

Flusher branches may be used at the upstream terminus of 6" main lines when the distance to the downstream manhole is not greater than 250 feet. The branch shall be placed as near to the end of the street as is possible. All flusher branches shall be designed or placed to prevent storm water inflow through the top of the manhole.

#### 4. Service Connections

A separate sewer service shall be provided from the sewer main to each legal parcel, except as otherwise provided in the Standard Specifications for duplex lots, single family attached units, and condominium units. The minimum size of service shall be 4 inches in inside diameter. The service shall be sized and designed to convey the Wet Weather Flows as calculated in accordance with this Standard or as may be otherwise required by the Building Code, whichever is greater.

### I. ALIGNMENT REQUIREMENTS

The horizontal and vertical alignment for sewer mains and services shall be designed in accordance with the following provisions.

#### 1. Mains in Streets

All new sewer mains shall be located in the public street right of way. Locations in easements require special approval of the City Engineer.

The Sewer line shall be placed opposite the storm line, 6 feet right or left of the centerline of the street. On streets with landscaped median islands, the sewer line shall be placed in the center of the lane adjacent to the island curb.

#### 2. Mains in Easements

Sewer mains located in easements across private property require special approval of the City Engineer.

The minimum size easement shall be 10 feet wide with the main centered in the easement, if there are no manholes within the easement. The minimum width is 12 feet if there are manholes within the easement, in order to accommodate the required access road to each manhole. Additional width shall also be added to the easement when the sewer main is deeper than 10 feet and/or when the sewer is a trunk main, or when other parallel underground utilities share the same easement.



**3. Horizontal Curves**

Horizontal curves will be allowed provided that the summation of the angle of curvature between manholes does not exceed 90°. The allowable joint deflection and curve radii requirements for VCP Sewer Pipe are listed in the following table:

Curvature and Deflection Requirements for VCP Sewer							
Nominal Pipe Diameter (inches)	Allowable Deflection Angle (°)	Equation for Minimum Radius	Minimum Radius of Curvature, for Pipe Length L				
			2 ft.	4 ft.	6 ft.	8 ft.	10 ft.
3 to 12	2.0	$R = 29 \times L$	58	116	174	232	N/A
15 to 24	1.5	$R = 38 \times L$	76	152	228	304	380
27 to 36	1.0	$R = 57 \times L$	114	228	342	456	570
39 to 42	0.75	$R = 76 \times L$	152	304	456	608	760

Refer to the Water Design Section for horizontal curve and deflection requirements on Ductile Iron Pipe used in Sewer Mains.

**4. Vertical Curves**

Vertical curves shall be used to change the profile alignment grade of sewer mains between structures. The minimum vertical curve length is 25 feet. The algebraic sum of the horizontal and vertical deflections shall not exceed the values in the above table.

**5. Services**

Sewer services shall be located within the center one-third of the lot frontage on the street. The preferred location is 5 feet west or south of the center of the lot. The service shall generally extend at a right angle from the main to the lot. Services shall not enter the main or a manhole at a deflection angle greater than 90°.

**6. Minimum and Maximum Cover**

The following minimum depths of cover shall be provided for all Sewer Pipes:

Minimum Cover for Sewer Pipes			
Pipe Material	To street centerline	To gutter flow-line	To Right of Way
Vitrified Clay	5.0 feet	4.5 feet	4.0 feet
Ductile Iron	3.0 feet	2.5 feet	2.0 feet

The maximum depth of cover shall not exceed the manufacturer's recommendations. Any sewer depths exceeding 16 feet requires special approval by the City Engineer.

**7. Clearance Requirements to Other Utilities**

The sewer facilities shall generally be located lower than all other utilities, except when it can be shown that this is not feasible. When the sewer main is above other facilities, then the Project Engineer shall comply with any additional requirements of the City Engineer, including, but not limited to, the use of Ductile Iron Pipe for all sewers.

**a. Horizontal and Vertical Clearances to Water Facilities**

Sewer facilities shall be installed at least 12 inches below all parallel or crossing water mains and services. Placement of sewer facilities above water facilities requires special approval of the City Engineer.

The vertical clearance may be reduced provided that Ductile Iron is used in place of Vitrified Clay. The Ductile Iron Pipe shall conform to all of the requirements for pressure water pipe in the City Standard Specifications. Whenever the sewer main crosses a water main or service, the minimum pipe length between joints shall be 18 feet and shall be centered on the water main or service. The sewer main shall cross perpendicular to the water main. Skew angle crossings (more or less than 90°) require special approval of the City Engineer.

Sewer facilities shall be installed with at least 10 feet of horizontal clearance to all parallel water mains or water services. Any reduction in horizontal clearance requires special approval of the City Engineer.

**b. Vertical Clearance to Other Utilities**

The preferred location for sewer mains is below all underground utilities. A vertical clearance of not less than 12 inches shall be maintained between all sewer mains and all crossing utilities.

A vertical clearance of not less than 6 inches shall be maintained between all sewer services and all crossing utilities.

The vertical clearances required above may be reduced provided that Ductile Iron Pipe is used in place of Vitrified Clay at the utility crossing. The minimum pipe length shall be 10 feet and shall be centered on the crossing utility.

**c. Horizontal Clearance to Other Utilities**

A horizontal clearance of not less than 5 feet shall be provided between all sewer facilities and all parallel utilities or structures.

**8. Sewer Main Clearance to Water Wells**

New sewer mains shall not be placed closer than 100 feet to any proposed or existing public water well or operating domestic water well. Whenever practical or feasible the water well shall be destroyed and relocated to provide 100 feet of clearance to a sewer main located in a public street right of way.

**J. OTHER CONSIDERATIONS**

The Project Engineer shall design the sewer facilities for all types and conditions of use which can be reasonably expected during the life of the sewer facilities. The minimum design life for all passive or non-mechanical items shall be 50 years. The minimum design life for all moving or mechanical items shall be 20 years. The longest possible design life shall be provided for any item or facility whenever it can be reasonably and practically attained.

**1. Connections to the Existing System**

All projects shall connect to the existing system at the locations specified by the City Engineer. When required by the City Engineer, the Project Engineer shall verify the capacity of downstream portions of the existing City Sewer system. The Project Engineer shall specify on the Plans the methods and procedures to be used in tapping into the existing system. All connections to the existing system shall be designed to minimize disruptions in service to existing users.

**2. Future Expansions of the System**

When a project is to be followed by subsequent phases of a multi-phase project, the Project Engineer shall provide facilities to expand the system beyond the phase boundaries. Sewer mains shall be extended beyond the edge of pavements to minimize disruption of traffic or disturbance of existing improvements.

**3. Trench loading**

All sewer facilities shall be designed to withstand the imposed loads of trench backfill and traffic. The Project Owner and/or the Contractor assumes full responsibility for providing adequate cover during construction activities.



#### **4. Sulfide Control**

All new sewer systems shall be designed to resist the corrosive properties of the waste stream. In particular, every effort shall be made to design a system which is immune to sulfide corrosion. Whenever available, products such as Vitrified Clay and Plastic lining shall be used instead of any other materials.

New manholes on trunk facilities shall be Spirolite®, or substantially equivalent. All sulfide control measures shall be subject to review and approval of the City Engineer.

#### **5. Sewer Lift Stations**

All sewer lift stations require special review and approval of the City Engineer. They shall be designed by an appropriately experienced Engineer. Considerations in Lift Station design include: fully automatic control systems, connection to City SCADA system, redundant pumping capability, manufacturer of pumps and related mechanical equipment, location and placement of station, and provisions for use by other areas of the City.

