Design Standards

Manual

Tucson Water Department

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DESIGN STANDARDS MANUAL OVERVIEW

8-01.0.0 DESIGN STANDARDS MANUAL OVERVIEW

These standards are developed to assure that the public water system is reliably capable of supplying adequate quantities of water which consistently meet applicable water quality standards and do not pose a threat to general public health.

8-01.1.0 Introduction

1.1 Purpose of Manual

For public water projects that will become a part of the Tucson Water system, the purpose of this manual is:

- to describe the requirements to obtain approval from Tucson Water for the design of public water project plans and specifications,
- to provide uniform standards to those who are involved in the planning, design, and construction of public water system facilities,
- to ensure the project is designed and approved while complying with, statutes, codes, ordinances and any applicable regulations.
- to ensure that the project is designed and constructed in a manner consistent with established operation and maintenance procedures.

These standards do not waive any applicable City, County, State or Federal regulations or codes.

1.2 Authority for Manual

The establishment of a design standards manual is deemed necessary by Tucson Water in accordance with applicable laws, such as:

A. A.R.S. 9-499.01, Powers of Charter Cities
"Charter cities … shall be vested with all the powers of incorporated towns … in addition to all powers vested in them pursuant to their respective charters, or other provisions of law relating to cities…."

B. A.R.S. 9-511, Power To Engage In Business Of Public Nature

1. "A municipal corporation may engage in any … enterprise ... and may construct, purchase, acquire, own and maintain within or without its corporate limits any such … enterprise.

2. A municipal corporation may also purchase, acquire and own real property for sites and rights-of-way for … the location thereon of waterworks …, pipelines for the transportation of … water …

3. The municipality may exercise the right of eminent domain either within or without its corporate limits … and may establish, lay and operate a plant, … or pipeline upon any land or right-of-way taken thereunder…."

C. Tucson Code, Chapter 27, Water

Sec. 27-4. Superintendent to control water supply; notice of shutting off pipelines. The superintendent of the water department shall attend to and control the water supply and at all times see to the sufficiency thereof.

8-01.2.0 Basic Requirements Overview

2.1 State of Arizona Requirements

Pursuant to the AAC R18-5-502 (A), recodified 1/30/04, a water system that is designed consistent with the criteria in ADEQ Engineering Bulletin No. 10, "Guidelines for the Construction of Water Systems," May 1978, shall be considered to have been designed using good engineering practices.

ADEQ Engineering Bulletin No. 10 provides guidance and minimum design criteria for the modification and construction of water systems. It is intended for use in the tasks of water system planning, design, plan development, specification writing, review and construction.

2.2 Tucson Water Requirements

This manual will supplement ADEQ Engineering Bulletin No. 10. Where possible, only items that are in addition to, or that exceed, those required in the bulletin will be included. Topics needing clarification or reinforcement will also be covered.

8-01.3.0 Tucson Water Department Overview

3.1 Water Department

For a detailed review of all City codes and ordinances related to the Water Department, please refer to the Tucson Code.

3.2 Director

The City of Tucson Director of the Utility Services Department includes duties and responsibilities the same as the Director of Tucson Water.

3.3 Organization

A. Mission Statement

Tucson Water's mission is to provide, in partnership with our community, excellence in water services to secure the future and enhance the quality of life. Our commitment is to ensure our customers receive high quality water and excellent service in a cost efficient and environmentally responsible manner.

B. Water Issues Overview

Tucson Water is charged with balancing the issues of water quality and related costs while managing sustainable water sources to meet current and future demand. Tucson Water maintains this balance by developing and operating the water system in a manner that is responsive to its customers, enhances the environment, and meets or exceeds all regulatory requirements.

C. Water Service Provider

As of 2004, Tucson Water provides water service to residents within a 300 square-mile service area that encompasses 78% of the greater Tucson metropolitan area's total population.

A network of wells, reservoirs, pumping stations, and water mains will deliver approximately 110,000 acre-feet of drinking water to city and county residents and businesses during calendar year 2004. In addition, about 12,000 acre-feet of reclaimed water (wastewater effluent treated by filtering and disinfecting) will be delivered for irrigation purposes.

Tucson Water recharges Colorado River water, secondary effluent, and reclaimed water into the aquifer, to "bank" water for future use.

8-01.4.0 Water System Overview

4.1 Current Sources of Water

A. Groundwater

Tucson Water produces groundwater from aquifers located in the Tucson Basin and in Avra/Altar Valley. There are five major well fields from which the water is produced:

- the Central, Santa Cruz and Tucson Airport Remediation Project/Southside well fields, in the Tucson Basin, and
- the South Avra Valley and Central Avra Valley well fields, in Avra/Altar Valley.

B. Surface Water
Tucson Water receives surface water from the Central Arizona Water Conservation District through the Central Arizona Project.

C. Effluent
Tucson Water receives secondary effluent from Pima County. The secondary effluent is either treated to a higher standard for direct non-potable use in the Reclaimed Water System or recharged for storage credits to be used later.

4.2 Existing Treatment Plants

The Tucson Reclaimed Water Treatment Plant has a designed treatment capacity of 10 million gallons per day.

4.3 Recharge Facilities

A. Central Avra Valley Storage and Recovery Facility
The Central Avra Valley Storage and Recovery Facility is used to recharge Central Arizona Project water into the aquifer. The water is then recovered along with native groundwater for use as a blended water supply for the Tucson potable water system.

B. Sweetwater Recharge and Recovery Facility
The Sweetwater Recharge and Recovery Facility recharges secondary effluent recovered for use in the reclaimed water system.

C. Pima Mine Road Recharge Facility
The Pima Mine Road Recharge Facility is jointly owned by Tucson Water and the Central Arizona Water Conservation District and is used to recharge Central Arizona Project water for future use.

4.4 Water Storage Facilities

The drinking water system has a total combined storage capacity of 273 million gallons as of 2004. The basic objectives of water storage facilities are to help meet peak flow requirements, to equalize system pressures, and to provide emergency water supply, such as fire flow requirements.

Storage in the reclaimed water system helps meet peak flow requirements, and equalizes system pressures.

4.5 Water Pressure Zones

The drinking water system and the reclaimed water system are completely separate systems. Both are composed of multiple pressure levels, or zones, based on topography and defined high water elevations.

A. Potable Drinking Water System

In the potable drinking water system, there are at present fifteen individual pressure zones. The high water elevations in each of the pressure zones are normally separated by about 105 feet in elevation.

Due to rapid elevation changes over a short distance, there are a few areas that have been designated as dual zones. The high water elevation in a dual pressure zone is about 210 feet above the adjacent lower zone, rather than the normal 105 feet. Water customers in the lower topographic area of a dual zone typically have a pressure-reducing valve in the water service line.

One or more water sources and storage facilities supply peak demand and local fire suppression requirements for each zone.

B. Reclaimed Water System

In the reclaimed water system, the high water elevations in each of the pressure zones are normally separated by about 222 feet in elevation.

4.6 Isolated Water Systems

"Isolated water system" applies to "water service area," or interconnected grouping of water service areas that are not connected to the integrated central water system. An isolated water system has a limited source of potable groundwater usually consisting of one or two wells.

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ADMINISTRATION OF WATER DESIGN STANDARDS MANUAL

8-02.0.0 ADMINISTRATION OF WATER DESIGN STANDARDS MANUAL

8-02.1.0 General

1.1 Purpose

The establishment of administrative procedures to amend the design standards manual is prudent and necessary to allow flexibility when experience or regulations necessitate an amendment to the current standard, requirement, or procedure.

1.2 Quality Review Standard

The procedures to amend these standards shall be followed to ensure the amendment receives appropriate professional review before adoption.

8-02.2.0 Procedures for Amending the Design Standards

2.1 Review Procedures

A. Proposed Amendment

Proposals to amend standards may be initiated by submitting a draft proposal to the Engineering Administrator.

B. Review Procedure

1. A proposed amendment shall be submitted in writing to the Engineering Administrator, who will give the amendment to the DSRC (See paragraph 2.2. in this section) for preliminary review and comment.

2. The DSRC will submit its comments and recommendations to the Engineering Administrator.

3. The Engineering Administrator may accept, reject or modify the recommendations of the DSRC and either:
   - return it to the members of the DSRC for additional review and recommendation, or
   - approve the proposed amendment as the final standard.

C. Amendment Approval Procedure

The Engineering Administrator is the final authority for any design standard amendment. The standard becomes effective upon the authorization of the Engineering Administrator. The authorization should be in writing and include the name and number of the

standard, approval signature and the date. The amendment will be included in the updated Design Standards Manual published on the Tucson Water website at http://www.tucsonaz.gov/water/pubs-gi.htm.

2.2 Design Standards Review Committee

The DSRC serves in a technical advisory capacity for the Engineering Administrator. It's primary function is to facilitate and expedite the review and approval of amendments to the design standards while ensuring compliance with the codes, ordinances, design standards, AWWA standards, good engineering practices and any other regulations applicable to the standard.

A. Membership

1. The Engineering Administrator, or a designated representative, will be the DSRC chairman responsible for coordinating, compiling, and maintaining the meeting discussion record.

2. Members of the DSRC shall possess the necessary expertise to properly evaluate matters before the DSRC and will respond expeditiously to the Engineering Administrator. The DSRC shall have, at a minimum, a representative from each of the following Water Department Sections or Divisions:
   - Planning and Development Section
   - Construction Section
   - Distribution Design Section
   - Plant Design Section
   - Reclaimed Water/Backflow Prevention Section
   - Water Quality Management Division
   - Operations and Maintenance Division

B. Meetings

The chairman of the DSRC shall schedule DSRC meetings to allow the submitter the opportunity to discuss the proposed amendment.

C. Review Comments

1. DSRC members shall review submittals for conformance with the codes, ordinances, design standards, AWWA standards, good engineering practices, and other applicable regulations.

2. DSRC members shall provide the DSRC chairman with written comments including any re-submittal requirements and will include pertinent code, ordinance, or other applicable citations in their comments.

3. The Engineering Administrator will make the DSRC comments available to the submitter.

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DESIGN ACCEPTANCE REQUIREMENTS, DEVELOPER-FINANCED PROJECTS

8-03.0.0 DESIGN ACCEPTANCE REQUIREMENTS, Developer-Financed Projects

8-03.1.0 General

1.1 Purpose

This section describes the requirements to obtain acceptance from Tucson Water for the design of developer-financed public water projects.

The following paragraph is intended to clarify the use in this section (8-03) of the terms accept, accepted, acceptance, or any other derivative:

> The action taken on these proposed projects submitted for review is to "accept" the projects—denoting that the project meets the requirements of Tucson Water, and may be forwarded to ADEQ for "approval" consistent with State statutes and regulations.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 Applicability

The water project acceptance requirements listed herein are unique to developer-financed public water projects.

Additional requirements are contained in other sections of the water project design standards manual that are associated with each type of water project. Depending on the developer-financed water facilities required for the developer's project, additional water project design standards shall be applicable.

Typical water projects that are governed by this standard include developer-financed water projects for onsite and off-site water system improvements. These typically consist of water line extensions, but may also include the construction of the following water projects:

- water storage facilities,
- water pumping stations,
- water pressure reducing stations, and
- other water facilities as may be required by Tucson Water to ensure compliance with the objectives stated in this Manual, and

- modifications to existing water infrastructure.

A. Tucson Water Approval
All projects require Tucson Water approval. Any change made to the Tucson Water system must be recorded and on file with the Tucson Water Mapping/GIS Section.

B. Approval to Construct Requirements of ADEQ
All public water projects must meet the Approval to Construct requirements of ADEQ before the initiation of construction. Refer to ARS 49-353(A)(2) and AAC R18-5-505, Approval to Construct, for current requirements.

C. Exemptions from Plan Review Requirements of ADEQ
Exemptions from the plan review requirements of ADEQ, including the requirements for the Approval to Construct and the Approval of Construction, pursuant to ARS 49-353 (A)(2)(e), are based on the drinking water project cost including design cost.

1. Project Cost of $12,500 or less
Pursuant to AAC R18-5-505, a project is exempt from the plan review requirements of ADEQ if the project cost is $12,500 or less and
   a. if the water line is not for a subdivision requiring plat approval by a city, town, or county, and
   b. if the design is prepared by a professional engineer registered in Arizona, and
   c. if the construction is reviewed for conformance with the design by a professional engineer registered in Arizona.

2. Water Line Cost Between $12,500 and $50,000
Pursuant to AAC R18-5-505(B)(3)(b), a project is exempt from the plan review requirements of ADEQ if the project cost is between $12,500 and $50,000 and
   a. if the water line is not for a subdivision requiring plat approval by a city, town, or county, and
   b. if the design is sealed and signed by a professional engineer registered in Arizona, and
   c. if the construction is reviewed for conformance with the design by a professional engineer registered in Arizona.

3. Notice of Compliance
Pursuant to AAC R18-5-505(B)(4), upon completion of a project exempt from the plan review requirements of ADEQ, Tucson Water must provide to ADEQ a “notice of compliance” which contains:
   - fair market value cost estimate for the project,
   - the name of the design engineer,
   - the name of the review engineer,
   - the project completion date, and

- the total construction time.

4. Reclaimed Water Projects
   At this time no reclaimed water conveyance (including pumping stations and storage facilities) or treatment facilities (including recharge basins and filtration plants) are submitted to ADEQ for review and/or approval.

8-03.2.0 Submittal, Review and Acceptance Process Requirements

The submittal, review and acceptance process for developer-financed water projects includes:

- Water Assurance Letters
- Water Master Plan Requirements
- Design Plan Review and Water Plan Acceptance
- Water Plan Revisions
- Plan Finalization or Cancellation
- Fees

2.1 Water Assurance Letters

Application for a Water Assurance Letter is required for developer-financed water projects that meet any one of the following condition(s):

- Planning and Zoning changes, subdivision plat process,
- Cost estimates, including design, greater than $12,500,
- Outside of Tucson City limits, and
- Water line extensions greater than 200 feet.

Application for a Water Assurance Letter is made through the Tucson Water New Development Unit and should include:

- an 8.5”x11” drawing delineating the area to be served
- township-range-section
- number and size of services, if known

Issuance of a Water Assurance letter should not be construed as Tucson Water acceptance of water plan or as containing construction review comments relative to conflicts with water lines and a development.

Water Assurance Letters are valid for a period of one year from issuance.

2.2 Water Master Plan Requirements

Water master plans are required for all developer-financed water projects.

All types of water master plans shall be submitted on 24” x 36” plan sheets, with a scale not to exceed 1” = 200; and shall contain the information described herein.

This subsection contains the following major topics:

- Research Water Master Plan
- Overall Water Master Plan
- Water Master Plan

A. Research Water Master Plan

Depending on the scope and location of a proposed developer-financed project, a "research" water master plan review is highly recommended. The review would examine the proposed water system and identify any required upgrades to the existing water system due to the developer-financed water project.

The research review does not replace the water master plan review process. The research review is a comprehensive analysis to describe for the owner/developer "unforeseen expenditures" that may affect the scope of the water project.

1. Research Water Master Plan Submittals

   Submittals required for Tucson Water to perform a research water master plan review include:

   - a completed Research Water Master Plan Checklist, obtained from the Tucson Water New Development Unit, and
   - a copy of a valid Water Assurance Letter, obtained from the Tucson Water New Development Unit.

2. Research Review Fee

   A research review fee will be assessed according to the number of sheets submitted. The review fee schedule is included in the Developer-Financed Water Project Handbook ("Handbook") available from the Tucson Water New Development Unit or can be found at http://www.tucsonaz.gov/water/misc_fees.htm.

3. Research Review Purpose

   The research review will include hydraulic modeling to examine the effect of the proposed development on the existing water system. Any potential improvements, which may include offsite water main extensions, new or existing facility upgrades, and onsite water mains, will be identified during the model scenario analysis.

   The research review also will identify issues in regard to protected mains and facilities, required easements, area fees, and engineering conflicts.

4. Expiration

   Research done on the proposed development is valid for a period of one year after the review.

B. Overall Water Master Plan

Water master plans that are divided into "Phases" require an overall water master plan review. The overall review examines the "stand alone" capability of each phase until the last phase is completed. Each phase must meet minimum pressure and storage requirements set by ADEQ.

The overall water master plan does not encompass design review of construction drawings. Once the overall water plan meets minimum standards, an acceptance letter will be issued.

Acceptance of the overall water master plan is a "conceptual acceptance" and minor changes may be shown in subsequent phased master plan reviews.

1. Overall Water Master Plan Submittals

Submittals required for Tucson Water to perform an overall water master plan review include:

- a completed Water Master Plan Checklist, obtained from the Tucson Water New Development Unit, and

- a copy of a valid Water Assurance Letter, obtained from the Tucson Water New Development Unit.

Each phase of the overall water master plan must be submitted to the New Development Unit, Tucson Water, for a phased master plan and design plan review. If the scope of the phased project no longer matches the overall water master plan or fire-flow requirements change, then the consultant/engineer will be required to resubmit that phase of the project for a new master plan review. If the New Development Unit reviewer determines a phased portion of the overall master plan has changed considerably from the approved overall master plan layout, a new overall water master plan submittal and review may be required.

2. Master Plan Review Fee

A master plan review fee will be assessed according to the number of sheets submitted. The review fee schedule is included in the Developer-Financed Water Project Handbook ("Handbook") available from the Tucson Water New Development Unit or can be found at http://www.tucsonaz.gov/water/misc_fees.htm.

3. Master Plan Review Purpose

The overall master plan review will use hydraulic modeling to interconnect phases and determine if there is adequate looping to existing water mains and new water mains in order to meet minimum peak day water demand plus fire-flow conditions.

4. Expiration
   The acceptance letter is valid for a period of one year from issuance date.

C. Water Master Plan

1. Purpose
   The purpose of the Master Plan is to assure the plan complies with the policies and standards as required by Tucson Water and State statutes.

2. General Information
   The scope of the project may be established by a water assurance letter, meeting with a master plan reviewer, telephone contact or direct submittal. All developer-financed projects shall be subject to Water Master Plan review to ensure hydraulic compliance.

3. Submittal Documents
   - One full-size copy of the plan
   - Water Master Plan Checklist
   - Tentative Plat or document showing existing elevations
   - Grading Plan, Sewer Plan or document showing finished grades
   - Appropriate review fee check

4. Review Process
   The proposed Water Master Plan will be forwarded to the primary reviewer to be reviewed and returned to the Developer's Engineer for correction, if needed. Corrections shall be resubmitted in a timely manner. The process shall continue until the plan meets all applicable requirements. Once the Water Master Plan is accepted, the Developer's Engineer shall be informed in writing.

5. Disposition
   The accepted Master Water Plan shall remain valid for a period of one calendar year from date of approval. At that time the Master Water Plan shall be cancelled and Tucson Water shall be released from any commitments relating to the allocation of resources to the project.

2.3 Design Plan Review and Water Plan Acceptance

A. All developer-financed water project designs must be reviewed and accepted by Tucson Water prior to construction. The Applicant shall be fully responsible for all aspects of the construction drawings. Review and acceptance by Tucson Water shall in no way relieve the Applicant of this responsibility.

B. After a water plan has received master plan acceptance, the plan will be reviewed for system design, drafting and sheet format consistent with the requirements of this manual.

C. Plans shall be submitted to Tucson Water, New Development Unit.

D. Review fees shall be paid at the time of plan submittal. The review fee schedule is included in the Developer-Financed Water Project Handbook ("Handbook") available from the Tucson Water New Development Unit or at http://www.tucsonaz.gov/water/misc_fees.htm.

E. All submittals shall conform to requirements set forth in this manual and the supplementary Handbook.

F. A water plan submitted for the first design review must be accompanied by a completed First Design Review Checklist as presented in the Handbook. Submittal requirements for the water plan are identified in the first section of the checklist.

G. Plans shall be resubmitted until compliance is achieved.

H. Plans are reviewed on a first-come, first-served basis.

I. An "Agreement for Construction of Water Facilities Under Private Contract" (hereinafter "Construction Agreement") must be executed prior to construction. The document will be prepared by the Tucson Water New Development Unit and will be forwarded to the Owner/Developer as early in the design review process as possible. An executed Construction Agreement becomes a commitment by Tucson Water to provide water service and defines all requirements for construction, liability, dedication of facilities, protected mains, and any other special conditions. In the event that a water plan is cancelled, the Construction Agreement shall also be cancelled. The Agreement is not a commitment to provide water service until the Construction Agreement is signed by Tucson Water. An example of this document is included in the Handbook.

J. The Applicant shall submit the PDEQ form titled "Water Service Agreement and Sewer Service Agreement" along with the water plan original when notified by the plan reviewer that the water plan is ready for acceptance. An example is included in the Handbook.

K. All required signatures, other than the Tucson Water signature, within the acceptance block on the cover sheet original must be obtained prior to acceptance by Tucson Water.

L. All accepted water plan originals will be retained by Tucson Water and become Tucson Water property. A full-size, reproducible copy of the accepted plan will be given to the Applicant for construction purposes.

M. Plans are valid for one year from the date of acceptance. Plans that exceed the deadline without acquiring a “Notice to Proceed” shall be cancelled in accordance with the cancellation subsection.

2.4 Water Plan Revisions

A. Water plans must, at all times, reflect the actual conditions and scope of the project. If the design concept, plat, or any other pertinent information changes after plan acceptance and prior to finalization, it will be the responsibility of the Applicant to promptly revise the original construction drawings.

B. An accepted plan that requires alteration must be formally revised. Construction of the proposed revision may not commence prior to review and acceptance of the proposed revision.

C. The Applicant shall submit to the Department a full-size copy of the accepted water plan with the proposed revision shown in red or any other contrasting color. The submittal shall include any appropriate documents pertinent to the revision, such as a revised plat, electric plan, easement description, or cost estimate.

D. The revision fee shall be paid at the time of submittal. The fee schedule is included in the Handbook.

E. The design reviewer will add any applicable comments to the submitted copy of the revised water plan. Depending upon the scope of the revision, the Master Plan reviewer may add additional comments or requirements.

F. The mark-up of the proposed revision will be returned to the Applicant along with Tucson Water’s signed original of the accepted water plan.

G. The Applicant shall revise the original water plan in accordance with the comments on the mark-up of the proposed revision.

H. If any aspect of the fire protection system has been altered, the revised original must be reviewed and accepted by the appropriate fire authority prior to submitting the revised original to Tucson Water.

I. The applicant shall submit the revised original, a full-size copy of the revised original, and the mark-up of the proposed revision to the design reviewer for review and acceptance.

J. Upon acceptance, a reproducible copy of the revised plan will be made for the Applicant. Tucson Water will retain the revised original.

2.5 Plan Finalization or Cancellation

A. Plan Finalization

1. Purpose

The purpose of plan finalization is to establish a process whereby all parties are notified of their compliance with responsibilities as prescribed in the Construction Agreement, the utility gains control of the system and the developer may order meters for installation.

2. General Information

A plan shall be considered complete when all the requirements of the Construction Section relative to the project have been successfully met. At such time, the Construction Section shall notify all applicable Tucson Water sections in writing.

3. Finalization Process

Once the Final Inspection and Acceptance Letter is received by the Tucson Water New Development Unit, the plan shall be purged in accordance with established procedures, appropriate records forwarded to Mapping/GIS section for archival purposes and the remainder of the file shall be retained for future reference.

B. Plan Cancellation

1. Purpose

The purpose of plan cancellation is to establish a process whereby all parties are notified of project inactivity and Tucson Water releases its resource allocation for the subject project for reallocation to other projects. A cancelled plan cannot be reactivated. It must be resubmitted as a new plan.

2. General Information

A plan shall be cancelled at the sole discretion of Tucson Water at such time as one calendar year has passed with no activity relative to the status of the project.

2.6 Fees

Mayor and Council have approved the collection of plan review fees; said fees can be found in Chapter 27 of the Tucson Code.

8-03.3.0 Approval Requirements – Arizona Dept. of Environmental Quality

Pipeline projects, are to be submitted to the PDEQ office, as provided for in ARS 49-107, local delegation of state authority. Submit projects for wells, storage and other appurtenances to ADEQ. The applicant is encouraged to meet with PDEQ and ADEQ at the initiation of their project planning process to ensure that the applicant is aware of the applicable approval requirements.

Generally, the project review and approval requirements of ADEQ are described in AAC R18-5-505, Approval to Construct, recodified January 30, 2004. This rule is required by ARS 49-353. Similar approval requirements are described in Chapter 1, section B. of the ADEQ Engineering Bulletin No. 10, Guidelines for the Construction of Water Systems, 5/78, but they are superseded by AAC R18-5-505.

8-03.4.0 Design Changes to Approved Projects

4.1 Tucson Water Approval of Design Changes

All design changes to a previously approved project design must comply with Section 8-07 of this Manual and will require Tucson Water approval. This includes:

- design changes before going to bid, after design approval,
- invitation for bid amendments, during the bidding process, and
- supplemental agreements/change orders, during construction.

A. Cover Sheet Revisions

Make revisions to revision block on cover sheet (or sheet index map) as follows:

1. Revision number
2. Revision date
3. Person designing revision
4. Revised sheets in “revision” column
5. Person checking revision
6. Seal and sign cover sheet

B. Revising Affected Sheets

Make revisions to the affected sheets as follows:

1. Retrieve original plan sheets from Mapping/GIS Section
2. “X” out deleted items
3. Draw a “cloud” around revised or added items
4. Put the revision number in triangle adjacent to each revisions
5. Fill in the revision block on each revised sheet
6. Seal and sign revision on each revised sheet

4.2 ADEQ Approval

A. Material Design Change Determination

Pursuant to AAC R18-5-506, Compliance with Approved Plans, any material change in the approved design will require approval by ADEQ if the change will affect:

- water quality,
- capacity,
- flow,
- sanitary features, or
- performance.

Revisions not affecting water quality, capacity, flow, sanitary features, or performance, may be permitted during construction without further ADEQ approval if record drawings document these changes, prepared by a professional engineer registered in Arizona.

B. Submittal and Review of Material Design Change
When there is a material change in the approved design, the revised plans and specifications and a written statement of the reasons for such change shall be submitted to ADEQ for review:

C. Approval of Material Design Change
Approval shall be obtained in writing from ADEQ before the work affected by the change is undertaken.

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DESIGN APPROVAL REQUIREMENTS, CAPITAL IMPROVEMENT PROGRAM PROJECTS

8-04.0.0 DESIGN APPROVAL REQUIREMENTS, Capital Improvement Program Projects

8-04.1.0 General

1.1 Purpose

This section describes the requirements to obtain approval from Tucson Water for the design of CIP public water projects of Tucson Water.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 Applicability

The water project design approval requirements listed herein apply to most water projects.

Additional requirements may be contained in other project design standards, defined by their function, i.e., pipeline, storage, pumping.

Tucson Water projects governed by this standard consist of:

- distribution and transmission pipeline projects
- water storage facilities,
- water pumping stations,
- water pressure reducing stations
- other water facilities as may be required by Tucson Water to ensure compliance with the objectives stated in this Manual, and
- modifications to existing water infrastructure

A. Tucson Water Approval

All projects require Tucson Water approval. Any change made to the Tucson Water system must be documented and on file with the Tucson Water Mapping/GIS Section.

B. Approval to Construct Requirements of ADEQ

All public water projects must meet the Approval to Construct requirements of ADEQ before the initiation of construction. Refer to ARS 49-353(A)(2) and AAC R18-5-505, Approval to Construct, for current requirements.

C. Exemptions from Plan Review Requirements of ADEQ

Exemptions from the plan review requirements of ADEQ, including the requirements for the Approval to Construct and the Approval of Construction, pursuant to ARS 49-353 (A)(2)(e), are based on the drinking water project cost including design cost.

1. Project Cost of $12,500 or less

   Pursuant to AAC R18-5-505, a project is exempt from the plan review requirements of ADEQ if the project cost is $12,500 or less and

   a. if the water line is not for a subdivision requiring plat approval by a city, town, or county, and
   b. if the design is prepared by a professional engineer registered in Arizona, and
   c. if the construction is reviewed for conformance with the design by a professional engineer registered in Arizona.

2. Water Line Cost Between $12,500 and $50,000

   Pursuant to AAC R18-5-505(B)(3)(b), a project is exempt from the plan review requirements of ADEQ if the project cost is between $12,500 and $50,000 and

   a. if the water line is not for a subdivision requiring plat approval by a city, town, or county, and
   b. if the design is sealed and signed by a professional engineer registered in Arizona, and
   c. if the construction is reviewed for conformance with the design by a professional engineer registered in Arizona.

3. Notice of Compliance

   Pursuant to AAC R18-5-505(B)(4), upon completion of a project exempt from the plan review requirements of ADEQ, Tucson Water must provide to ADEQ a “notice of compliance” which contains:

   - fair market value cost estimate for the project,
   - the name of the design engineer,
   - the name of the review engineer,
   - the project completion date, and
   - the total construction time.

4. Reclaimed Water Projects

   At this time no reclaimed water conveyance (including pumping stations and storage facilities) or treatment facilities (including recharge basins and filtration plants) are submitted to ADEQ for review and/or approval.

8-04.2.0 Submittal Requirements

2.1 General

The following subsections contain the names of the various documents to be submitted. The requirements for the specific content of each document are contained in other sections. Where applicable, the section number of the Design Standard has been provided for the content requirements.

2.2 Documents to be Submitted

A. Basic Documents

The following list of basic documents are to be submitted to Tucson Water for review of all projects:

- Project/Construction Plans (original), Section 8-07
- Special Specifications, Section 8-13
- Engineer's Estimate of Probable Construction Cost, Section 8-15
- Project Bid Schedule, Section 8-15

B. Additional Documents

The following list of additional documents will be required, if applicable, depending on the specific needs of the project:

- Easement description, with current title report or recorded deed, Section 8-15
- Design report, Section 8-15
- Native Plant Preservation Plan, to City of Tucson Landscape Review Section, Development Services
- Cultural Resources Survey/Archeology Report
- Pygmy Owl Survey, to U.S. Fish & Wildlife
- Endangered Species Survey/Pima Pineapple cactus

This list is not intended to be inclusive of all documents, which might be required for the approval of a specific project. The designer should consult with the approval agency for a comprehensive list of documents required for approval.

8-04.3.0 Review Requirements

3.1 Tucson Water Review

A. Primary Reviewer

The Tucson Water design section that normally has the responsibility for a particular type of project design shall be the primary reviewer of the project documents submitted from the designer. For example, the Plant Design Section has the responsibility to review storage facility projects, and the Distribution Design Section has the responsibility to review pipeline projects.

The primary reviewer shall be responsible for coordinating the review by others as described below.

B. Reviews by Tucson Water

All Tucson Water sections affected by the project shall review the project documents periodically during the design period. Review signatures are required only on preliminary plans.

1. Mandatory Review

A mandatory review of the project documents is required of the following Tucson Water divisions, sections and units:

- Construction Section (for constructability and survey data),
- System Planning Section (to determine or verify pipeline sizes and the general location and route),
- Modifications Unit (potential roadway project conflicts),
- Operation and Maintenance Division, and
- Public Information Office (cover sheet only).

2. Selective Review

All project plans for new pipe, or a connection to existing pipe, shall be reviewed, by the Corrosion Control Unit, for corrosion prevention and monitoring requirements, if the pipe meets the following requirements of material and size, or location:

a. Any metallic pipelines sixteen inches or greater in diameter including steel pipe, concrete cylinder pipe, prestressed concrete cylinder pipe, or ductile iron pipe, and

b. located in an area known for potential corrosion problems.

3.2 Reviews Outside of Tucson Water

Review by outside agencies shall be documented with the initials of the reviewer on the plans, by memo, or by email.

A. Mandatory Review

1. Fiber Optics

The City of Tucson General Services Department requires a mandatory review of the preliminary (30%) design plans for all water main projects to determine if fiber optic conduit shall be included.

2. Right-of-Way

Review of the preliminary design for all water projects in the right-of-way is required by the applicable right-of-way jurisdiction.

B. Selective Review

1. Preliminary Design Review by Utilities

Besides the agencies listed in subsection 8-04.4 below, review of the preliminary design shall be requested of the appropriate utilities such as natural gas, electric, petroleum products, wastewater, telephone, cable communications, military installations, transportation utilities and irrigation lines.

2. Final Design Review by Fire Suppression Authority
   Review of the final design for all water main projects shall be requested of the appropriate fire suppression authority if the project includes the addition or deletion of fire hydrants.

3.3 Final Review

All project documents will be reviewed in a timely manner and returned to the designer with comments for re-submittal. Re-submittals will continue until accepted pursuant to subsection 8-04.4.

8-04.4.0 Approval Requirements

4.1 Approval Requirements by Tucson Water

At a minimum, approval signatures are required from the Engineering Division Administrator and the Deputy Director before the project can proceed to construction.

4.2 Additional Approval Requirements

Additionally, other project related approvals might be required by other governing agencies such as (but not limited to):

- Pima County or City of Tucson Development Services,
- Pima County Wastewater Management Department,
- The Arizona Department of Transportation,
- City of Tucson or Pima County Department of Transportation.

Approvals by the property owners or other jurisdictions (Marana, Oro Valley, etc.) may also be required.

4.3 Approval by Fire Suppression Authority

If applicable to this project, approval must be obtained from the fire suppression authority.

A. Preliminary Plans
   Preliminary plans shall be submitted to the fire suppression authority to determine fire flow requirements.

B. Final Plans
   Final plans shall be submitted to the fire suppression authority for approval signatures before Tucson Water approval.

4.4 Approval by ADEQ

A. Project Approval
   - Pipeline projects require submittal to the PDEQ office, as provided in ARS 49-107, local delegation of state authority. Projects for wells, storage and other appurtenances will be submitted to ADEQ. Any reference to ADEQ may also mean PDEQ.

   - A fee is charged by ADEQ to Tucson Water.

- The designer should consult with ADEQ for their latest "Plan Review Submittal Checklist" for current submittal requirements.

- Generally, the project review and approval requirements of ADEQ are described in AAC R18-5-505, Approval to Construct. This rule is required by ARS 49-353.

B. Project Completion

Pursuant to AAC R18-5-505(E), the Approval to Construct may become void unless an extension of time has been granted by ADEQ within 90 days after the passage of one of the following:

- Construction has not commenced within one year after the date of issue of the Approval to Construct,

- There is a halt in construction of more than one year, or

- Construction is not completed within three years after it begins.

8-04.5.0 Design Changes to Approved Projects

5.1 Tucson Water Approval of Design Changes

All design changes to a previously approved project design must comply with Section 8-07 of this Manual and will require Tucson Water approval. This includes:

- design changes before going to bid, after design approval,
- invitation for bid amendments, during the bidding process, and
- supplemental agreements/change orders during construction.

A. Cover Sheet Revisions

Make revisions to revision block on cover sheet (or sheet index map) as follows:

1. Revision number
2. Revision date
3. Person designing revision
4. Revised sheets in "revision" column
5. Person checking revision
6. Seal and sign cover sheet

B. Revising Affected Sheets

Make revisions to the affected sheets as follows:

1. Retrieve original plan sheets from Mapping/GIS Section
2. "X" out deleted items
3. Draw a "cloud" around revised or added items
4. Put the revision number in triangle adjacent to each revisions
5. Fill in the revision block on each revised sheet
6. Seal and sign revision on each revised sheet

5.2 ADEQ Approval of Design Changes

A. Material Design Change Determination

Pursuant to AAC R18-5-506, Compliance with Approved Plans, any material change in the approved design will require approval by ADEQ if the change will affect:

- water quality,
- capacity,
- flow,
- sanitary features, or
- performance.

Revisions not affecting water quality, capacity, flow, sanitary features, or performance, may be permitted during construction without further ADEQ approval if record drawings document these changes, prepared by a professional engineer registered in Arizona.

B. Submittal and Review of Material Design Change

When there is a material change in the approved design, the revised plans and specifications and a written statement of the reasons for such change shall be submitted to ADEQ for review:

C. Approval of Material Design Change

Approval shall be obtained in writing from ADEQ before the work affected by the change is undertaken.

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DESIGN ACCEPTANCE REQUIREMENTS, SYSTEM MODIFICATIONS PROJECTS

8-05.0.0 DESIGN ACCEPTANCE REQUIREMENTS, System Modifications Projects

8-05.1.0 General

1.1 Purpose

This section describes the requirements to obtain acceptance from Tucson Water for the design of public water system modification projects, under the CIP of Tucson Water.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 Applicability

The water project acceptance requirements listed herein are unique to Public Agency public water projects.

Additional requirements are contained in other sections of the water project design standards manual that are associated with each type of water project. Depending on the developer-financed water facilities required for the Public Agency's project, additional water project design standards shall be applicable.

Typical water projects that are governed by this standard include ratepayer water projects for onsite and off-site water system improvements. These typically consist of water line extensions, but may also include the construction of the following water projects:

- water storage facilities,
- water pumping stations,
- water pressure reducing stations, and
- other water facilities as may be required by Tucson Water to ensure compliance with the objectives stated in this Manual, and
- modifications to existing water infrastructure.

A. Tucson Water Approval

All projects require Tucson Water approval. Any change made to the Tucson Water system must be recorded and on file with the Tucson Water Mapping/GIS Section.

B. Approval to Construct Requirements of ADEQ
All public water projects must meet the Approval to Construct requirements of ADEQ before the initiation of construction. Refer to ARS 49-353(A)(2) and AAC R18-5-505, Approval to Construct, for current requirements.

C. Exemptions from the Plan Review Requirements of ADEQ
Exemptions from the plan review requirements of ADEQ, including the requirements for the Approval to Construct and the Approval of Construction, pursuant to ARS 49-353 (A)(2)(e), are based on the drinking water project cost including design cost.