Figure 4 Peaking Factor for Sewer Flows

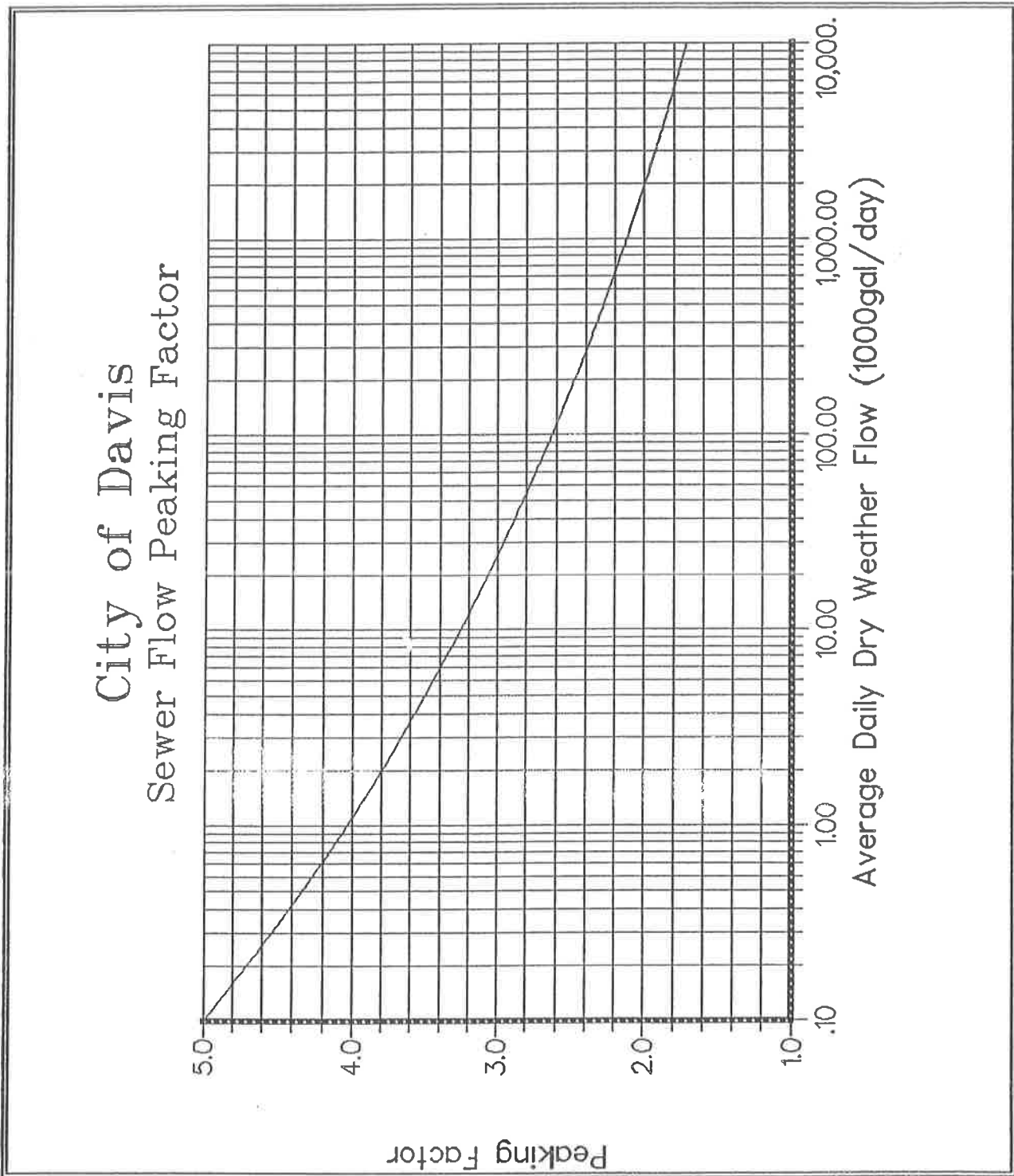
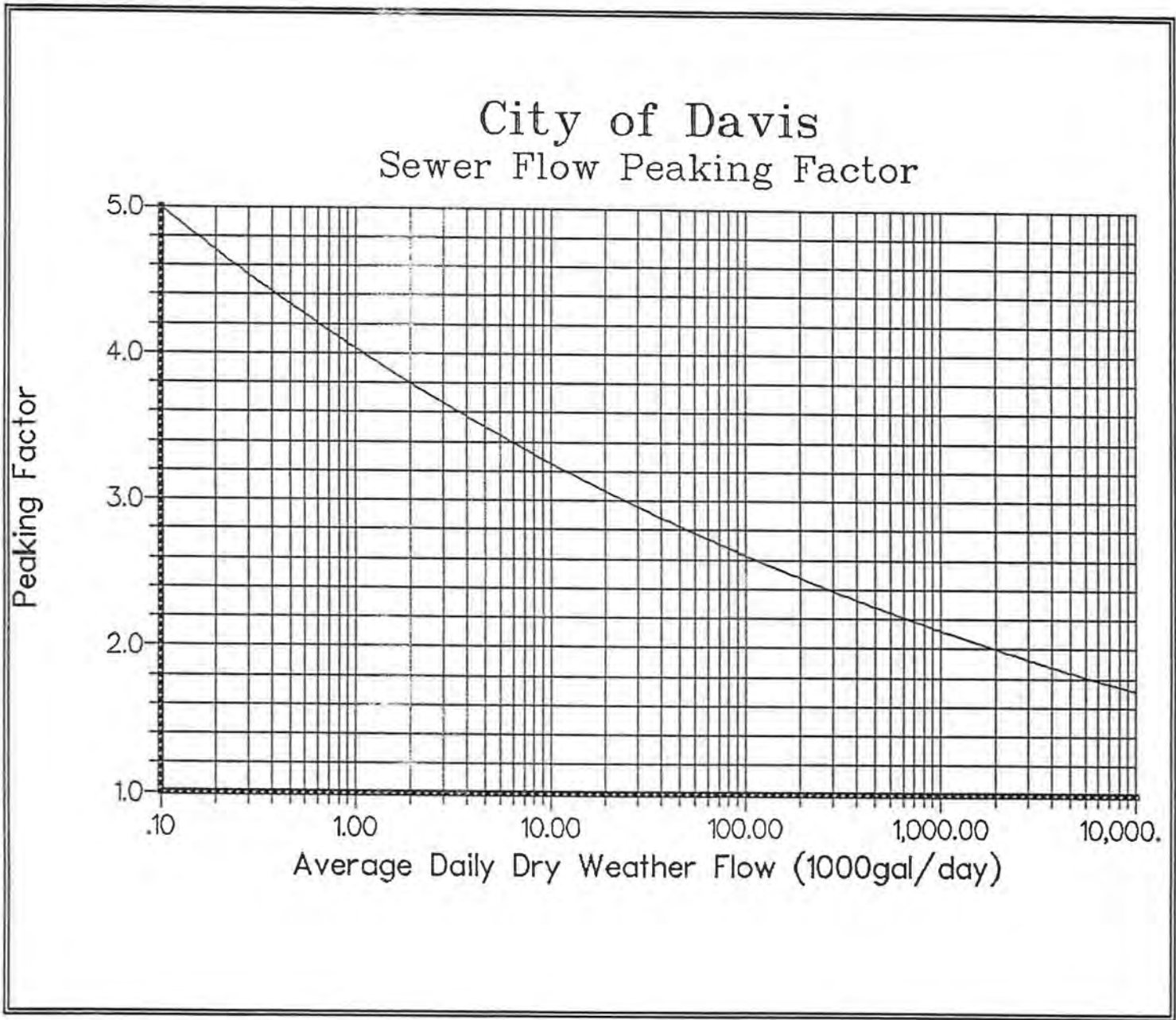


Figure 4 Peaking Factor for Sewer Flows









## SECTION VIII

### WATER SUPPLY SYSTEMS DESIGN

#### A. GENERAL

The Project Engineer will present all design information and calculations in a neatly written and well organized format. The design calculations shall be submitted with the initial submittal of the Improvement Plans. All design calculations shall be appropriately titled, dated, stamped and signed by the Project Engineer.

##### 1. Computer Design Aids

The Public Works Department uses the computer program commonly known as *KY-PIPE* to perform engineering analysis of the water system. Copies of the computer data files will be provided to the Project Engineer at no charge. The Project Engineer shall perform the analysis using this program and return a disk-copy of the project calculation files to the City along with the printed submittal of the calculations. All computer input and output files shall become the property of the City upon approval of the project.

##### 2. Water System Master Plan

All design work shall conform to the provisions of the Davis Water System Master Plan. This document was prepared to analyze the City's use patterns and present recommendations for future system improvements to accommodate growth. The criteria used in this document have been incorporated into these Standards where appropriate.

Contact the Water Division of PW for the latest information in regard to the system model.

#### B. DESIGN FLOWS

The demand rates in this section shall be used in conjunction with the land uses to determine the design flow requirements for the public water mains serving a project. These figures may not be applicable to sizing of water meters.



**1. Average Day Unit Water Demands**

The following table shall be used to determine the unit water demand by user type.

Unit Water Demands		
Type of Use	Unit Water Demand	Units of Measure
Single-Family Residential (including Duplexes)	612	Gallons per DU-day
Multiple-Family Residential (3 or more units per Building)	260	Gallons per DU-day
Mobile Home Parks	270	Gallons per DU-day
Institutional (Schools and Hospitals)	1,800	Gallons per Acre-day
Retail, Commercial and Industrial	2,500	Gallons per Acre-day
Other Uses	As Approved	N/A

**2. Land Use Densities**

The above Unit Demand Rates shall be applied to the Land Uses as determined by the General Plan. The maximum allowable densities according to the General Plan shall be used to determine the design flows and pressures. The maximum allowable densities shall be used for all land uses regardless of the proposed project uses and densities.

**a. Single Family**

All Single Family uses will be calculated at the maximum allowable densities based on the current version of the City's General Plan (4.2 units per gross acre). If applicable, the General Plan Density bonus (up to 25%) allowed for affordable housing units shall also be included in this density calculation.

**b. Multiple Family**

All Multiple Family uses will be calculated at the maximum allowable densities based on the current version of the City's General Plan (30 units per gross acre - Core area, 15 units per gross acre - All other areas). If applicable, the General Plan Density bonus (up to 25%) allowed for affordable housing units shall also be included in this density calculation.

**c. Retail and Commercial Uses**

The areas of Retail Commercial and Industrial uses shall be calculated based on gross areas, including any adjacent streets.

### 3. Fire Flow Demand

Fire Flow demand shall be based on the following table for design of mains within a particular project. The most severe fire flow demand within a particular use area shall be the basis for fire flow demand. The sizing and design of city-wide distribution mains shall be based on criteria established by PW.

Fire Flow Demand (Based on ISO Criteria)		
Type of Use or Area Classification	Minimum Firefighting Flow (gallons per minute)	Duration of Flow (hours)
Single-Family Residential	1,000	2
Multiple-Family Residential (low density)	2,500	2
Multiple-Family Residential (high density)	3,500	3
Core Area Commercial	4,000	4
Neighborhood Shopping Center	2,500	2
Motel Complex	3,000	3
Heavy Industrial	4,000	4
Schools, Elementary	2,500	2
Schools, Secondary	3,000	3
Hospitals	3,000	3

### 4. Peaking Factors

#### a. Maximum Day Demand

The Maximum Day Demand shall be determined by applying a peaking factor of 2.0 to the Average Day Demand.

#### b. Maximum Hourly Demand

The Maximum Hourly Demand shall be determined by applying a peaking factor of 1.8 to the Maximum Day Demand.

## C. DISTRIBUTION SYSTEM DESIGN

All public water mains and private fire systems shall be designed to operate within the following parameters.

### 1. Fire Flow plus Maximum Day Design Condition

The minimum allowable pressure in all water and fire mains shall be 20 psi.

### 2. Maximum Hour Design Condition

The minimum allowable pressure at any point in the system shall be 35 psi.

### 3. Maximum Head Loss

The maximum allowable head loss in any section of main shall not exceed a ratio of 4/1000 (.004 ft per ft).

### 4. Pipe Design Formula

The Hazen-Williams method shall be used in conjunction with the computer net analysis to verify and design the pipe system. A C-factor of 120 shall be used for all pipes.

### 5. System Loop Requirement

All lengths or sections of main longer than 250 feet shall be looped to another section of main. Any section of main with two or more fire hydrants shall also be looped to another section of main. The system shall be designed such that the longest section of main isolated during a shut-down is 500 feet.

### 6. Minimum Velocity

The desirable minimum velocity in any looped main of 8" size and larger is 2 feet per second at maximum day flows. The Project Engineer shall design the system to achieve the greatest possible flushing action in the looped mains at average day flows.

### 7. Minimum Sizes

The minimum size of main is 6 inches in inside diameter.

## D. STRUCTURES AND APPURTENANCES

### 1. Nominal Design Pressure

The nominal design pressure rating for all pipes and related facilities shall be 200 psi.



## **2. Valves**

Valves shall be placed at intervals not to exceed 500 feet and at the intersections of all main lines.

All weather access shall be provided to all valves not in the public street right of way. Standard bicycle paths are an acceptable access.

## **3. Fire Hydrants**

Fire hydrant locations will be approved by the Fire Department. Fire hydrants shall be placed on all public streets at intervals not to exceed 500 feet, regardless of access restrictions or design features on adjacent properties.

## **4. Blow-Offs**

A Blow-off shall be used at the upstream terminus of a 6" main line when the distance to the nearest loop is not greater than 250 feet. The blow-off shall be placed as near to the end of the street as is possible.

# **E. SERVICE CONNECTIONS**

A public water service shall be provided from the public main to each legal parcel, except as otherwise provided herein.

## **1. Water Meters**

As required by the Municipal Code, meters shall be provided on all water services. In Multiple-Family projects, separate meters shall be provided for landscaping and domestic uses.

## **2. Backflow Prevention and Cross-Connection Control**

Backflow prevention and cross-connection control shall be provided between all public water facilities and the private uses, in accordance with the rules and regulations prepared by PW.

## **3. Minimum Size**

The minimum size of service is 1 inch in inside diameter. The service size shall be designed by the Project Engineer to meet the requirements of the intended use.

## **4. Attached Single-Family Services**

On attached single-family units, a single water service may be used between the water main and the common property corners at the right of way line. Individual water meters shall be installed near the right of way line to serve each unit. Installation of long runs of water services parallel to the right of way will not be allowed.

## 5. Condominium Services

Each unit in a condominium project, or similar project with individual ownership of the living units, shall be provided with a publicly owned and maintained water meter. An onsite system of domestic water mains may be installed to distribute water to each individual living unit. Any such onsite system, except the water meters, shall be privately owned and maintained. The meters shall be installed between the onsite domestic water mains and the individual living units. Separate meters shall be installed for common area landscaping and/or community buildings. The locations of the meters will be subject to approval of the City Engineer. Access rights shall be granted to the City to enter upon the property to operate, read and maintain the meters.

## F. ALIGNMENT REQUIREMENTS

The horizontal and vertical alignment for water mains and services shall be designed in accordance with the following provisions.