1. Project Cost of $12,500 or less
Pursuant to AAC R18-5-505, a project is exempt from the plan review requirements of ADEQ if the project cost is $12,500 or less and
   a. if the water line is not for a subdivision requiring plat approval by a city, town, or county, and
   b. if the design is prepared by a professional engineer registered in Arizona, and
   c. if the construction is reviewed for conformance with the design by a professional engineer registered in Arizona.

2. Water Line Cost Between $12,500 and $50,000
Pursuant to AAC R18-5-505(B)(3)(b), a project is exempt from the plan review requirements of ADEQ if the project cost is between $12,500 and $50,000 and
   a. if the water line is not for a subdivision requiring plat approval by a city, town, or county, and
   b. if the design is sealed and signed by a professional engineer registered in Arizona, and
   c. if the construction is reviewed for conformance with the design by a professional engineer registered in Arizona.

3. Notice of Compliance
Pursuant to AAC R18-5-505(B)(4), upon completion of a project exempt from the plan review requirements of ADEQ, Tucson Water must provide to ADEQ a “notice of compliance” which contains:
   - fair market value cost estimate for the project,
   - the name of the design engineer,
   - the name of the review engineer,
   - the project completion date, and
   - the total construction time.

4. Reclaimed Water Projects
At this time no reclaimed water conveyance (including pumping stations and storage facilities) or treatment facilities (including recharge basins and filtration plants) are submitted to ADEQ for review and/or approval.

8-05.2.0 Submittal Requirements, Water System Modifications

2.1 General

The specific document content requirements are contained in the supplemental documents provided by the Tucson Water, Distribution Design Section, Modifications Unit. All submittal documents from the Agency includes, but are not limited to, road, drainage, sewer, sidewalk, lighting, other utilities, and floodplain.

2.2 Documents to be Submitted

A. Basic Documents
The following documents must be submitted for review of projects:
- Agency Project Construction Plans
- Water System Modification Construction Plans
- Special Provisions to Pima County/City of Tucson Standard Specifications for water work
- Engineer's Project Cost Estimate.

B. Additional Documents
The following additional documents will be required, if applicable, depending on the specific needs of the project:
- Road/Drainage Survey Control Sheets,
- Road Geotechnical Soils Report
- Corrosion Pre-Design Report
- Road Design Report;
- Bid Sheet,
- Easement description for water,

This list is not intended to be inclusive of all documents that might be required for the acceptance of a specific Water System Modification project. The designer should consult with Tucson Water and the particular Public Agency constructing the water system modifications.

8-05.3.0 Review Requirements, Water System Modifications

3.1 Tucson Water Review

A. Primary Reviewer
The Modifications Unit shall review a water system modification project in a timely manner and return it to the Agency's designated

contact. Revisions will continue until accepted by Tucson Water. All plan reviews shall be documented by marking a set of the plan submittal documents and preparing a project correspondence letter.

B. Reviews by Tucson Water

All Tucson Water sections affected by the project shall review the project documents periodically during the design period. Review signatures are required only on preliminary plans. The Modifications Unit shall coordinate distribution of project documents to the other Tucson Water Sections as specified below.

1. Mandatory Section Review

Mandatory review of the project documents is required of the following Tucson Water Sections:

a. Water System Modification Plans
   - Construction Section (constructability review);
   - Corrosion Control Unit
   - Operations and Maintenance

b. Modifications Unit Memorandum with attachments
   - New Development
   - Distribution Design
   - Plant Design
   - Control Systems
   - System Planning

2. Selective Review

All project plans for new pipe, or a connection to existing pipe, shall be reviewed, by the Corrosion Control Unit, for corrosion prevention and monitoring requirements, if the pipe meets the following requirements of material and size, or location:

a. Any metallic pipe including steel pipe, concrete cylinder pipe, prestressed concrete cylinder pipe, or ductile iron pipe, and

b. pipelines 16-inch in diameter and larger, or

c. located in an area known for potential corrosion problems.

3.2 Reviews Outside Tucson Water

Review by outside agencies shall be documented in a letter from the Agency with any appropriate attachments.

A. Tucson Water shall review any comments from outside agencies on the design for all water works projects.

B. Review of the final design for all water main projects shall be requested of appropriate fire district if the project includes the addition or deletion of fire hydrants.

8-05.4.0 Acceptance Requirements, Water System Modifications

4.1 Minimum Acceptance Requirements

At a minimum, signatures of acceptance are required from the Modification Unit Supervisor and Distribution Design Section Manager before the project can proceed to construction:

4.2 Additional Approval Requirements

Additionally, other project related approvals may be required by other governing agencies such as (but not limited to):

- Pima County or City of Tucson
- The Arizona Department of Transportation,
- Other jurisdictions such as Town of Marana, South Tucson, etc.

Approvals by property owners or other jurisdictions may also be required.

4.3 Approval by Fire Suppression Authority

If applicable to this project, approval must be obtained from the fire suppression authority.

A. Preliminary Plans
Preliminary plans shall be submitted to the fire suppression authority to determine fire flow requirements.

B. Final Plans
Final plans shall be submitted to the fire suppression authority for approval signatures before Tucson Water approval.

4.4 Approval by ADEQ

A. Project Approval

- Pipeline projects require submittal to the PDEQ office, as provided in ARS 49-107, local delegation of state authority. Projects for wells, storage and appurtenances will be submitted to ADEQ. Any reference to ADEQ may also mean PDEQ.

- A fee is charged by ADEQ to Tucson Water.

- The designer should consult with ADEQ for their latest “Plan Review Submittal Checklist” for current submittal requirements.

- Generally, the project review and approval requirements of ADEQ are described in AAC R18-5-505, Approval to Construct. This rule is required by ARS 49-353.

B. Project Completion
Pursuant to AAC R18-5-505(E), the Approval to Construct may become void unless an extension of time has been granted by ADEQ within 90 days after the passage of one of the following:

- Construction has not commenced within one year after the date of issue of the Approval to Construct,
- There is a halt in construction of more than one year, or
- Construction is not completed within three years after it begins.

8-05.5.0 Design Changes to Approved Projects

Unless otherwise specifically required, plan revisions do not have to be submitted to ADEQ for approval.

5.1 Plan Revisions

All design changes to a previously approved project design must comply with Section 8-07 of this Manual and will require Tucson Water acceptance. This includes:

- design changes before going to bid, after design approval,
- invitation for bid amendments, during the bidding process, and
- supplemental agreements/change orders, during construction.

A. Cover sheet revisions.
Make revisions to revision block on cover sheet (or sheet index map) as follows:
1. Revision number
2. Revision date
3. Person designing revision
4. Revised sheets in “revision” column
5. Person checking revision
6. Seal and sign cover sheet if the person designing the revision is someone other than the original designer or other than someone working under the original designer.

B. Revising affected sheets
Make revisions to the affected sheets as follows:
1. Retrieve original plan sheets from Mapping/GIS Section
2. “X” out deleted items
3. Draw a “cloud” around revised or added items
4. Put the revision number in triangle adjacent to each revisions
5. Fill in the revision block on each revised sheet
6. Seal and sign revision on each revised sheet if the person designing the revision is someone other than the original designer or other than someone working under the original designer.

5.2 ADEQ Approval

A. Material Design Change Determination

Pursuant to AAC R18-5-506, Compliance with Approved Plans, any material change in the approved design will require approval by ADEQ if the change will affect:

- water quality,
- capacity,
- flow,
- sanitary features, or
- performance.

Revisions not affecting water quality, capacity, flow, sanitary features, or performance, may be permitted during construction without further ADEQ approval if record drawings document these changes, prepared by a professional engineer registered in Arizona.

B. Submittal and Review of Material Design Change

When there is a material change in the approved design, the revised plans and specifications and a written statement of the reasons for such change shall be submitted to ADEQ for review:

C. Approval of Material Design Change

Approval shall be obtained in writing from ADEQ before the work affected by the change is undertaken.

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WATER FACILITY MINIMUM SIZING AND RELIABILITY STANDARDS

8-06.0.0 WATER FACILITY MINIMUM SIZING AND RELIABILITY STANDARDS

8-06.1.0 General

1.1 Purpose

This section describes the design and reliability standards and requirements for the minimum sizing of public drinking water projects.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms. Note: The word “customer” means “customer / property owner.”

1.3 Applicability

The requirements listed herein apply to all water projects. Additional requirements are contained in other design standards for the various types of projects.

8-06.2.0 Water Pressure

This subsection contains the following major topics:

- Water System Boundary
- Minimum Dynamic Pressure, State of Arizona
- Static Pressures, Tucson Water Standard
- Customer's Pressure Responsibilities
- Dynamic Pressure and Flow, Computerized Modeling

2.1 Water System Boundary

A. Public Water System
The public water distribution system ends at a location that includes the water meter.

B. Customer’s Water System
The customer’s private plumbing system begins at the discharge side of the water meter (AAC R18-5-101.91).

2.2 Minimum Dynamic Pressure, State of Arizona

A potable water distribution system shall be designed to maintain and shall maintain a pressure of at least twenty pounds per square inch at ground level at all points in the distribution system under all conditions of flow, as required by AAC R18-5-502.B, Minimum Design Criteria.

2.3 Static Pressures, Tucson Water Standard

A. Single Zones

Generally, water is to be provided at the utility's water service connection, the water meter, within a static pressure range of thirty-five pounds per square inch to eighty-five pounds per square inch. Due to localized topographic conditions, certain locations may receive pressure slightly less or greater than the stated range.

B. Dual Zones

In some areas, typically called dual zones or two zone lifts, a static pressure range of thirty-five pounds per square inch to 130 pounds per square inch may be provided.

Tucson Water may consider creation of dual zones where the elevation changes rapidly in a short distance and the service needs warrant it.

Customers located in the lower portion of the dual zone will be required to install a pressure reducing valve with an integral bypass in the service line and/or an expansion tank inside the home. The residence will then be in accordance with the Uniform Plumbing Code, 1994 Edition, as modified and adopted on 11/20/95 by Mayor and Council, as the Tucson Code, Section 6-124, including any more recent adoptions, hereinafter referred to as the Uniform Plumbing Code.

2.4 Customer's Pressure Responsibilities

A. Applicable Pressure Regulations

The Uniform Plumbing Code limits the water pressure within the customer's facility to a minimum of fifteen pounds per square inch and a maximum of eighty pounds per square inch in order to prevent damage to the customer's piping and fixtures.

B. Pressure Regulation Devices

- When the public water system minimum pressure described in paragraph 2.2 is met at the meter, it is the responsibility of the customer to increase the water pressure when the supply in the customer's plumbing is less than fifteen (15) pounds per square inch or if a plumbing fixture requirement is higher than fifteen (15) pounds per square inch.

- Reducing the pressure when it exceeds eighty (80) pounds per square inch is the responsibility of the customer.

- When a pressure reducer or a booster pump is installed, a closed system may be created. The customer is responsible for reviewing local plumbing codes for pressure relief and thermal expansion device requirements that are intended to prevent damage to the customer's piping and fixtures.

2.5 Dynamic Pressure and Flow, Computerized Modeling

Tucson Water maintains hydraulic computerized models of the existing water systems. They are used to determine specific capabilities and requirements of system improvements. These models assist in the sizing and alignment of facilities, surge protection, and contamination remediation.

A. Water Demand Models

The results of the analysis of computerized models of water demands are used to determine whether proposed water system improvements and/or land development projects meet requirements for water pressure, headloss, and velocity.

Real-time data is also used in analysis, system curves, pumping evaluation, and for control assessment purposes.

B. Surge Protection Models

Tucson Water will review proposed new pipelines, large services and facility plans for the surge protection needs of the Tucson Water system. Analysis of surge modeling shall help determine the need for mitigation of water hammer (see Section 8-16) in the design stage.

The engineer shall design and submit the methods and equipment proposed for surge protection of the Tucson Water system.

C. Modeling Performed by Design Engineers

Tucson Water will review all engineer-generated water demand computerized models for accurate and complete data inputs.

8-06.3.0 Water System Planning Criteria, Project-Level

The criteria used for water system planning and water system improvements due to an individual land development project include the following types of water use:

- General Service
- Fire Suppression Service

The land development project must include all the water system improvements needed to maintain water system pressure while meeting the land development project's future water demands. The water improvements may include pipelines, pumping stations, pressure reducing stations, storage facilities, and wells. They may be "on-site" and/or "off-site" depending upon the land development project's specific location and needs.

3.1 General Service

General service requirements for water demand include the rate of water delivered during a specified period. The periods that must be met by the water system improvements include yearly, monthly, daily, and hourly periods. Water demand can also vary from area to area, depending on the type of water users within that area.

A. Average Daily Demand

At the individual project level, average daily demand includes residential and nonresidential types of water uses averaged over a one-year period:

1. Residential Use
   a. The gallons per capita per day value for residential units to include single, multi-family, townhouse, and condominium is determined using the most recent Tucson Water ADWR Annual Report. As of the 2023 Annual Report, this value is 74.

   b. The persons per housing unit is determined using the most recent United States Government Census. As of the 2020 Census this value is 2.34 persons per residential unit. Variations to this factor may be considered during the plan review process, at Tucson Water's sole discretion.

2. Nonresidential Use
   a. Commercial and Industrial Use – 2,000 gallons per acre per day (1.39 gallon per minute per acre) shall be used if no more specific data is available. Variations may be considered during the plan review process, at Tucson Water's sole discretion.

      Note: Section 27-31 of the Tucson Code defines industrial use as at least five (5) million gallons per month, or sixty (60) million gallons per calendar year. The use is specifically for manufacturing purposes; thus, the water use would not include landscape irrigation, restrooms, or drinking fountains.

   b. Turf – 0.8 acre-foot per acre of turf, total annual demand minimum (for types of turf typically used by schools in the southwest). Reclaimed water is required for all new golf courses. Some pumping facilities may not pump twenty-four hours per day, but only a maximum of six or eight hours per day. Therefore, flow rate and required pipeline size design increases accordingly.

c. The project engineer shall provide detailed calculations for the land development project's intended use, including peak water demands.

B. Peak Water Demand Factors

If no more specific data is available, the factors to be used for determining peak water demand, except for higher factors as determined by Tucson Water, for individual land development project design include the following:

1. The average day of the peak month demand factor is 1.5 times the average daily demand.

2. The peak day demand factor is 1.8 times average daily demand.

3. The peak hour demand factor is 3.15 times average daily demand.

4. Maximum day factor for turf is 2.64 times average daily demand.

3.2 Fire Suppression Service

The water project design shall include the fire suppression service requirements of the fire suppression authority, or of Tucson Water, whichever is higher.

Since the fire flows listed herein are added to the peak day demand requirements, the total flow rates required through the pipeline will be greater than the fire flow requirements alone.

A. Fire Suppression Authority Requirements

1. For fire suppression service requirements of the structures in the project area, the design engineer shall consult with the fire suppression authority for:

   a. the fire flow rates, in gallons per minute, and
   b. the associated fire flow duration (in hours).

2. This information shall be provided on the water plans.

B. Tucson Water Fire Suppression Requirements

Additional minimum requirements for fire suppression from Tucson Water facilities, new system additions and extensions, and "fire hydrant only" projects include:

1. 1,000 gallons per minute for two hours, for single-family residential up to 3,600 sq. ft. Homes above 3,600 square feet require fire sprinklers and/or greater fire flow according to fire authority review and approval

2. 1,500 gallons per minute for two hours, for multi-family residential
3. 1,500 gallons per minute for two hours, for commercial
4. 4,000 gallons per minute for four hours, for industrial and downtown areas

8-06.4.0 Water Pipeline Sizing

When stating pipe or pipeline size, this refers to the inside diameter. This subsection contains the following major topics:

- Demand Conditions for Pipelines
- Minimum Pipeline Sizing
- Pipeline Velocity and Headloss Limitations
- Service Line Sizing for Single-Family Residential Units
- Valve Sizing for Pipelines
- Reliability Standards of Water Pipelines

4.1 Demand Conditions for Pipelines

The demand conditions in the water distribution system for each individual pipeline and appurtenance, such as pressure reducing valves, include peak day demand and fire suppression requirements.

The demands are based on the total service connections and the type of structures to be served by the pipeline. This includes future connections and structures if the land development project or water system improvement is constructed in phases, or where extensions of the pipeline are possible.

As previously stated, the pressure requirements of subsection 8-06.2 must be met for all distribution piping. Discussion can be found in ADEQ Engineering Bulletin No. 10, Chapter 7 – Distribution Systems, Section C. Water Main and System Design, subsection 2. System Pressures.

4.2 Minimum Pipeline Sizing

This subsection contains the following topics:

- Distribution System, Looped Pipeline, Minimum Size (6-inches)
- Distribution System, Dead-End Pipeline, Minimum Size (8-inches)
- Transmission Mains, Phasing
- Blow-off Valve Assembly
- Drain Valve Assembly

A. Distribution System, Looped Pipeline, Minimum Size (6-Inches)
Looped pipelines provide for equalization of pressure and flow by reducing the total headloss at any given customer location. This piping configuration significantly improves the reliability of service to customers because it improves water system operational flexibility by providing a backup water supply during a planned or unplanned shutdown to one portion of the pipeline.

1. Configuration of a Looped Pipeline
The ideal configuration for a looped pipeline has two independent sources of water supply. The number of customers who are still in service when one portion of the looped pipeline is out of service determines the degree of effectiveness of a looped pipeline. For example, if a pipeline (connected to the distribution system water main) is connected to itself at the point it goes into and out of a subdivision (forming a loop), the subdivision would not be effectively looped.

2. Minimum Size of Looped Pipelines
Where fire suppression is or may be required, the minimum size for a looped pipeline in the distribution system shall under no circumstance be less than six (6)-inches. Final determination of the pipe size will be based on hydraulic analysis of the area and may result in a larger, but not smaller, size.

B. Distribution System, Dead-End Pipeline Minimum Size (8-Inches)
Dead-end pipelines are defined as pipelines that are not looped or connected to a second pipeline or other water source in the distribution system.

Dead-end pipelines are normally not permitted because they create the potential for water to become stagnant. The disinfection residual can become depleted, allowing bacterial growth and the occurrence of taste and odor problems. Dead-end pipes also do not have a second source of water if the pipeline is out of service.

- When the use of a dead-end water main is unavoidable, a blow-off valve assembly or a drain valve assembly shall be provided at the terminal end of the water main. This will permit the flushing of the water main to improve water quality by discharging stagnant water and particulates, such as sand. Detailed requirements of these assemblies are provided below in the appropriate paragraphs of this subsection.

- Where fire suppression is or may be required, the minimum size for a dead-end pipeline in the distribution system shall under no circumstance be less than eight (8)-inches. Final determination of the pipe size will be based on hydraulic analysis of the area and may result in a larger, but not smaller, size.

Other sizes of dead-end pipelines may be considered and analyzed on an individual basis, if requested by the design engineer, as described below:

1. Two-Inch Dead-End Pipeline, No Fire Suppression Required
When using two-inch pipe in the distribution system, there shall be no more than five equivalent 5/8-inch meters connected:

   - where no fire suppression or fire hydrants are required,
   - where the pipe is less than 250 feet long, and
   - where no future extension is possible, as determined by Tucson Water.

2. Four-Inch Dead-End Pipeline, No Fire Suppression Required
When using four-inch pipe in the distribution system, there shall be no more than twenty equivalent 5/8-inch meters connected:

   - where no fire suppression or fire hydrants are required,
   - where the pipe is less than 350 feet long, and
   - where no future extension is possible, as determined by Tucson Water.

   Equivalent 5/8-inch meters are defined as follows:

   - 1-inch meter equals two and a half 5/8-inch meters
   - 1.5-inch meter equals five 5/8-inch meters
   - 2-inch meter equals eight 5/8-inch meters

C. Transmission Mains, Phasing

1. Justification for a Phased Pipeline
   All transmission mains may be "phased" (separated into equivalent capacity and installed over time) using two or more smaller pipelines:

   - when justified by an economic analysis,
   - provides other benefits to the water system such as reliability (a second source of water supply under phase two), and
   - must be acceptable to Tucson Water.

2. Projected Water Demands During Each Phase
   All pipelines shall be capable of providing water demands projected during each phase and associated time period of the transmission main, and shall meet any other minimum pipeline requirements addressed elsewhere in this manual.

D. Blow-off Valve Assembly
   See Tucson Water Standard Details for a description of blow-off valve assemblies and modified blow-off valve assemblies.

1. Location
   A blow-off valve assembly or modified blow-off valve assembly shall be provided at the terminal end of a dead-end pipeline and/or temporary stub out for flushing and disinfection.

2. Minimum Pipe Size
   The minimum pipe size in a blow-off valve assembly (or a modified blow-off) is two (2) inches for use with dead-end pipelines up to eight-inches in diameter.

3. Type to be Installed
   A modified blow-off valve assembly shall always be installed where a future water pipeline extension is possible. Where a future water pipeline is not possible, Tucson Water may approve installation of a blow-off valve assembly.

4. Minimum Pipeline Velocity
   The pipe in a blow-off valve assembly or a modified blow-off valve assembly shall be sized to maintain a minimum water main velocity of 2.5 feet per second (2.5 fps) which is intended to scour sand and silt from the water main. (AZ State Health Bulletin No. 8, Disinfection, Water Mains, Preliminary Flushing, p. 18)

E. Drain Valve Assembly
   Drain valve assemblies shall be provided at low points in pipelines to facilitate draining the pipe. These assemblies shall not be located in sidewalks or driveways.

1. Location
   Drain valve assemblies will be required on transmission mains sizes of thirty-six (36) inches or larger at approved locations.

2. Minimum Pipe Size
   The minimum pipe size in a drain valve assembly is six (6) inches.

4.3 Pipeline Velocity and Headloss Limitations

New pipelines shall have a minimum Hazen-Williams pipe roughness coefficient of 120.

A. Distribution System Pipelines

1. Peak Day Demand Conditions

For pipelines twelve (12) inches or less, the following criteria must be met under peak day demand conditions in the distribution system:

- the velocity shall not exceed five (5) feet per second, or
- the headloss shall not exceed ten (10) feet/1000 feet.

2. Peak Day Demand and Fire Flow Conditions

For pipelines twelve (12) inches or less, the following criteria must be met under peak day plus fire flow demand conditions in the distribution system:

- The velocity shall not exceed eight (8) feet per second, where extensions of the same pipeline are possible.

- The velocity shall not exceed eleven (11) feet per second, where no extensions of the same pipeline are possible.

B. Transmission Mains

In transmission mains sixteen (16) inches or larger, the following criteria must be met under any conditions of flow:

- the velocity shall not exceed five (5) feet per second, or
- the headloss shall not exceed three (3) feet/1000 feet.

4.4 Service Line Sizing for Single-Family Residential Units

This portion of the standard applies only to the size of a specific pipeline (service line) used for a specific customer classification (single-family residential).

For location requirements, refer to Section 8-08, Water Pipeline Design Standards.

- “Service line” means the pipeline located between the distribution system water main and the water meter.

- “Water service connection” means the service line and the water meter.

The following residential customer classifications of service are found in the Tucson Code, Article II, Rates and Charges, Section 27-31, Definitions:

Family Units:

- “Single-family unit” means one (1) residential unit, served by one meter.
- “Duplex unit” means two (2) residential units, served by one meter.
- “Triplex unit” means three (3) residential units, served by one meter.

Multi-Family Units:

- “Multi-family unit” means four (4) or more residential units, served by one meter.

A. Water Service Line – Minimum Size
The minimum service line size is one (1)-inch, nominal diameter, for a single-family residential unit using a 5/8-inch or a 1-inch water meter.

The minimum service line size for larger than a one (1)-inch nominal diameter meter shall be equal to the water meter nominal diameter, unless otherwise directed by the engineer.

B. Water Service Line Split – Not Permitted
The use of one common service line for two (2) or more single-family residential units, each connected at one branch piece (a.k.a. split, split service), but each unit using its own separate water meter, is not permitted.

4.5 Valve Sizing for Pipelines

In general, isolation or shut-off valves shall be the same size as the pipeline in which they are installed. Typical isolation or shut-off valves used are gate and butterfly valves.

A. Distribution System Valves
Gate valves in the distribution system shall not be downsized on pipe sixteen (16) inches or smaller in diameter.

B. Transmission Main Valves
1. Gate Valves
Gate valves in transmission mains may be downsized one standard size on pipe twenty-four (24) to forty-eight (48) inches in diameter provided the velocity through the valve does not exceed the valve manufacturer's specifications.

2. Butterfly Valves
Butterfly valves in transmission mains shall not be downsized on pipe sixteen (16) inches or smaller in diameter.

4.6 Reliability Standards of Water Pipelines

Reliability standards are intended to minimize disruption of service to customers by constructing facilities in a way that takes into account planned or unplanned interruption of operation of the facility.

The degree of reliability designed and constructed into the water system is based on a number of factors, including:

- the probable frequency of the emergency condition,
- the cost of such a condition in terms of loss of service and customer satisfaction, and
- the cost of providing the additional reliability.

The standard of Tucson Water is to maintain an acceptable level of customer service. This level of service is defined in terms of a water-demand scenario.

Tucson Water will provide pipeline redundancy whenever possible for increased reliability of service to Tucson Water customers. The redundancy is defined as follows:

At a minimum, the average daily demand (ADD) shall be met whenever any pipeline is out of service.

A. Parallel Pipelines
Parallel lines may be required at Tucson Water's discretion if looped pipelines are not feasible or where two different pressure zones converge to serve the project.

B. Looped Pipelines
Wherever practicable, new distribution system pipelines shall be connected to two separate pipelines in order to provide two separate sources of water supply in the event that one fails to function.

8-06.5.0 Water Storage Facility Sizing

This subsection contains the following topics:

- Types of Water Storage Facilities
- Sizing Components of Water Storage Facilities
- Reliability Standards of Water Storage Facilities
- Additional Requirements of Water Storage Facilities

5.1 Types of Water Storage Facilities

Storage capacity is met by use of elevated or ground storage facilities. For purposes of these design standards, Tucson Water uses the following terms:

- "high-water storage" will be used instead of "elevated storage," and
- "forebay" will be used instead of "ground."

A. High-Water Storage
Any storage facility is considered to be high-water storage if it is at an elevation above the upper zone boundary elevation of that portion of the distribution system it serves.

- Thus, ground or subsurface tanks built on high ground are called high-water storage (defined by ADEQ and American Water Works Association as elevated storage). High-water storage can also be referred to as gravity storage tanks or reservoirs depending on their size and materials.

- Most of the Tucson Water system's major water storage facilities are defined as high-water storage whose water surface level defines the hydraulic gradient elevation of that portion of the distribution system it serves.

- This type of configuration is classified as an open system because it is open to atmospheric pressure.

B. Forebay Storage
Forebay storage is typically used as a source of water supply that is re-pumped to another service area at a higher elevation. Also, forebay storage can be used to assist in meeting peak demands in a hydro-pneumatic pressure system since it functions as a source of water supply to that system.

C. Combined Storage
A storage facility can also be combined to serve both functions of forebay and high-water storage:

- Forebay Storage - A portion of the storage facility capacity is sized for use as forebay storage to serve a service area at the same or higher elevations.

- High-water Storage - Another portion of the storage facility capacity is sized for use as high-water storage to serve a service area by gravity.

5.2 Sizing Components of Water Storage Facilities

A. Objectives
For the water service area (area of influence) that the water storage facility is intended to serve, the total net (usable) capacity of the storage facility shall provide components:

- for flow and pressure equalization,
- for fire suppression, and
- for an emergency water supply.

Net capacity is less than gross capacity due to the unusable volume of the storage facility. This unusable capacity is dependent upon the shape of the storage facility and the elevation of the outlet pipe.

These objectives are also further explained in ADEQ Engineering Bulletin No. 10, Chapter 6, Water Storage. The storage facilities are called reservoirs or tanks, depending on their size and materials.

B. Equalization Storage Component
The storage components for equalization are required to meet water system demands in excess of water system delivery capabilities. Tucson Water's delivery capabilities (water supply facilities) are sized to meet the average day of the peak month demand. Therefore, the equalization storage component shall be at least equal to the peak day demand.

C. Fire Suppression Storage Component
The following criteria shall be used to determine the storage component for fire suppression of the total volume required initially and at full build-out of the water service area.

1. Area of Influence
   - Each storage facility shall be able to provide the fire suppression requirement within its area of influence.
   - The area of influence is a function of the water service area's peak day demands, fire-flow demands, and distribution piping configuration.

2. Minimum Fire Suppression Component
   The storage component for the minimum fire suppression requirement shall be based on the largest structure that requires the highest flow rate and associated

duration as determined by the fire suppression authority, or Tucson Water, whichever is higher.

D. Minimum Emergency Storage Component
To meet demands in the event of an emergency situation, such as a power outage, a line break or a pumping station failure:

1. The storage component for an emergency shall be at least five (5) percent of the peak day demand.

2. Due consideration shall be given to the water service area that the storage facility serves and the water system piping and storage facility arrangement. This may cause the minimum emergency net storage capacity percent to increase or decrease. A decrease will be allowed only if offset by an excess storage component in another storage facility located in the same pressure zone.

5.3 Reliability Standards of Water Storage Facilities

Reliability standards are intended to minimize disruption of service to customers by constructing facilities in a way that takes into account planned or unplanned interruption of operation of the facility.

A. Operational Requirements of Storage Facilities
1. To meet future demands and current water demands when the storage facility is out of service, the storage facility shall, at Tucson Water's discretion, be divided into multiple cells that can be operated independently to maintain service. This includes phase one if there is more than one phase.

2. If the storage facility is a tank, at Tucson Water's discretion, a second tank may be required in the site design for phase two.

B. Pipeline Redundancy Requirements for Storage Facilities
1. Looped pipelines from the storage facility to the service area shall be part of the pipeline design configuration. The pipelines shall start as near to the storage facility as possible.

2. Parallel pipelines may be required at Tucson Water's discretion if looped pipelines are not feasible.

5.4 Additional Requirements of Water Storage Facilities

A. Phasing of Storage Facilities
Storage facilities may be phased if justified by an economic, engineering, and operational analysis. Each storage facility shall meet all water demands projected for the duration of each phase.

The projected water demand for each phase of the land development project shall be submitted for Tucson Water review.

B. Elevation of Storage Facilities

1. For high-water storage, the upper operating level in the storage facility will be at the high-water elevation of the zone to be served by the storage facility.

2. The depth between the upper operating level and lower operating level of a storage facility shall be twenty-five (25) feet unless otherwise approved by Tucson Water.

3. Storage facilities shall be located above the 100-year flood prone area, with in-ground storage facilities also located above the groundwater table.

C. Pipeline Size for Storage Facilities

Pipelines serving the storage facility must be of sufficient size to provide the design flow out of the facility, as well as the refill flow into the facility, and to maintain water system pressure during peak flows.

The pipelines for each phase of the storage facility shall meet all water demands projected for the duration of that phase.

8-06.6.0 Pressure Reducing Valve Station Standards

Pressure reducing valve (PRV) stations provide a source of water supply that shall be available upon demand to a lower pressure zone from a higher pressure zone.

6.1 Sizing of PRV Stations

A. Water Demand

The Water System Planning Section of Tucson Water shall provide the water demand data, which may include a development project's demands, existing and future, as the basis for sizing of the pressure reducing valves (PRV) and associated piping.

B. Velocity in Piping

Velocity of the water shall not exceed five feet per second in the supply and discharge piping. Reducers and increasers shall be used to connect the typically larger onsite supply and discharge piping to meet pipeline velocity requirements before and after the pressure reducing valve.

Pressure reducing valves may be downsized from the inlet and outlet pipeline sizes to which they are connected, provided the velocity across the valve does not exceed the valve manufacturer's specifications.

6.2 Pressure Controls

All pressure reducing stations shall be equipped with pressure controls that allow the pressure settings to be adjusted.

A. Primary Source, Pressure Setting

Pressure reducing stations that serve as the primary source of water supply, where no other water production facility serves the area of influence, shall be set at the high-water of the pressure zone being served.

B. Supplemental or Backup Source, Pressure Setting
Pressure reducing stations that serve as the supplemental or back up source of water supply for meeting peaking or fire flow demand shall be set slightly below the high-water setting (i.e. 10+/- pounds per square inch below normal operating pressure).

Water system analysis shall be used to determine the optimum setting whereby pressure standards for all operational conditions are maintained. Back-up facilities are designated as such due to a secondary efficiency rating in a cost of energy comparison of water sources.

6.3 Reliability Standards of Pressure Reducing Stations

A. A pressure reducing station shall have two pressure regulating valves of the same size, installed in parallel, to provide reliability during maintenance periods or failure of components.

B. Each pressure reducing valve and lateral piping shall be sized to independently accommodate the full flow of the pressure reducing station, as determined in subsection 8-06.6.1.

C. Where another suitable pressure reducing station serves the same water service area, Tucson Water may determine the other to be of sufficient redundancy. To be considered, the other offsite pressure reducing station shall serve the same area of influence and be capable of meeting the total flow requirements.

8-06.7.0 Pumping Station Standards for Closed Systems

This subsection on pumping station requirements for closed systems contains the following major topics:

- General
- Pump and Pipe Sizing
- Pressure Tank Sizing
- Pump Elevation
- Reliability Standards for Closed Systems

A water system serving a water service area that is supplied by a pumping station is classified as a closed water system because it is not open to atmospheric pressure, as is the case when there is a high water storage facility.

This type of system uses a hydro-pneumatic pressure tank to assist in maintaining pressure, to minimize pump cycling, and to meet instantaneous water demand.

7.1 General

A. Principles of Operation of a Hydro-Pneumatic Pressure System

1. The basic types of applications and principles of operation of a hydro-pneumatic pressure system are explained in ADEQ Engineering Bulletin No. 10, Chapter 5, Hydro-Pneumatic Pressure Tanks.

2. At a minimum, all requirements in Chapter 5 must be met.

B. Purpose

The purpose of the hydro-pneumatic pressure tank system is:

- to develop and maintain pressure in the water system by means of compressed air as an alternative to high water storage, and

- to minimize pump cycling. (Cycling is the turning on-and-off of a pump, which increases the wear and tear on a pump much more than the constant running of a pump.)

- to protect the system from pressure transients (water hammer).

These closed water systems typically serve water service areas where it is not possible to construct a high water storage facility.

7.2 Pump and Pipe Sizing

A. Total Capacity of Pumping Station

1. Because there is no storage facility, the total capacity of the pumping station (or stations) must be sized to provide the water demand for the water service area at planned build-out. Total capacity shall include:

   - either peak day water demand plus fire suppression requirements,
   - or peak hour water demands, whichever is greater,

   - plus water demands being lifted or regulated to another pressure zone(s).

2. All piping within the pumping station shall be sized for the total water demand at planned build-out of the water service area.

3. A minimum of two (2) pumps shall be provided above a maximum instantaneous demand rate of 105 gallons per minute in accordance with ADEQ Bulletin 10, page 5-2.

B. Initial Pump Sizes

1. Sizing of Initial Pumps
   The initial set of pumps installed in the pumping station shall be sized for the total water demand during the pump's estimated life, usually ten (10) years.

2. Net Pump Capacity
   A sufficient number of pumps shall be selected to work together at the same discharge pressure in order to provide required total station capacity. In all cases, a larger "gross capacity" sum of the pumps is required to reach the net operating output required.

C. Pump Cavitation
   Pump sizing shall not exceed capacity of the suction line or the NPSH requirements of the pump.

D. Onsite Pipelines of the Pumping Station

1. Velocity for Total Station Capacity
   Onsite pipelines of the pumping station shall be sized at five (5) feet per second maximum velocity for discharge piping, three (3) feet per second maximum for suction piping, based upon total station capacity. (See section 8-10 for information.)

2. Reserved Space for Pump Additions
   Typically, space along the manifold and ground at the pumping station site is reserved, with blind flanged lateral(s) provided, for future pump additions anticipated to meet total water demand at planned build-out of the area.

7.3 Pressure Tank Sizing

A. Discharge Pressure Tank Components

Pressure tanks shall be designed and sized to meet the purpose of the water pressure system as described in paragraph 7.1.B. Tucson Water's standard hydro-pneumatic pressure tank size for a typical pumping facility is 5,000 gallons. Tank size refers to the total internal volume for water and air. The water volume typically represents ten to fifty percent of the total tank volume.

1. Pump Cycling Component

The cycling reduction component of the total pressure tank volume shall include sufficient volume to minimize the frequency of on-off cycles of the water supply pumps. Normal pump cycling is in the range of two (2) to six (6) times per hour.

2. Minimum Instantaneous Demand Component

Determination of the tank size shall include a component for supplying the minimum instantaneous demand.

a. The hydro-pneumatic pressure tank must be sized together with the pumps so that the facility can supply instantaneous demand for a minimum of twenty minutes. (Subsection C, page 5-2, ADEQ Engineering Bulletin No. 10.), or

b. Instantaneous demand shall be determined from Table 3, Maximum Instantaneous Demand Flows for Residential Use, page 5-3, ADEQ Engineering Bulletin No. 10.

c. Instantaneous demand, Table 3, is used solely to provide a sizing component of the tank. Instantaneous demand is not the same as peak hour demand.

3. Water Hammer Component

Surge protection design calculations shall be provided.

B. Suction Pressure Tank Size

A suction pressure tank of the same size as the required discharge tank shall be required unless the suction supply is provided from an on-site forebay storage facility.

7.4 Pump Elevation

- The pumps shall be located so that they will not produce a negative pressure upon the suction lines.