### 1. Mains in Streets

All water mains shall be located in the public street right of way. Placement of water mains in easement locations requires special approval of the City Engineer.

The Water main shall be placed on the same side of the street as the storm line, opposite the sewer line. It shall be placed between the storm line and any curb or the right of way. At least 5 feet of clearance shall be maintained between the water main and any parallel storm line or drop inlets. The water main shall not be placed under the gutter or sidewalk, except for perpendicular crossings.

### 2. Mains in Easements

The minimum size easement shall be 10 feet wide with the main centered in the easement. Additional width shall be added to the easement if other parallel underground utilities share the same easement. A sewer main and a water main in the same easement shall be 10 feet apart.

**3. Horizontal Curves**

Horizontal curves will be allowed provided that the maximum angle of curvature does not exceed 90° between valves. The allowable joint deflection and curve radii requirements for DIP Water Main are listed in the following table:

Curvature and Deflection Requirements for DIP Water Mains						
Nominal Pipe Diameter (Inches)	Allowable Deflection Angle (°)	Equation for Minimum Radius	Minimum Radius of Curvature, for Pipe Length L			
			12 ft.	16 ft.	18 ft.	20 ft.
4 to 12	4.0	$R = 14.3 \times L$	175	230	260	290
14 to 48	2.5	$R = 22.9 \times L$	275	365	410	460

**4. Vertical Alignment Changes**

Changes in the profile grade of water mains shall not exceed the values listed above for allowable joint deflection. Vertical curves may also be used to keep the joint deflection within allowable limits. Joint deflections which exceed the allowable shall use appropriate fittings with thrust blocks.

**5. Services**

Water services shall be located within the center one-third of the lot frontage on the street. The preferred location is 5 feet east or north of the center of the lot. The service shall generally extend at a right angle from the main to the lot.

**6. Minimum Cover**

The minimum depth of cover for all Ductile Iron water facilities shall be 3.0 feet below finish street centerline grade. Water services shall be installed at least 2.5 feet below finish gutter flowline grade.

The Project Engineer and/or the Contractor assumes full responsibility for providing adequate cover and protection to pipes and water materials during construction activities.

**7. Clearance Requirements to Other Utilities**

The water facilities shall generally be located above all other utilities, except when it can be shown that this is not feasible.



**a. Horizontal and Vertical Clearances to Sanitary Sewer Facilities**

Water facilities shall be installed at least 12 inches above all parallel or crossing sewer mains and services. The vertical clearance may be reduced provided that Ductile Iron is used in place of Vitrified Clay on the sewer facility. The Ductile Iron Pipe shall conform to all of the requirements for pressure water pipe in the City Standard Specifications.

Water facilities shall be installed with at least 10 feet of horizontal clearance to all sewer mains or services. Any reduction in horizontal clearance requires special approval of the City Engineer.

**b. Vertical Clearances to Other Underground Utilities**

A vertical clearance of not less than 12 inches shall be maintained between all water facilities and all other crossing utilities.

**c. Horizontal Clearances to Other Underground Utilities**

A horizontal clearance of not less than 5 feet shall be provided between all water facilities and all parallel utilities or structures.

**G. WATER WELLS**

All public water supply facilities (wells) are owned and operated by the City. They shall be designed in accordance with the requirements of the City Engineer. All new water system supply components shall conform to the City Water Master Plan.

**1. New Water Well Sites**

New water well site(s) shall be provided within a project at the locations specified by the City Engineer. The City shall have the right to enter upon the proposed well site and conduct a sub-surface investigation of the suitability of the site prior to obtaining the site from the Project Owner. If the City is satisfied with the test results, then the Project Owner shall enter into an agreement to dedicate the site to the City. If the test results are not satisfactory, then another site shall be located within the project by the City Engineer and additional testing conducted at this alternate location to determine its suitability. Alternate sites shall be offered until a suitable site is chosen.

**2. Water Well clearance to Sewer Mains**

New sanitary sewer mains shall not be placed closer than 50 feet to any existing public water well or domestic water well. New water wells shall be placed so that they are at least 50 feet from any proposed or existing sanitary sewer main located within a public street right of way. Well locations shall also meet the other setback requirements of Bulletin 74-90 and Yolo County Ordinance.

### **3. Abandoned Water Wells**

In accordance with Yolo County Ordinance, any water wells which are inoperable for a period of one year or longer shall be considered to have been abandoned. Any existing wells within a project, which will not be used after completion of the project, shall also be considered to be abandoned.

### **4. Procedure for Destroying Abandoned Water Wells**

All abandoned water wells shall be destroyed in accordance with the provisions of Bulletin 74-90, Water Well Standards: State of California, Department of Water Resources, California Resources Agency, in accordance with Yolo County Ordinance and in accordance with these Design Standards. All well destruction work shall be performed by a California licensed Well Driller.

#### **a. Permit Requirement**

Separate permits shall be obtained from Yolo County Health Services Department and Davis Public Works prior to destroying the well. Except as otherwise provided herein, the permits shall be obtained prior to proceeding with any activities required to destroy the well.

#### **b. Inspection of Well**

The well inspection procedures specified in this section may occur prior to application for a permit to destroy the well. The Project Owner shall notify PW of the time and date of the well inspection. PW personnel shall be allowed onsite to review the procedures and data as the inspection work progresses.

The Well driller shall use appropriate means to determine the depth of the well and any obstructions within (abandoned pumps and piping), screen locations, ruptures in the casing, and other important physical features. The Well driller shall indicate all of this information on a well inspection log. Whenever practical or feasible, all wells to be destroyed shall be inspected using TV equipment. PW will use the TV tape and well inspection log to review and approve the procedures required to destroy the well.

#### **c. Perforating Well Casing**

When required, the well casing shall be perforated to allow penetration of the grout into the gravel envelope or to fill any voids between the casing and ground. The size and spacing of the perforations will be approved by the City Engineer.

#### **d. Fill casing with Grout**

The entire well casing shall be filled with an appropriate mix of grout. The grout shall be pumped into place by the use of a tremie pipe placed to the bottom of the well. The tremie pipe shall be removed as the fill operation proceeds.

#### **e. Well Drillers Log**

The Well driller shall keep a complete log of the well destruction procedures, as required by State Law. A copy of the log shall be provided to PW upon completion of the operation. The precise location of the

well shall be shown in the log and shall be determined by the Project Engineer. The location shall be tied to the nearest adjacent boundary line of any proposed lots in the project.

## **H. OTHER CONSIDERATIONS**

The Project Engineer shall design the water facilities for all types and conditions of use which can be reasonably expected during the life of the water facilities. The minimum design life for all passive or non-mechanical items shall be 50 years. The minimum design life for all moving or mechanical items shall be 20 years. The longest possible design life shall be provided for any item or facility whenever it can be reasonably and practically attained.

### **1. Connections to the Existing System**

All projects shall connect to the existing system at two locations to create a looped system through the project. The Project Engineer shall specify on the Plans the methods and procedures to be used in tapping into the existing system. All connections to the existing system shall be designed to minimize disruptions in service to existing users.

### **2. Future Expansions of the System**

When a project is to be followed by subsequent phases of a multi-phase project, the Project Engineer shall provide facilities to expand the system beyond the phase boundaries. Water mains shall be extended beyond the edge of pavements to minimize disruption of traffic or disturbance of existing improvements. Valves shall be provided on the main extensions to preferably eliminate or minimize future disruptions in service.

### **3. Trench Loading**

All water facilities shall be designed to withstand the imposed loads of trench backfill and traffic.

### **4. Corrosion Control**

The Project Engineer shall give due consideration to preventing premature failure of water facilities due to corrosion. All ductile iron water mains shall be poly-wrapped (encased in polyethylene plastic per AWWA C105) unless tests to determine the soil corrosivity, performed in accordance with AWWA Standard C105, Appendix A, indicate otherwise. All onsite soil corrosivity testing shall be included in the Project Soils Report.



## SECTION IX

### STREET LIGHTING and TRAFFIC SIGNAL DESIGN

#### A. GENERAL

The Project Engineer will present all design information and calculations in a neatly written and well organized format. The design calculations shall be submitted with the initial submittal of the Improvement Plans. All design calculations shall be appropriately titled, dated, stamped and signed by the Project Engineer.

##### 1. General Design Methods

Street Lighting shall be designed in accordance with these Design Standards and ANSI/IES RP-8, "American National Standard Practice for Roadway Lighting" of the American National Standards Institute and Illuminating Engineering Society of North America (IES). The lighting criteria specified in these Standards take precedence over the requirements of ANSI/IES RP-8.

##### 2. Street Light Requirement

Street Lighting shall be provided on all publicly owned and maintained streets. Private Streets and common driveways shall provide lighting at the connection of the street or driveway to the public street.

##### 3. Parking Lot Requirement

The City Code requires Parking Lot Lighting in all office, commercial and industrial uses with over 10 parking spaces in any one parking lot. These requirements are repeated herein for convenience.

#### B. LIGHTING DESIGN REQUIREMENTS

The design of lighting systems shall conform to the requirements of this section. Calculations shall be presented for each distinctly different conduit and conductor run. Calculations shall also be provided for light distribution and illuminance whenever light locations and lighting patterns differ from these Standards.

##### 1. Standard Street Lighting Layouts

The following table lists standard light requirements by street type and right of way width. Any project, except for Major Arterial Streets and Intersections, using these standard lighting requirements does not need to prepare calculations to verify the lighting distribution and illuminance. The City Engineer may require the preparation of lighting calculations for special circumstances and non-standard situations.

Minimum Street Lighting Requirements for High Pressure Sodium Vapor Lights							
Type of Street	R/W Width	Lamp Wattage	Mounting Height	Type Distribution (See Note 1)	Average Illuminance (footcandles)	Light Location	Light Spacing
Major Arterial	125' ±	150	30'	III	0.60 See Note 2	Medians	200'
Major Arterial	125' ±	150	30'	III	0.60 See Note 2	Back of Walk (BW)	100'
Minor Arterial	107'	100	30'	III	0.35	BW	100'
Collector	65'	70	30'	III	0.20	BW	200'
Modified Local	50'	70	25'	II	0.15	BW	250'
Local	44'	70	25'	II	0.09	BW	300'
Cul-de-Sac	34'	70	25'	II	0.09	BW	300'
Bike Paths (off-street)	20'	70	14' or 16'	I-II(long)	N/A	N/A	135'
Signalized Arterial Intersections	N/A	150	30'	III	See Note 3	On each corner signal pole	N/A
Unsignalized Arterial Intersections	N/A	150	30'	III	See Note 3	At each corner	N/A
Unsignalized Collector Intersections	N/A	70	30'	III	See Note 3	2 at opposite corners	N/A
Unsignalized Local Intersections	N/A	70	30'	II	See Note 3	1 at corner	N/A

Note 1. The standard distribution pattern is the indicated Type, medium, with a semi-cutoff lens. The City Engineer may require a differing pattern (Type I, II, III, IV or V and short, medium or long) and/or a cutoff or non-cutoff lens, depending on the application.

Note 2. All Major Arterial street lighting systems require special design and approval by the City Engineer.

Note 3. The lighting requirements for the streets entering the intersection are added together to determine the required average illuminance. For Example: The required average illuminance for the intersection of a Local Street and a Collector Street is  $0.20 + 0.09 = 0.29$  footcandles.

## 2. Standard Parking Lot Design Requirements

All Parking Lot lighting shall be designed based on the following horizontal illuminance requirements. In general, the Building Official reviews and approves all private lighting designs. PW will generally review and approve lighting designs on public projects.

Parking Lot Lighting Requirements		
Type of Use	Average Illuminance (footcandles)	Minimum Illuminance (footcandles)
Malls and Multi-Tenant Shopping Centers	2.50	0.50
Office, Commercial and Industrial Uses (10 or more spaces)	1.25	0.25
Multiple Family Residential Complexes	0.125	0.025

## 3. Horizontal Illuminance Design

The light locations, type of distribution, sizes, pole and mast arm heights shall be analyzed using these methods whenever it is a non-standard situation, a Major Arterial street or a parking lot. Calculations shall be prepared by the Project Engineer for review by PW. All parking lot lighting will be reviewed by the Building Official.

### a. Computer Design/Analysis

A computer program similar to the Lighting Sciences, Inc., "Micro Site Lite" shall be used to analyze and design the lighting layout. This program uses the IES format for photometric data. Copies of the computer printouts shall be presented with the lighting system design calculations.

### b. Average Values

The lighting layout shall be designed to achieve the above listed Average Intensities for the area in question. The average intensities shall be additive at intersections.

### c. Uniformity

Different combinations of lighting layouts shall be analyzed to determine the option with the smallest differences between the average illuminance and minimum illuminance. In parking lots the minimum illuminance listed above shall be provided at all locations within the paved areas. On public streets the



desired maximum ratio of average/minimum illuminance on Arterial streets is 5:1 and on Collector and other Local Residential streets is 10:1.

**d. Illumination Depreciation**

The minimum combined depreciation factor shall be 0.75. This factor shall be based on the manufacturer's data for aging of the bulb, expected accumulation of dirt, and other factors affecting light loss during the life of the luminaire.

**4. Requirements at Intersections**

The minimum number of lights shall be provided at all intersections as listed in the above table. When Traffic Signals are proposed at an intersection, then lights shall be placed on the signal poles.

**5. Pedestrian and Bike Path Connections to Streets**

Adequate lighting shall be provided at the connection of a Pedestrian or Bike Path to a public street. The nearest street light shall be placed such that its light projects down the path. If this is not possible, then a Post-Top light shall be provided at the end(s) of the path to provide lighting on the path. Whenever the path is a short "cross-block" path, additional lighting along the path shall be provided whenever the distance between lights or both ends of the path exceeds 200 feet. Otherwise the maximum distance between lights is 135 feet on any public paths.

**6. Open Space Uses (Greenbelts and Parks)**

Lighting shall be provided in all public Open Space areas, such as Parks and Greenbelts. In Parks and Greenbelts the lighting distribution pattern shall generally be Type III or Type V. The Type III distribution shall be used whenever the desired lighting pattern is linear. The Type V distribution shall be used whenever the desired lighting pattern is area oriented. Any park lighting requires special review by the City Engineer and the Parks and Community Services Department.

The Project Engineer shall consider the locations and orientations of future and existing houses in the placement of pathway lighting. Lower mounting heights (12' is the lowest), non-standard distribution, cut-off devices, and shields shall be used to direct the light away from the houses along the path. The City and/or the Project Engineer shall observe the (night-time) performance of the lighting system after installation. The Contractor shall be required to make night-time adjustments to obtain the desired lighting patterns and/or shielding.

**7. Field Adjustment**

The Contractor shall be required to adjust all lighting in the field after the lighting circuit is energized by PG&E. The field adjustment shall take place after sunset when the lights are on. The alignment of luminaires (angle and direction) will be adjusted to provide the desired lighting pattern on the street and/or bike paths. The bulb will be raised or lowered in any cut-off type luminaires to provide the proper pattern.