- Intake pressure shall be at least twenty (20) pounds per square inch with automatic cutoff of pumps if the pressure falls to ten (10) pounds per square inch (subsection D, p. 3-7, ADEQ Engineering Bulletin No. 10).

- A stand-alone pumping station, not located at a reservoir site, shall not be placed above the lower zone boundary elevation of the pressure zone that the pumping station supplies.

7.5 Reliability Standards for Closed Systems

Reliability standards for the pumping stations are intended to minimize disruption of service to customers by constructing facilities in a way that takes into account planned or unplanned interruption of operation of the facility.

The degree of reliability designed and constructed into the water system is based on a number of factors, including:

- the probable frequency of the emergency condition,
- the cost of such a condition in terms of loss of service and customer satisfaction, and
- the cost of providing the additional reliability.

The standard of Tucson Water is to maintain an acceptable level of service defined in terms of a water-demand scenario.

Tucson Water will provide pumping station (closed system) redundancy whenever possible for increased reliability of service to Tucson Water customers. The redundancy is defined as follows:

> Average daily demand shall be met during an interruption of the power supply for the customers served by a pumping station.

A. Power Supply

There shall be an electrical connection and switching capability built in at panels for the pumping station to be operated by either of two independent sources of power supply. These normally consist of the main power supply and a backup supply.

B. Back Up Source of Power

1. In the event of an interruption of the main power supply, a backup power supply hook-up shall be provided for a portable generator to be placed on site to meet average daily water demands until the main power supply is restored.

2. There shall be an area reserved on-site for a self-powered portable electric generator near the backup power supply hook-up.

3. Where a natural gas main is unavailable to a facility, space for a portable fuel storage tank shall be provided in the event one needs to be transported to, and set up on, the site in an emergency. Placement of such fuel tanks shall meet all local fire and safety codes.

C. System Bypass of Pumping Station

1. A system bypass of the pumping station shall be available to minimize the number of affected customers when it is out of service or not operating as designed (refer to subsection D, page 3-7, ADEQ Engineering Bulletin No. 10).

2. A system bypass alternative can be accomplished if a closed zone-boundary valve is present on the water main supply located within the adjacent right-of-way.

3. Motor operated valves may also be designed to be remotely operated as a system bypass alternate.

D. Limit on Consecutive Chain of Pumping Stations
No more than two consecutive pumping stations for closed systems shall be built to serve adjacent water service areas, without high-water storage being constructed simultaneously for one of the service areas.

8-06.8.0 Pumping Station Standards for Open Systems

This subsection for pumping station requirements for open systems contains the following topics:

- General
- Pump and Pipe Sizing
- Pressure Tank Sizing
- Pump Station Elevation
- Reliability Standards for Open Systems

8.1 General

A. Principles of Operation of a Pumping Station

1. The basic types of applications and principles of operation of pumping stations are explained in ADEQ Engineering Bulletin No. 10, Chapter 3, Pumping Facilities.

2. At a minimum, all requirements in Chapter 3 must be met.

B. Purpose
The purpose of the pumping station is to provide a relatively constant source of water supply for the service area. For closed system requirements, refer to subsection 8-06.7.0. This includes refilling the storage facilities during low demand periods.

8.2 Pump and Pipe Sizing

A. Total Capacity of Pumping Station
The total capacity of the pumping station (or stations) must be sized to provide the water demand that will not be supplied from storage for the water service area at planned build-out. Total capacity shall include:

- either peak day water demand plus fire suppression requirements,
- or peak hour water demands, whichever is greater,

- plus water demands being lifted or regulated to another pressure zone(s).

B. Initial Pump Sizes

1. Sizing of Initial Pumps
The initial set of pumps installed in the pumping station shall be sized for the total water demand during the pump's estimated life, usually ten (10) years.

2. Net Pump Capacity
A sufficient number of pumps shall be selected to work together at the same discharge pressure in order to provide required total station capacity. In all cases, a larger "gross capacity" sum of the pumps is required to reach the net operating output required.

C. Pump Cavitation
Pump sizing shall not exceed capacity of the suction line or the NPSH requirements of the pump.

D. Onsite Pipelines of the Pumping Station
1. Velocity for Total Station Capacity
Onsite pipelines of the pumping station shall be sized at five (5) feet per second maximum velocity for discharge piping, three (3) feet per second maximum for suction piping, based upon total station capacity. (See Section 8-10 for information.)

2. Reserved Space for Pump Additions
Typically, space along the manifold and ground at the pumping station site is reserved, with blind-flanged lateral(s) provided, for future pump additions anticipated to meet total water demand at planned build-out of the area.

8.3 Pressure Tank Sizing

A. Discharge Pressure Tank Sizing
Pressure tanks shall be designed and sized to accommodate water hammer. Surge protection design calculations shall be provided.

B. Suction Tank Size
A suction pressure tank of the same size as the required discharge tank shall be required unless the suction supply is provided from an on-site forebay storage facility.

8.4 Pump Elevation

- The pumps shall be located so that they will not produce a negative pressure upon the suction lines.

- Intake pressure shall be at least twenty (20) pounds per square inch with automatic cutoff of the pump if the pressure falls to ten (10) pounds per square inch (Subsection D, p. 3-7, ADEQ Engineering Bulletin No. 10).

- A stand-alone pumping station, not located at a reservoir site, shall not be placed above the lower zone boundary elevation of the pressure zone that the pumping station supplies.

8.5 Reliability Standards for Open Systems

Reliability standards for the pumping stations are intended to minimize disruption of service to customers by constructing facilities in a way that takes into account planned or unplanned interruption of operation of the facility.

The degree of reliability designed and constructed into the water system is based on a number of factors, including:

- the probable frequency of the emergency condition,
- the cost of such a condition in terms of loss of service and customer satisfaction, and
- the cost of providing the additional reliability.

The standard of Tucson Water is to maintain an acceptable level of service defined in terms of a water-demand scenario.

Tucson Water will provide pumping station (open system) redundancy whenever possible for increased reliability of service to Tucson Water customers. The redundancy is defined as follows:

> Average daily demand shall be met during an interruption of the power supply for the customers served by a pumping station.

A. Power Supply
Where sufficient high-water storage is available to the pumping station, no back-up power supply is needed to cover the duration of the typical power outage.

B. Back Up Source of Power
If the high-water storage is insufficient or is located too far from the pumping station to provide an adequate emergency supply to the entire service area, then a back up source of power is required at the pumping station.

1. In the event of an interruption of the main power supply, a backup power supply hook-up shall be provided for a portable generator to be placed on site to meet average daily water demands until the main power supply is restored.

2. There shall be an area reserved on-site for a self-powered portable electric generator near the backup power supply hook-up.

3. Where a natural gas main is unavailable to a facility, space for a portable fuel storage tank shall be provided in the event one needs to be transported to, and set up on, the site in an emergency. Placement of such fuel tanks shall meet all local fire and safety codes.

C. System Bypass of the Pumping Station
1. A system bypass of the pumping station shall be available to minimize the number of affected customers when it is out of service or not operating as designed (refer to subsection D, page 3-7, ADEQ Engineering Bulletin No. 10).

2. A system bypass alternative can be accomplished if a closed zone-boundary valve is present on the water main supply located within the adjacent right-of-way.

3. Motor operated valves may also be designed to be remotely operated as a system bypass alternate.

8-06.9.0 Water Well Minimums

9.1 General

A. Central Water System
The total water supply for the central water system shall equal 1.5 times the central water system average daily demand. The source of the water supply includes wells as well as the Clearwater facility.

B. Isolated Water Systems
Where practicable, there shall be a minimum of two (2) wells for the reliability of isolated systems.

9.2 Minimum Physical Requirements

A. Size of Well Site
The minimum well site size is 120 feet by 120 feet. Plant Design Section shall review any proposed site configuration variation of equivalent size, for sufficient room for:

- a second well,
- storage or pressure tanks,
- parking,
- equipment crane,
- an emergency source of power, and
- turn around access.

Lot size minimums of local zoning code shall also be met, whichever is greater. (See Section 8-10.5.0.)

B. Well Casing Size and Acceptance Criteria
1. The typical well size minimum standard consists of well casing diameters of sixteen and twenty inches.

2. Aquifer testing shall determine aquifer parameters and maximum sustainable yield for the well.

3. Developed well shall contain no more than 0.1 mg of silt and suspended solids per liter of water at maximum discharge capacity.

C. Source Protection
1. The minimum depth for watertight protection from surface contamination shall be ten feet. Additional discussion can be found in ADEQ Engineering Bulletin No. 10, Chapter 2 – Source Development and Construction, Section D. Groundwater Source Development, subsection 5. Source Protection.

2. Well casing vents shall consist of tamper-resistant materials and be secured with a commercial grade pick-resistant lock, to prevent unauthorized access.

3. Comprehensive water quality testing meeting or exceeding minimum State and Federal listed constituent's standards shall be performed, taking into account local mineralogy and history.

D. Supply Pipeline
The minimum size of a well supply pipeline to the distribution system shall be sized to maintain maximum velocity of five (5) feet per second based on the well yield.

E. Location of Well Site
The Resources and Technical Support Section shall review proposed well sites to ensure each site does not adversely affect existing wells, aquifers, or neighborhoods. Sites shall meet or exceed well site restrictions as detailed in AAC R12-15-818 (Well Location); and ARS Title 45 (Waters). Article 4 (Groundwater Rights and Uses In General), Article 10 (Wells).

9.3 Reliability Standards of Water Wells

These standards are intended to minimize the number of affected customers when the water facility does not operate properly.

A. Power Supply
There shall be an electrical connection and switching capability built-in at panels for the water facility to be operated by either of two independent sources of power supply. These normally consist of the main power supply and a backup supply.

B. Back Up Source of Power
1. In an emergency, a backup power supply hook-up shall be provided for a portable generator to be placed on site to meet water demands until the main power supply is restored.

2. There shall be an area reserved on-site for a self-powered portable electric generator near the backup power supply hook-up.

3. Where a natural gas main is unavailable to a water facility, space for a portable fuel storage tank shall be provided in the event one needs to be transported to and set up on the site in an emergency. Placement of such fuel tanks shall meet all local fire and safety codes.

8-06.10.0 Water Source and Supply Facility Minimums

10.1 Minimum Number of Water Supply Facilities

Water supply facilities serving a water service area may include a well, pipeline, pressure reducing station, storage facility, pumping station, or any combination of these facilities.

At least two water supply facilities are needed for reliability of service to each water service area in the water system, whenever practicable.

10.2 Minimum Capability of Water Supply Facilities

The combination of all water supply facilities (see 9.1 above) shall be capable of providing peak day demand plus fire suppression requirements, or the peak hour demand whichever is greater, of each water service area.

10.3 Water Sources

A. Quantity of Source
Unless other arrangements are permitted, all developer-financed projects shall provide one-half (½) acre-foot per year wet water source per equivalent residential unit, or provide transfer of an equivalent amount of the property's State of Arizona Central Arizona Project allocation if applicable.

B. Wells
When a second well facility is not practicable in an isolated system, calculate the number of services allowed on the system using a safety factor of two (2) designed into the total well capacity.

C. Pipelines
Wherever practicable, each pipeline segment of a loop shall be sized so that remaining pipelines can provide the total supply when one pipeline is out of service for repair or replacement.

D. Isolated Systems
- The total yield from the supply facilities shall be at least twice the peak day demand.
- The amount of on-site storage required shall be twice the average daily demand.
- The total pumping station capacity shall meet peak hour demand.

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WATER PLAN DRAFTING STANDARDS

8-07.0.0 WATER PLAN DRAFTING STANDARDS

8-07.1.0 General

1.1 Purpose
This section describes water construction plan standards and requirements for public water projects.

1.2 Definitions
Refer to Section 8-18 for definitions, abbreviations, and acronyms.

1.3 Applicability
These requirements apply to all water plans, including the plans for CIP, system modifications, and developer-financed projects. Additional requirements may be contained in other water design standards for various types of projects.

8-07.2.0 Content Requirements, Water Plan Sheets

This subsection on water plan drafting standards contains the following major topics:

- Content Requirements, All Plan Sheets
- Content Requirements, Cover Plan Sheet
- Content Requirements, Second Plan Sheet
- Content Requirements, Standard Plan Sheets
- Content Requirements, Section and Detail Plan Sheets
- Content Requirements, Survey Control Plan Sheets
- Content Requirements, Landscape Plan Sheets

For purposes of this section, the name “Water Construction Plan” refers to the complete set of sheets or drawings that together show the work to be constructed. The information required as part of the water plan submittal will be shown graphically or provided by notes on the plan.

2.1 Content Requirements, All Plan Sheets

All sheets shall contain or meet the following requirements:

A. Project Title Block

See Exhibit 7-1, Block A and Exhibit 7-1A. The title block, "A," shall be horizontally divided into three equal subsections and shall include:

1. First Subsection: Project name, centered, in bold Roman typeface (sized according to project name), as follows:

“PROJECT NAME”

2. Second Subsection: Second subsection of title block A, "sheet title block," centered, identifying all contents of the specific sheet. Examples include:
   a. First sheet title shall read "Cover Sheet."

   b. Second sheet title shall read "Notes, Legend, Abbreviations and Sheet Index.”

   c. See Exhibit 7-1B. Remaining plan sheets sheet titles shall read specific contents of plan sheets including; the location, street name and station number and can include Sections and Details, Corrosion Details, Survey Control Line, Landscape and Irrigation, and other sheet descriptions as needed.

3. Third Subsection:
   a. Names, Designed by dates, Drawn by, and Checked by

   b. Scale: Vertical, Horizontal

   c. Field book number and page, NAVD 88 datum

   d. Sheet number and total number of sheets

   e. Plan Number
   See Exhibit 7-1 Block B and Exhibit 7-1A.
   - A plan number must be obtained for each project from the Tucson Water Mapping/GIS Section, 791-2631.

   - All project documents shall include a reference to the project using the Tucson Water project plan number.

   - System modifications plans shall use the controlling agency's project plan number. The Tucson Water project plan number will be applied in the margin by the Tucson Water Modifications Unit.

   System modifications plans shall include all of the above information but use the controlling agency's standard title block.

B. Tucson Water Logo and Engineer's Seal
See Exhibit 7-1 Block C and Exhibit 7-1C. (Optional for system modifications plans)
1. The Engineer's seal and signature shall appear on each sheet of drawings or maps.

2. The Engineer shall sign, date, and seal a professional document before the document is submitted to Tucson Water or any other regulatory agency, unless the document is marked "preliminary," "draft," or "not for construction."

3. Refer to AAC Rule R4-30-304. Use of Seals, to assure compliance with all requirements of this rule.

C. Consultant's Logo
See Exhibit 7-1 Block D and Exhibit 7-1C. Consultant's logo with clear identification of the firm responsible for design, if applicable. (Optional for system modifications plans.)

D. North Arrow
See Exhibit 7-1 Block E and Exhibit 7-1D. The north arrow shall be located in the upper right corner of the plan view whenever possible.

E. Sheet Revision Block
See Exhibit 7-1 Block F and Exhibit 7-1D. Sheet revision block, including space for sequential numbers, designer's name and date, description, and "approved by" name and date.

F. Bluestake Logo
See Exhibit 7-1 Block G.

G. Notes
Applicable sheet specific notes

2.2 Content Requirements, Cover Plan Sheet
See Exhibit 7-2. The cover sheet is the first sheet of the water plan. For system modifications plans it may not be the first sheet of the overall plans, but it will be the first sheet of the system modifications portion of the overall plans. It shall include all requirements of paragraph 2.1 of this section and shall also include:
- Project Name Block
- Signature Block
- Other approval signatures
- Physical Site Address (Tucson Water Plant Design plans only)
- Location Map Requirements
- Sheet Index Plan Content Requirements
- Record Drawing Block

- Plan Number
- System Schematics (Tucson Water Plant Design plans only)

A. Project Name Block
See Exhibit 7-2 Block A. The project name shall be located top center

B. Signature Block
See Exhibit 7-2 Block B and Exhibit 7-2A. If a signature is not required for a particular project, the signature space shall be omitted.

1. Approval signatures
Approval signatures are acquired from the P&E Administrator and Deputy Director to authorize proceeding with CIP construction projects. Also, approval signatures are acquired from the fire suppression authority for fire flow rates and duration and hydrant locations. Approval signatures are located in the signature block.

2. Acceptance signatures
Acceptance signatures are acquired for system modifications plans and developer-financed plans from Section Supervisors for substantial concurrence with standard specifications and details. Acceptance signatures are located in the signature block.

C. Other approval signatures
See Exhibit 7-2 Block C and Exhibit 7-2B. Other approval signatures are acquired from other regulatory agencies including but not limited to Pima County Wastewater Management, Pima County Department of Transportation, Arizona Department of Transportation, etc. These approval signatures are located adjacent to the top of the title block. For system modifications plans, other approval signatures are obtained by the controlling agency and will appear on the plan cover sheet, not necessarily on the system modifications cover sheet.

D. Physical Site Address (Tucson Water Plant Design plans only)
The physical site address is the official assigned address by Pima County Development Services.

E. Location Map Requirements
See Exhibit 7-2 Block E and Exhibit 7-2C. The location map, (also known as the vicinity map) shall be located in a dedicated area in the top right corner of the cover sheet and shall be labeled “Location Map.” The Location Map shall cover a minimum of one square mile at a scale of 3” = 1 mile or shown on a dedicated area on the cover, not to exceed 7” (H) x 6” (W) at an appropriate scale, and shall include:

- “This Project” arrow showing the project centered in the map
- Existing conditions such as major streets, watercourses, and surroundings that may affect the project

- Section, township, range, section corners, north arrow, and scale

- A text label identifying the political subdivision, such as City of Tucson ward, County Supervisor district, Town of Marana, Oro Valley, South Tucson

- Latitude and longitude at the beginning of construction and at the approximate center of construction for system modifications plans

F. Sheet Index Plan Content Requirements
See Exhibit 7-2 Block F. Content requirements of the Sheet Index Plan shall include:

1. Sheet Index Plan
A sheet index plan shall be included on the cover sheet that shows a plan view (overhead, bird's eye view) of the entire project on one sheet.

2. General Items
General items, all to be labeled, include:
   a. North arrow, scale. (typically up or left direction)

   b. Water service area boundary, if near the project area

   c. Sheet index number arrows

   d. Project boundary line

   e. Project beginning and ending location

   f. Project phase lines

   g. Section, township, range; and section corners and quarter section corners

   h. Legend, if unique to the site plan

3. Existing and Proposed Mains and Structures
Where the existing system is within or affected by the new project, show the location and size of existing and proposed water mains including protected mains, labeled as such. Also include valves and fire hydrants, and the location and name of existing and proposed waterworks structures.

4. Major Streets, Water Courses
Show existing or proposed major streets and all watercourses including the 100-year flood limit contour.

5. Pressure Zone Boundaries

Show pressure zone boundaries, with closed valves, if within the water sheet index plan sheet.

G. Record Drawing Block
The record drawing block shall contain space for the Engineer's seal and inspector's as-built (record drawing) information consisting of details relating to the project such as Contractor's name, inspector's name, project completion date, pipe materials, valve types, etc.

H. Plan Number
1. Source
A plan number will be assigned for each project by the Tucson Water Mapping/GIS Section, 791-2631.

2. Usage
All project documents shall include a reference to the project using the Tucson Water project plan number.

3. Location
The Plan number shall be located on the upper right-hand corner, vertically, inside the border of the plan so that the number terminates at the upper right corner of the sheet.

4. System Modifications Plans
For system modifications plans, the plan number will be obtained by the Tucson Water Modifications Unit and applied to the record set of plans retained by Tucson Water.

I. System Schematics (Tucson Water Plant Design plans only)
1. Water System Schematic
A water system schematic diagram will be shown on the cover sheet. The schematic diagram shall show the water service areas adjacent to the new facility, including the High Water elevations of these water service areas. In addition, it will show the new facility and site elevation schematically linked to the adjacent water service areas.

2. Pump and Motor Requirement Table
A pump and motor requirement table will be shown on the cover sheet. This table will include the following information for each pumping unit of the new facility:
- Design Capacity
- Design Total Dynamic Head
- Minimum Shut-Off Head
- Voltage
- Phase
- Minimum Horsepower

3. Pump Settings
   A table of pump settings will be on the cover sheet for applicable projects and will show the pressure setting in pounds per square inch for the on and off point for each pump of the new facility.

2.3 Content Requirements, Second Plan Sheet

The second sheet contains requirements of paragraph 8-07.2.1 and includes:

- Construction Notes
- Sheet Index List
- Legend
- Abbreviations List
- Section Indicator - Detail Number Cross Referencing System
- Content Requirements (Tucson Water Plant Design plans only)

A. Construction Notes

1. General Construction Notes
   General construction notes found in Tucson Water SD-105, 11 pages, apply to all projects and are not to be included on the plans, other than those required herein.

2. Additional Construction Notes
   Additional construction notes shall be located to the left side of the sheet, and labeled “Additional Construction Notes.”
   a. Include, as the first note, the entire text contents of Note No. 1, found in Tucson Water SD-105, General Construction Notes.

   b. Do not include construction notes that are already in the General Construction Notes, other than those required above.

   c. Do not include notes that are not applicable to this project.

3. Developer-Financed Projects
   For general construction notes on developer-financed plans, see Exhibit 7-10. Approved notes may be placed on the cover sheet.

4. System Modifications Projects
   For General Construction notes on system modifications plans, see Exhibit 7-11. Notes may be placed on the cover sheet. Any special notes unique to the project shall be included.

B. Sheet Index List

The purpose of the sheet index list is to provide a comprehensive list of all content to quickly facilitate finding any topic of interest.

1. Sheet Index List
   The Sheet Index List, sometimes referred to as the Plan or Drawing Index List, is a list containing sheet numbers and corresponding sheet subtitles used in the plans. This list shall be labeled “Sheet Index List.”

2. Group Categories
   The Index should be categorized into groups with headings and sheet subtitles such as:
   a. General
      - Cover Sheet
        - Location Map, Site Plan
      - Second Sheet (Additional Construction Notes, Boundary and Marker Symbols, Legend, Sheet Index, Abbreviations, Culture Symbols)

   b. Civil Sheets
      - Plan Sheets
      - Plan Sections & Details Sheets
        - Structural (Concrete, Anchorage Bolt Support, Grating)
        - Miscellaneous (Corrosion, Pipe trench, Air Release, Valve Assembly, Blow-Off Assembly, Lifting Lug)
      - Survey Control Sheet

   c. Landscape Sheets
      - Landscape Restoration Key Plan (Site Plan) Sheets
      - Landscape Restoration Template Sheets (Plan)
      - Irrigation Plan Sheets (Plan)
      - Sections & Details Sheets
      - Landscape and Irrigation Sheet

C. Legend
   The legend is a list containing symbols and corresponding features used in the project plans. This list shall be labeled “Legend.”
   1. Symbols
      Include all symbols used on the plans for this project. See Exhibits 7-3A through 7-3D.

   2. Symbol Sources
      Use only symbols that are in the Symbols section of the Tucson Water Standard Specifications and Details and the Pima Co. / City of Tucson Standard Details for Public Improvements

   3. Symbol Limitations
      Do not include symbols that are not applicable to this project.

   4. Symbol Groups
      Symbols should be in groups with a heading, such as:
      - utility
      - boundary and marker
      - survey
      - culture

D. Abbreviations List
The Abbreviations List is a list containing letters and corresponding definitions used in the plans and shall be labeled "Abbreviations List."
- Include all abbreviations used on the plan sheets for this project.
- Use only abbreviations that are in the Abbreviations section of the Tucson Water Standard Specifications and Details and the Pima County / City of Tucson Standard Specifications and Details for Public Improvements
- Do not include abbreviations that are not applicable to this project.

E. Section Indicator and Detail Number Cross-Referencing System
A graphical representation of the section indicator cross-referencing system and the detail number cross-referencing system shall be shown as defined and explained in subsection 5.3.

F. Content Requirements (Tucson Water Plant Design plans only)
The second sheet of the water plans for plant design projects shall be a Site Grading and Enclosure Plan. This sheet shall be named "Site Grading and Enclosure Plan" and shall include the following:
- General Site Layout
- Facility Tie-in to Existing Distribution System
- Property Boundaries
- Existing Topography
- Site Final Grade
- Perimeter Enclosure Location and Grade
- Drainage
- Site Access

2.4 Content Requirements, Standard Plan Sheets
The detailed plan sheets show a plan view of the work to be constructed. These sheets consist of much more detail than in the water site plan in order to show what the project is and where it is to be constructed and what may affect construction. This subsection contains:
- Plan Sheets Content
- Profile View Content

A. Plan Sheets Content
The plan sheets shall not include an aerial photographic survey background but will include the following:
1. Right-of-way dimensions and names, existing and proposed. State the recordation information, location, width and purpose, with street names labeled public or private. Also, comply with Tucson Water SD-340, System Installation Outside Public right-of-way. (Not applicable for system modifications plans.)

2. Survey control line, including bearing and distance between control points, control point, and stationing.

3. Survey benchmarks relative to NAVD 88 datum.

4. Property lines, lot addresses, block numbers, subdivision names, parcel numbers, sidewalks, driveways, edge of pavement, and curb lines.

5. All appurtenances, structures or equipment and any utilities that may be found to exist having any connection with this project that will assist the Contractor in properly evaluating the obstructions he will encounter when installing the project. Examples include:
   - Corrosion test stations, air release valve assemblies, drain valve assemblies, fire hydrants, all existing and future water main tie-overs, renewals, and abandonments,
   - Service taps, water meters, and water service lines,
   - Natural gas mains and gas services, gasoline lines,
   - Power and telephone poles to include lights and transformers,
   - Underground traffic signal loops, electric, telephone and television cables, fiber optics and conduits,
   - Sewers with base map number and manholes with invert elevations and house connection to sewer (if obtainable), and
   - Storm sewers.

6. Materials including fittings, valves, & appurtenances which shall be called out in a suitable area near their location on the drawing and boxed with a tapered leader to the location on the drawing. Call out shall include stationing, offset, quantities and sizes.

STA 10+23.84, 10’ RT
1 – 12” Gate Valve, B&C
1 – 45º Bend
Δ = 2º 30’ 15”, RT

   System modifications plans shall be stationed to the nearest foot followed by a plus/minus sign. Similar to: STA 10+24$\pm$; 10'$\pm$ RT.

7. Any utility proposed in the area of construction that will not be in place but will affect the water project installation and will be marked “Proposed.”

8. Sheet specific sections and details labeled as “Sheet Notes.”

   a. Any main to be abandoned will be marked with a boxed note showing the size, material, and “abandon” in various suitable locations. For example: The note shall be boxed with a tapered leader to the station location of the cut.

Sta. _____” “Cut and Plug Abandon existing 6” steel pipe” according to TW SD-350

   System modifications plans shall include within the boxed note a beginning station to ending station with a quantity of pipe to be abandoned. Reference shall be to Standard Detail W-350.

   b. Section arrows will be in the direction of the abandoned main.

9. Water main horizontal alignment design deflections.

STA 10+23.84, 10’ RT Horizontal Deflection $\Delta = 2^{o}$ 30’ 15”, RT

10. Match lines when more than one sheet is used.

11. Butterfly valve actuator stem placement south or west of main.

12. Call out box with pipe diameter lengths on each sheet, i.e.

Total 24” Pipe Material Length This Sheet = XXXX ft

B. <u>Profile View Content</u>

1. <u>All Pipe Widths</u>
   Two lines will depict all pipe widths (diameter).

2. <u>Thick Walled Pipe, Larger Than Forty-Eight Inches</u>
   The wall thickness will be drawn for thick walled pipelines (i.e., concrete cylinder pipe) larger than forty-eight inches in diameter.

3. <u>Profile Stationing</u>
   a. Negative stationing is not allowed.

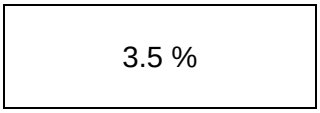
   b. Station labels are to read from left to right on the sheet. System modifications plans shall read the same as the paving and drainage plans of the agency's project plans.

c. Stationing shall begin at above ground, permanently identifiable survey points, such as section corners, ¼ corners, 1/8 corners, 1/16 corners, centerline intersections, or other acceptable survey monuments. System modifications plans shall use the same stationing as the agency's project plans.

d. The stations in a profile view must line up vertically with the stations in a plan view.

e. Grade breaks call outs shall be on the respective station.

f. Label the main profile slope between each profile grade break:



4. Material Call Outs
Material call outs, including fittings, valves, and appurtenances, shall include stationing, quantity, size, and invert or centerline elevations on the respective station.

2.5 Content Requirements, Section and Detail Plan Sheets

Section and detail sheets contain only project specific sections and details. Section and detail sheets can contain numerous project specific sections of top (plan) views and side (section) views and/or additional details that are not included as part of any department Standard Details.

Section and detail sheets provide a location to put any sections and details that may apply by reference to more than one sheet. This is in contrast to a section or detail that applies only to one specific plan sheet located on that sheet.

Section and detail sheets are usually created when it is determined necessary to clarify or make specific requirements on the construction item. These sheets shall be labeled as “Section and detail sheets.“

2.6 Content Requirements, Survey Control Plan Sheets

(Not required for system modifications plans. Agency project plans may include a Survey Control Plan Sheet)

The survey control sheets show the results of the field surveys performed during the design phase of the project. This information should be used during construction of the project and to include:

- Legend
- North arrow
- Abbreviations
- Signed Registered Land Surveyor seal

- Survey control line, right-of-way or easement lines, stations, bearings, length, bench marks, calculated and controls points, and streets
- Temporary project construction, utility, and private easements, including docket and page numbers
- For subdivisions, include Book and Page numbers
- Notes for basis of bearing and basis of elevation
- Survey data table: project title, prepared by name and date, control and calculated point numbers, northing, easting, elevations, and descriptions
- Curve data (curve number, delta, radius, arc, chord, tangent, etc.)
- Line data to include the line number, bearing, and distance
- Point files with points on CD converted to ASCII or .CR5 files and in Arizona State plane coordinates

2.7 Content Requirements, Landscape Plan Sheets

A. Landscape Plan Sheets

(Not required for system modifications plans)
If required by the Native Plant Preservation Ordinance, plan sheets shall meet all municipal or local jurisdiction requirements. In Pima County and the City of Tucson these include but are not limited to:

1. Pima County Native Plant Preservation Ordinance and resulting Procedures for the Issuance of Right-of-Way Permits and Regulations of Work Under Permit.

2. City of Tucson Development Standards:
   - No. 2-06.0, Landscaping and Screening
   - No. 2-07.0, Landscape Plan Content and Specification
   - No. 2-15.0, Native Plant Preservation
   - No. 9-06.0, Landscape Plant Materials

B. Landscape Sheets Signed and Sealed

Landscape sheets, including irrigation details, shall be included when they are a part of the project and shall be signed and sealed by a Registered Landscape Architect. Sheet types shall generally conform to these standards, such as:

1. Landscape Restoration Key Plan (Site Plan)

2. Landscape Restoration Template Sheets (Plan)

3. Irrigation Plan Sheets (Plan)

4. Sections & Details (Landscape and Irrigation)

8-07.3.0 Content Requirements, Standard Plan Sheets, Pipelines

This subsection contains the following major topics:

- Plan Sheet Content, Pipelines
- Profile Sheet Content, Pipelines
- Stationing, Pipelines

3.1 Plan Sheet Content, Pipelines

A. Protected Mains

All the requirements in Tucson Water Departmental Procedures, Protected Main Policy, No. IV.B.03, must be met. These include showing existing and proposed participating properties, the protected main, the water supply connection location, and each water service connection location.

B. Stationing

1. Alignment

Show stationing at each tie-in/connection location, valve, service connection, fire hydrant (at the tee), blow-off assembly, air relief valve, fitting, tee, horizontal deflection/ bend, corrosion test station, station equation, grade break, outlet, intersection centerline, etc.

2. Location - Intervals

Control survey lines and stationing shall be along street or right of way centerlines when there are no section lines; along quarter, half, and full section lines, or centerline of easements, when there are no streets.

3. Location - Other

Show stationing at 100-foot intervals along the survey control line, identified at every station.

C. Surveying

1. Scale

- horizontal scale shall be 1” = 40’
- vertical scale shall be 1”= 4’.

2. Surveying Services

Surveying services shall include identifying all physical obstructions which may influence the location of the new pipeline such as fences, curbs, sidewalks, street lighting, major vegetation, and traffic control devices; and locations and elevations at inverts of sanitary sewers, storm sewers and other similar underground structures where applicable.

The surveying services shall meet the following requirements:

a. All survey services will be performed by qualified Arizona registered land surveyors.

b. Field surveys shall be properly indexed and recorded in field book(s) and CDs. Showing all work performed in the field with the date, name of crewmembers, and type of equipment used.

c. The horizontal control shall meet Second Order, Class I standards. The control survey shall tie all existing survey monuments in cross streets within seventy-five feet of the control line. The final adjusted survey with all items shall be shown on a separate plat and be made a part of the final package of construction drawings.

3.2 Profile Sheet Content, Pipelines

A. Profiles Required

In addition to plan views, pipeline profile views are required for all pipelines twelve inches in diameter or larger.

At Tucson Water's request, pipeline profile views may be required:

1. for pipelines located in existing Pima County right-of-way

2. in hilly terrain to verify the proper location of blow off assemblies or air release and vacuum relief valves, and

3. for profiles to depict stream, railroad, highway crossings, drainage structures, and congested areas.

B. Survey Benchmarks

Survey benchmarks, relative to NAVD 88 datum only, shall be shown at 1,000-foot intervals/each design sheet. Profile stations will also be required at one hundred feet intervals and at all major street or wash crossings on all potable water mains.

The bench mark(s) that are the basis of each survey must be called out in the data disk or in the field book(s).

Benchmarks shall not exceed 1,000-foot intervals with supplemental elevation established on all survey monuments along the entire bench circuit. The control line shall be the center of street, section line, 1/4 section line, etc., when possible, with benchmarks on each sheet.

C. Restrained Joints

Show all restrained joints and required lengths in the profile view or in a properly labeled table.

D. Subgrade Elevation

In the profile view, show existing subgrade elevation directly or in proximity over pipe design alignment.

E. Stationing
Repeat the label information from the plan view in the profile view. Include the pipe invert elevation to the nearest hundredth of a foot, such as "INV. EL. 2,548.77." Include the steel pipe (concrete cylinder pipe and welded steel pipe) centerline/springline elevation to the nearest hundredth of foot, such as "CL. EL 2,548.77".

F. Slope
Show the slope of grade breaks in each pipe section to two decimal places, such as "+45.07%," calculated relative to the horizontal distance along the survey control line, not the true length of the pipe.

3.3 Stationing, Pipelines

A. Show stationing at each valve, service connection, fire hydrant (at the tee), blow-off assembly, horizontal and vertical fitting, tee, bend, grade break, outlet, and intersection centerline, etc.

B. Control survey line and stationing shall be along section line, 1/4 section line, or portions of section line, when possible, or along street or easements centerline, when no section lines are involved.

C. Show stationing at 100-foot intervals identified at every station.

8-07.4.0 Content Requirements, Water Plan Sheets, System Modifications

4.1 Formats and Layouts
Formats and layouts for system modifications plans shall follow the requirements of the Supplemental documents issued by Tucson Water.

4.2 Water System Information
Water system information shown on the system modification plans shall use, but not be limited to, these sources of information:

- available water records at Tucson Water,
- field surveys,
- water pot holes if required, and
- plan review comments from Tucson Water.

4.3 Water Plan Submittals
Water plan submittals to Tucson Water shall include all information related to producing an acceptable plan to Tucson Water and shall include, but not be limited to:

- Engineer's estimate of probable construction cost,
- special provisions for water work and
- other project documentation as may be required by Tucson Water.

4.4 Materials List

For system modifications projects, provide a materials list for items such as crosses, tees, bends, valves, fire hydrants, service connections, etc. If applicable, include a reference to a standard detail.

8-07.5.0 Drafting Requirements, Water Plan Sheets

This subsection contains the following major topics:

- Drafting Requirements, General
- Drafting Requirements, Plan Symbols, Pipelines

5.1 Drafting Requirements, General

A. Sheet Size

(Not applicable for system modifications plans. Sheet size shall be as required by the controlling agency.)

The drawings shall be on standard 24" x 36" (+/- 1/32 inch) Mylar or vellum sheets, or eighteen-pound translucent bond, including a minimum one-half inch margin. This standardizes material for more efficient record keeping and assures legibility when microfilmed.

B. Plan Symbols

See Exhibits 7-3A through 7-3D.

C. Lettering and Line Weights

The purpose of this requirement is to assure that all lettering is legible when reviewed and will maintain that legibility when reproduced and photographically reduced (microfilmed) for record-keeping purposes. See Exhibits 7-3A and 7-3D.

All lettering shall be clear, not congested, and readable when converted to half-size and microfilms size.

1. Lettering and dimensions size shall be equal to or greater than twelve point (0.125" to 0.12" or 3.175 mm to 3.048 mm). Letter line weight thickness shall be a minimum of 0.125" (3.175mm).

2. Line weight thickness shall be a minimum of 0.0075" (0.1905 mm).

3. Profile stationing numbers size shall be 0.1875" to 0.25" (4.7625 mm to 6.35 mm). Profile stationing numbers line weight thickness shall be 0.01969" to 0.125" (0.50 mm to 3.175mm).

4. Profile grid lines are: major grid solid line (100 foot horizontal and 10 foot vertical) weight is 0.0100, mid grid solid line (50 foot horizontal and 5 foot vertical) weight is 0.004, and minor grid dotted line (10 foot horizontal and 1 foot vertical) weight is 0.0004.