## C. CONDUCTOR DESIGN

The system of conductors and conduits providing electrical power to the lights shall be designed in accordance with the provisions of this section. Calculations shall be prepared by the Project Engineer to determine the voltage drop between the point of connection to the Pacific Gas and Electric Co. system and each light in the system.

All conductor systems shall use buried conduits containing the conductors in accordance with the requirements of the Standard Specifications. Pull boxes shall be provided at the PG&E service point, at each street light, and at intervals not to exceed 200 feet.

### 1. Voltage Criteria

All street lighting systems shall be designed to operate at 120 volts (nominal) single phase. The use of greater voltages or three phase systems requires special approval of the City Engineer.

The PG&E starting voltage shall be assumed to be 120 volts. The maximum allowable voltage drop from the connection point to the connection in the base of the pole shall be 3% of the PG&E starting voltage.

### 2. Voltage Drop Formula

The voltage drop shall be calculated using Equation (G).

Equation (G) Voltage Drop Formula - 2 or 3 wire Single Phase Circuits

$$V = \frac{2k \times L \times I}{d^2} = 2R \times L \times I$$

$$d^2 = \frac{2k \times L \times I}{V}$$

*V* = drop in circuit voltage (volts)

*k* = resistivity of conductor metal (cir mil-ohms/ft)

= 12 for circuits loaded to more than 50% capacity

= 11 for circuits loaded to less than 50% capacity

*L* = one-way length of circuit (ft)

*I* = current in conductor (amperes)

*d*<sup>2</sup> = cross-section area of conductor metal (circular mils)

*R* = resistance per ft of conductor (ohms/ft)

**3. Conductor Variables**

The conductor variables for use in Equation (G) shall be based on the following tables.

Conductor Properties <sup>1</sup>								
Size (AWG/MCM)	Area (Cir. Mills)	Stranding		Overall		AC Resistance for Uncoated Copper Wires (Ohms per 1000')		
		Quan.	Diam. (in.)	Diam. (in.)	Area (in. <sup>2</sup> )	PVC Conduit	AL Conduit	Steel Conduit
8	16510	1	--	0.128	0.013	0.78	0.78	0.78
8	16510	7	0.049	0.146	0.017	0.78	0.78	0.78
6	26240	7	0.061	0.184	0.027	0.49	0.49	0.49
4	41740	7	0.077	0.232	0.042	0.31	0.31	0.31
3	52620	7	0.087	0.260	0.053	0.25	0.25	0.25
2	66360	7	0.097	0.292	0.067	0.19	0.20	0.20
1	83690	19	0.066	0.332	0.087	0.15	0.16	0.16
1/0	105600	19	0.074	0.373	0.109	0.12	0.13	0.12
2/0	133100	19	0.084	0.419	0.138	0.10	0.10	0.10

Note 1: Based on Table 8, "Conductor Properties," and Table 9, "AC Reactance and Resistance for 600 V cables, 3 phase, 60 Hz, ...", National Electric Code.



#### 4. Power Data for Standard Luminaires

The following table lists the power data to be used in Equation (G). The Project Engineer shall provide manufacturer's data for determining the power data for luminaires other than the GE M250A. The City Engineer will review the data and approve the appropriate design criteria.

Power Data for the General Electric M250A (120 volt, single phase)			
Lamp Size (Watts)	Power Factor	Voltage Tolerance	Line Power (Watts)
70	90%	±5%	83
100	95%	±10%	146
150	95%	±10%	199
200	95%	±10%	246
250	95%	±10%	320
400	95%	±10%	500

### 5. Maximum Number of Conductors per Conduit

The maximum number of (equivalent) conductors in any section of conduit shall not exceed the values listed in the following table.

Maximum Number of Conductors per Conduit <sup>2</sup>							
Conductor Type	Conductor Size (AWG)	Conduit Trade Size (Inches)					
		1	1-1/4	1-1/2	2	2-1/2	3
THWN	8	9	16	22	36	51	79
	6	6	11	15	26	37	57
	4	4	7	9	16	22	35
	3	3	6	8	13	19	29
	2	3	5	7	11	16	25
	1	--	3	5	8	12	18
	1/0	--	3	4	7	10	15
	2/0	--	--	3	6	8	13
THW	8	5	10	13	22	32	49
	6	4	7	10	16	23	36
	4	3	5	7	12	17	27
	3	--	4	6	10	15	23
	2	--	4	6	9	13	20
	1	--	3	4	6	9	14
	1/0	--	--	3	5	8	12
	2/0	--	--	3	5	7	10

Note 2: Based on Table 3(A, B & C) "Maximum Number of Conductors in Trade Sizes of Conduit or Tubing," National Electric Code.

## D. ALIGNMENT REQUIREMENTS

The Project Engineer shall completely detail and design the street lighting system on the Plans. All lighting system components shall be accurately drawn to scale. The horizontal and vertical alignment shall conform to the requirements of the Standard Specifications and these Design Standards. Many of the requirements in the Standard Specifications are repeated herein for convenience.

### **1. Street Light Locations**

All street lights shall be located immediately adjacent to the back of sidewalk. When there is no adjacent walk, then the light shall be located adjacent to the back of curb. When, due to phasing of construction, a sidewalk is proposed to be located within the right of way in the future, then the light shall be placed so that it is not within the walk area. Street lights in medians shall be placed at the center of the median.

### **2. Conduit, Conductor and Pull Box Locations**

All conduit shall be located 1 foot behind the adjacent sidewalk. When, due to phased construction, the walk will be constructed in the future, then the conduit shall be placed 1 foot inside of the right of way line. Conduit shall not be placed within any Public Utility Joint Trench, except for perpendicular crossings.

A typical trench section shall be shown on the plans to clearly indicate the locations and depths of the lighting conduits for the various situations encountered. The types, sizes and numbers, including the ground, of conductors shall be indicated on the Plans for each run.

Pull Boxes shall be placed level and square to the sidewalk or right of way line. A Pull Box shall be provided adjacent to every light.

### **3. Pacific Gas and Electric Co. Requirements**

The Project Engineer shall contact PG&E to determine the service point for the lighting system. The Project Engineer shall also request that PG&E assign street light numbers. The service point and all street light numbers shall be shown on the plans.

## **E. TRAFFIC SIGNAL DESIGN**

All Traffic Signals shall be designed by an engineer with the appropriate types of experience, knowledge and training. The signal plan shall contain the information listed in Section III of these Design Standards.

### **1. Standard Design Requirements**

All City Traffic Signals shall be designed in accordance with the City Standard Special Provisions for Traffic Signals. Signal program logic shall be as specified by the City Engineer. All signal design shall conform to the standards adopted by the Committee for Uniform Traffic Control Devices (a statewide committee).

### **2. Project Design Meeting and Preliminary Signal Layout**

The Project Engineer shall attend a Project Design Meeting for the purpose of reviewing and discussing the signal design assumptions and criteria. The Project Engineer shall deliver copies of a Preliminary Signal Layout to PW at least one week prior to this meeting. The City Engineer and the Project Engineer will discuss the project and determine the basic design criteria and signal layout. The results of this meeting will be the basis for further review of the project by PW.



### 3. City Traffic Corridor Requirements

PW has selected specific signal controllers and related equipment for use on certain arterial corridors. PW will inform the Project Engineer at the Project Design Meeting of these requirements. This specified equipment has been selected to insure design and operation compatibility for the corridor. The signal program operation along these corridors will eventually be or is being coordinated via a Master Signal Controller. On development projects, PW will coordinate specification and purchase of the controller provided that the Developer deposits the purchase cost with PW.

### 4. City Signal Requirements

All Signals shall be designed in accordance with the following provisions. It is recognized that all situations may not fit these requirements. In these cases, additional direction will be provided by the City Engineer. The Traffic Signal Plans shall contain a separate legend for symbols unique to this plan.

#### a. Signal Controller

All signal controllers and cabinets will be specified and ordered by the City. Specified equipment generally includes: programmable 8 phase (Quad) controller; bicycle logic controller; load switches; detector amplifiers; conflict monitor; and override capability.

All signal controllers will be tested by PW prior to field installation. The minimum test period is 30 days.

#### b. Signal Program Logic

All signals shall be designed to be fully traffic actuated for the anticipated vehicular, pedestrian and bicycle movements. Vehicular, and bicycle when required, detection shall be accomplished via inductive detector loops placed in the pavement. Buttons shall be provided for pedestrian and bicycle activation. When required, emergency vehicle and/or bus preemption shall be provided.

#### c. Signal Power Service

The Project Engineer shall contact PG&E to determine the location of the service point. All signals shall be metered using a Caltrans Type III service pedestal. The meter and circuit breakers shall be housed in the service pedestal. A standard pull box shall be provided at the PG&E service point.

#### d. Signal Poles

All signal poles shall be designed for 80 mph wind loading conditions. The primary signal pole for each direction shall include a mast arm mounted street light luminaire. All signal heads shall be mounted to the pole using standard brackets and mounting hardware. Whenever possible, pedestrian push buttons and signals shall be mounted on the primary signal pole.

#### e. Signal Heads

All signal heads shall be 12" diameter with one each red, yellow and green lens, or arrow lenses or other approved symbol. At least two far side heads and one near side head shall be provided for each

direction of travel. At least two arrow heads shall be provided for signalized turn movements. All three heads on turn movements shall be arrow lenses. Programmed visibility heads shall not be used.

All signal heads shall be metal and shall be provided with visors and backplates. Mast arm backplates shall be louvered. Reflectors shall be alzac and lenses shall be glass.

**f. Automobile Requirements**

Any automobile approaching an intersection shall be able to see at least two of the heads, not including any turn movement heads. The minimum required sight distance shall be the stopping sight distance at the street design speed. Inductive loop detectors shall be provided in all vehicle lanes.

**g. Bicycle Requirements**

All signals shall be designed to accommodate bicycle movement through the intersection. Inductive loop detectors shall be provided in the bike lanes approaching the intersection, as required by the City Engineer. Bike buttons shall be provided adjacent to the bike lanes at the intersection. The legends on the bike buttons shall have a bicycle symbol. Additional logic shall be provided in the signal controller to provide the required green time for bicycles.

**h. Pedestrian Requirements**

All signals shall be designed to accommodate pedestrian and handicap movement through the intersection. Pedestrian buttons, handicap ramps and pedestrian signal heads shall be provided at each end of each street crossing.

The standard pedestrian head shall be a modular solid-state type with the Portland orange UPRAISED HAND symbol and the white WALKING PERSON symbol.

**i. Electrical Conduits, Conductors and Pull Boxes**

All electrical power conductors and inductive loop detector wiring shall be placed in standard conduits with pull boxes. A pull box shall be placed at each corner to service the poles and buttons in the vicinity of the corner. A pull box shall be provided at the controller for termination of all conduit runs. A pull box shall be placed at the end of a run of conduit when the distance between a pull box and a pole or other signal device is greater than 50 feet in length. Otherwise, intermediate pull boxes shall be provided at a spacing of 200 feet for long runs of conduit.

The maximum size of conduit is 3 inches in inside diameter.

Type A handhole boxes (spider boxes) shall be used for all sets of loop detectors. The handhole shall be the termination point for the loop runs in the pavement.

Within the limits of the signal work, traffic signal conductors, lighting conductors and interconnect conductors may all be placed within the same conduits and pull boxes. A separate conduit run shall be provided for all lighting systems which are not a part of the signal system. A separate conduit run shall be provided for future signal interconnect placed beyond the signal limits of work. The limits of the interconnect will be specified by the City Engineer.

All pull boxes shall be labeled either; 1) TRAFFIC SIGNAL, 2) STREET LIGHTING, or 3) INTERCONNECT, as appropriate. If more than one type of conductor is contained in the conduit and pull box, then only one label shall be provided, with the labeling precedence as listed above.

## **5. Traffic Signal Special Provisions**

A separate set of Special Provisions shall be prepared to accompany each Traffic Signal Project. These Special Provisions shall clearly list all special materials and methods of construction which are not covered by the PW Standard Specifications. On development projects, bound sets of Special Provisions shall be provided with any Traffic Signal Plans when they are reproduced for checking, approval or construction purposes.

### **a. PW and Caltrans Standard Specifications**

The PW Standard and Caltrans Specifications shall be referenced in the Project Special Provisions. The appropriate Caltrans item, when more than one choice or option exists for any item, shall be indicated. References to other standards shall also be indicated.

### **b. Shop Drawing Review**

The signal Special Provisions shall indicate that all signal equipment and materials are subject to the PW Shop Drawing review procedures. All items subject to Shop Drawing review shall also be reviewed and approved by the Project Engineer. All materials are provided and all methods are performed subject to a one year unconditional guarantee, in addition to any other standard warranties or guarantees.

### **c. Materials**

All materials to be used on the job shall be clearly and concisely indicated. Sufficient detail shall be provided to the Contractor to enable selection of qualifying materials. Reference standards such as ASTM, ANSI, AASHTO, etc., shall be used to specify materials, whenever possible or feasible. The Project Engineer shall research materials requirements to determine if there is such a reference standard available.

### **d. Methods**

All methods of construction shall be clearly defined. The Project Engineer shall exercise care to avoid situations where standard methods of construction may be anticipated to produce undesirable results. Whenever possible or feasible, the expected level of performance shall be defined.

## **F. OTHER CONSIDERATIONS**

The Project Engineer shall design the Lighting and Traffic Signal facilities for all types and conditions of use which can be reasonably expected during the life of the facilities. The minimum design life for all passive or non-mechanical items shall be 50 years. The design life for various electronic components subject to burn-out or limited in life due to their very nature shall be the longest which is practical or feasible to achieve, as approved by the City Engineer. The minimum design life for all moving or



mechanical items shall be 20 years. The longest possible design life shall be provided for any item or facility whenever it can be reasonably and practically attained.

### **1. Connections to the Existing System**

All projects shall connect to the existing system at the locations specified by the City Engineer. The Project Engineer shall specify on the Plans the methods and procedures to be used in tapping into the existing system. All connections to the existing system shall be designed to minimize disruptions in service of existing systems.

### **2. Future Expansions of the System**

When a project is to be followed by subsequent phases of a multi-phase project, the Project Engineer shall provide facilities to expand the system beyond the phase boundaries. Lighting conduits and signal interconnect conduits shall be extended beyond the edge of pavements to minimize disruption of traffic or disturbance of existing improvements.

### **3. Trench Loading**

All facilities shall be designed to withstand the imposed loads of trench backfill and traffic.

### **4. Corrosion Control**

The minimum design life for any lighting or signal facility is 50 years. Consideration shall be given to choosing materials and methods which provide the longest life. Metal pipes and similar materials shall not be used in highly corrosive soils. All miscellaneous iron work shall be hot-dip galvanized or shall be stainless steel.



## SECTION X

### CONSTRUCTION STAKING

#### A. LICENSE REQUIREMENT

All Construction Staking shall be provided by or under the direction of a registered California Civil Engineer or licensed Land Surveyor, with a current registration. In accordance with the provisions of State Law, Civil Engineers with initial registrations dated after December 31, 1981, shall not set or locate any property or boundary points or monuments.