D. Engineering Scale

1. The Engineering scale on plan sheets shall have no more than forty feet to the inch, 1" = 40 feet (horizontal), 1" = 4 feet (vertical where applicable). The sheet index plan scale and location map (cover sheet) will vary depending on the scope of the project.

   This scale is the minimum for detailed information required to show compliance. It also affords greater clarity after photographic reduction (microfilming) for record keeping purposes.

2. The scale chosen must produce clearly legible, uncluttered drawings when microfilmed.

3. The scale chosen must have room for "record drawing" information that will be hand applied by the field inspector.

E. Cross-Hatching

1. Shading or "zip-a-tone" will not be accepted.

2. Intermittent cross-hatching shall show edge of pavement and shall be removed from behind all street names, dimensions, etc.

F. Location Format

The location of the following items applies to all sheets: See Exhibit 7-1A through Exhibit 7-1D. (System modifications plans may use the agency title block format.)

1. Project Title block, in the bottom right corner of the sheet.

2. PE seal, to the left of the project title block. On the cover sheet, it shall be located left of the approval signatures.

3. Tucson Water logo, in the upper portion of the PE seal block.

4. Sheet revision block, to the left of the PE seal block

5. Design Consultant's "logo," to the left of the Revision block.

6. Bluestake logo, left of the Revision block.

G. North Arrow

The north arrow shall point to the left or top of the sheet and shall never point to the bottom of the sheet. For system modifications plans, the system modifications sheets shall be oriented in the same direction as the paving and drainage plan sheets.

H. Plan Layout, Conventional
Conventional plan layout shall begin on the left-hand side of the top half of the sheet and continue on the left-hand side of the bottom half, with match lines and a note about where the continuation can be found. No more than two lines of layout shall be used per sheet.

I. Plan Layout
PipesThe plan layout shall be drawn in a manner such that all pipes shown in plan view to be shown in a profile view if it were required.

J. Main Dimensions
The mains will be dimensioned from the centerline of the street at least twice in each half of the street.

K. Pipelines Larger Than Thirty-Six Inches
For pipelines larger than thirty-six inches in diameter, two lines shall be drawn to depict pipe width in the plan view.

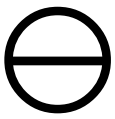
5.2 Drafting Requirements, Plan Symbols, Pipelines

A. Plan Symbols, Standard Details
Plan symbols used in the preparation of the water plan shall be according to the Pima Co. / City of Tucson Standard Details for Public Improvements, Detail No. 100 – Plan Symbols, 8 pages.

B. Allowable Exceptions
Allowable exceptions and additions are listed in Tucson Water SD-1850, Plan Symbols (2 pages), Standard Water Details section, Tucson Water Standard Specifications and Details.

C. Section Indicator or Detail Number Cross Referencing System
For the purposes of this subsection of this standard, a section is a cross-section, or imaginary cut or slice, through a pipe, structure or appurtenance that is illustrated on the same or another sheet. The section indicator cross-referencing system shall be:

1. A circle with a horizontal line through the center shall be the basic symbol for the section or detail cross-reference.



2. For the sheet on which the section is cut:

   a. In the upper half of the circle identify the section with a single letter.

b. In the lower half of the circle, the sheet page number on which the section appears shall be identified. If it is the same page, a dash (-) shall be used.

3. For the sheet on which the section appears:
   a. In the upper half of the circle identify the section with a single letter.

   b. In the lower half of the circle, the sheet page number on which the section is cut shall be identified. If it is the same page, a dash (-) shall be used.

   c. A descriptive name shall accompany the drawing.

4. The letters “I” and “O” are not to be used in section labels to avoid confusion with numbers.

5. The detail number cross-referencing system is identical to that described above, except that a number, not a letter, is used.

8-07.6.0 Exhibits

Exhibit 7-1, Plan Sheet
Exhibit 7-1A, Project Title Block
Exhibit 7-1B, Plan Sheet Title Block
Exhibit 7-1C, Logo Blocks
Exhibit 7-1D, Sheet Revision Block
Exhibit 7-2, Cover Sheet
Exhibit 7-2A, Signature Block
Exhibit 7-2B, Other Signatures Block
Exhibit 7-2C, Location Map
Exhibit 7-2D, As-Built (Record Drawing) Block
Exhibit 7-3A, Plan Symbols
Exhibit 7-3B, Plan Symbols
Exhibit 7-3C, Plan Symbols and Details
Exhibit 7-3D, Plan Symbols and Details
Exhibit 7-4A, Drafting, Water Mains
Exhibit 7-4B, Symbols, Water Mains
Exhibit 7-5A, Drafting, Gate Valves
Exhibit 7-5B, Symbols, Gate Valves
Exhibit 7-6A, Drafting, Butterfly Valves
Exhibit 7-6B, Symbols, Butterfly Valves
Exhibit 7-7A, Drafting, Tees and Crosses
Exhibit 7-7B, Symbols, Tees and Crosses
Exhibit 7-8A, Drafting, Bends
Exhibit 7-8B, Symbols, Bends
Exhibit 7-9, Drafting, Rotated Bends
Exhibit 7-10, General Construction Notes, New Development
Exhibit 7-11, General Construction Notes, System Modifications

Exhibit 7-1, Plan Sheet

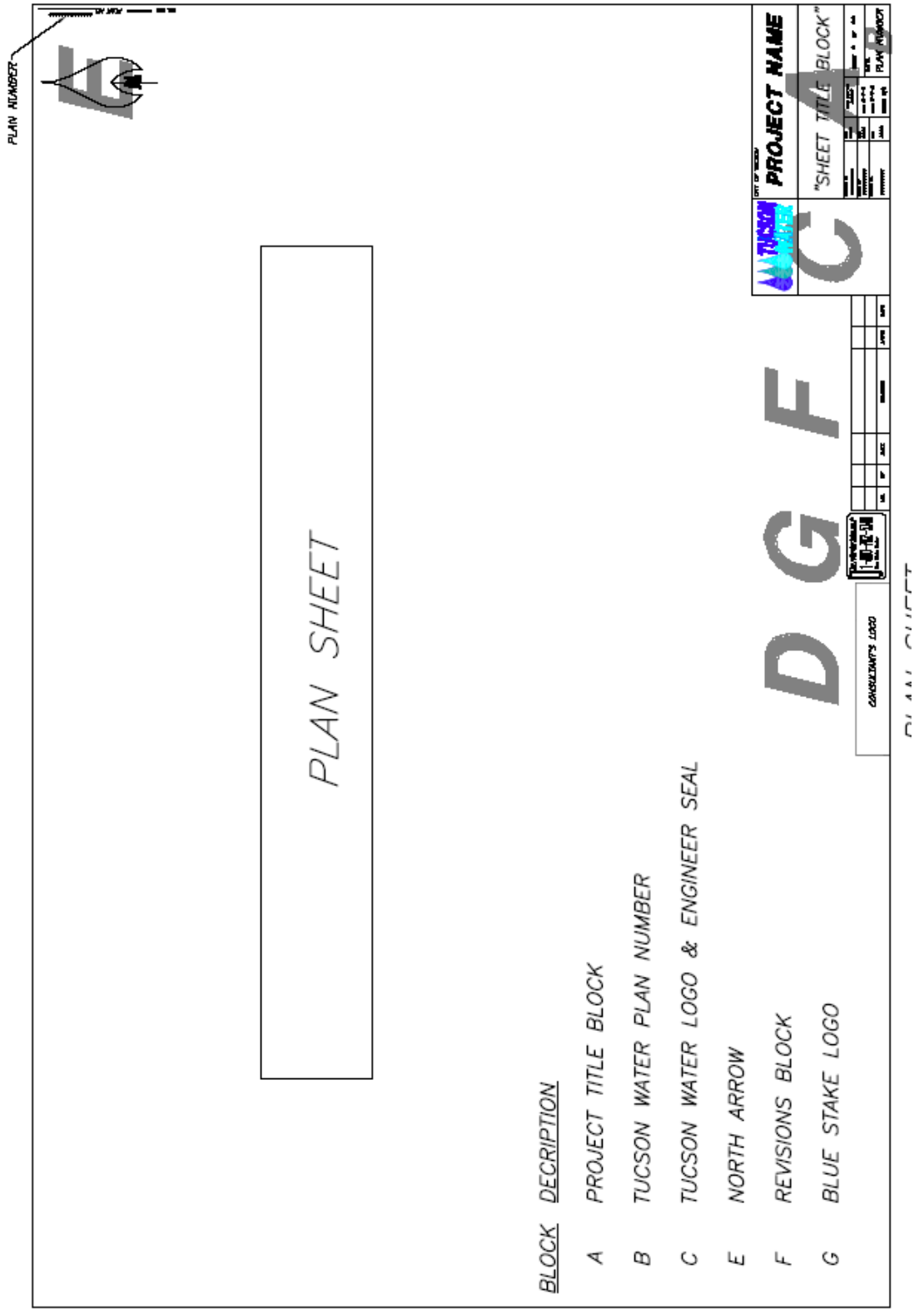


Exhibit 7-1A, Project Title Block

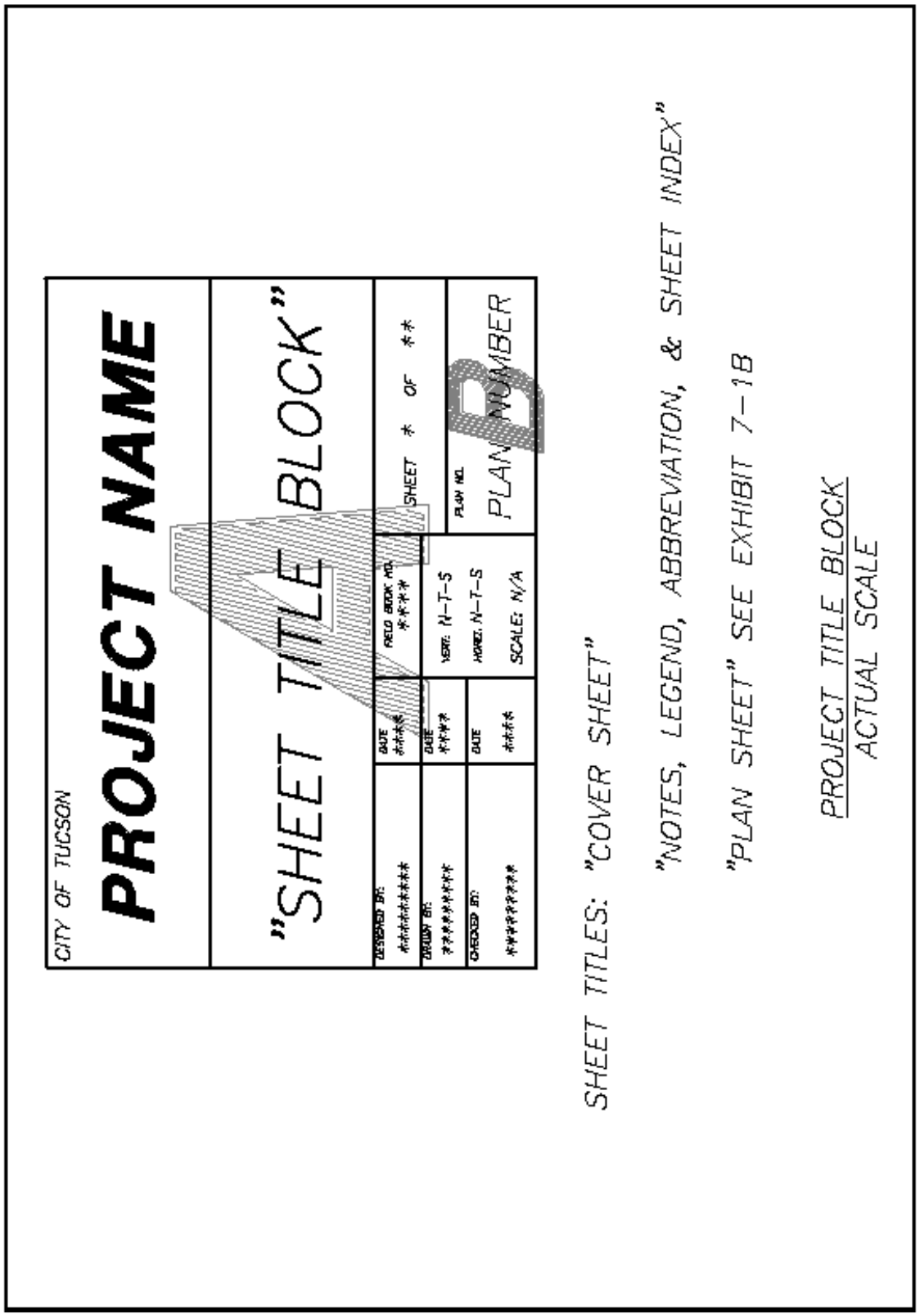


Exhibit 7-1B, Plan Sheet Title Block

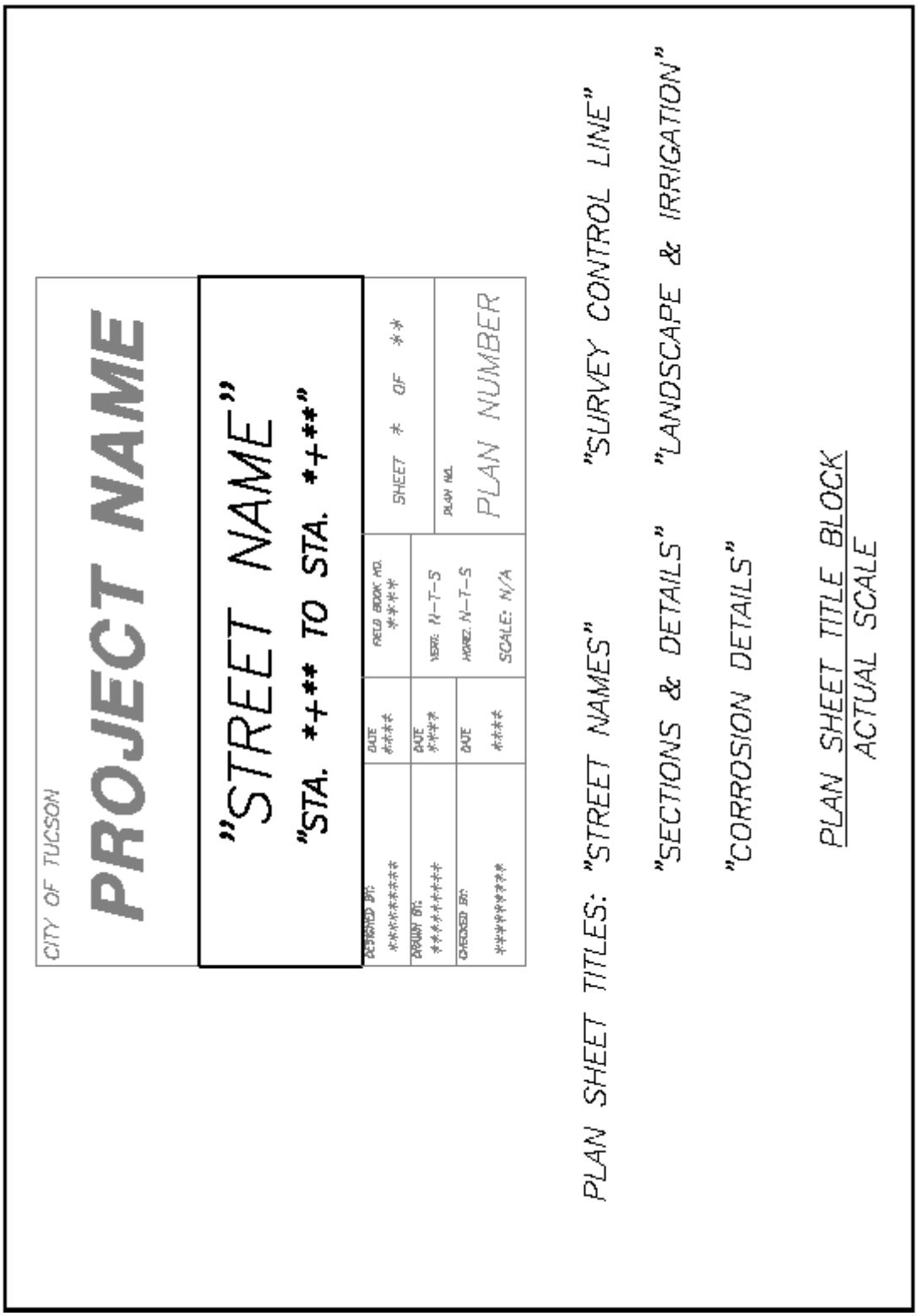


Exhibit 7-1C, Logo Blocks

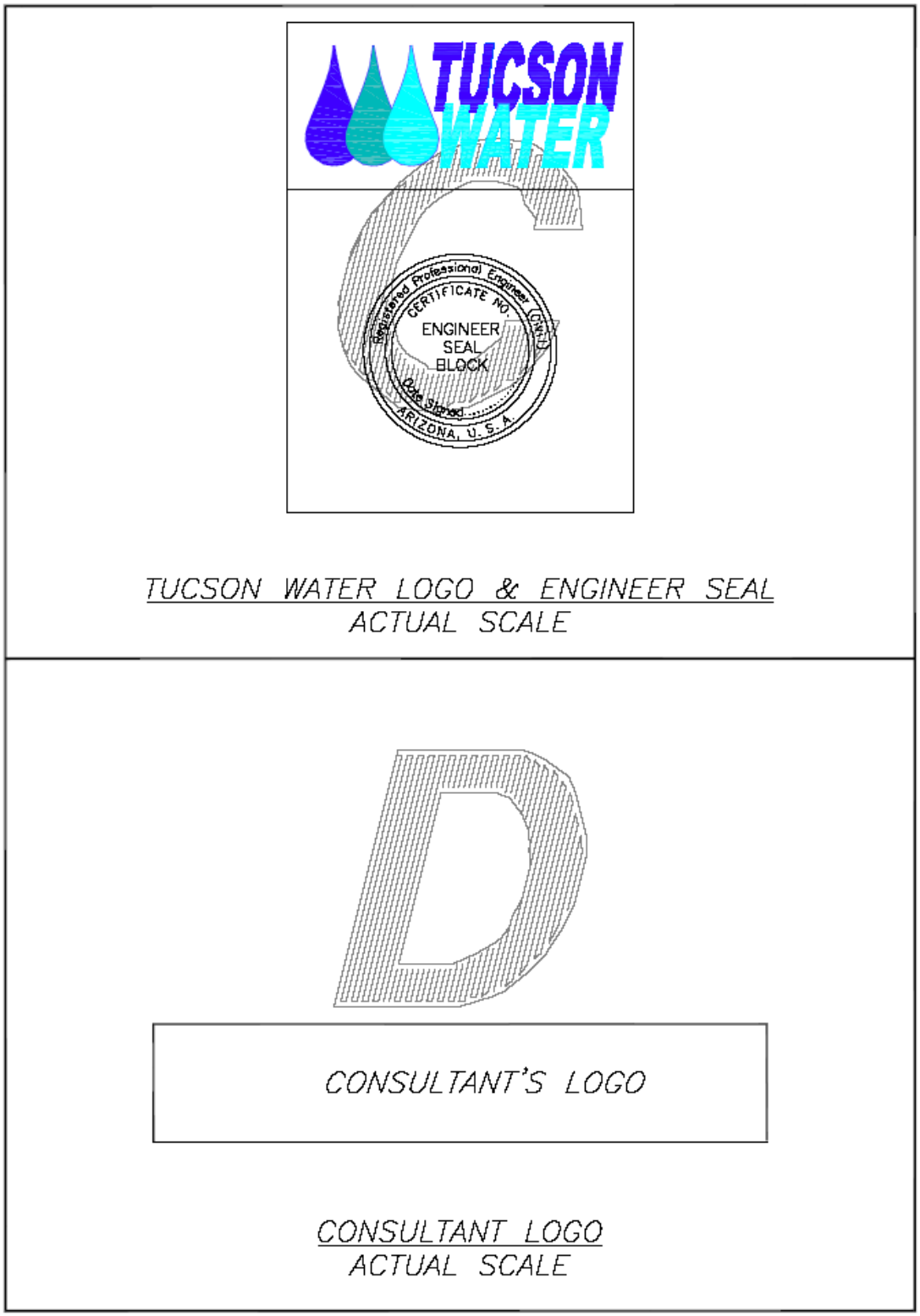
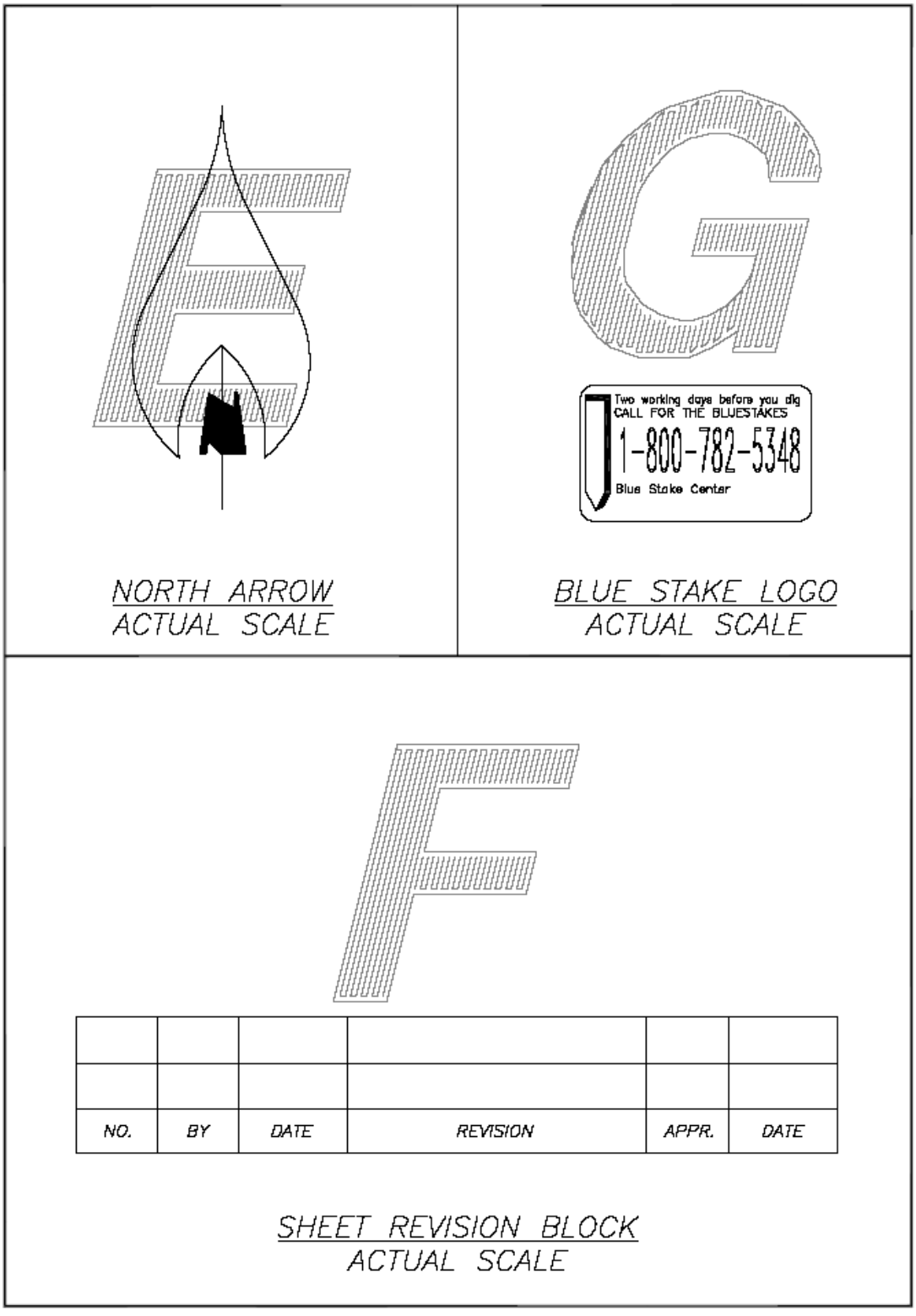


Exhibit 7-1D, Sheet Revision Block



NORTH ARROW
ACTUAL SCALE

BLUE STAKE LOGO
ACTUAL SCALE

SHEET REVISION BLOCK
ACTUAL SCALE

Exhibit 7-2, Cover Sheet

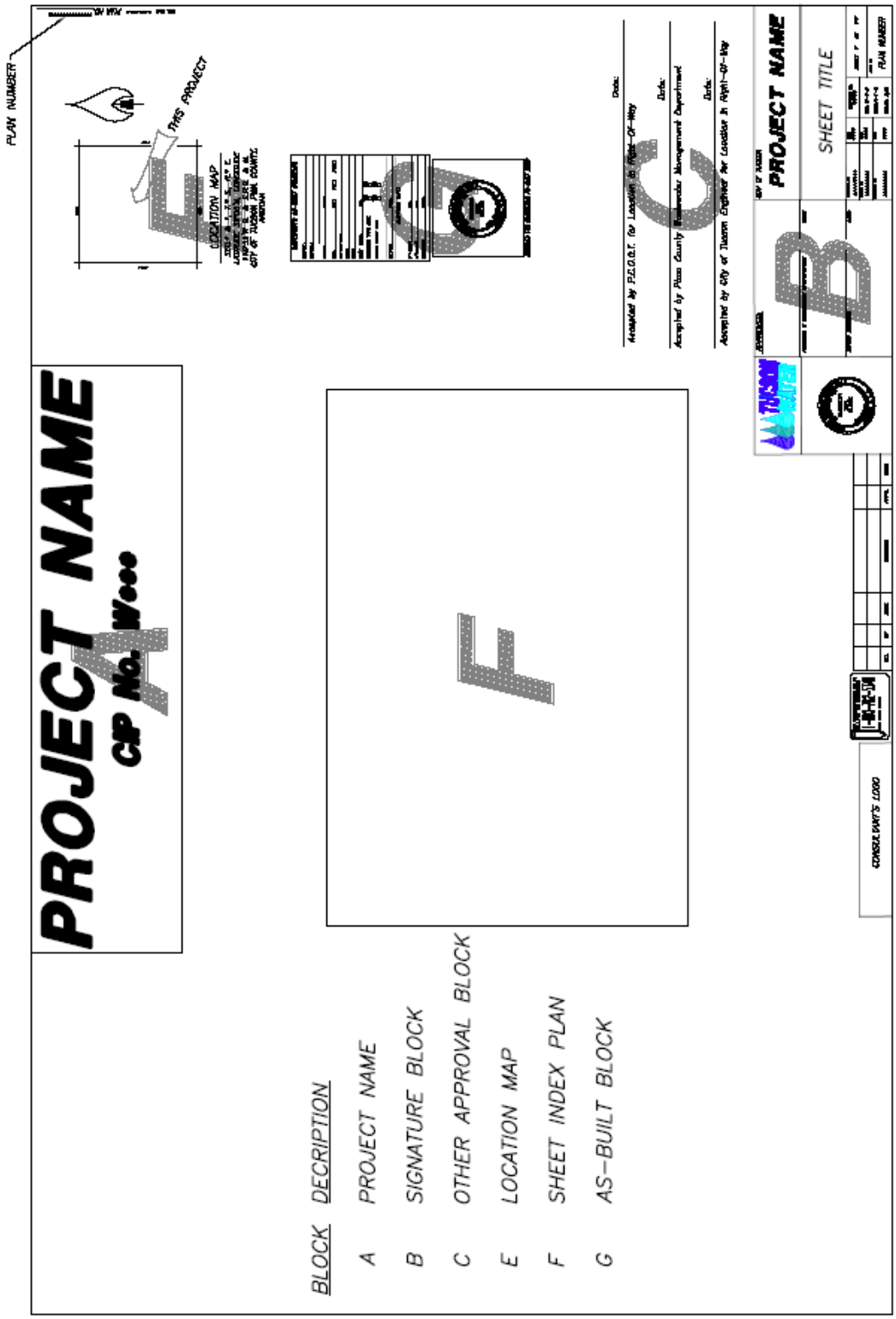


Exhibit 7-2A, Signature Block

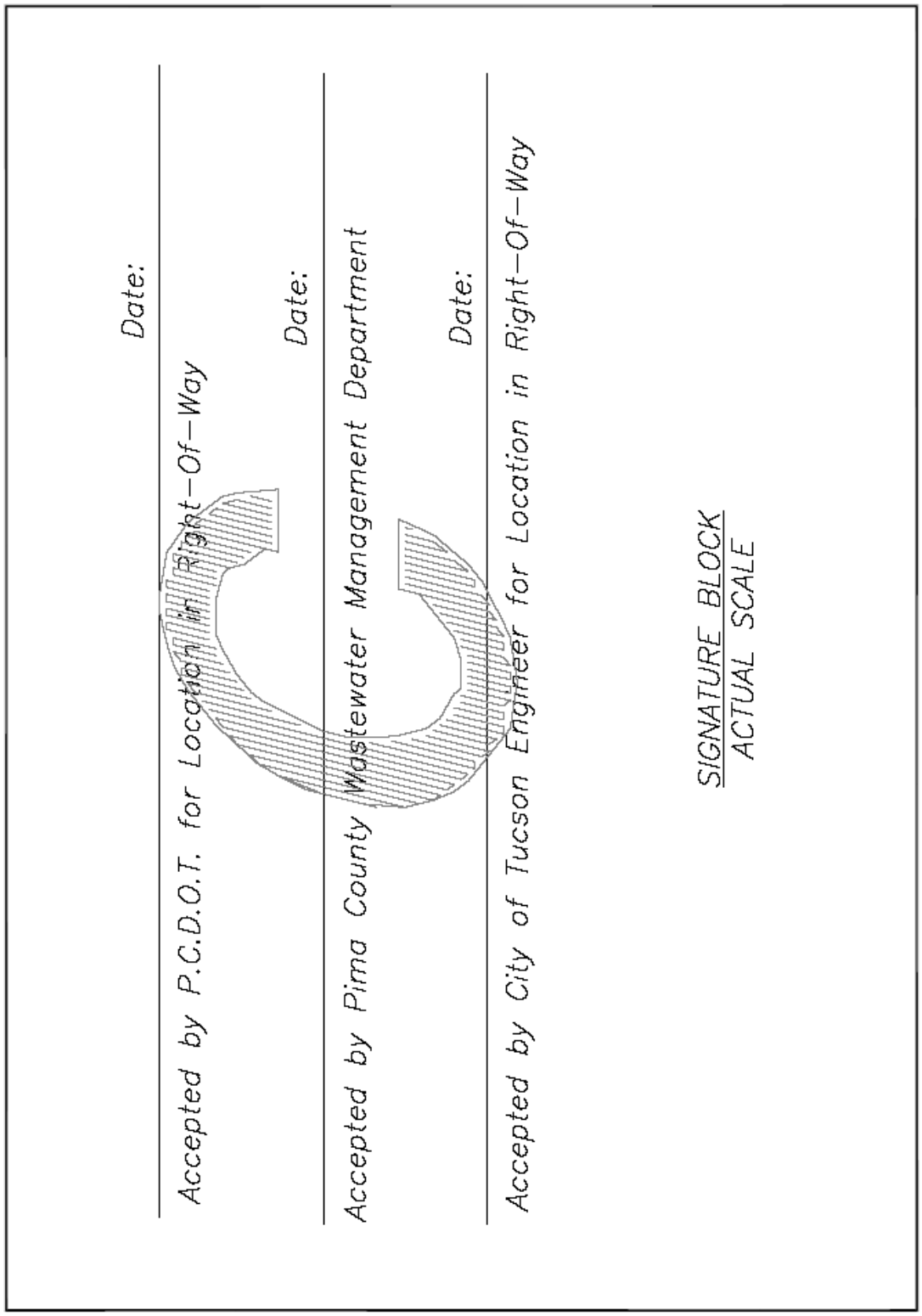
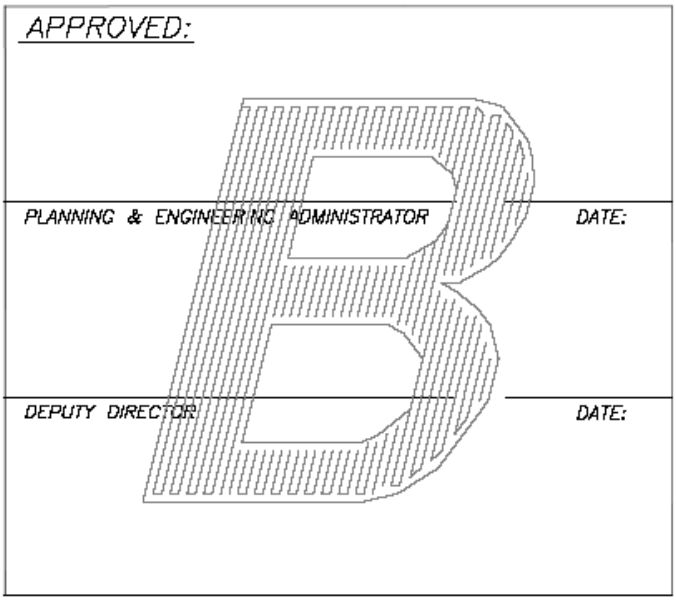


Exhibit 7-2B, Other Signatures Block



OTHER SIGNATURES
ACTUAL SCALE

Exhibit 7-2C, Location Map

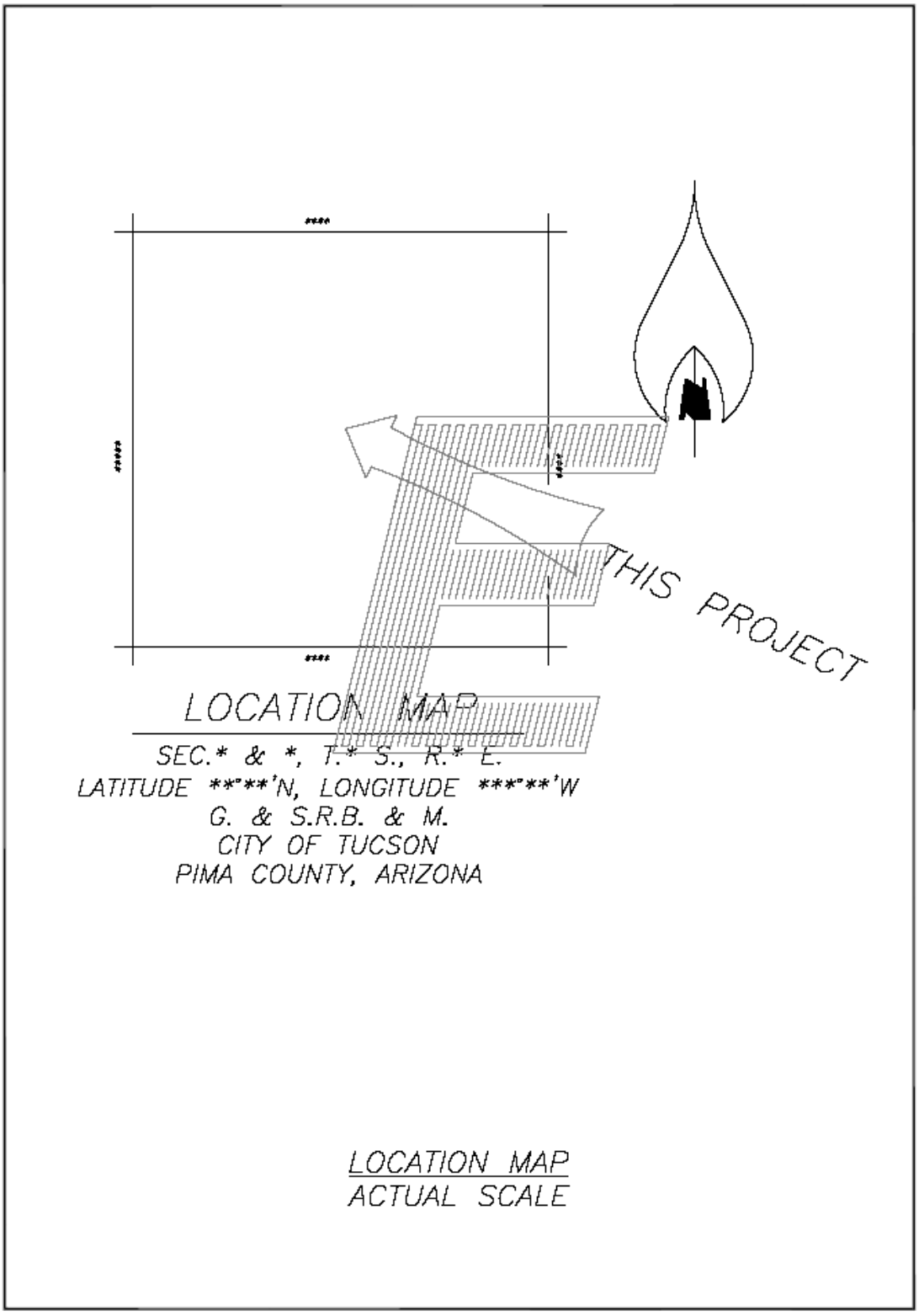
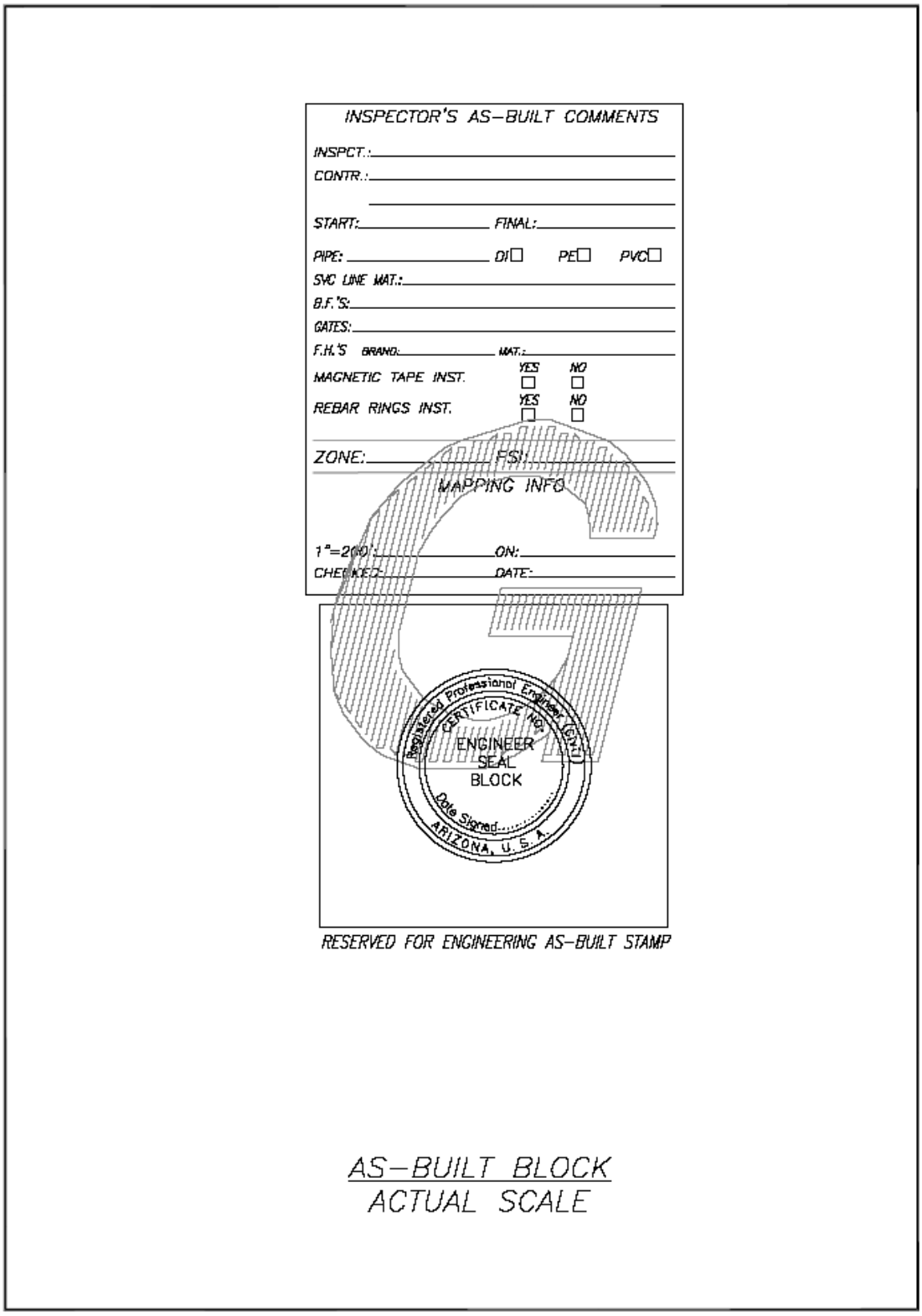