#### B. CONTROL REQUIREMENTS

The monuments and other reference information, upon which any required Map is based or upon which the design field survey work was based, shall be used to establish the staking control for the construction work. The design elevation bench mark shall be used to establish any Temporary Bench Mark for construction purposes.

##### 1. Project Control Requirements

All interim control points which are to be used as control for construction staking, shall be set to the appropriate degree of surveying accuracy. All City street monuments shall be set to third order accuracy.

##### 2. Lost or Destroyed Monuments

Any existing monuments which need to be saved and were lost or destroyed during construction operations shall be reset by an Engineer or Surveyor prior to issuance of the Notice of Completion for the project. The same methods and accuracy shall be used to reestablish a lost or destroyed monument as was used to set it. This means that first and second order monuments shall be reset using first and second order surveying accuracy and practices, respectively.

###### a. Documentation of Reestablished Monuments

Any official documents required to be prepared for any reestablished monument and recorded or otherwise filed with a Federal, State or Local Agency, shall also be performed prior to issuance of the Notice of Completion.

###### b. Security for Reestablishing Monuments

In lieu of completing this work, the Contractor may post a Cash Bond for the estimated cost of performing this work, or provide suitable evidence of an Agreement with the party performing the work.



### 3. Temporary Project Benchmark

A Temporary Project Benchmark (commonly referred to as a TBM) shall be established immediately adjacent to the limits of the construction work. After it is set, the TBM shall be clearly flagged and marked "TBM - Project Name, Elevation - ##.##". The TBM shall be established using appropriate surveying techniques for an elevation benchmark. The location of the TBM shall be indicated on the Improvement Plans. The point or object chosen for the project TBM shall be of a durable nature so that it can't be easily removed or otherwise damaged or altered in elevation. The operating nuts of fire hydrants or valves shall not be used as TBM's.

## C. PROJECT STAKING REQUIREMENTS

All of the following staking requirements are meant to establish a performance standard to indicate the expected level of quality and the general number and type of stakes required for any particular item of construction. Due to the nature of construction and the different means employed by Contractors, some variation will be acceptable provided that the staking needs for a particular project are discussed with and approved by the Inspector.

### 1. Construction Methods

The Construction Contractor and the Staking Engineer or Surveyor shall meet with the Inspector to discuss methods of construction and staking requirements. The Inspector may require that the Staking Engineer or Surveyor place the stakes at the minimum listed spacings when the Contractor is using manual methods of determining line and grade (string line, batter boards and hand held dip stick with level). When the Contractor is using automatic methods of determining line and grade (laser level controlled equipment) then the stakes may set at the larger spacings.

### 2. Project Boundaries

Sufficient boundary points shall be established to allow the Contractor and City to determine the location of the work. In accordance with State Law, at least one side of the property shall be fully marked. The elevation bench mark to be used during construction shall also be flagged and marked prior to the start of construction. Any other existing property corners or monuments which need to be saved and which are close to the work shall also be flagged and marked.

### 3. Staking Requirements

Construction stakes shall be set to the types and quantities as listed in the following table. Stakes may be set for installation of more than one item provided that they are appropriately protected and maintained in good condition. A separate set of stakes shall be provided for grading operations, building corners, sanitary sewer installation, underground utilities, street lights, traffic signals, road sub-grade, finish concrete work and fencing/retaining walls.

Where underground utilities are parallel to the centerline of a street, the street centerline stakes may be used for each of the utilities, and marked with multiple offsets and cuts or fills.

Construction Staking Requirements				
Item	Stake Intervals	Offset Distance	Offset Cut/fill Elevation	Special Items and Comments
Temporary Property Corners	2 Corners on same line	At Corners	N/A	Used during construction
Rough Grading Operations	50' - 100' centers±	max: Street CL to RW	Finish Grade	As needed
Building and Structures	Corners (100'± max)	3' - 10'	Finish Floor	As needed
Sanitary Sewer	25' - 50'	10' - 15'	Invert Pipe	Manholes, Flusher Branches, Services
Sewer/Storm Manholes	2 Stakes	10' - 15'	Invert and Rim	N/A
Storm Drain	25' - 100'	10' - 15'	Invert Pipe	Inlets and Manholes
Storm Drain Inlets (Rough)	3 Stakes	10' - 15'	Invert and top	1 stake for center, 2 stakes for Face of Curb
Water Supply	25' - 100'	10' - 15'	Invert Pipe	Services and Valves
Fire Hydrants	2 Stakes	5' - 10'	Finish Grade of Sidewalk	N/A
Street Lighting	50' - 100'	5' - 15'	No Elev.	Lights and Pullboxes
Public Utilities	50' - 100'	10' - 15'	Finish Grade above utilities, Finish Grade vaults	Poles, Vaults and Boxes
Street Sub-grade	25' - 50'	0' - 10'	top of Sub- grade	Centerline & ¼ pts, curb or gutter, and walks.
Concrete Work	25' - 50'	2' - 10'	Finish Grade	Inlets, curb or gutter, walks, transitions, returns, etc.
Street Corners (Concrete work)	5 Stakes (min.)	2' - 10'	Finish Grade	Beginning and ends of curve, ¼ & ½ pts.
Drop Inlets (Finish)	5 Stakes or 3 stakes & ex. conc.	5' - 10'	Top DI, Flowline gutter	Center of DI, beginning and end of gutter transitions
Pavement	25' - 50'	0' - 10'	Finish Grade	Centerline and ¼ & ½ pts, as needed
Street Monuments	2 sets @ ea. mon.	2' - 5'	Location only	CL mon.

#### 4. Horizontal and Vertical Curves

Stakes shall be set at a maximum interval of 25 feet on horizontal and vertical curves, regardless of the methods of construction. A stake shall be provided at the beginning and ends of the curves. At least one stake shall be provided at the mid-point of the curve. Otherwise the stakes inside the curve shall be more or less evenly spaced between the beginning and end of the curve.

#### 5. Accuracy of Staking

Stakes for the item being staked shall be set to obtain the accuracies as required by the Standard Specifications. In general, a wood hub (usually 1"x2"x6") and a wood lath (usually 1/2"x2"x36"), or the equivalent, shall be provided at each stake location. The wood hub shall be used to measure the location and elevation of the staked item. The wood lath shall be appropriately flagged and marked with the staking information.

A larger wood hub (usually 2"x2"x8") shall be used on items for which the grade is particularly flat (approx. 0.35% or less). Larger and longer hubs shall be provided when the supporting soils are soft or unstable. Hubs smaller than 1"x1" will generally not be allowed.

A nail shall be provided in the top of the wood hub to indicate location for any finish concrete work, building layout, monument construction, or other item where accuracy to within 0.01' is required.

The use of large nails (20d+ size) in hard ground, and nails/shiners on pavement and painted messages are typical acceptable alternates. Care shall be exercised to avoid permanently damaging any newly constructed work.

#### 6. Cut Sheets

Cut Sheets shall be provided to the City and Construction Contractor for all construction staking. The Cut Sheets shall be delivered to the Public Works Inspector within 1 working day of setting of construction stakes for any particular item of work. Delivery of Cut Sheets by use of telecommunication equipment is acceptable.

The Cut Sheets shall be organized in a neat professionally written manner. They shall list or itemize the item being staked, stake station, elevation, offset, plan grade, cut or fill, and any other pertinent staking information. Each Cut Sheet shall also have a heading listing the Land Surveyor or Engineer, California registration number, company address and phone, field personnel (if any), Project Name, date of staking, and sheet numbering. See the following Sample Cut Sheet.





## END OF DESIGN STANDARDS