Exhibit 7-2D, As-Built (Record Drawing) Block



AS-BUILT BLOCK
ACTUAL SCALE

Exhibit 7-3A, Plan Symbols

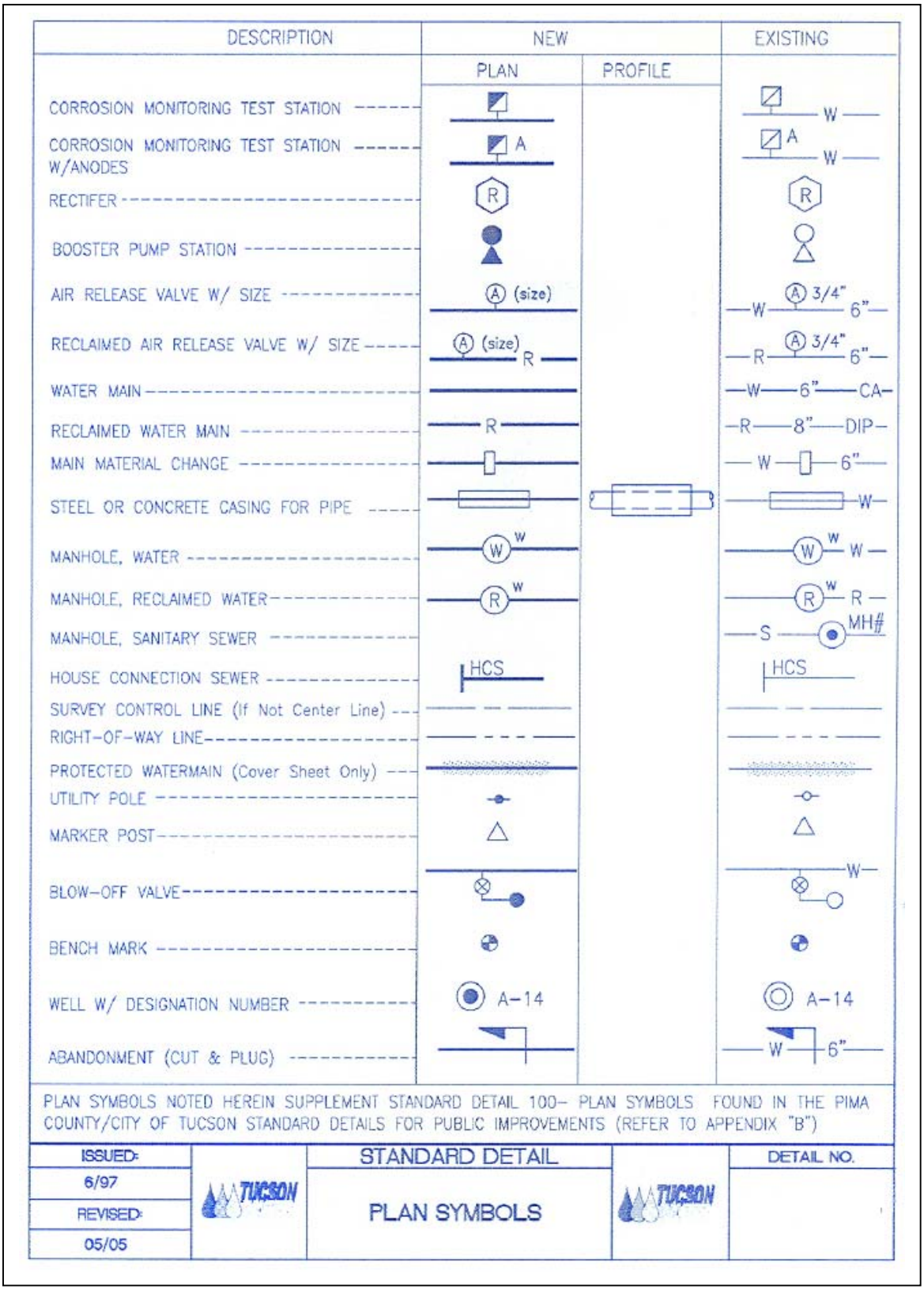


Exhibit 7-3B, Plan Symbols

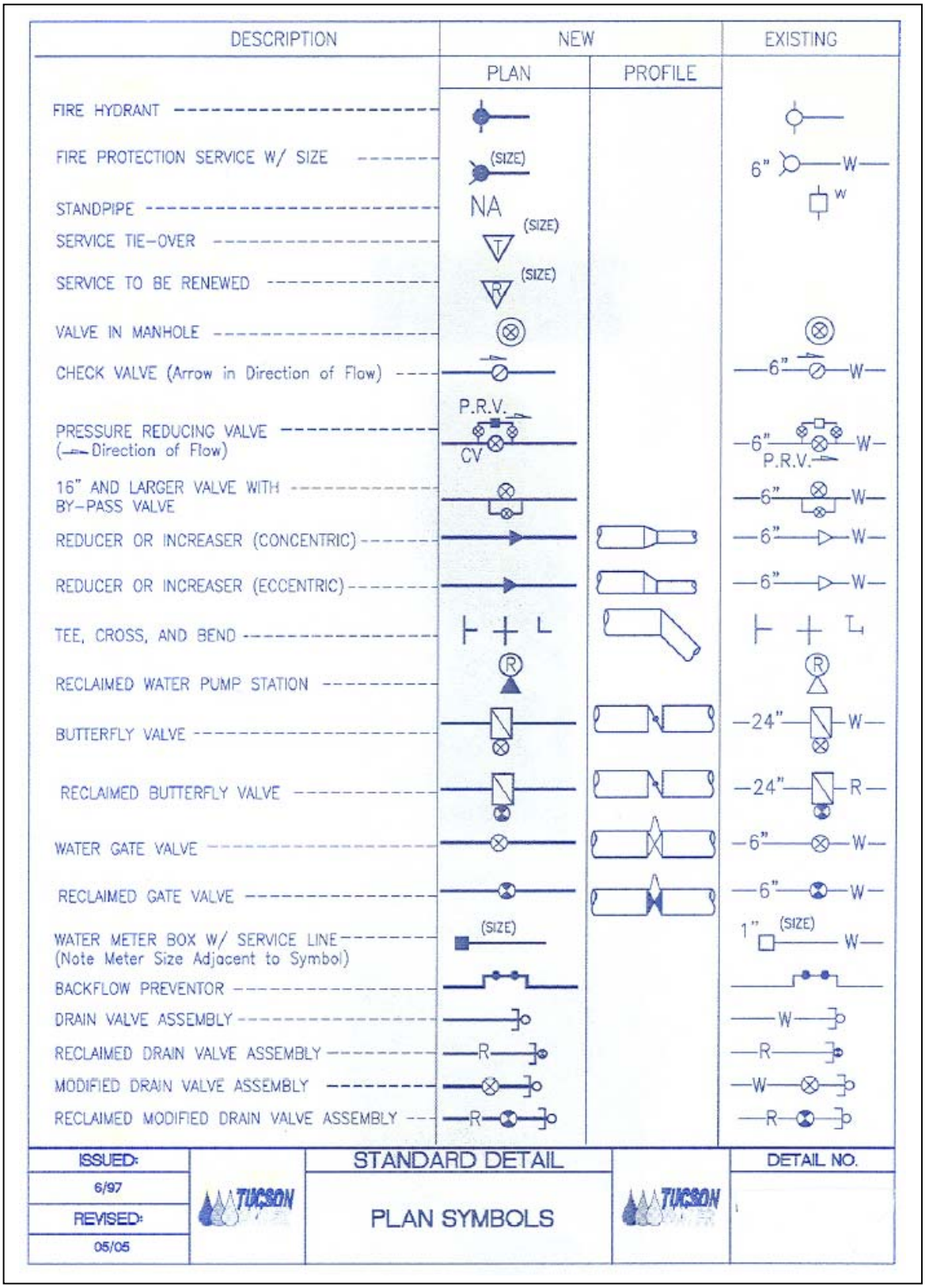


Exhibit 7-3C, Plan Symbols and Details

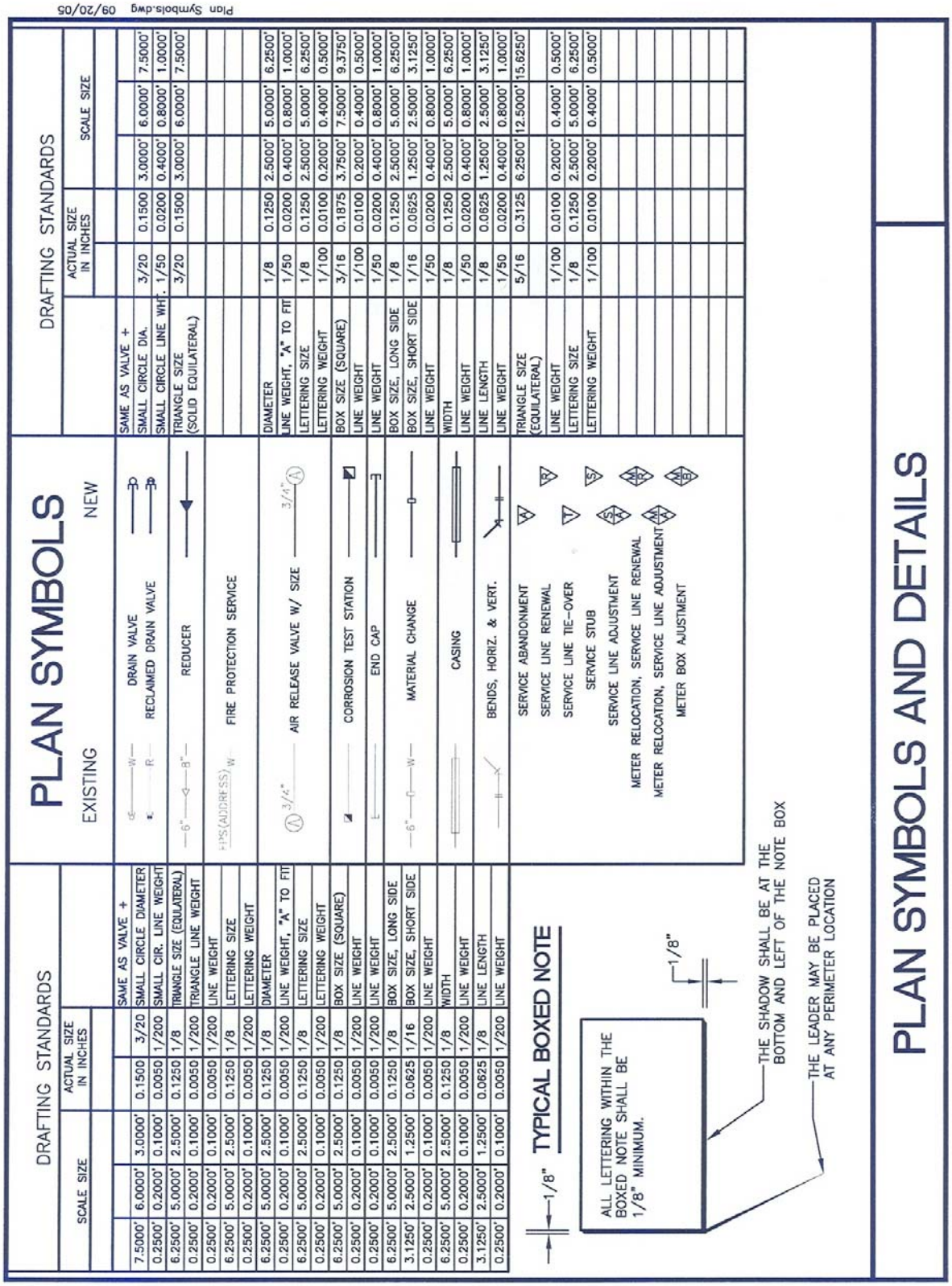


Exhibit 7-3D, Plan Symbols and Details

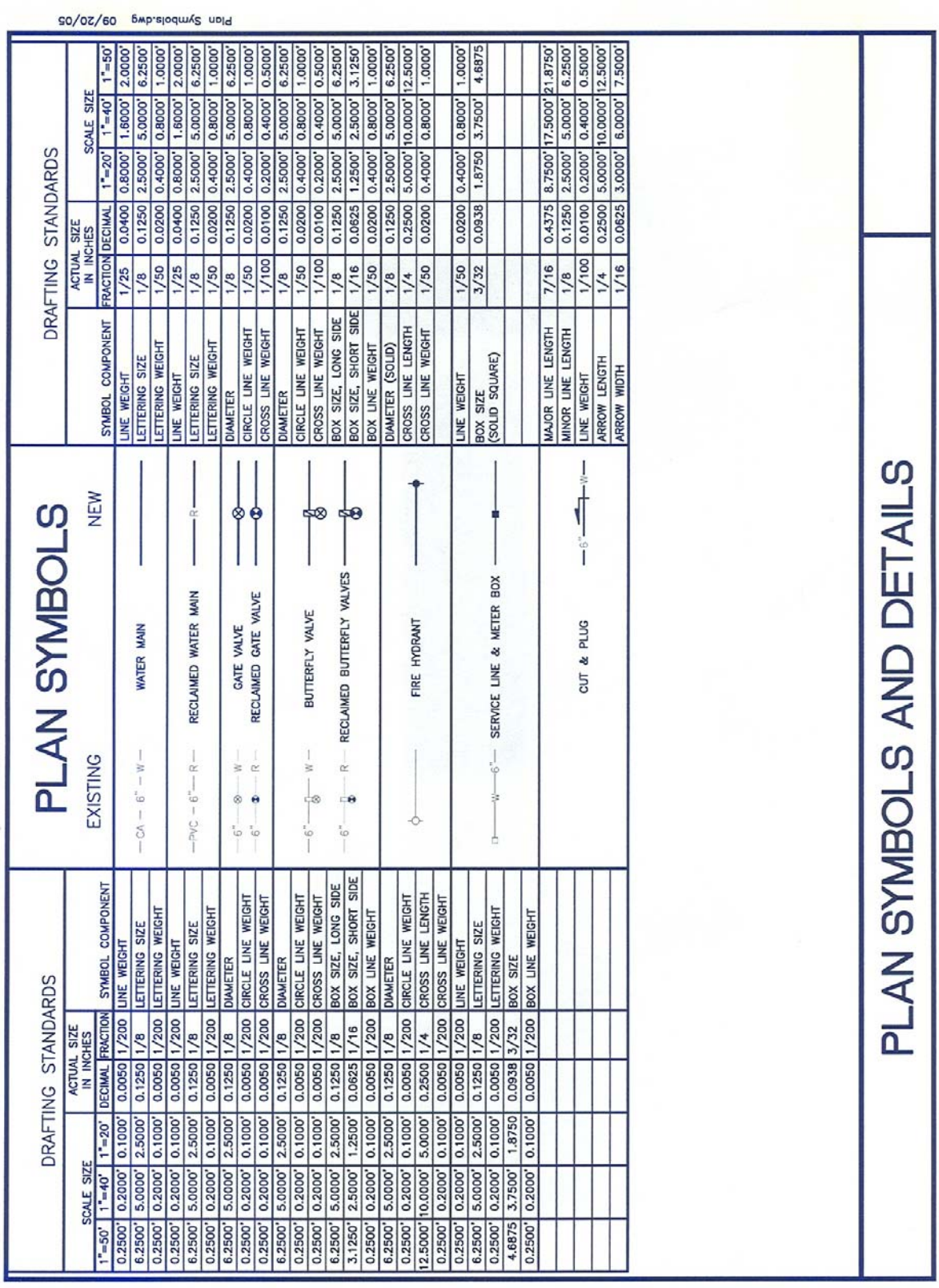


Exhibit 7-4A, Drafting, Water Mains

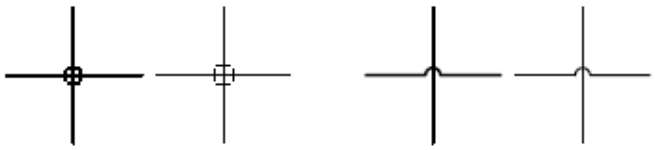
WATER MAINS

DESIGN USAGE

WATER MAINS ARE OF VARIOUS MATERIALS DEPENDING ON THE SIZE, LOCATION AND FIELD CONDITIONS.

DRAFTING CONVENTIONS

ALL MAINS ARE SHOWN IN PLAN AS A SINGLE LINE. IN PROFILE WATER MAINS ARE SHOWN AS TWO PARALLEL LINES SPACED ACCORDING TO THEIR SIZE.



CONNECTED NOT CONNECTED

PARTIAL LIST OF PIPE MATERIAL ABBREVIATIONS

CA	CEMENT ASBESTOS	GALV	GALVANIZED
CC	CONCRETE CYLINDER	PE	POLYETHYLENE
CI	CAST IRON	PVC	POLYVINYL CHLORIDE
DI	DUCTILE IRON	STL	STEEL

DESIGN AND DRAFTING STANDARDS

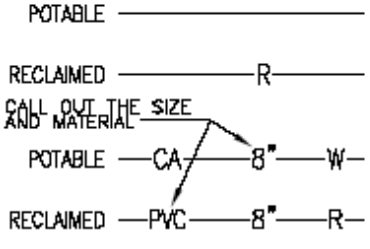
Sym-Water-Mains.dwg 11/16/04

Exhibit 7-4B, Symbols, Water Mains

WATER MAINS

DESIGN DRAFTING DRAWING SYMBOLS

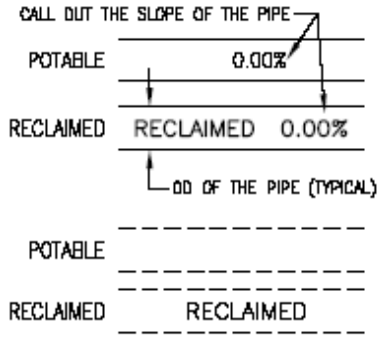
PLAN



	ACTUAL SIZE IN INCHES		SCALE SIZE		
NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
LINE WEIGHT	1/25	0.0400	0.8000	1.6000	2.0000
LETTERING SIZE	1/8	0.1250	2.5000	5.0000	6.2500
LETTERING WEIGHT	1/50	0.0200	0.0400	0.0800	1.0000

EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
LINE WEIGHT	1/200	0.0050	0.1000	5.0000	6.2500
LETTERING SIZE	1/8	0.1250	2.5000	5.0000	6.2500
LETTERING WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500

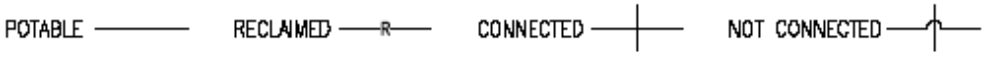
PROFILE



	ACTUAL SIZE IN INCHES		SCALE SIZE		
NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
LINE WEIGHT	1/25	0.0400	0.8000	1.6000	2.0000
LETTERING SIZE	1/8	0.1250	2.5000	5.0000	6.2500
LETTERING WEIGHT	1/50	0.0200	0.0400	0.0800	1.0000

EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
DASH LENGTH	1/10	0.1000	2.0000	4.0000	5.0000
SPACE BETWEEN DASHES	1/20	0.0500	1.0000	2.0000	0.2500
LETTERING SIZE	1/8	0.1250	2.5000	5.0000	6.2500
LETTERING WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500

QUARTER SECTION VALVE MAP SYMBOLS



DESIGN AND DRAFTING STANDARDS

Sym-Water-Mains.dwg 11/16/04

Exhibit 7-5A, Drafting, Gate Valves

VALVES, GATE

DESIGN USAGE

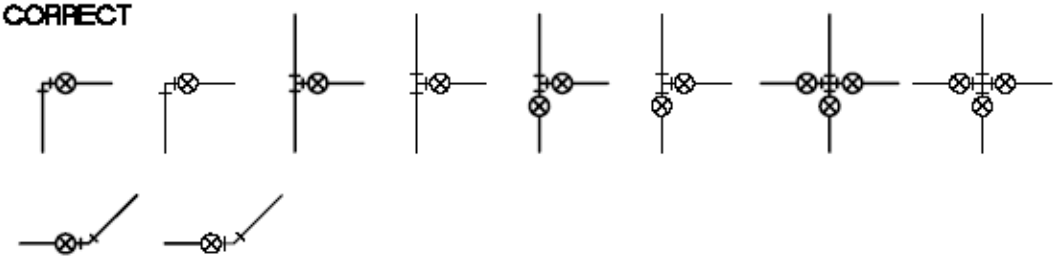
GATE VALVES ARE DEVICES TO CONTROL THE FLOW OF WATER THROUGH A WATER MAIN. THEY MOST OFTEN OCCUR NEXT TO OR NEAR A TEE OR CROSS. GATE VALVES ARE CURRENTLY USED IN 16" AND SMALLER WATER MAINS.

THEY ARE CALLED OUT ON CONSTRUCTION PLANS IN BOXED NOTES WITH A SIZE AND THE NOTE B&C. THE B&C REFERS TO THE BOX AND COVER. IF ONLY THE EXISTING SURFACE IS TO BE CHANGED, ONLY THE BOX AND COVER MAY NEED TO BE ADJUSTED TO FINISHED GRADE. SEE PAGE X-X FOR SUPPLEMENTAL DETAILS FOR RAISING VALVE BOXES.

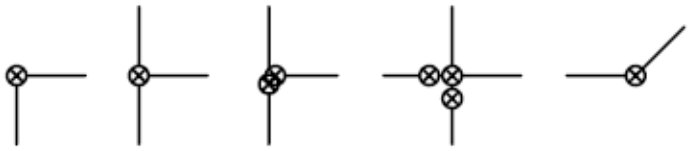
DRAFTING CONVENTIONS

IF VALVES ARE NEXT TO A TEE OR CROSS, EACH VALVE SHOULD BE DRAWN TO ILLUSTRATE THE WATER MAIN IT CONTROLS. EACH VALVE SHOULD BE DRAWN DISTINCT FROM ANY ADJACENT FITTINGS OR VALVES. EXAMPLES OF CORRECT AND INCORRECT DEPICTIONS ARE SHOWN BELOW.

CORRECT



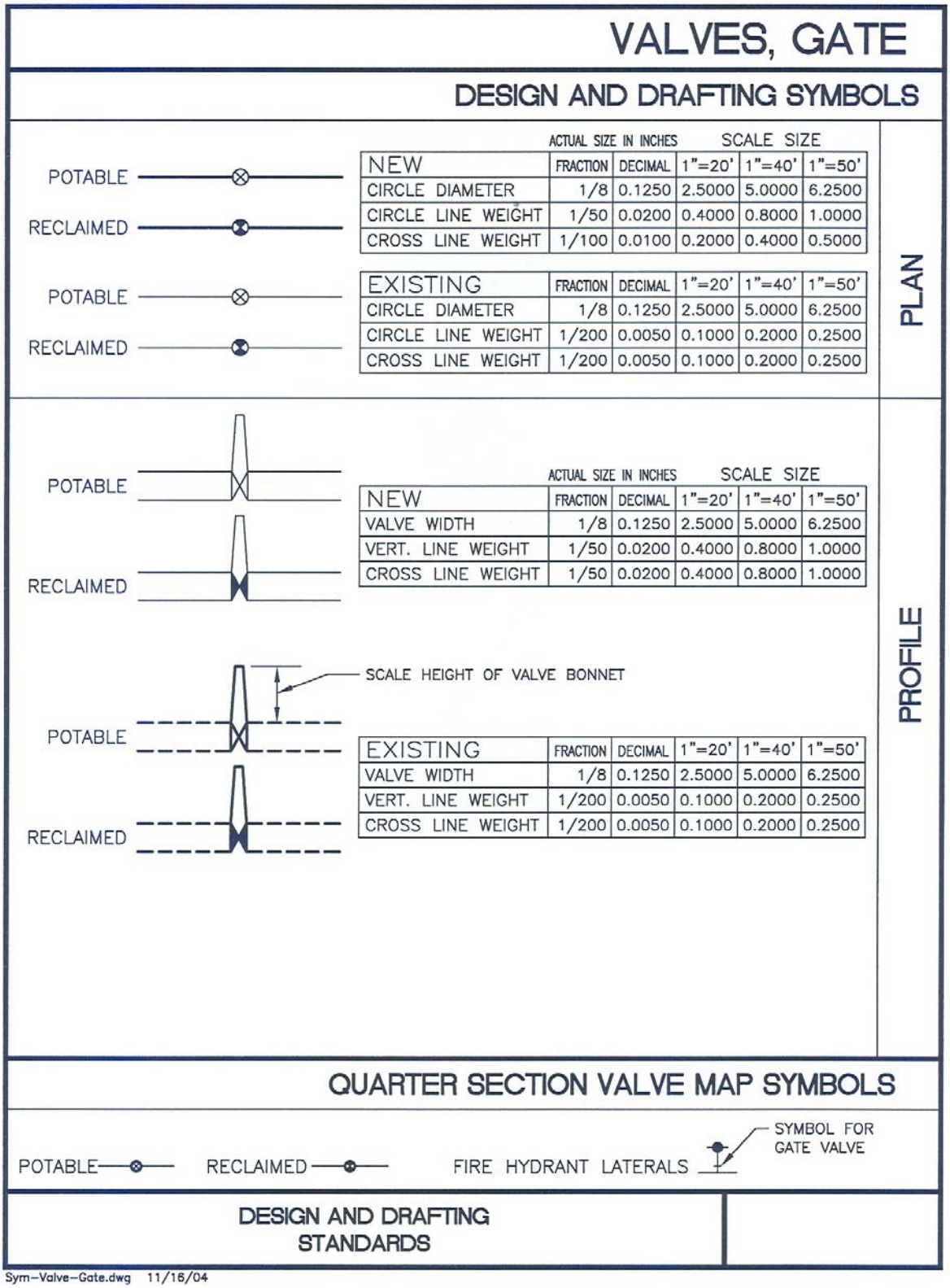
INCORRECT



DESIGN AND DRAFTING STANDARDS

Sym-Valve-Gate.dwg 11/16/04

Exhibit 7-5B, Symbols, Gate Valves



	ACTUAL SIZE IN INCHES		SCALE SIZE		
NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
CIRCLE DIAMETER	1/8	0.1250	2.5000	5.0000	6.2500
CIRCLE LINE WEIGHT	1/50	0.0200	0.4000	0.8000	1.0000
CROSS LINE WEIGHT	1/100	0.0100	0.2000	0.4000	0.5000

EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
CIRCLE DIAMETER	1/8	0.1250	2.5000	5.0000	6.2500
CIRCLE LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
CROSS LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500

	ACTUAL SIZE IN INCHES		SCALE SIZE		
NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
VALVE WIDTH	1/8	0.1250	2.5000	5.0000	6.2500
VERT. LINE WEIGHT	1/50	0.0200	0.4000	0.8000	1.0000
CROSS LINE WEIGHT	1/50	0.0200	0.4000	0.8000	1.0000

EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
VALVE WIDTH	1/8	0.1250	2.5000	5.0000	6.2500
VERT. LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
CROSS LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500

Exhibit 7-6A, Drafting, Butterfly Valves

VALVES, BUTTERFLY

DESIGN USAGE

BUTTERFLY VALVES ARE DEVICES TO CONTROL THE FLOW OF WATER THROUGH A WATER MAIN. THEY MOST OFTEN OCCUR NEXT TO OR NEAR A TEE OR CROSS. IN OLDER SMALL DIAMETER MAINS, I.E. 12" AND SMALLER, THEY WERE OFTEN USED WHEN THE DEPTH WAS SHALLOW. BUTTERFLY VALVES ARE CURRENTLY USED ONLY IN LARGE DIAMETER MAINS, I.E. 24" AND LARGER.

THEY ARE CALLED OUT ON CONSTRUCTION PLANS WITH A SIZE AND THE NOTE B&C. THE B&C REFERS TO THE BOX AND COVER. IF ONLY THE EXISTING SURFACE IS TO BE CHANGED ONLY THE BOX AND COVER MAY NEED TO BE ADJUSTED TO FINISHED GRADE. SEE PAGE X-X FOR SUPP.EMENTAL DETAILS FOR RAISING VALVE BOXES.

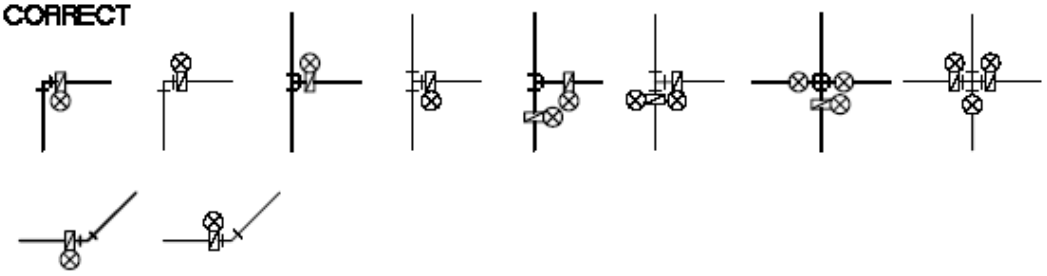
DRAFTING CONVENTIONS

IF VALVES ARE NEXT TO A TEE OR CROSS, EACH VALVE SHOULD BE DRAWN TO ILLUSTRATE THE WATER MAIN IT CONTROLS. THE ORIENTATION OF THE OPERATOR NUT SHOWN ON THE PLAN SHOULD RELFECT THE ACTUAL INSTALLATION OF EXISTING VALVES AND DIRECT THE INSTALLATION OF NEW VALVES. EACH VALVE SHOULD BE DRAWN DISTINCT FROM ANY ADJACENT FITTINGS OR VALVES.

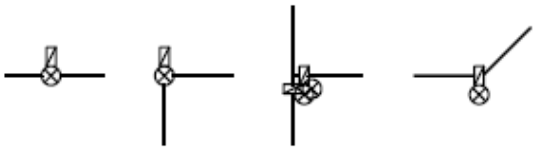
VALVES MAY NOT ALWAYS BE DRAWN AT THEIR EXACT STATION. CONSIDERATIONS MUST BE GIVEN FOR CLAIRITY WHEN PLOTTING NEW AND EXISTING VALVES. VALVE ACTUATOR STEM PLACEMENT SHALL FOLLOW THE SOUTH OF THE MAIN AND WEST OF MAIN LOCATION CONVENTION.

EXAMPLES OF CORRECT AND INCORRECT DEPICTIONS ARE SHOWN BELOW.

CORRECT



INCORRECT



DESIGN AND DRAFTING STANDARDS

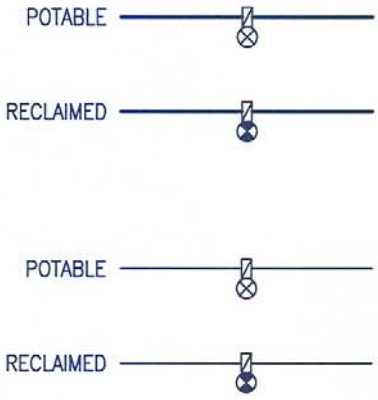
Sym-Valves-Butterfly.dwg 11/15/04

Exhibit 7-6B, Symbols, Butterfly Valves

VALVES, BUTTERFLY

DESIGN AND DRAFTING SYMBOLS

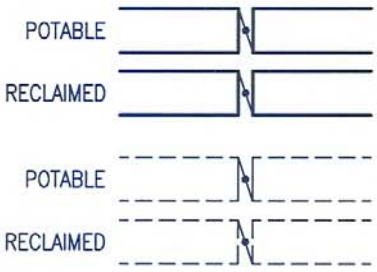
PLAN



NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
	ACTUAL SIZE IN INCHES		SCALE SIZE		
CIRCLE DIAMETER	1/8	0.1250	2.5000	5.0000	6.2500
CIRCLE LINE WEIGHT	1/50	0.0200	0.4000	0.8000	1.0000
CROSS LINE WEIGHT	1/100	0.0100	0.2000	0.4000	0.5000
BOX SIZE, LONG SIDE	1/8	0.1250	2.5000	5.0000	6.2500
BOX SIZE, SHORT SIDE	1/16	0.0625	1.2500	2.5000	3.1250
BOX LINE WEIGHT	1/50	0.0200	0.4000	0.8000	1.0000

EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
CIRCLE DIAMETER	1/8	0.1250	2.5000	5.0000	6.2500
CIRCLE LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
CROSS LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
BOX SIZE, LONG SIDE	1/8	0.1250	2.5000	5.0000	6.2500
BOX SIZE, SHORT SIDE	1/16	0.0625	1.2500	2.5000	3.1250
BOX LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500

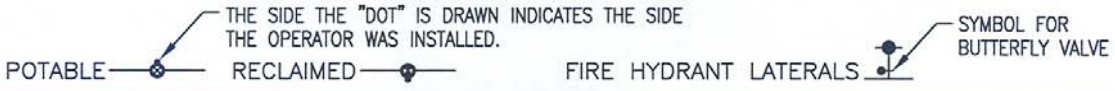
PROFILE



NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
	ACTUAL SIZE IN INCHES		SCALE SIZE		
VALVE WIDTH	1/8	0.1250	2.5000	5.0000	6.2500
VERTICAL LINE WEIGHT	1/50	0.0200	0.4000	0.8000	1.0000
CROSS LINE WEIGHT	1/50	0.0200	0.4000	0.8000	1.0000

EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
VALVE WIDTH	1/8	0.1250	2.5000	5.0000	6.2500
VERT. LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
CROSS LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500

QUARTER SECTION VALVE MAP SYMBOLS



DESIGN AND DRAFTING STANDARDS

Sym-Valves-Butterfly.dwg 11/16/04

Exhibit 7-7A, Drafting, Tees and Crosses

TEES + CROSSES

DESIGN USAGE

TEES AND CROSSES ARE FITTINGS TO ADD OUTLETS TO A PIPE. THESE FITTINGS ARE MANUFACTURED FROM DUCTILE IRON (DI) FOR POLYVINYL (PVC) AND DI PIPE. THE WATER DEPARTMENT ONLY USES MANUFACTURED TEES AND CROSSES THAT INTERSECT AT 90° FOR PVC AND DI PIPE. THE "BRANCH" OF ANY TEE MAY NOT BE LARGER THAN THE "RUN" OF THE TEE.

TEES AND CROSSES FOR CONCRETE CYLINDER PIPE (CCP) ARE FABRICATED AS REQUIRED AND MAY BE ANY DEGREE OF INTERSECTION THAT MAY BE REQUIRED.

DRAFTING CONVENTIONS

EACH FITTING SHOULD BE DRAWN DISTINCT FROM ANY ADJACENT FITTING OR VALVE.

TEES AND CROSSES MAY NOT ALWAYS BE DRAWN AT THEIR EXACT STATION. CONSIDERATIONS MUST BE GIVEN FOR CLARITY WHEN PLOTTING NEW AND EXISTING FITTINGS.

DESIGN AND DRAFTING
STANDARDS

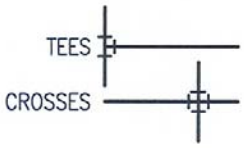
Exhibit 7-7B, Symbols, Tees and Crosses

TEES + CROSSES

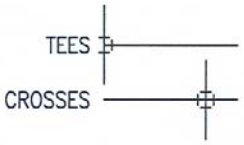
DESIGN AND DRAFTING SYMBOLS

PLAN

SYMBOLS ARE THE SAME FOR BOTH POTABLE AND RECLAIMED

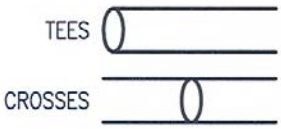


	ACTUAL SIZE IN INCHES		SCALE SIZE		
NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
LINE LENGTH	8/100	0.0800	1.6000	3.2000	4.0000
LINE WEIGHT	1/100	0.0100	0.2000	0.4000	0.5000
SPACING FROM INTERSECTION	1/16	0.0625	1.2500	2.5000	3.1250

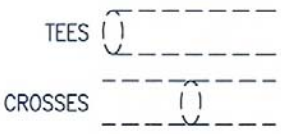


EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
LINE LENGTH	1/16	0.0625	1.2500	2.5000	3.1250
LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
SPACING FROM INTERSECTION	1/20	0.0500	1.0000	2.0000	2.5000

PROFILE



	ACTUAL SIZE IN INCHES		SCALE SIZE		
NEW	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
ELLIPSE LINE WEIGHT	1/100	0.0100	0.2000	0.4000	0.5000
ELLIPSE WIDTH	1/8	0.1250	2.5000	5.0000	6.2500
ELLIPSE HEIGHT SHALL BE EQUAL TO THE PIPE SIZE					



EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
ELLIPSE LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
ELLIPSE WIDTH	1/8	0.1250	2.5000	5.0000	6.2500
ELLIPSE HEIGHT SHALL BE EQUAL TO THE PIPE SIZE					

QUARTER SECTION VALVE MAP SYMBOLS

NO SYMBOLS FOR TEES OR CROSSES ARE USED IN THE QUARTER SECTION VALVE MAPS

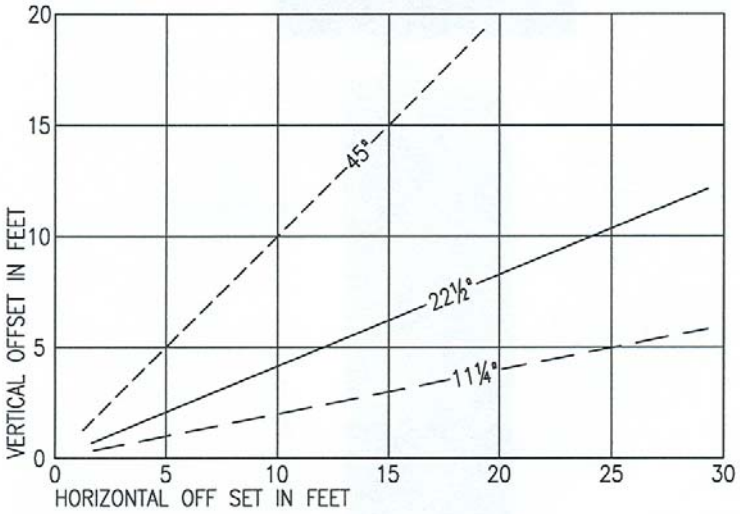
DESIGN AND DRAFTING STANDARDS

Exhibit 7-8A, Drafting, Bends

BENDS

DESIGN USAGE

BENDS ARE FITTINGS USED TO CHANGE THE DIRECTION OF PIPE. MANUFACTURED BENDS ARE USED FOR DUCTILE IRON (DI) AND POLYVINYL (PVC) PIPE. THESE BENDS ARE AVAILABLE IN 90°, 45°, 22½° AND 11¼°. BENDS FOR CONCRETE CYLINDER PIPE (CCP), AND WELDED STEEL PIPE (WSP) ARE FABRICATED AS REQUIRED AND ARE AVAILABLE IN ANY DEGREE OF BEND REQUIRED.



45° BENDS MAY BE USED IN PAIRS FOR VERTICAL OFFSETS GREATER THAN TWO FEET (2') WHERE THE AVAILABLE RUN LENGTH IS LIMITED.

22½° BENDS MAY BE USED IN PAIRS FOR VERTICAL OFFSETS GREATER THAN ONE FOOT (1'). PAIRS OF THIS DEGREE BEND ARE THE MOST COMMON AND DESIRABLE.

11¼° BENDS ARE NOT NORMALLY USED FOR VERTICAL OFFSETS. THEY MAY BE USED IN SERIES TO CREATE A LARGE RADIUS OF IN COMBINATION WITH OTHER BENDS TO FORM NON STANDARD ANGLES.

DRAFTING CONVENTIONS

EACH BEND SHOULD BE DRAWN DISTINCT FROM ANY ADJACENT FITTINGS OR VALVES.

BENDS MAY NOT ALWAYS BE DRAWN AT THEIR EXACT STATION. CONSIDERATIONS MUST BE GIVEN FOR CLARITY WHEN PLOTTING NEW AND EXISTING BENDS.

WHEN BENDS ARE "ROTATED", I.E. INSTALLED IN SO THE DIRECTION CHANGE IS NOT VERTCAL, THEY SHALL BE SHOWN IN PROFILE AS A HORIZONTAL BEND WITH A VERTICAL LINE AT THE STATION OF THE BEND.

DESIGN AND DRAFTING STANDARDS	

Sym–Bends.dwg 11/16/04

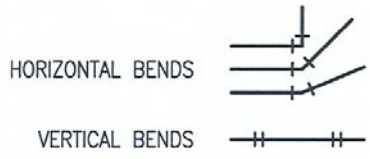
Exhibit 7-8B, Symbols, Bends

BENDS

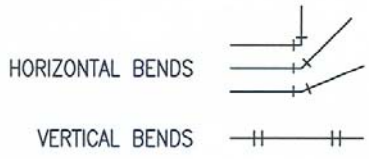
DESIGN DRAFTING SYMBOLS

PLAN

SYMBOLS ARE THE SAME FOR BOTH POTABLE AND RECLAIMED

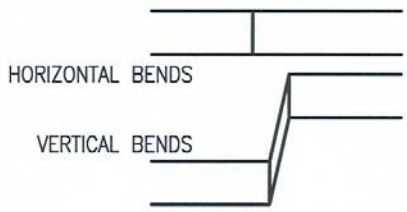


NEW	ACTUAL SIZE IN INCHES FRACTION	DECIMAL	SCALE SIZE 1"=20'	1"=40'	1"=50'
LINE LENGTH	8/100	0.0800	1.6000	3.2000	4.0000
LINE WEIGHT	1/100	0.0100	0.2000	0.4000	0.5000
SPACING FROM INTERSECTION	1/16	0.0625	1.2500	2.5000	3.1250

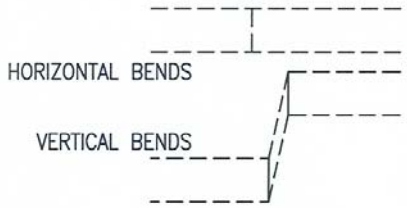


EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
LINE LENGTH	1/16	0.0625	1.2500	2.5000	3.1250
LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500
SPACING FROM INTERSECTION	1/20	0.0500	1.0000	2.0000	2.5000

PROFILE



NEW	ACTUAL SIZE IN INCHES FRACTION	DECIMAL	SCALE SIZE 1"=20'	1"=40'	1"=50'
VERTICAL LINE WEIGHT	1/100	0.0100	0.2000	0.4000	0.5000



EXISTING	FRACTION	DECIMAL	1"=20'	1"=40'	1"=50'
VERTICAL LINE WEIGHT	1/200	0.0050	0.1000	0.2000	0.2500

QUARTER SECTION VALVE MAP SYMBOLS

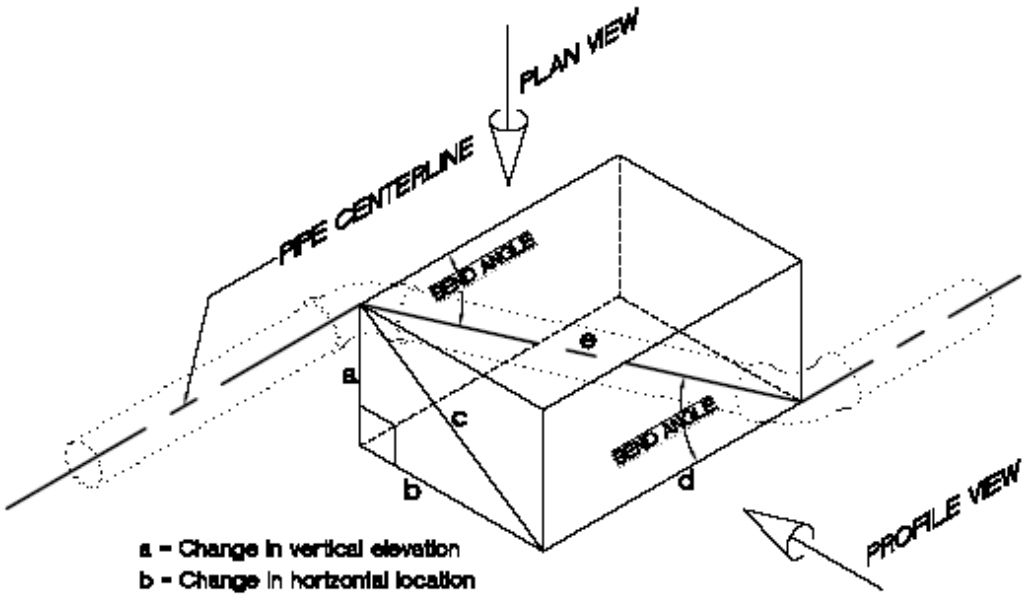
NO SYMBOLS FOR BENDS ARE USED IN THE QUARTER SECTION VALVE MAPS

DESIGN AND DRAFTING STANDARDS

Sym-Bends.dwg 11/16/04

Exhibit 7-9, Drafting, Rotated Bends

ROTATED BENDS



a = Change in vertical elevation
b = Change in horizontal location
c = The hypotenuse of a and b
d = The horizontal run length
e = The true pipe length

1. Calculate c using
$\sqrt{a^2+b^2}$

2. Calculate d, the horizontal run length using:
tan(90?-Bend Angle) x c

3. Calculate e, the true pipe length using
$\sqrt{c^2+d^2}$

90° - 45° = 45°	tan = 1.000
90° - 22½° = 67½°	tan = 2.414
90° - 11¼° = 78¾°	tan = 5.027

For use with 12" and smaller pipe where the upper an lower pipe has less than 4% slope.

DESIGN AND DRAFTING STANDARDS

Exhibit 7-10, General Construction Notes, New Development

GENERAL CONSTRUCTION NOTES
(For Developer-financed Projects)

All Cases:

- 1/8" minimum lettering, typical.
- General contract notes included in S.D. 105 shall not be duplicated on the plan.
- Notes 1 through 12, as shown below, shall be included on all water plans.
- Notes 13 through 33, as shown below, shall be included on water plans to which they apply.
- Additional notes may be required.

1. Tucson Water SD-105, "General Contract Notes," shall apply to and become an integral part of this contract. All design standards, materials, and workmanship are to be according to Tucson Water Standard Specifications and Details, latest Edition.

2. Construction water for pressure testing, chlorinating and flushing shall be provided through the existing water system and shall cost $_____, plus tax. Construction water for trench backfill and compaction and other construction needs shall be through an approved metered water source obtained from Tucson Water Customer Service Division under a separate permit/agreement.

3. All PVC pipe installed for this project shall be class 200, unless otherwise specified.

4. Water service will be provided as shown on this plan. Any changes to parcel configuration may necessitate additional requirements.

5. This water system is designed to accommodate _____gallons per minute fire flow.

6. All fire hydrant laterals shall be ductile iron pipe.

7. At the time of plan approval, this development is located within _____ zone. Minimum design pressures for this development are as follows:
   1. Static pressure:_____pounds per square inch.
   2. Peak day pressure: pounds per square inch.
   3. Peak day + fire flow: pounds per square inch.

   Due to water system operational variances pressure will vary as much as 10 pounds per square inch +/-.

   (The pressures provided should be the lowest pressures developed through the project site).

8. This plan meets the minimum pressure and storage requirements in AAC R18-5-502 & 503.

9. _____ linear feet of new pipeline (excluding water service line) will be installed according to this project. A pipeline inspection fee of $5.00 per linear foot of pipeline to be installed will be assessed prior to issuance of "notice to proceed."

10. It will be the responsibility of the developer to provide and install meter boxes on all services. Services installed will be in compliance with Tucson Water SD-309 and SD-310. Meter boxes will comply with Tucson Water SD-318.

11. Payment of the Water System Equity Fee is required at the time of water meter application, according to Ordinance No. 9842, amending the Tucson Code, Chapter 27, Section 27-36.

12. Construction shall not commence prior to issuance of an Approval to Construct by ADEQ or the delegated authority, and operation of the line shall not commence prior to issuance of the Approval of Construction by ADEQ or the delegated authority.

13. The responsible party for fire service billing is the owner/developer as called out on the plan.

14. This water system is designed to accommodate _____ gallons per minute fire flow. Indemnification agreement required due to insufficient fire flow, according to Agreement for Construction of Water Facilities Under Private Control**,** Note No. 5, Residential/Commercial sprinklers may be required in accordance with local fire department authority.

15. For service protection backflow prevention requirements, contact Tucson Water Reclaimed/Backflow Prevention Section at 791-2650. A pressure drop is anticipated across the backflow device.

16. Plan review and acceptance by Tucson Water, New Development Unit does not constitute approval of private plumbing. Private plumbing includes all backflow protection and plumbing from the water meter to the premise, and fire services beyond the right-of-way or easement lines. Contact the appropriate backflow prevention, city, or county officials for private plumbing review.

17. This development falls within an isolated water service area (New Services information only).

18. This project is within the Midvale Park service area. A Midvale Park reimbursement may apply. Contact Tucson Water New Development at 791-4718 for processing requirements.

19. This project is within the Continental Ranch service area. A Continental Ranch reimbursement may apply. Contact Tucson Water New Development at 791-4718 for processing requirements.

20. New water main shall be installed with _____ inches of minimum cover according to S.D. 105, unless otherwise indicated on these plans.

21. Any construction across lots _____, including walls, is prohibited in the public water or public utility easement.

22. All fittings shall be restrained according to Tucson Water SD-600 or approved Engineer's calculation.

23. Separate meters will be required for irrigation systems. Domestic and irrigation service shall not be interconnected.

24. This project may receive higher than normal pressure and may require individual pressure reducers as part of the private plumbing: The installation of a pressure reducer may create a closed system. Consult local plumbing codes for pressure relief and thermal expansion requirements.

25. This project may receive lower than normal pressure and may require individual pressure pumping stations as part of the private plumbing.

26. The new water main designated in this plan as protected will be protected for a period of 15 years according to Section 27-38 of the Tucson Code starting on _____ ___ and terminating on _____.

27. This project will not be finaled until payment has been received by Tucson Water for protected main fees, as established by Plan No. _____.

28. This project will not be finaled until the finalization of _____, Plan No. _____.

29. The _____ new _____ inch pipeline will be oversized by Tucson Water to _____ inch pipeline. The project applicant will be eligible for an oversize refund according to Tucson Water Code Section 27-37 and Section 27-38.

30. This project will not be finaled until the owner of the well (Registry #) located on this property has filed a waiver with ADWR allowing Tucson Water to exceed 10 feet of additional cumulative draw-down over a 5-year period. Documentation verifying ADWR waiver must be submitted to Tucson Water Hydrology Division before project finalization. In addition, all Tucson Water metered connections will require backflow protection.

31. This project will not be finaled until the well (Registry No. _____) located on this property has been properly abandoned according to provisions of ADWR Regulation R-12-15-816. Documentation of well abandonment must be submitted to Tucson Water Hydrology Division before project finalization.

32. Twenty-four hour emergency access for Tucson Water shall be the same as for City of Tucson Fire Department (24-Hour Emergency access) consisting of a key to the gate padlock in a fire box permanently secured to _____ *(proper description filled in here)* _____ _____.

33. According to the Tucson Code, Section 27-37, this project will not be finaled until the protected facility fees for _____ have been paid. The fee for this project is $ _____.

34. Any reclaimed water service shall not be turned on until it has been inspected and approved by the Tucson Water Reclaimed/Backflow Prevention Section.

Rev. 10/1/05

Exhibit 7-11, General Construction Notes, System Modifications

SYSTEM MODIFICATIONS NOTES

1. All system modifications construction work shall conform to the following standards and special provisions:

   a. The Pima County / City of Tucson Standard Specifications for Public Improvements, current Edition.

   b. The system modifications special provisions for this project.

2. System modifications preconstruction procedure:

   a. The Contractor shall contact the City of Tucson Water Department, Construction Section (791-2665), a minimum of three (3) days prior to any water work. The Contractor shall refer to the City of Tucson Water Department plan no. _____.

   b. The City of Tucson Water Department construction section will schedule the time and place for the meeting.

   c. No water system construction shall begin until a “notice to proceed” has been issued by the City of Tucson Water Department.

   d. Any water work installed prior to the notice to proceed date shall be removed by the Contractor at the Contractor’s expense.

3. Construction on the _____ inch (___") main(s) shall take place only in the off peak season between October 1 and March 30. The Contractor shall be allowed a maximum of _____ (___) days down time for any one shut-down. Multiple shut-downs will be allowed with a minimum of _____ (___) days between shut-downs.

4. All dimensions, slopes and grades of existing water lines are taken from "as built" drawings. It shall be the Contractor's responsibility to determine exact information before ordering any special fittings or equipment.

5. Shut-down of the existing water system requiring the operation of Tucson water valves shall be coordinated through a City of Tucson Water Department Construction Inspector.

6. New water mains shall be installed at a minimum depth of three feet (3.0’) from the bottom of any excavation or scarification to the top of the new pipe. This depth shall be maintained for five feet (5.0') beyond any excavation, measured perpendicular to the proposed structure or edge of the proposed roadway. In no case shall new water mains be installed less than three and sixty seven hundredths feet (3.67’) deep from the finished grade to the top of the new pipe.

These minimums shall apply to all water mains unless otherwise noted on the plans.

7. New service lines, two inch (2") and smaller, shall be installed at a minimum depth of two feet (2.0') from the bottom of any excavation or scarification to the top of the new service line. This depth shall be maintained for five feet (5.0') beyond any excavation, measured perpendicular to the proposed structure or edge of the proposed roadway. In no case shall new service lines be installed less than three feet (3.0') deep from the finished grade to the top of the new service line. These minimums shall apply to all service lines unless otherwise noted on the plans.

8. The Contractor shall be responsible for all water meters and meter boxes in the construction area. This will include but not be limited to:

   a. Removal and installation:
      during this operation meters shall be tagged with the correct address to ensure their reinstallation at the same location.

   b. Protection of meters:
      at all times the Contractor shall take precautions to avoid any damage to the meters. The Contractor shall provide for their safe storage and the proper equipment for their handling.

   c. Access to meters:
      the Contractor shall maintain access to all in service meters during construction. At the close of the project the Contractor shall ensure that all meters are left accessible and that all meter boxes are adjusted to final grade.

9. Forty-eight (48) hours prior to shut-down of any fire hydrants or fire protection service lines the Contractor shall provide the City of Tucson Water Department construction inspector with a written report indicating the location and duration of any fire hydrant or fire protection service shut-downs. The Contractor shall notify the City of Tucson Water Department Construction Inspector when fire hydrants or fire protection services are back in service.

10. The Contractor shall be responsible for maintaining service to all water customers during construction. It shall be the Contractor's responsibility to determine which services will be effected by this project. It may be necessary to accomplish tie-overs, re-connections, etc. While business customers are closed. If interruption of service is unavoidable the Contractor shall notify the water inspector a minimum of forty-eight (48) hours in advance to coordinate shut-downs. Every effort shall be made to minimize disruption to the customer. If the Contractor chooses to abandon any portion of the existing water supply system without concurrent new construction as called for on the plans, the Contractor shall provide any and all materials and construction of a temporary or permanent water system to maintain continued water service to customers at no additional cost.

11. Prior to commencing work, the Contractor shall apply for two (2) special water use permits from the City of Tucson Water Department Commercial Section.

a. Construction water special permit:
   there will be no charge for this permit, but the Contractor must pay the sum of $_____ plus tax as the estimated cost of the water to be used. This water may only be used for trench settling, disinfection and testing.

b. Metered fire hydrant only permit:
   this non-transferable permit will entitle the Contractor to use water through a meter from existing fire hydrants at approved locations. Water used under this permit is for general construction purposes such as dust control, site preparation, etc.

12. All materials, fittings, and appurtenances called for on the plans, or required for a complete installation, shall be new. No refurbished items or materials will be allowed.

13. The Contractor shall be responsible for adjusting all new and existing water valve boxes to the finished grade per Standard Detail W-300.

14. The Contractor shall use mechanically restrained joints at all changes of direction in the water mains. The lengths of restrained pipe on both sides of the restrained joint shall be as called for on the plans or as per Standard Detail W-600. With the approval of the Engineer, the Contractor may use concrete thrust blocking in lieu of mechanically restrained joints. Concrete thrust blocking shall comply with Standard Detail W-610.

15. If any existing detectable marking tape is disturbed or destroyed during construction, the Contractor shall furnish and install appropriate new tape. There shall be no additional charge for this reinstallation.

16. This project has corrosion control/monitoring work included as part of the contract. The Contractor shall provide all submittals, components and reports of the corrosion work as called for on these plans and in the special provisions.

TABLE OF CONTENTS

WATER PIPELINE DESIGN STANDARDS

8-08.0.0 WATER PIPELINE DESIGN STANDARDS

8-08.1.0 General

1.1 Purpose

This section describes the design standards and requirements for public water pipeline projects.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 Applicability

The design standards and requirements listed herein apply to and are applicable to all projects including potable (drinking water), nonpotable (reclaimed water), system modification (other public agency), and developer-financed.

8-08.2.0 Water Pipeline Design Requirements

The requirements described below are based, in part, on ADEQ Engineering Bulletin No. 10, Chapter 7, Distribution Systems.

This subsection contains the following major topics:

- Pipeline Pressure Rating
- Detailed Pipeline Design
- Anchorage
- Utility Separation Requirements
- Crossing Requirements

2.1 Pipeline Pressure Rating

A. Water Pressure Zones

All water pipelines in a water service area with a single or double water pressure zone shall be designed for a minimum internal pressure of 200 pounds per square inch. This includes appropriate allowances for water hammer, which is 40% of the operating pressure in the water service area.

B. Higher Pressure Zones
In water service areas that may experience water pressures higher than described in paragraph A, i.e., if a water service area experiences water pressure of 170 pounds per square inch, the allowance for water hammer would be 40% or 68 pounds per square inch which would require a pipe of a minimum rating of 238 pounds per square inch.

2.2 Detailed Pipeline Design

This subsection contains the following major topics:

- Material Selection Considerations
- Pipeline Location
- Pipeline Location and Length
- Development Boundary
- Looped Connection
- Pipeline Depth
- Grade Breaks and Horizontal Deflections
- Transmission Main Tees
- Abandoned Mains
- Thermal Contraction/Expansion of Pipelines

A. Material Selection Considerations
Selection of pipeline material for a particular use shall include the following considerations:

- Tucson Water's approved material list. Refer to the Tucson Water Standard Specifications and Details.
- Ability of the material to withstand internal loads (pressures), temperatures (reclaimed water), and external loads
- Ease of installation of the material
- Resistance to corrosion of the material
- Availability of the material
- Durability of the material
- Water industry application and experience with the material
- Compatibility of material with backfill and bedding materials
- Ease of tapping the material for service connections

B. Pipeline Location

1. Standard Location
Water pipelines shall be ten feet south or west of right of way centerline, or in a dedicated utility corridor where possible.

2. Utility Coordinator Location
Water pipelines located in a right of way shall be designed in the location authorized by the applicable city or county utility coordinator, unless the location is precluded by the existence of other extenuating circumstances.

3. Location Considerations
   Pipeline location shall include the following considerations:
   - Paving moratoriums
   - Utility congestion
   - Geotechnical data
   - Native plant vegetation and undisturbed areas
   - Environmental clearance (archaeology, endangered species)
   - Service interruptions
   - Traffic disturbance
   - Future operations and maintenance working space
   - Constructibility
   - Future development

C. Pipeline Location and Length
   All water pipeline extensions shall be installed in the adjacent street, alley, or easement, the entire length of the property to be served.

D. Development Boundary
   The developer's engineer will design water pipelines, service connections, valves, fittings, and appurtenances within the boundary and the streets bounding the development.

E. Looped Connection
   The developer shall design and construct all offsite water pipelines as necessary to complete a looped connection to existing mains and provide the required water flows to the development.

F. Pipeline Depth
   Sufficient cover, distance from top of pipe to final grade, is necessary to give protection against traffic live and dead loads and provide anchorage for normal sections of straight pipe.
   1. Minimum Depth
      a. The depth of cover to the top of the pipe shall not be less than forty-four inches unless adequate structural protection is provided and justified by the design engineer, and approved by Tucson Water. If the design engineer directs that more cover is needed, it shall be noted on the plans.

      b. Within a non-final grade right of way such as in undeveloped areas, mains shall be installed with a minimum of sixty inches of cover from the existing grade which shall also be noted and shown on the profile plans.

      c. Final grade shall be defined as an existing or proposed roadway that includes permanent curbs.

      d. All transmission mains (sixteen-inch or larger) shall have a minimum of sixty inches of cover from final grade.

2. Calculated Depth
   Under certain conditions and pipe materials, the depth of cover must be calculated to provide distribution of external stress from superimposed loads. These include static and dynamic forces.
   - Static forces may include overlying material, such as earth fill and the weight of traffic over a deeply buried pipeline.
   - Dynamic forces may include traffic impact loads due to moving vehicles on highways and railways.

G. Grade Breaks and Horizontal Deflections
   1. PVC Pipe
      Grade breaks and horizontal deflection in PVC pipe design is not permissible at joints. PVC pipe design deflections shall be accomplished in the pipe longitudinal bending in accordance with the manufacturer's recommendations. Otherwise, fittings shall be used for grade breaks or horizontal deflections.

   2. Ductile Iron Pipe
      Grade breaks and horizontal deflection in ductile iron pipe design may be accomplished at joints. Pipe design deflections shall be in accordance with the manufacturer's recommendations. Otherwise, fittings shall be used for breaks or deflections.

H. Transmission Main Tees
   Tees in a transmission main are provided to permit distribution system lateral tie-ins to parallel or crossing mains. Tees in a transmission main normally shall be no closer together than 1,320 feet, unless approved by Tucson Water. See also Section 8-04.

   There shall be the smallest number of tees consistent with providing a proper water source to that portion of the distribution system served as defined in standard 8-06, Water Source Minimums.

   The smallest tee in a transmission main shall be six-inches in diameter. The smallest tee for air relief valve and drain valve appurtenances may be a minimum of four-inches in diameter, with Tucson Water approval.

I. Abandoned Mains
   Mains intended to be taken out of service due to the design of new mains will be left in place and are considered abandoned mains (see Tucson Water SD-350, System Abandonment).

   If removal or grout filling of abandoned mains is required by the agency having jurisdictional authority over the right-of-way, removal shall be in accordance with Tucson Water Standard Specification

Section 0204. Grout filling will be in accordance with the requirements of jurisdictional authority.

J. Thermal Contraction/Expansion of Pipelines
In certain fixed and rigid pipeline circumstances, the design engineer shall consider thermal movement of pipeline materials, and provide provisions in the pipeline design to compensate for thermal contraction and expansion.

2.3 Anchorage

Because an internal thrust force occurs in a pipeline under pressure and acts to separate the joints of the pipe, an external force is required to counteract this force. This counter force is called anchorage.

Sections of straight pipe are usually not a concern because anchorage is provided by the soil around the pipe, which keeps the axis of the pipe aligned from section to section. Pipe hung on bridges is anchored by straps to keep it in place.

Changes in direction of flow and changes in velocity of the water require additional anchorage. This occurs at bends, tees, valves being closed, pumps turning off or on, reducers, closed valves and dead-ends.

This subsection contains the following major topics:
- New Pipeline Design/Construction
- Existing Pipeline Modification/Construction
- Thrust Blocks
- Anchor Blocks Design Requirements
- Restrained Joint Length Requirements

A. New Pipeline Design/Construction
1. For new pipe, tension joints shall be used in place of thrust and anchor blocks where required.

2. A pipe with tension joints, usually referred to as restrained joints, normally does not need additional forms of anchorage. A qualified engineer shall provide design requirements, not the contractor nor the inspector.

B. Existing Pipeline Modification/Construction
1. Generally, the use of thrust blocks is not permissible.

2. In the event thrust and anchor blocks are unavoidable, placement of the blocks must not cover or encase the fitting or pipe joints. Joints and end caps must remain functional.

3. A qualified engineer, not the contractor nor the inspector, shall make the determination of whether or not a given section of

existing pipeline that is to be modified needs thrust blocks or other means of anchorage. If the design engineer directs that it is needed, it shall be noted on the plans, or in a contract supplemental agreement.

C. Thrust Blocks

A thrust block transfers force from the fitting to a wider load bearing soil surface and is used to counteract downward vertical thrusts and horizontal thrusts, but not for upward thrusts. In the event thrust and anchor blocks are unavoidable:

1. Tucson Water SD-610, Concrete Thrust Blocking. The information furnished in Tucson Water SD-610, Concrete Thrust Blocking, Tucson Water Standard Specifications and Details, is based on very limited design parameters and these are listed in the detail.

2. Variances from Tucson Water SD-610. When project specific conditions vary from the design parameters listed in Tucson Water SD-610, such as when the pressure may exceed 200 pounds per square inch (including surges) or when the pipe is larger than twelve inch, additional information and calculations are needed. In such a case, the practices found in the Manual of Water Supply Practices – M9, Concrete Pressure Pipe, by the American Water Works Association, shall be followed.

3. Allowable Soil Bearing Capacity. The allowable bearing capacity is taken as the ultimate bearing capacity divided by a safety factor against shear failure or excessive settlement.

4. Factor of Safety. The factor of safety is 2.0 for cohesion-less soils (sands), 3.0 for cohesive soils (clays).

5. Undisturbed Soil. When approved by Tucson Water, thrust block designs of sufficient size to reduce the pressure on the soil to the allowable bearing capacity of the undisturbed soil shall be provided to resist downward vertical thrust and horizontal thrusts.

6. Disturbed Soil. In the event of disturbed soils, an aggregate base course backfill material and compaction complying with Standard Specifications for Public Improvements, most current Edition, City of Tucson/Pima Co., Section 303 shall be provided to resist vertical and horizontal thrusts. A qualified engineer, not the contractor nor the inspector, shall determine this.

D. Anchor Blocks Design Requirements

1. For upward vertical thrusts, anchor blocks are needed at valves and vertical direction changes.

2. Anchor blocks may be needed on slopes that exceed twenty degrees since pipelines have a tendency to creep downhill.

3. When using weight calculations, the weight of the anchor block shall be considered as submerged (i.e., buoyant) due to a leak.

4. Tie bars are used to connect the anchor block to the fitting or pipe. The diameter of tie bars placed against the fitting or pipe should be large enough to prevent point loading on the fitting or pipe.

5. The concrete surface of the anchor block placed against the fitting or pipe should be large enough to prevent point loading.

E. Restrained Joint Length Requirements

A restrained joint is a tension joint that provides the force required counteracting internal thrust forces.

1. Tucson Water SD-600, Restrained Joints. Designers of small pipe, less than twelve inches, may utilize Tucson Water SD-600, Restrained Joints, rather than provide design lengths.

   The information furnished in Tucson Water SD-600, Restrained Joints, Tucson Water Standard Specifications and Details, is based on design parameters listed in the detail.

2. Variances from Tucson Water SD-600

   When project specific conditions vary from the design parameters listed in Tucson Water SD-600, such as when the pressure may exceed 200 pounds per square inch (including surges), or when the pipe is larger than twelve inches, additional information and calculations shall be provided.

   In such a case, the restrained joint length design practices found in the specific pipe material manuals, i.e., Manual of Water Supply Practices – M9, Concrete Pressure Pipe, by the American Water Works Association for concrete pipe, or DIPRA and M41 for ductile iron pipe, or another method approved by industry standards, shall be followed.

3. Allowable Soil Friction Resistance

   a. Allowable friction resistance between soil and the pipe is taken as the ultimate friction resistance divided by a safety factor.

   b. The factor of safety is 2.0 for cohesion-less soils (sands), 3.0 for cohesive soils (clays).

   c. The restrained joint length shall be sufficient to reduce the friction to the allowable soil friction resistance. A qualified engineer, not a contractor nor inspector shall determine this.

2.4 Utility Separation Requirements

This subsection contains the following major topics:

- Sewer Separation Requirements
- Other Utility Separation Requirements
- Joint-Use Trench Separation Requirements
- Storm Drain Separation Requirements

A. Sewer Separation Requirements
Installation of water pipes near sewer mains shall comply with the following to prevent potential cross connection issues:

1. State of Arizona Criteria.
   a. AAC R18-5-502.C, Minimum Design Criteria, Water and Sewer Mains, includes requirements for separation of facilities, materials, types of joints and encasement. For additional detail, refer to Tucson Water SD-106.

   b. All public water and sewer line invert elevations shall be shown on the design drawings and the record drawings at each crossing to verify the separation requirements.

2. Tucson Water Standard
   All the requirements of Tucson Water SD-106, Sewer/Water Crossing Details, Tucson Water Standard Specifications and Details, must be met.

3. Fire Hydrant and Service Connections Not Allowed
   Where extra protection is needed near sewer mains as required by AAC R18-5-502.C, Minimum Design Criteria, Water and Sewer Mains, no fire hydrants or customer water service connections shall be installed.

4. Reclaimed Water Pipes
   Reclaimed water pipes located adjacent to potable water pipes shall comply with the separation criteria established for pressure sanitary sewer lines. Where reclaimed water pipes are installed in the vicinity of sanitary sewer lines, the reclaimed water pipes shall be considered potable with respect to clearances.

B. Other Utility Separation Requirements
Other utilities are defined as electric, natural gas, fiber optic, telephone and cable television lines, conduits or structures.

Water main installation shall conform to the following separation requirements concerning other utilities:

1. Horizontal and Vertical Separation
   Water mains shall not be designed for placement within a five foot horizontal distance of parallel utility lines. The minimum vertical separation, at any location, shall be twelve inches.

2. Property Corners
Customer water services and fire hydrants shall not be installed at the same property corner as electrical or communications pedestals or transformers. This will minimize the risk of damage during installation and facilitate water system maintenance.

If this requirement absolutely cannot be met, there shall be a minimum horizontal distance of ten feet between the other utility's structures and the water mains and waterworks structures.

C. Joint-Use Trench Separation Requirements
When other utilities are laid parallel to water facilities, they shall not be installed with less than five feet horizontal clearance from the water main unless the system has been approved for Joint-Use Trench. In these cases, the joint-use trench detail (Tucson Water SD-108) must be shown on the plans.

D. Storm Drain Separation Requirements
The requirements stated in this section are in addition to the requirements in Tucson Water SD-107, Drainage Facilities Crossing Details, Tucson Water Standard Specifications and Details.

1. Water Pipe Below Structure
When the water main can be installed below a storm drain structure, the minimum vertical separation shall be in accordance with Tucson Water SD-107.

2. Water Pipe Above Structure
When installing water mains over a storm drain structure and minimum cover cannot be achieved, the contractor, with the approval of the Tucson Water engineer, may install the water main with less than the minimum cover under the following conditions:

a. The water pipe material shall be ductile iron.

b. Separation between the water main and the top of the storm drain structure shall be no less than twelve inches.

c. Under no circumstances shall the pipeline have less than twenty-four inches of cover to final grade.

2.5 Crossing Requirements

This subsection contains the following major topics:

- Surface Water Crossing Requirements
- Utility and Transportation Crossing Requirements

A. Surface Water Crossing Requirements

This subsection contains the following major topics:

- Above Surface Water Crossings
- Below Surface Water Crossings
- Pipelines Parallel to Surface Water Crossings

A surface water crossing includes a river, stream, or wash (dry or wet). It does not include a local, unimproved drainage ditch that experiences no scour.

All surface water crossings of "Navigable Waters of the United States" will require review and approval from the appropriate government agencies, including:

- City of Tucson Floodplain Section,
- Pima County Flood Control District, and
- EPA (404 Permit, Nationwide Permit 12 administrated by Army Corp of Engineers).

1. Above Surface Water Crossings

   Above surface water crossings occur on bridges or on a suspended cable, and are not acceptable without approval.

2. Below Surface Water Crossings

   a. A design evaluation shall be performed, if required by Tucson Water, and shall include the following tasks:

      - Prepare all hydrologic reports that may be required, including a scour analysis.

      - Review records and projections of storm water runoff and flood events affecting the project area.

      - Determine magnitude of flood events and the constraints that they may impose during and after construction.

      - Determine the extent of flood limits.

      - A final report shall include the results of all the required tasks, and shall show elevations of the streambed with normal and extreme low and high water levels.

   b. Crossing Minimum Requirements

      The design of the pipeline and any other support structures shall include restrained joints within the flood limits.

      Additionally, a Floodplain Use Permit Application shall be filed with the permitting agencies.

ADEQ Engineering Bulletin No. 10 contains the following additional requirements:

- The water pipeline shall be located a minimum of two feet below the scour depth.
- There shall be two valves, one at each side of the crossing, which are accessible and not subject to flooding.
- Pipe taps shall be provided on each side of the crossing for water quality sampling, pressure testing, and applying compressed air, all located between the valves.

3. Pipelines Parallel to Surface Water Crossings
   Extra protection shall be considered for pipelines parallel to a river, stream, or wash that has a history of bank erosion or appears likely to be subjected to future erosion.

B. Utility and Transportation Crossing Requirements

1. Utilities Crossing Requirements
   The companies of the following utilities shall be contacted for the latest crossing requirements:
   - natural gas pipelines
   - gasoline pipelines (petroleum products)
   - telephone lines,
   - military installations,
   - irrigation lines or canals.
   - communications cables or conduits
   - electric lines, or conduits,
   - fiber optic cables or conduits

2. Transportation Crossings Requirements
   A transportation crossing includes a highway or railroad crossing that may cause vibrations to the pipeline.
   a. Design Evaluation
      A design evaluation shall be performed, if required by Tucson Water, and shall include the following tasks:
      - Prepare all reports that may be required.
      - Review records and projections of traffic loads and frequency affecting the project area.
      - Determine magnitude of loadings and the constraints that they may impose during and after construction.
      - Determine the extent of vibration effects.
      - A final report shall include the results of the required tasks.

b. Crossing Minimum Requirements
The design of the pipeline and any other water support structures shall include the following minimum requirements for transportation crossings:

- Restraint joints shall be used within the determined length of vibration effects.
- A sleeve or casing shall be used to jack and bore beneath the crossing to avoid disturbance of the traffic system.
- The wall thickness of the sleeve or casing shall be sized to withstand H-20 traffic loading and or transportation agency specifications.
- The sleeve or casing shall be designed to reduce the vibration effects to the water pipeline.
- A sleeve or casing shall be designed to permit drainage for water pipeline leaks or pipe rupture.
- A sleeve or casing shall be supported and allow easily removable of the pipeline for repair.
- There shall be two valves, one at each side of the crossing. The designer shall locate the valves out of the flood plain and minimize the number of customers that would be out of service.

c. Jacking and Boring
Calculations are required for the design of steel jack and bore casing diameter and thickness sizing, and design shall be pursuant to Tucson Water SD-800. The carrier pipe shall be restrained beyond the ends of the casing for a minimum of 18-inches or equal to one-half times the carrier pipe diameter, whichever is greater. A second gasket joint shall be a minimum of two times the carrier pipe diameter beyond the casing.

8-08.3.0 Water Pipeline Appurtenance Requirements

This subsection contains the following major topics:

- Valve Requirements
- Fire Hydrant and Stub-out Location
- Pipeline Access Manways and Manholes

3.1 Valve Requirements

In this manual, valves are classified according to function rather than application, motion or port size. The functional classification of valves can be categorized into three areas:

- shutoff and isolation valves, which allow either flow and pressure to pass, or block flow and pressure;
- non-return valves, which allow flow and pressure to travel in one direction only;
- throttling valves, which allow regulation of flow or pressure by varying the valve stroke between fully opened to fully closed. Thus, they can also act as on-off valves.

A. Shutoff Valves

Types of shutoff valves include gate, ball, and corporation stops.

1. Shutoff Valves in Water Distribution Mains

Generally, a water distribution main (sixteen-inch diameter and smaller) includes any pipe if direct water service to an individual customer is provided from that pipe.

- The shutoff valves are used to divert flow around an area or distribution section needing maintenance or repair while minimizing customer service interruptions.
- Special consideration shall be given to minimize the number of fire hydrants taken out of service.
- The valves in a new distribution system shall be located so as to require no more than four valves to shut down a water main. A project for a new pipeline may have to add new valves to the existing water system to meet this requirement.

2. Distribution Main Connection to Transmission Main

When connecting a distribution main to a transmission main (42-inch and larger), the designer shall apply the “double block and bleed” OSHA criteria, which requires two consecutive valves for isolation of the distribution main.

- The “double block and bleed” OSHA criteria is applied for safety during installation and for subsequent use by operation and maintenance personnel.
- To minimize cost, an existing valve in the distribution main shall be used as one of the "consecutive valves" as long as no customer water service connections are present between this valve and the transmission main.

B. Shutoff Valve Location
Within the distribution piping (sixteen-inch diameter, if there are water service connections, and smaller), shutoff valves are required in:
- commercial areas – every 500 feet or no more than from intersection to intersection,
- all other areas – every 660 feet or between intersections.

C. Intersections in Distribution Mains
The number of shutoff valves at distribution main intersections is one less than the number of radiating pipes. One valve will be omitted from the pipeline that principally supplies flow to the intersection.

D. Fire Hydrant Branch
One shutoff valve is required on each fire hydrant branch. Refer to Tucson Water SD-500.

E. Gate Valve (Bonnet) Cover Minimum
The gate valve bonnet shall have a three-foot minimum cover distance from top of bonnet to the roadway subgrade.

F. Isolation Valves in Transmission Mains
Isolation valves used on transmission mains, sixteen-inch to twenty-four-inch, are the gate type (top actuated). Isolation valves used on transmission mains, thirty-six-inches or larger, are the butterfly valve type (mechanical seat) and shall have a thirty-inch or greater side or top manway access (up or downstream) of valve location. Vault access for both valves and manways shall be provided for routine maintenance and repair.

1. Location of Isolation Valves
At pipeline intersections, isolation valves shall be located upstream of the determined predominant flow pattern so that, when closed, there will be the least disruption of service to the water customer and shall permit the necessary shut down of transmission mains for maintenance or repair.

2. Separation of Isolation Valves
Although each project's valve placement will be evaluated separately and will be dependent upon the location of the tees/welded outlets for distribution system lateral tie-ins to parallel or crossing mains, in-line isolation valves are generally located:
- Every 1,320 feet for sixteen-inch pipe,
- Every 2,640 feet for sixteen-inch and no more than thirty-six-inch diameter pipe,
- Every 5,280 feet (maximum) for larger than thirty-six-inch pipe.

3. Downsizing Valves on Large Pipe
   - Downsizing is not allowed on fifty-four-inch and smaller pipe.
   - Valve downsizing on pipes greater than fifty-four-inch shall be considered by Tucson Water on a case by case application and following a cost benefit evaluation.

G. Flushing Devices

Flushing devices take on various names depending on the intended use or purpose. These include blow-off valve assemblies, drain valve assemblies, and fire hydrants.

- In the potable drinking water system, in large pipelines (thirty-six-inches and above), the location of drain valve assemblies shall be at low points along the transmission main, as determined by Tucson Water, so that the discharged water can be disposed of easily. This also permits the draining of the pipeline to allow for repairs or discharging of stagnant water to improve water quality.
- For particulate removal, such as sand, a properly designed flushing device shall to attain the velocity (2.5. feet per second) needed to perform this function. Refer to ADEQ Bulletin No. 8.
- All dead-end potable pipelines shall have a blow-off valve assembly type flushing device. These devices shall not be located in washes, detention/retention areas, sidewalks or driveways.

H. Air and Vacuum Release Valves

Air and vacuum release valves are designed to release accumulated air and for the admission and subsequent release of air during an event such as a power failure.

This valve will prevent the development of a vacuum with induced external pressures that may collapse a pipe made of a flexible material. Accumulated air, sometimes referred to as an air lock or air pocket, can cause resistance to flow and an increase in power cost.

All air and vacuum release valves shall be a combination air/vacuum release type.

Air and vacuum release valves are required at critical high points in all pipelines, in which there are no connections, such as a fire hydrant or a water service connection, that would otherwise permit accumulated air to be released.

When a shut-off valve is also at the high point in a pipeline, air and vacuum release valves shall be provided on each side of the valve.

I. Above-Grade Venting

In order to prevent intrusion, automatic air and vacuum release valves and similar appurtenances should be designed to have above-grade venting (at least one foot) and be designed to be tamper-proof to avoid deliberate contamination of the water system.

Intrusion refers to the flow of non-potable water into pipelines through leakage points, submerged air and vacuum release valves, faulty seals, or other openings.

Intrusion can occur during low or negative pressure transient events. Pressure transients can be caused by:

- main breaks,
- uncontrolled pump starting or stopping,
- opening and closing of fire hydrants,
- power failures,
- the slamming of an air valve,
- flushing operations,
- fire flow, and
- other conditions including venturi effects.

J. Air Valve Capacity

Pipeline size and profile, together with critical temperature and time considerations, shall be used to establish the capacity required at a given high point. The design engineer should specify air valve capacity and the manufacturer can best determine valve size and number required.

Air valve capacities for a given size vary considerably between manufacturers. Acceptance tests are to be required.

3.2 Fire Hydrant and Stub-out Location

None of the requirements stated in this section shall take precedence over the requirements in Tucson Water SD-500, Fire Hydrant Installation, Tucson Water Standard Specifications and Details.

A. New Fire Hydrants

1. The number of fire hydrants and their location shall be as approved by the local fire suppression authority without violating any other requirement contained herein.

2. Horizontal ninety-degree bends in fire hydrant laterals are undesirable and will be avoided when possible. If unavoidable, a minimum of ten feet of ductile iron pipe will be installed between the bend and the hydrant. Where practicable, the ninety-degree bend shall consist of two forty-five-degree bends.

B. Fire Hydrant Replacement
Unless otherwise directed by Tucson Water, fire hydrants on substandard mains will be replaced with a new hydrant if:
1. the hydrant is more than ten years old, and

2. the hydrant is in poor visual or recorded substandard condition,

3. but not until the substandard main is replaced.

C. Fire Hydrant Not Allowed
1. Transmission Mains
There shall be no fire hydrant or service connections located directly on transmission mains over twelve-inches.

2. Extra Protection Near Sewer Mains
There shall be no fire hydrant connections located where extra protection is needed near sewer mains as required by AAC R18-5-502.C, Minimum Design Criteria, Water and Sewer Mains. This will reduce any potential risk involving the fire hydrant barrel drain.

3. Limitation of the Available Water Supply
There shall be no fire hydrants installed where there is a limitation of the available water supply to provide the flow implied by the presence of a fire hydrant.

4. Impediment
The hydrant should be located so that it will not impede vehicular or pedestrian traffic, block driveways, take parking space, etc.

3.3 Pipeline Access Manways and Manholes
Thirty-six-inch to fifty-four-inch diameter and larger (all material) transmission mains shall be designed with thirty-inch vertical manways and vertical seventy two-inch diameter vaults. Sixty-six-inch diameter and larger (all material) transmission mains shall be designed with forty-two-inch vertical manways and vertical seventy-two-inch diameter vaults. These appurtenances shall be designed at a minimum of 2,640-foot intervals and shall be equally spaced between in-line isolation valves.

Flanged inspection ports twelve inches in diameter shall be designed in a vertical orientation on all twenty-four-inch diameter pipelines in 2,640-foot intervals.

8-08.4.0 Water Pipeline Miscellaneous Requirements

4.1 Customer Water Service Connections

A water service connection includes the service clamp or saddle, corporation stop, copper pipe, angle meter stop, tracer wire, locator tape, meter box and lid. Please refer to Tucson Water SD-309, 310, 311 and 312 for additional requirements.

A. Customer Water Service Connections
Each customer water service connection shall be individually metered. The customer shall install and maintain their own shutoff valves in their water service line (a.k.a. private plumbing) between the water meter and the customer structure, and shall be financially responsible for their water service line.

A contractor or Tucson Water shall install the service connection.

B. Customer Water Service Connections, Location
1. For automated meter reading and easy access by vehicles, each water service connection shall be installed within the public right-of-way or an easement (approved by Tucson Water for the project) and adjacent to the property to be served.

2. The water meter will be installed by Tucson Water after the project has been accepted.

C. Main Replacement Water Service Connections
When new water mains replace existing mains, all existing water services shall be connected to the new main by either a water service connection tie-over or a water service renewal. Please refer to Tucson Water SD-316 for additional requirements.

Service renewals will be used in areas that involve an improvement district with definite paving plans or when the service has been acquired from a private water company and the angle meter stops were not installed.

Iron or any unacceptable material used for water service lines shall be replaced with copper pipe all the way to the meter unless an excessive amount of paving will have to be cut. In that event, the connection to the service line is to be made in the shortest distance.

D. Water Service Locations Not Allowed
1. On water pipeline sizes over twelve-inches, there shall be no water service connections.

2. Where extra protection is needed near sewer mains as required by R18-4-502.C, Minimum Design Criteria, Water and Sewer Mains, no customer water service connections shall be installed.

E. Irrigation and Fire Services
For commercial developments, water used for irrigation will be separately metered. Once the potable water enters these systems, it is then defined as nonpotable.

4.2 Water Loading Stations

Water dispensing facilities, such as those used to load water trucks, present special problems regarding contamination. To prevent contamination of the potable water supply, the requirements described in ADEQ Engineering Bulletin No. 10, Chapter 7, Distribution Systems, Section K., Water Loading Stations, must be met. Contamination may occur when filling non-potable tanks or contaminated vessels.

4.3 Landscape Plantings

This subsection replaces Distribution Design Section Procedure 1-01-005, 02/01/94, Required Spacing Between New Landscape Plantings and Existing Waterlines.

A. Purpose

The requirements in this subsection have been established to protect all Tucson Water facilities after the planting of new landscaping for a water construction project. These facilities include pipelines, sleeves, casings, water mains, water services lines, and water meters. These requirements also apply to reclaimed water system projects.

B. Large Root-Ball Sizes

For trees of fifteen-gallon root-ball size and larger, a horizontal distance of ten feet is to be provided from the outside of the waterline to the outside diameter of the root-ball.

If the ten foot condition cannot be met, then a minimum horizontal distance of five feet should be provided from the outside of the waterline to the outside diameter of the root-ball with the following requirements:

- The contractor is to uncover the existing waterline, exposing its joints for a horizontal distance of ten feet either side of the centerline for the proposed tree well.

- The contractor is to install a polyethylene sheet wrap around the pipe joints for a distance of eighteen inches either side of the joint. The polyethylene wrap shall be in accordance with American Water Works Association C105-88, Class A, with the installation by Method C. The sheet wrap seams are to be sealed to the pipe and itself by the use of watertight, Mylar tape wrap.

C. Medium and Smaller Root-Ball Sizes

For plantings with smaller than fifteen-gallon root-ball sizes, a horizontal distance of five feet is to be provided from the outside of the waterline to the center of the plant root-ball.

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WATER SYSTEM MODIFICATIONS DESIGN STANDARDS

8-09.0.0 WATER SYSTEM MODIFICATIONS DESIGN STANDARDS

8-09.1.0 General

1.1 Purpose

This section describes the design standards and requirements for public water system modifications projects.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms. The following definitions are unique to this section.

A. "Modification" means the reconstruction redesign of City of Tucson water pipeline system facilities with new materials to resolve water conflicts with construction of Public Agency roadway projects.

B. "Public Agency project" means any project performing work to replace or maintain public infrastructures. That includes roadways, storm drains, sewer, sidewalks, pole and underground duct structures for traffic and lighting, street overlays, landscaping and other work that could impact City of Tucson water system pipeline facilities.

C. "Water conflict" means that a construction conflicts exists between an existing water pipeline and the proposed facilities being constructed by the Public Agency project.

D. "Direct water conflict" means that the existing water pipeline facility must be reconstructed to relocate to a different location in order to avoid physical contact or to provide physical space for a facility being constructed by the Public Agency project.

E. "Proximity water conflict" means that the existing water pipeline facility must be reconstructed to relocate to a different location in order to provide adequate space between a facility being constructed by the Public Agency project and the subject water facility.

Other construction conditions that are considered a proximity conflict include any construction that exposes any pipe bedding materials, any construction damaging concrete thrust blocking, and, any pole foundations located within five feet of a water pipeline.

F. "Minimum construction working space" over a water pipe shall be defined as two feet, measured in the vertical direction from the bottom

of all excavation for roadway sub grades and all trenches to the top of all existing water pipeline facilities.

1.3 Applicability

All water system modifications shall adhere to Intergovernmental Agreements or other agreements between agencies. In the absence of any Intergovernmental Agreements or other agreement, the provisions of these standards shall apply.

The requirements listed herein are in addition to all other standards.

Water system modifications involve the following types of water conflicts:

A. Direct Water Conflicts
Reconstruction of existing water pipeline facilities is required if proposed Public Agency project will have direct construction contact with the existing water pipeline facility.

B. Proximity Water Conflicts
1. Reconstruction of existing water pipeline facilities is required if the Public Agency project has facilities that have less than two feet vertical working cover over the water pipelines.

2. Reconstruction of existing water pipeline facilities is required if there is less than five feet minimum horizontal distance from the outside of the water pipeline and the outside wall of any pole foundation for electric or traffic facilities.

3. Reconstruction of existing water pipeline facilities is required if any proposed trenches that parallel existing water pipelines will expose the bedding materials of subject water facilities.

4. Reconstruction of existing water pipelines is required if proposed trenches weaken any trench support of concrete thrust blocking.

8-09.2.0 Design Requirements, Water System Modifications

These requirements are in addition to those found in Section 8-08.

2.1 General Responsibilities

A. Public Agency
1. Projects for Public Agency shall include contract provisions to have the project work scope include the design and construction of the necessary water system modifications. Project coordination with Tucson Water requires project plan submittals for Tucson Water comments on project plans and acceptance of water system modifications plans.

2. Public Agency project alignments shall be considered to minimize the amount of modifications to water mains, transmission mains, and appurtenances.

B. Project Designer

1. Identify all water conflicts within the construction scope of the Public Agency project by reviewing alignments of proposed structures of the Public Agency project facilities and existing water pipeline facilities consisting of water mains and water transmission mains and appurtenances.

2. Prepare the plans for water system modifications to resolve water conflicts and construction of Public Agency project improvements.

3. Make plan submittal to appropriate staff at Tucson Water and coordinate any changes required.

C. Tucson Water

1. Tucson Water shall provide written plan review comments including identification of discrepancies according to Section 8-05.

2. Tucson Water may contact and request written confirmation from the responsible governmental agency that proper consideration was given during development of conceptual alignments for the subject roadway/drainage facilities.

2.2 Scope of Design

A. Design Work

The design work shall include, but not be limited to, all work for research, development, and production of a concise set of biddable project documents for water system modifications. Tucson Water acceptance is required for water system modifications on a Public Agency project.

B. Pipeline Work

All pipeline design for water system modifications shall be subject to review by Tucson Water. Acceptable pipeline designs shown on the water system modifications plan shall be sealed by the Designer and submitted to Tucson Water for signature.

C. Facilities and New Components

The design work shall identify the new water facilities to be reconstructed and shall specify all water pipeline components that are needed to replace the conflicting water facilities. Tucson Water will advise the Designer of any needs to upsize the pipe diameters or changes to configuration of the water system.

D. Water System Modifications
All pipeline alignments for water system modifications within the work scope of a Public Agency project shall be located to avoid construction conflicts with project improvements and any water pipelines and utilities. The Designer shall obtain acceptance from the governmental agency having right of way authority for all pipeline alignments. The construction of water system modifications shall use all new materials to reconstruct water mains and water transmission mains and appurtenances.

2.3 Location of New Water Pipelines

This subsection contains the following major topics:

- General
- Horizontal Alignments of New Pipelines
- Vertical Alignments of New Pipelines
- Depth of New Pipelines
- Location of Water Appurtenances
- Water Services Location
- Utility Separation
- Design of New Pipelines and Appurtenances

A. General

1. New pipelines within the construction scope of the Public Agency project shall comply with the following as minimum requirements for determining the most economical and acceptable pipeline alignments (horizontal and vertical). The following paragraphs are minimum requirements and must be collectively evaluated as part of the determination of the pipeline alignments.

2. The designer shall make all efforts to design the pipe alignments to minimize or avoid pipe alignments that place a horizontal diagonal pipe alignment across a street intersection.

3. In all cases, new pipeline shall be located within right of way.

B. Horizontal Alignments of New Pipelines

1. New pipelines alignments shall be located to avoid construction conflicts with project underground improvements and any water pipelines and utilities to remain.

2. New pipelines in new pavement located next to new curb shall be located no closer than four feet to new curb and shall be located to place water valve boxes outside of the vehicular wheel track.

3. New pipelines located outside of pavement or back of curb and next to a pole foundation shall be placed no closer than five feet, from outside wall of new pipe to outside wall of any pole foundation for traffic or street lighting facilities.

4. New pipelines in new pavement or outside new pavement located parallel to existing water lines shall be no closer than five feet, from outside wall of new pipe to outside wall of existing pipe. This minimum five feet shall be increased as required to handle these conditions, varying sandy and silty soil site conditions and any differences in elevation between pipe inverts when new pipe is installed at lower invert elevations. In all situations the new pipe alignments that horizontally parallel existing waterlines alignments must provide sufficient horizontal spacing between the new and existing water line facility as to avoid any exposure of bedding materials when trenching for new waterline.

5. New pipelines to replace existing pipeline may be installed in the same alignments as existing water mains provided that sufficient looped pipelines are in place to minimize interruption of service.

C. Vertical Alignments of New Pipelines
   1. New pipeline alignments shall be located to avoid construction conflicts with Public Agency project underground improvements and any water pipelines and utilities to remain.

   2. The minimum vertical separation at a crossing between new pipelines and existing utility lines shall be twelve inches.

   3. The minimum vertical separation at a crossing between new pipelines and storm drain facilities shall be as follows:
      a. Crossing over storm drain facility. The minimum vertical separation shall be twenty-four inches measured from the top of the storm drain structure and the top of the new pipeline.

      b. Crossing under a storm drain facility. The minimum vertical separation shall be thirty-six inches measured from the bottom of the trench floor and the top of the new pipeline.

D. Depth of New Pipelines
   1. General
      a. Sufficient trench backfill cover over the top of pipelines is necessary to give protection against transmittal of excessive external live loading onto the installed pipe and to provide anchorage for normal sections of straight pipe.

      b. In all cases the cover depth shall be identified to mean the vertical distance measurement from the top of the pipe to the point identified as the terminus elevation point final grade. Increased amount of cover may be allowed if required to provide additional protection against transmittal of excessive external live loading onto the installed pipe.

c. Final grade for the project roadways shall be defined as the top surface elevation of the finished pavements including curb cuts or undisturbed pavement scheduled to remain.

2. Trench Minimum Backfill
For trench minimum backfill covers, all new pipelines shall be installed to maintain a minimum cover of thirty-six inches from the bottom of any excavation or scarification during all project construction periods prior to completion of project final grades. The depth of cover to the top of the pipe shall not be less than three feet, unless adequate structural protection is provided and justified by the design engineer, and approved by Tucson Water.

E. Water Services Location
Locate all water meters within project right of way and out of new pavement as follows: (See also Section 8-08.)

1. Where room permits between new curb and sidewalks locate behind new curbs at an minimum of eight inches set back distance from the back of curb to the face of the meter box lid.

2. Where placing in new sidewalks locate at an acceptable location within the new sidewalk and provide a detail showing provisions for meter box to incorporate concrete collar. When installing meter boxes in new sidewalks, provide a detail showing provisions for the meter box to incorporate a concrete collar. Placement and location of meter boxes in a sidewalk shall be consistent with standard specs and details.

3. The work to change location of the water meter will be identified as either a water meter relocation service line adjustment (requires partial replacement of service line) or water meter relocation service line renewal (requires full replacement of service line including new service connection on water main).

F. Utility Separation
All pipeline design alignments shall comply with separation requirements for utilities in accordance with this Section and any conflicting requirements shall be resolved by using the more restrictive requirement.

TABLE OF CONTENTS

WATER PLANT DESIGN STANDARDS

8-10.0.0 WATER PLANT DESIGN STANDARDS

8-10.1.0 General

1.1 Purpose

This section describes the design standards and requirements for public water plant projects.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 Applicability

The design standards and requirements listed herein apply to all plant projects including potable (drinking water) projects, nonpotable (reclaimed water) projects, system modification (other public agency) projects, and developer-financed projects.

8-10.2.0 Water Pumping Station Requirements

The requirements described below are based, in part, on ADEQ Engineering Bulletin No. 10, Chapter 3, Pumping Facilities.

This subsection contains the following major topics:

- Site Requirements
- Pumping Units
- Headers and Yard Piping
- Hydropneumatic Tanks

2.1 Site Requirements

This subsection contains the following topics:

- Title of Property
- Site Conditions
- Site Access
- Site Surface
- Sanitary Control Distances
- Site Clearances
- Site Size and Shape
- Site Enclosures
- Site Drainage
- Site Elevation

A. Title of Property

The property for a pumping station will normally be conveyed in fee title to Tucson Water or the City of Tucson.

B. Site Conditions

The site shall meet at least one of the following conditions for access:

1. Have sixty feet or more of frontage directly along at least one public street having a right of way width of at least sixty feet, or

2. Have an access easement of at least thirty feet in width from a public right of way to the site, or

3. Access that has drainage problems, is unduly steep, or has conditions that limit access will not be acceptable unless remediated and approved by Tucson Water.

C. Site Access

1. Access shall be an all-weather road of not less than twelve feet in width, except that access roads, which exceed fifty feet in length, shall not be less than sixteen feet in width.

2. An all-weather road is defined as an improved surfacing with drainage improvements as required. Improved surfacing will be gravel, chip-seal, asphaltic concrete, or concrete as determined by Tucson Water on a project-specific basis.

D. Site Surface

Gravel surfacing of the interior of the site shall be required to provide reasonable access to all components of the pumping station.

E. Sanitary Control Distances

Sanitary control distances shall be as required by ADEQ.

F. Site Clearances

Sites being conveyed to Tucson Water or the City of Tucson shall comply with all requirements of the City of Tucson Real Estate Division, which includes, but may not be limited to, the following:

- Archaeological Clearance
- Environmental Site Assessment Clearance
- Biological Assessment Clearance

G. Site Size and Shape

The pumping station site shall be of a sufficient size and appropriate shape to allow for all equipment and any necessary maintenance and repair activities, but in no case shall it be less than 8,000 square feet. The narrowest side shall be not less than one-half the dimension of the widest side.

H. Site Enclosures

All sites shall be enclosed by an intruder resistant enclosure. The security enclosure shall be completely located within the property boundary of the site, and shall include one sixteen-foot (minimum) drive-through gate and one three-foot walk-through gate. Gates shall be of equivalent height as enclosure and shall be lockable. Depending on the site location, an acceptable enclosure may be one of the following:

1. Chain link fencing with a minimum height of six feet of chain link fabric, with three strands of barbed wire on top, for total fence height of seven feet, minimum, or

2. Masonry wall with a minimum height of seven feet.

I. Site Drainage

All sites shall be designed to allow for drainage of storm water and for any drainage of the pumping station for testing, maintenance, or repair.

1. Use drainage swales, curbs, culverts, storm sewers, or a combination thereof, as required, to provide internal site drainage.

2. If an offsite storm sewer or major drainage way is available, site drainage shall be collected before leaving the site.

3. The internal site collection system shall be sized to accommodate storm water as well as any additional water from testing of the pumping station or drainage for repairs.

J. Site Elevation

The site shall be located at an elevation that allows for provision of required Net Positive Suction Head to the pumps.

2.2 Pumping Units

This subsection contains the following topics:

- General Requirements
- Type of Pumps
- Operations
- Electric Motor Drivers
- Design Requirements

A. General Requirements

1. Pumps shall be designed to maximize efficiency and flexibility of operation. Options may include:

    a. Use of controls to alternate starts between pumping units,
    b. Pumping units sized to meet flows and pressures required, and
    c. Use of variable speed controllers.

2. All pumps in a pumping station shall have the same discharge pressure, with due consideration for frictional head losses.

B. Type of Pumps

The following types of pumps are acceptable:

1. End-suction centrifugal
2. Horizontal split-case centrifugal
3. Vertical turbine
4. Multi-staged

C. Operations

1. Pump speeds shall be between 1,800 rpm to 3,600 rpm (nominal).

2. Minimum discharge pressure shall be in accordance with Tucson Water's standard pressure zone requirements.

3. Pump operation shall be controlled by either pressure differentials as a function of demand or tank level of water storage facility.

4. Pressure sensing and pump control shall be in accordance with these standards.

5. Pumping units shall be controlled such that the unit is shut down and locked out of operations in either a low suction pressure condition, or a high discharge pressure condition.

D. Electric Motor Drivers
1. Electric motors of 350 horsepower and less shall be three-phase, 480 volt.
2. Electric motors shall be sized to accommodate the maximum design-operating load of the station pump without using the motor service factor.
3. The minimum service factor shall be 1.15.
4. Motor enclosures may be open drip proof, WP-1, or totally enclosed, fan cooled.
5. Motors of fifty horsepower or more shall have reduced-voltage starting.

E. Design Requirements
1. For pressure-controlled sites, the pump shall be designed with an operating band of twenty pounds per square inch (nominal). The "on" position will be ten pounds per square inch below the designed operating pressure, and the "off" position will be ten pounds per square inch above the designed operating pressure.

2. The actual pumping head at the "off" position shall not be less than ten feet below the total pump head on the specific pump curve at the far left (0 gallons per minute flow) point of the curve.

3. The vibration limit of a pump shall be as described in the Hydraulic Institute Standards, except that peak-to-peak vibration amplitude shall not exceed two mils for any frequency at any distance from base to point of measurement.

2.3 Headers and Yard Piping

This subsection contains the following topics:

- Definitions
- Materials
- Piping System Design Requirements
- Layout and Clearances
- Valves and Appurtenances on Header and Lateral Piping
- Valves and Appurtenances on Yard Piping

A. Definitions

For the purpose of this Design Standard, the following terms shall have the following definitions which are unique to Section 8-10:

1. "Suction Header" refers to the piping on the suction side of the station that distributes water to the suction laterals of the pumps.

2. "Suction Lateral" refers to piping from the suction header to the suction side of each pump. For vertical turbine pumps, this will also include the pump can.

3. "Discharge Header" refers to the piping on the discharge side of the pumping station that collects water from the discharge laterals of the pumping units.

4. "Discharge Lateral" refers to the piping from the discharge side of each pump to the discharge header.

5. "Yard Piping" refers to the below ground and suction and discharge piping on the pumping station site that connects the pumping station headers to the distribution system.

B. Materials

Above-ground piping shall be fabricated or mill type standard steel pipe in accordance with ASTM A53. Below-ground piping may be steel pipe, ductile iron pipe, or PVC, except that below-ground headers and laterals shall be steel pipe.

1. Ductile iron pipe and materials shall conform to the requirements of Section 1401 of the Tucson Water Standard Specifications with the following fittings:

   a. Flanges shall be Class 125 in accordance to ANSI B16.1 for operating pressures up to 250 pounds per square inch. For operating pressures above 250 pounds per square inch, flanges shall be Class 250 in accordance with ANSI B16.1.
   b. Nuts and bolts shall be grade 316 stainless steel.
   c. Gaskets shall be Grade 1 (rubber) or Buna N.

2. PVC pipe and fittings shall conform to the requirements of Section 1404 of the Tucson Water Standard Specifications.

3. Steel pipe and materials shall be fabricated or mill-type standard steel pipe in accordance with ASTM A53.

   a. The minimum wall thickness shall be as follows:

      - Less than 5-inch diameter: Schedule 40
      - 6 to 10-inch diameter: 3/16–inch
      - 12 to 14-inch diameter: 7/32–inch
      - 16 to 42-inch diameter: 1/4-inch
      - 48 to 60-inch diameter: 3/8 –inch
      - 66 to 72-inch diameter: 1/2-inch

   b. Fittings

      - Flanges shall be Class 125, ANSI B16.1, for operating pressures up to 250 pounds per square inch. For operating pressures above 250 pounds per square inch, flanges shall be Class 250, ANSI B16.1.

      - Above-ground fittings shall be flanged, welded, or coupled. Nuts and bolts shall be hot dip galvanized steel or epoxy painted.

      - Below ground fittings shall be welded or coupled. Nuts and bolts shall be grade 316 stainless steel.

      - Gaskets shall be Butyl or EPDM.

4. Protective Coating

   a. Internal coating shall be a three-coat, two-component catalyzed epoxy system. The epoxy system shall conform to all NSF requirements for potable water service. The minimum thickness shall be 12.0 dry mils, but in no case shall any individual coat be less than 4.0, nor more than 7.0 dry mil.

   b. External coating for above-ground service shall be a two-coat, two-component epoxy system or a polyurethane system. The thickness of this coating system shall be between 6.0 and 9.0 dry mils. The first coat shall be between 4.0 and 6.0 dry mils, and the second coat shall be between 2.0 and 3.0 dry mils.

   c. External coating for below-ground service shall be a factory-applied polyurethane system, as approved by Tucson Water.

C. Piping System Design Requirements

1. The flow velocity in suction headers before any reducers shall not exceed three feet per second.

2. The flow velocity in discharge headers shall not exceed five feet per second.

3. Design thrust restraint is required for all above-ground and below-ground pipe installation.

4. Use restrained joints, welded joints, or joint harnesses for thrust restraint. Reaction blocking and anchors will only be allowed for special conditions as approved by Tucson Water.

5. The design for use of flexible couplings shall allow for expansion, contraction, and maximized serviceability of equipment and will provide for a restrained joint.

6. Corrosion control of below-ground metallic pipe shall be in conformance with Section 8-11 of these Design Standards.

D. Layout and Clearances

1. As a minimum, allow the larger of three feet or two pipe diameters of clear space from the outside of header piping to any wall, fence, or structure to provide adequate access to valves and fittings.

2. Provide adequate space for access between headers, laterals, pumps, motors, and other appurtenances to allow for maintenance and repair. Specific requirements will vary depending on physical layout and size of components.

3. Suction laterals from the suction header to the pump suction nozzle shall be as short and direct as possible. Reducers used in the suction lateral shall be eccentric reducers, with the flat side on top to reduce the potential for entrapped air in the suction lateral. The lateral angle from one end of the reducer to the other shall not be greater than fifteen degrees.

4. Yard piping shall be located in areas easily accessible for maintenance and repair.

5. Clearance between waterlines and sanitary sewers shall conform to the requirements set forth by ADEQ.

E. Valves and Appurtenances on Header and Lateral Piping

1. Provide an isolation valve on the suction and discharge lateral of each pump for isolation from the headers.

2. Provide a silent check valve on the discharge lateral of each pump, between the pump and the isolation valve to prevent reverse flow when the pump is off.

3. Provide a combination air-vacuum release valve on the high point of the suction header to release air trapped in lateral piping.

4. Provide a magnetic flow meter on the discharge header.

   a. The flow velocity in the flow meter shall be in the range of one to fifteen feet per second for all designed flow conditions.

   b. A minimum of five pipe diameters of clear, unobstructed piping shall be provided on each side of the flow meter.

   c. If the discharge header piping requires reduction in size to obtain the desired flow velocity, said reduction shall be by means of eccentric reducers placed outside of the five pipe diameter clear distance from each side of the meter.

5. A test head lateral and isolation valve shall be provided off the discharge header for performance testing.

6. Provide sufficient taps as needed for pressure transducers, sample taps, dewatering, etc.

7. All isolation valves of four-inch diameter or greater on headers and laterals shall be butterfly valves.

F. Valves and Appurtenances on Yard Piping

1. Yard piping shall be of standard pipe size (i.e., 4-, 6-, 8-, 12-, 16-, 24-, 30-, and 36-inch diameter).

2. Locate valves for ease of access and operation.

3. Isolation valves shall be installed on piping entering and leaving the site to provide the ability to isolate the pumping station from the distribution system.

4. Underground valves from four- to twelve-inch in diameter shall be gate valves.

5. Underground valves from sixteen- to thirty-inch in diameter shall be either gate valves or butterfly valves.

6. Underground valves thirty-six-inch in diameter and larger shall be butterfly valves.

7. A sample spigot shall be provided from the discharge side of the pumps. The sample tap should be located on the pumping station site, just prior to entry into the water distribution system.

2.4 Hydropneumatic Tanks

A. Design Requirements

1. There are various methods for sizing the components of hydropneumatic pressure tanks. For the surge suppressant component, acceptable methods include, but are not limited to:

   a. "Hydro-Pneumatic Pressure Systems," Peerless Pump Company
   b. "Hydro-Pneumatic Tanks," Redcoat Reports

2. Regardless of the method used, the following parameters shall be considered:

   a. Operating Pressure Range
   b. Pumping Rate
   c. Water Seal over the tank outlets
   d. Pumping Cycles per Hour

3. Standard tank sizes are 1,500, 3,000, and 5,000 gallon. Specific tank sizing shall be performed for any pumping station with operating pressure in excess of 175 pounds per square inch, or a flow rate of greater than 5,000 gallons per minute.

4. Refer to Section 8-06 for additional design requirements.
5. No portion of the hydropneumatic tank shall be buried.
6. Protective coatings shall be NSF approved for potable use.

7. Specifications shall include tank capacity, dimensions, appurtenances, pressure rating, disinfection procedures, and air compressor capacity.

B. Tank Appurtenances

1. Tanks shall have isolation valves such that they can be isolated from the rest of the pumping station.

2. Tanks shall be equipped with an air compressor and shall be automated to maintain proper water and air volumes within the tank. Additional items include a stilling well and magnetic switches for air compressor controls, and for low suction alarm.

3. Tanks shall also be equipped with:
   - a pressure relief valve
   - a pressure gauge
   - a bottom drain and valve to completely drain the tank.
   - An access port for personnel entry to perform inspections.

4. Tanks shall be equipped for installation of a pressure pedestal.
5. Tanks shall have two lifting lugs on top of each tank.

8-10.3.0 Pressure Reducing Station Requirements

3.1 General Design Requirements

This subsection contains the following topics:

- Station Layout and Size
- Pressure Reducing Station Minimum Capacity
- Piping Size
- Above-Ground Valves
- Station Bypass

A. Station Layout and Size

1. Layout
   The pressure reducing station shall be an above-ground installation and shall be located within a secure enclosure. Tucson Water, Plant Design Section has sample layouts available.

2. Site Size
   The pressure reducing station site shall be of sufficient size to accommodate future installation of a magnetic flow meter, pressure transducers, and remote monitoring equipment.

B. Pressure Reducing Station Minimum Capacity
The minimum capacity of the pressure reducing station shall be 125% of the planned water demand. The water demand condition will be determined based on Section 8-06 of these standards.

C. Piping Size
Piping shall be sized to accommodate existing and future demands as described in Section 8-06 of these Design Standards.

D. Above-Ground Valves
All above-ground isolation valves shall be butterfly valves.

E. Station Bypass
The pressure reducing station shall be equipped with a bypass to allow continued service downstream during maintenance and repair activities. The minimum bypass pipe size and present and future water demand shall be as provided in Section 8-06.

3.2 Operations

The pressure reducing station shall be adjustable from 30 to 300 pounds per square inch downstream pressure and shall conform to Tucson Water standard pressure zone requirements.

3.3 Variances

Exceptions or variances shall be submitted for approval to Tucson Water and will only be considered on a project specific basis.

8-10.4.0 Water Storage Facility Requirements

This subsection contains the following topics:

- Site Requirements
- Types of Water Storage Reservoirs
- Reservoir Design Requirements
- Piping Requirements
- Valves and Appurtenances
- Leakage Testing

4.1 Site Requirements

This subsection contains the following topics:

- Title of Property
- Site Conditions
- Site Access
- Site Surface
- Sanitary Control Distances
- Site Clearances
- Site Size and Shape
- Site Enclosures
- Site Drainage
- Site Elevation

A. Title of Property

The property for a storage facility will normally be conveyed in fee title to Tucson Water or the City of Tucson.

B. Site Conditions

The site shall meet at least one of the following conditions for access:

1. Have sixty feet or more of frontage directly along at least one public street having a right of way width of at least sixty feet.

2. Have an access easement of at least thirty feet in width from a public right of way to the site.

3. Access that has drainage problems, is unduly steep, or has other conditions that limit access will not be acceptable unless remediation of these problems is provided.

C. Site Access

Access shall be an all-weather road of not less than twelve feet in width, except that access roads, which exceed fifty feet in length, shall not be less than sixteen feet in width. An all-weather road will be defined as an improved surface with drainage improvements as required. Improved surface will be gravel, chip-seal, asphaltic concrete, or concrete as determined by Tucson Water.

D. Site Surface

Gravel surfacing of the interior of the site shall be required to provide reasonable access to all components of the pumping station.

E. Sanitary Control Distances
Sanitary control distances shall be as required by ADEQ.

F. Site Clearances
Sites being conveyed to Tucson Water or the City of Tucson shall comply with all requirements of the City of Tucson Real Estate Division, which includes, but may not be limited to, the following:

- Archaeological Clearance
- Environmental Site Assessment Clearance
- Biological Assessment Clearance

G. Site Size and Shape
The storage facility site shall be of a sufficient size and appropriate shape to allow for all equipment and any necessary maintenance and repair activities, but in no case shall it be less than 8,000 square feet. The narrowest side shall be not less than one-half the dimension of the widest side.

H. Site Enclosures
All sites shall be enclosed by an intruder resistant enclosure. The security enclosure shall be completely located within the property boundary of the site. Depending on the site location, an acceptable enclosure may be one of the following:

1. Chain link fencing with a minimum height of six feet of chain link fabric, with three strands of barbed wire on top, for total fence height of seven feet, minimum.

2. Masonry wall with a minimum height of seven feet.

3. One sixteen-foot (minimum) drive-through gate and one three-foot walk-through gate. Gates shall be of equivalent height as enclosure and shall be lockable.

I. Site Drainage
All sites shall be designed to allow for drainage of storm water and for any drainage of the pumping station for testing, maintenance, or repair.

1. Use drainage swales, curbs, culverts, storm sewers, or a combination thereof, as required, to provide internal site drainage.

2. If an offsite storm sewer or major drainage way is available, site drainage shall be collected before leaving the site.

3. The internal site collection system shall be sized to accommodate storm water as well as any additional water from testing of the pumping station or drainage for repairs.

J. Site Elevation
The site shall be located at an elevation that allows for provision of required Net Positive Suction Head to the pumping station, present or future.

4.2 Types of Water Storage Reservoirs

The type of reservoir will depend on various factors including but not limited to, size, location, environmental and neighborhood concerns.

A. Above-Ground Storage

1. Welded Steel Tank
   Welded steel tanks shall conform to the most current revision of AWWA D-100. In general, welded steel tanks will range from 10,000 gallons to 2.0 million gallons in capacity.

2. Bolted Steel Tank
   Bolted steel tanks shall conform to the most current revision of AWWA D-103. In general, bolted steel tanks will range from 10,000 gallons to 500,000 gallons in capacity.

3. Pre-Stressed Concrete Tank
   Pre-stressed concrete tanks shall conform to the most current revision of AWWA D-110. In general, pre-stressed concrete tanks will range from 250,000 gallons to 2.0 million gallons in capacity.

B. In-Ground Storage

1. Reinforced Concrete Reservoirs
   In general, Reinforced Concrete Reservoirs will range from 2.0 million gallons to 20.0 million gallons in capacity.

2. Pre-Stressed Concrete Reservoirs
   Pre-stressed concrete reservoirs shall conform to the most current revision of AWWA D-110. Pre-stressed concrete reservoirs will range from 250,000 to 2.0 million gallons in capacity.

4.3 Reservoir Design Requirements

This subsection contains the following topics:

- Above-Ground Storage
- In-Ground Storage

A. Above-Ground Storage

1. Provide one or more inlets for each reservoir. The inlet shall be located in the side wall of the tank and at least 45° from the reservoir outlet. The inlet may be located at the top or bottom of the tank wall depending on the system conditions or requirements.

2. On single reservoir installations, provide two outlets located at least 90° apart and at least 45° from a tank inlet. On multiple reservoir installations, the dual outlets will be required only on the first reservoir. On outlets which provide suction supply to station pumps, the outlet piping shall be equipped with an internal 90° fitting turned downward to prevent development of a vortex. The fitting shall be a ductile iron flange and flare; a ductile iron 90° long radius elbow; or a welded steel mitered fitting. Outlets shall have a minimum of twelve-inch clearance from the reservoir floor.

3. Provide an internal overflow weir inlet with an external overflow pipe. The overflow assembly shall be sized to handle the maximum tank influent rate with a maximum water level rise over the inlet weir of six-inches. The overflow discharge pipe shall terminate above ground, not be subject to submergence, and be fitted with a hinged flap valve or other approved check valve. The top of the overflow weir shall be a minimum of one-foot below the bottom of any roof rafter.

4. Provide one or more drains. The drains shall not be less than four-inch diameter and shall include an isolation valve. It shall be located a minimum practical distance above the tank floor. Alternatively, a flush-type drain in accordance with API 650, Section 3.7.8 may be used with Tucson Water approval. The drain may be connected to the overflow discharge pipe outside of the tank.

5. Provide one or more air vents located at or near the center of the roof, at the highest point practical. Vents shall be sized to prevent unacceptable atmospheric pressure changes for the maximum influent and effluent rates. Only the effective (net) screen opening area shall be considered for required airflow. Vents are to be double gooseneck type with the openings protected by 316 Stainless Steel Screen, 16 mesh.

6. Foundation:
   a. Welded Steel and Bolted Steel Tanks
      The tank shall be supported by compacted aggregate base course on compacted native soil. The top of the foundation shall be at least eight inches above finished grade of the yard. The compacted material shall be contained by a steel foundation ring or a reinforced concrete foundation ring as required by detailed design. Additional reinforced concrete pads may be required for center ring or columns as determined by detailed design. The tank floor shall be sloped downward at least one-inch vertical to every ten-feet horizontal from the tank center to the outside edge.

   b. Prestressed Concrete Reservoir
      The foundation shall be designed by a professional structural engineer registered in the State of Arizona, and the design shall be based on a site-specific geotechnical report.

7. Access
   a. Ladders

      - Provide an exterior ladder extending to the full height of the tank. The exterior ladder shall comply with all OSHA Standards including safety cage and landings as required.
      - Provide an interior ladder. The interior ladder shall be offset from the exterior ladder by at least two feet.

   b. Roof Guard Rails
      Provide hand rails along the roof edge for a minimum distance of ten feet on both sides of the exterior ladder and a minimum of five feet on both sides of any perimeter appurtenance.

c. Roof Hatch
The primary roof hatch shall have a minimum size of thirty-inches in diameter with a four-inch curb. The roof hatch shall have a hinged cover with a two-inch downward overlap and provisions for locking. The location shall be offset from the exterior ladder centerline over the interior ladder. A secondary roof hatch shall be located over the tank overflow.

d. Walkways
Provide non-skid walkways on the roof of steel tanks to allow safe access to any appurtenance.

e. Shell Manholes
- Welded Steel Tanks. Provide at least two shell manholes. One manhole shall be thirty inches in diameter with a hinged cover in accordance with AWWA Standards. The second manhole shall be a forty-eight-inch by forty-eight-inch flush-type cleanout in accordance with API Standards complete with hinge or davit arm. Locate the manholes approximately 180° apart.

- Bolted Steel Tanks. Provide two flush-type cleanouts in accordance with API Standards. Cleanouts shall be a minimum of twenty-four-inch wide by forty-eight-inches high and be located approximately 180° apart.

B. In-Ground Storage
1. Provide one inlet per reservoir located near the top of the reservoir and at the opposite side of the reservoir from the outlet.

2. Provide the reservoir outlet connection through an outlet structure at the bottom of the reservoir with a minimum four-inch silt stop.

3. Provide an internal overflow weir with an external overflow pipe or drainage channel. Size the overflow assembly to handle the maximum reservoir influent rate with a maximum water level rise over the weir of six inches.

4. Provide one drain with an isolation valve. Make drain connection through the bottom of the reservoir and terminate in an open top concrete drain box connected to a storm sewer system or adequate site drainage swale.

5. One or more vents, as necessary, shall be located at the highest point of the reservoir wall or at or near the highest point of the roof. The vents shall be sized for the maximum influent and effluent rates. Only the effective (net) screen opening shall be considered to pass air flow. Vents shall be of the gravity-type with openings protected by 316 Stainless Steel screen, 16 mesh.

6. The foundation shall be designed by a professional structural engineer registered in the State of Arizona and design shall be based on a site-specific geotechnical report.

7. Based on geotechnical report, existing environmental conditions, and Tucson Water's direction, a reservoir underdrain system and/or leak detection and monitoring system may be required.

8. Access
   a. Stairs/Ladders

      - Provide an exterior stairway or ladder extending to the roof of the reservoir.
      - Provide an interior stairway or ladder to access the interior of the reservoir.

   b. Roof Guard Rails
      Provide handrails according to OSHA standards along the edge of the roof.

   c. Roof Hatch

      - The primary roof hatch shall be a minimum of 2'-6" by 10'-0", with a four inch curb. The roof hatch shall have a hinged cover with a two-inch downward overlap and provisions for locking.

      - Additional roof hatches shall be required for sampling. These hatches shall be located at a minimum of one hatch centered over each quarter of the reservoir and shall be a minimum of eighteen inches square.

   d. Walkways
      Provide non-skid walkways on the roof to allow safe access to any appurtenance and to prevent damage to reservoir roof.

4.4 Piping Design

A. Materials
Piping shall be either standard steel pipe in accordance with ASTM A53 or ductile iron pipe in accordance with the requirements of Section 1401 of The Tucson Water Standard Specifications.

B. Piping Configuration
1. Water storage facilities shall be designed with a separate inlet and outlet. The inlet and outlet shall be configured to minimize detention time of water.

2. The piping for water storage facilities that include a pumping station will be configured to allow the pumps to operate with the reservoir isolated from its source of supply.

3. Water storage facilities that include a pumping station will have piping configured to allow bypass of water back to reservoir.

4. Piping shall be configured to allow for any planned future facilities. This may include additional reservoir or an additional pumping station or station upgrade.

4.5 Valves and Appurtenances

A. Isolation Valves

1. A manually operated valve will be provided on the reservoir outlet piping to provide isolation of the reservoir.

2. A motor-operated valve with remote-operating capability will be provided on the reservoir inlet piping.

3. Provide valves as required to isolate any major appurtenances to allow for future repair or replacement.

B. Control Valves

Provide control valves as required to allow for isolation of the reservoir with continued ability to use any associated pumping station and for isolation of any associated pumping station with continued ability to use the reservoir.

C. Appurtenances

Depending on system requirements, a flow meter may be required on the inlet and/or outlet of the reservoir. A staff gauge and water level indicator shall be provided to verify tank level on site.

4.6 Leakage Testing

All new reservoirs shall pass a leakage test prior to acceptance by Tucson Water. Testing requirements shall be clearly defined in the Contract Specifications, and shall conform to the latest industry standard for the type of reservoir being tested (i.e.: AWWA for welded or bolted steel tanks; ACI for reinforced concrete reservoirs.)

8-10.5.0 Water Production Well Equipping Requirements

This subsection for water production well equipping contains the following topics:

- Site Requirements
- Site Layout Design Requirements
- Piping, Valves and Appurtenances
- Pumping Units
- Pump Drivers

5.1 Site Requirements

This subsection contains the following topics:

- Title of Property
- Site Conditions
- Site Access
- Site Surface
- Site Surface
- Sanitary Control Distances
- Site Size and Shape
- Site Enclosures
- Site Enclosures
- Site Drainage

A. Title of Property

The property for a well site will normally be conveyed in fee title to Tucson Water or the City of Tucson.

B. Site Conditions

The site shall meet at least one of the following conditions for access:

1. Have sixty feet or more of frontage directly along at least one public street having a right of way width of at least sixty feet.

2. Have an access easement of at least thirty feet in width from a public right of way to the site.

3. Access that has drainage problems, is unduly steep, or has other conditions that limit access will not be acceptable unless remediation of these problems is approved by Tucson Water.

C. Site Access

Access shall be an all-weather road of not less than twelve feet in width, except that access roads, which exceed fifty feet in length, shall not be less than sixteen feet in width. An all-weather road will be defined as an improved surfacing with drainage improvements as required. Improved surfacing will be gravel, chip-seal, asphaltic concrete, or concrete as determined by Tucson Water.

D. Site Surface
Gravel surfacing of the interior of the site shall be required to provide reasonable access to all components of the pumping station.

E. Sanitary Control Distances
Sanitary control distances shall be as required by ADEQ.

F. Site Clearances
Sites being conveyed to Tucson Water or the City of Tucson shall comply with all requirements of the City of Tucson Real Estate Division, which includes, but may not be limited to, the following:

- Archaeological Clearance
- Environmental Site Assessment Clearance
- Biological Assessment Clearance

G. Site Size and Shape
The pumping station site shall be of a sufficient size and appropriate shape to allow for all equipment and any necessary maintenance and repair activities, but in no case shall it be less than 14,450 square feet. The narrowest side shall be not less than one-half the dimension of the widest side (85 feet x 170 feet, minimum).

H. Site Enclosures
All sites shall be enclosed by an intruder resistant enclosure. The security enclosure shall be completely located within the property boundary of the site. Depending on the site location, an acceptable enclosure may be one of the following:

1. Chain link fencing with a minimum height of six feet of chain link fabric, with three strands of barbed wire on top, for total fence height of seven feet, minimum.

2. Masonry wall with a minimum height of seven feet.

3. One eighteen-foot (minimum) drive-through gate and one three-foot four inches walk-through gate. Gates shall be of equivalent height as enclosure and shall be lockable.

I. Site Drainage
Sites shall allow for drainage of storm water and for any drainage of the pumping station for testing, maintenance, or repair.

1. Use drainage swales, curbs, culverts, storm sewers, or a combination thereof, as required, to provide internal site drainage.

2. If an offsite storm sewer or major drainage way is available, site drainage shall be collected before leaving the site.

3. The internal site collection system shall be sized to accommodate storm water as well as any additional water from testing of the pumping station or drainage for repairs.

5.2 Site Layout Design Requirements

This subsection contains the following topics:

- Well Location
- Location of Appurtenances
- Encroachments and Obstructions
- Aboveground Clearances
- Discharge Piping

A. Well Location

Locate the well a minimum of forty feet from the water production facility enclosure (wall or fence, etc.) at the point of access. Provide a thirty-two foot by forty-five foot open area on the quadrant of the well site as indicated in Exhibit 10-1 for laying out column piping during pump repair.

B. Location of Appurtenances

See Exhibit 10-1 for a well site general arrangement. The location of control buildings, hydropneumatic tanks, transformers, and any other appurtenances shall remain clear of the open area.

C. Encroachments and Obstructions

No site boundary, public street right-of-way, utility easement, or power company aerial easement shall encroach on the area within forty feet in front of the well and twenty feet on either side of the well. No physical obstructions on the site shall be within this area.

D. Aboveground Clearances

With the exception of well discharge piping, all plant equipment, fences, plant structures, and aboveground piping shall be at least thirty feet from wells.

E. Discharge Piping

See Exhibit 10-1. Where space permits, locate well discharge piping at a right angle to the direction of well access opposite the open area.

5.3 Piping, Valves and Appurtenances

This subsection contains the following topics:

- Piping General
- Fabrication of Steel Pipe Requirements
- Ductile Iron Pipe and Materials
- PVC Pipe and Materials
- Piping System Design Requirements

A. Piping General

1. The piping shall be designed so that the well will discharge directly into the system or a reservoir.

2. Wells with a direct connection into the distribution system shall be disinfected according to ADEQ and Tucson Water requirements.

3. The aboveground discharge piping shall be fabricated steel or mill type standard steel pipe in accordance with ASTM A53.

4. The below-ground discharge piping shall be fabricated steel pipe, mill type standard steel pipe, ductile iron pipe, or PVC pipe.

5. The aboveground discharge piping shall include piping, check valves, butterfly valves, flex couplings, flow meters, test tees, and other above ground discharge piping appurtenances required for a complete installation. See Exhibit 10-2 for a typical aboveground discharge piping detail.

6. The discharge piping shall be sized for proper operation of the check valve and water meter. Normal velocities should be five feet per second.

7. Put a sample tap and an air release valve before the check valve.

8. Put a pressure gauge between the check valve and flow meter.

9. Put a length of ten pipe diameters of straight pipe leading into the flow meter and a minimum length of five pipe diameters of straight pipe downstream of the flow meter or install in accordance with the meter manufacturer's recommendations, whichever is greater.

10. Provide a well test tee downstream of the flow meter.

B. Fabrication of Steel Pipe Requirements

1. Steel pipe shall be fabricated steel pipe or mill type standard steel pipe in accordance with ASTM A53.

2. The minimum wall thickness shall be as follows:

a.	Less than 5-inch diameter:	Schedule 40
b.	6 to 10-inch diameter:	3/16 –inch
c.	12 to 14-inch diameter:	7/32 –inch
d.	16 to 42-inch diameter:	1/4 -inch
e.	48 to 60-inch diameter:	3/8 –inch
f.	66 to 72-inch diameter:	1/2 -inch

3. Fittings
   a. Flanges shall be Class 125 in accordance with ANSI B16.1 for operating pressures up to 250 pounds per square inch. For operating pressures above 250 pounds per square inch, flanges shall be Class 250 in accordance with ANSI B16.1.

   b. Above-ground fittings shall be flanged, welded, or coupled. Nuts and bolts shall be hot dip galvanized steel or epoxy painted.

   c. Below ground fittings shall be welded or coupled. Nuts and bolts shall be grade 316 stainless steel.

   d. Gaskets shall be butyl or EPDM.

4. Protective Coating
   a. Internal coating shall be a three-coat, two-component catalyzed epoxy system which shall conform to all NSF requirements for potable water service. The minimum thickness shall be 12.0 dry mils, but in no case shall any individual coat be less than 4.0 nor more than 7.0 dry mils.

   b. External coating for above-ground service shall be a two-coat, two-component epoxy system or a polyurethane system. The thickness of this coating system shall be 6.0 - 9.0 mils. The first coat shall be between 4.0-6.0 dry mils, and the second coat shall be between 2.0-3.0 dry mils.

   c. External coating for below-ground service shall be a factory-applied polyurethane system.

C. Ductile Iron Pipe and Materials
1. Ductile iron pipe shall conform to the requirements of Section 1401 of the Tucson Water Standard Specifications.

2. Fittings
   a. Flanges shall be Class 125 in accordance with ANSI B16.1 for operating pressures up to 250 pounds per square inch. For operating pressures above 250 pounds per square inch, flanges shall be Class 250, ANSI B16.1.
   b. Nuts and bolts shall be grade 316 stainless steel.
   c. Gaskets shall be Grade 1 rubber or Buna N.

D. PVC Pipe and Materials
PVC Pipe and fittings shall conform to the requirements of Section 1404 of the Tucson Water Standard Specifications.

E. Piping System Design Requirements
1. The discharge piping shall be sized for proper operation of the check valve and flow meter. Normal velocities shall not exceed five feet per second.

2. Thrust Restraint
   a. Design thrust restraint is required for all above and below-ground installation.

   b. Use restrained joints, welded joints, or joint harnesses for thrust restraint. Reaction blocking and anchors will only be allowed for special conditions as approved by Tucson Water.

   c. Design for flexible couplings to allow expansion, contraction, and maximum serviceability of equipment. Flexible couplings shall be designed to provide a restrained joint.

3. Corrosion control of below-ground metallic pipe shall be in conformance Section 8-11 of these Design Standards.

4. Layout and Clearances
   a. Yard piping shall be located in areas accessible for maintenance and repair.

   b. Clearance between waterlines and sanitary sewers shall conform to the requirements set forth by ADEQ.

5.4 Pumping Units

A. Pumps General

1. Pumps may be either line shaft driven vertical turbine or submersible.

2. The pump capacity shall be such that the run time shall be a minimum of two hours.

3. A pump may be installed in a well that has a design capacity greater than the rated capacity of the pump.

4. The pump should have adequate submergence to allow a pumping level decline for approximately seven-years based on historic regional decline data in the area.

5. The pump curve for the pump shall be as steep as practicable, and shall exhibit a continuously rising characteristic to shut-off head, with no points of zero slope reversal. The pump bowl's efficiency shall be as high as practicable.

6. The pump performance shall be measured at the pump discharge.

B. Line Shaft Driven Vertical Turbine Pumps

1. Vertical turbine well pumps shall be capable of operating at 150% of design head or shut-off head, whichever is less, for not less than two minutes without excessive vibration, binding, rubbing of rotating parts, or damage to the pump.

2. The column pipe assembly shall consist of column pipe, oil tube, line shaft, couplings, bearing and oil tube centralizing stabilizers (spiders). The inner-column (oil tube, line shaft, couplings and bearings) shall be manufactured to Johnston new style standard dimensions and threading.

3. The column pipe and inner column shall be sized to have a column velocity of +/- 5 feet per second at the design point. The column pipe shall be furnished in interchangeable sections of a nominal length of ten feet.

C. Submersible Pumps

Submersible pump construction shall conform to the requirements of Section 1204 of the Tucson Water Standard Specifications.

5.5 Pump Drivers

A. Electric Motors

1. Electric motors shall be three-phase, 480 volt.

2. Size electric motors to carry the full load of the well pump without using the motor service factor.

3. Motor enclosures may be open drip-proof, WP-1 or totally enclosed fan-cooled.

4. Motors of fifty horsepower or more shall have reduced-voltage starting.

5. Provide an anti-reverse ratchet or timer lockout for all vertical turbine pumps. Should the ratchet fail during normal operation, the motor will not start until reverse rotation has stopped. The timer lockout shall provide for two delays in series.

6. In all cases, provide a timer on the well motor start circuit to prevent starting of the well within 300-seconds of shutdown.

7. Motors should be selected to allow compliance or modification for compliance with the City of Tucson and Pima County noise ordinances.

B. Natural Gas Engines

1. Natural gas engines are generally used at remote locations where sound would not be a problem for neighbors.

2. A concrete engine base shall be designed to contain oil spills, or engine crankcase ruptures.

3. A shade structure shall be installed to protect the engine and related hardware.

4. The engine shall be cooled by a dual-wall heat exchanger system.

8-10.6.0 Electrical, Instrumentation and Control Requirements

6.1 Power

A. Electric Service

1. Electric service for Tucson Water facilities shall be designed for actual connected and future loads. Method for sizing service entrance shall comply with Institute of IEEE and NEC guidelines.

2. Service shall be designed for three-phase, 480 volts where available. Single phase power and other service voltages may be acceptable depending upon Tucson Water facilities requirements.

3. Location of the service transformer and meter/current transformer may be either on or off Tucson Water property depending upon Tucson Water water plant requirements. Conduits and service conductors shall be adequately sized for the designed load and shall meet electric utility design standards, National Electric Code and applicable codes.

4. Service meter and current transformers shall be provided by the electric utility. Connection of service entrance equipment and startup shall be coordinated between Tucson Water representatives and contractor and appropriate electric utility personnel.

B. Electrical Distribution System

1. Electrical equipment on the load side of the meter/current transformer shall be owned and operated by Tucson Water.

2. Site layout, electric room general arrangement and power distribution equipment shall be designed to minimize voltage drop, provide operation and maintenance ease and accessibility and meet space requirements in accordance with NEC guidelines.

3. Electrical distribution system may consist of a single or multiple three-phase 480 or 120 volt service disconnect(s) and 480/120 volt power distribution equipment.

4. Distribution equipment may consist of motor control centers or pump panels, circuit breakers and/or fused disconnect switches, motor starters, 480-240/120 volt service transformers, wireway and/or conduit, etc.

5. Distribution system and equipment shall be designed to adequately supply the design load and shall be in accordance with National Electric Code, National Electrical Manufacturers Association, IEEE and applicable codes and practices.

6.2 Instrumentation and Control

A. Process Control and Instrumentation
Process control and instrumentation at Tucson Water facilities may be local and remote with manual override capabilities or local with manual override capabilities depending upon site. Process control and instrumentation equipment shall be selected for use within manufacturers recommended guidelines.

B. Field Devices
Field devices shall be located on or near piping and reservoir roofs and consist of pressure and/or flow switches/sensors, flow meters, level sensors and switches, transmitters, actuators, etc. Field devices shall be designed and calibrated to meet site specific flow, level and pressure ranges, etc.

C. Motor Control Circuitry
Motor control circuitry shall be located in a motor control center or pump panel enclosure, which can be either in the field or electric room. Motor control center or pump panel shall be sized to provide adequate space for motor power and control circuitry.

D. Control and Instrumentation Compatibility
All control and instrumentation shall be compatible with and routed through a PLC located in a station control panel either indoors or outdoors, which is used for controlling and/or monitoring the site.

E. Communications and SCADA
Communications and SCADA shall use radio or leased lines depending on facility water plant requirements.

8-10.7.0 Disinfection Requirements

Tucson Water will determine the requirements for disinfection systems on a case by case basis.

If a disinfection system is required based on Tucson Water's determination, the system will be designed to accommodate the specific needs of the water system.

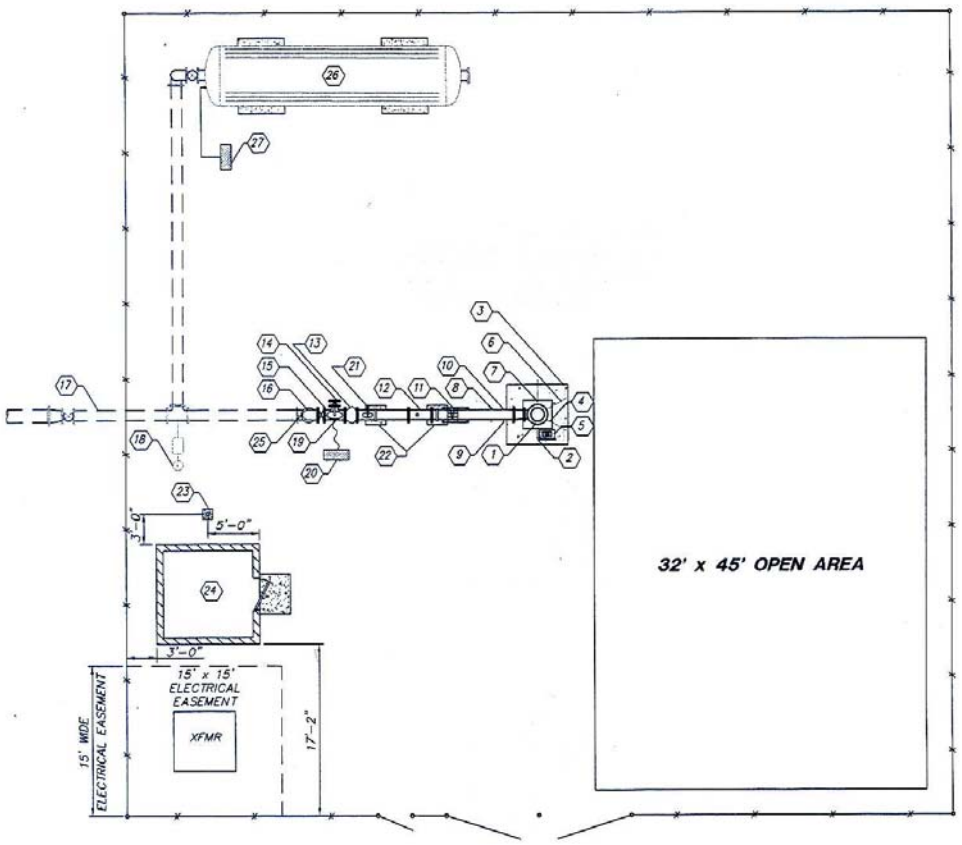
All disinfection systems will be designed by Tucson Water.

8-10.8.0 Exhibits

Exhibit 10-1, Example Site Layout of Typical Pumping Station
Exhibit 10-2, Example of Typical Above-Ground Discharge Piping Detail

Exhibit 10-1, Example Site Layout of Typical Pumping Station

EXAMPLE SITE LAYOUT (ILLUSTRATION 1)

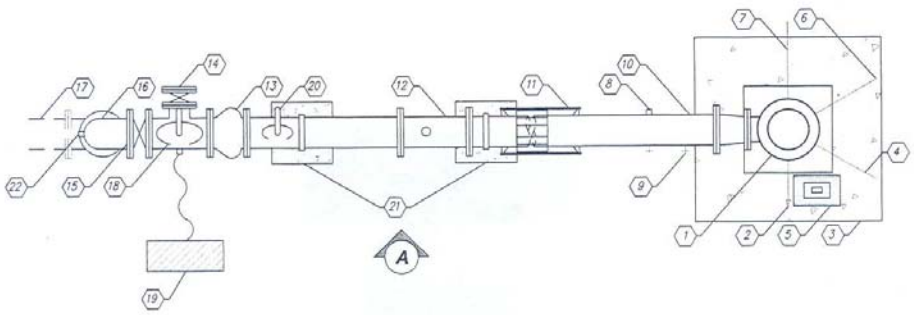


PIPING & EQUIPMENT

1. PUMP & MOTOR
2. GRAVEL FILL TUBE
3. 6' x 6' CONCRETE WELL BASE
4. WATER LEVEL SENSING DEVICE
5. OIL RESERVOIR
6. SOUNDING TUBE
7. SCREEN VENT
8. 3/4" THRED-O-LET ON HOIZ ℄ W/PLUG
   3/4" THRED-O-LET ON HORIZ ℄ (OPPOSITE SIDE) CORPORATION, HOSE BIBB & VACUUM BREAKER
9. 3/4" THRED-O-LET ON HORIZ ℄ W/ 3/4" CORPORATION & SAMPLE PLAIN END FAUCET
10. STANDARD STEEL SPOOL PIECE (S.S.S.P.)
11. FLEX COUPLING & HARNESS ASSEMBLEY
12. FLOWMETER
13. CHECK VALVE
14. TEST TEE W/BUTTERFLY VALVE & BLIND FLANGE
15. BUTTERFLY VALVE
16. 90° BEND, VERTICAL W/ 1" THRED-O-LET & CORP.
    S.S.S.P., VERTICAL
    90° BEND, VERTICAL
17. BELOWGROUND PIPING
    NOTE: ALL UNDERGROUND PIPE SHALL BE INSTALLED WITH RESTRAINED JOINTS.
18. SAMPLE FAUCET
19. 3" THRED-O-LET & BALL VALVE ON TOP OF TEST TEE
20. PRESSURE CONTROL ASSEMBLY, BASE & PEDESTAL
21. 2" THRED-O-LET ON TOP VERTICAL ℄ W/2" COMBINATION AIR RELEASE VALVE
22. PIPE SADDLE SUPPORT
23. ANTENNA
24. CONTROL BUILDING
25. 1" THRED-O-LET & CORPORATION ON VERTICAL S.S.S.P. FOR DISINFECTION
26. HYDRO TANK
27. AIR COMPRESSOR

Exhibit 10-2, Example of Typical Above-Ground Discharge Piping Detail

EXAMPLE ABOVE-GROUND DISCHARGE PIPING DETAIL (ILLUSTRATION 2)



PIPING & EQUIPMENT

1. PUMP & MOTOR
2. GRAVEL FILL TUBE
3. 6' x 6' CONCRETE WELL BASE
4. WATER LEVEL SENSING DEVICE
5. OIL RESERVOIR
6. SOUNDING TUBE
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   3/4" THRED-O-LET ON HORIZ ℄ (OPPOSITE SIDE) CORPORATION, HOSE BIBB & VACUUM BREAKER
9. 3/4" THRED-O-LET ON HORIZ ℄ W/ 3/4" CORPORATION & SAMPLE PLAIN END FAUCET
10. STANDARD STEEL SPOOL PIECE (S.S.S.P.)
11. FLEX COUPLING & HARNESS ASSEMBLEY
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13. CHECK VALVE
14. TEST TEE W/BUTTERFLY VALVE & BLIND FLANGE
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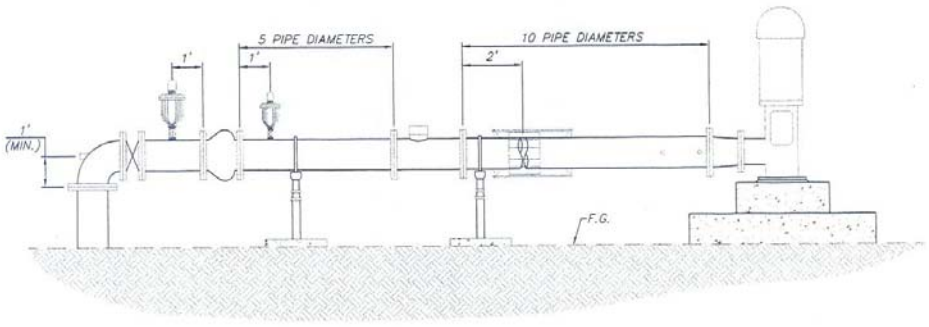


SECTION A-A

TABLE OF CONTENTS

WATER CORROSION CONTROL DESIGN STANDARDS

8-11.0.0 WATER CORROSION CONTROL DESIGN STANDARDS

8-11.1.0 General

1.1 Purpose

This section describes design standards and requirements for corrosion control of public water projects.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms. The following definitions are unique to this section.

A. "Cathodic Protection Design Report." A report based on the findings of the Corrosion Pre-Design Report or Corrosion Pre-Design Survey. This report provides Cathodic design and supporting information for the design of a Cathodic Protection System.

B. "Cathodic Protection." Electrical current applied to the water main to protect the metallic components from corrosion.

C. "Corrosion Letter Report." A report in letter form submitted by the designer at the close of a project. This report is not required if a Final Corrosion Report will be produced.

D. "Corrosion Monitoring System Design Report." A report based on the findings of the Corrosion Pre-Design Report or Corrosion Pre-Design Survey. This report provides design and supporting information for the design of a Cathodic Monitoring System.

E. "Corrosion Monitoring System." A series of CTSs to monitor the metallic components of the pipe to determine if there is any corrosion occurring.

F. "Corrosion Pre-Design Report." A report submitted by the designer identifying potential corrosion issues for any new pipe.

G. "Corrosion Pre-Design Survey." A report submitted by the designer identifying potential corrosion issues for any new pipe.

H. "CTS." Acronym for Corrosion Test Station.

I. "Final Corrosion Report." A report submitted by the designer at the close of a project.

J. "Metallic Water Mains." Any pipe used for water mains that have any metallic components, i.e., concrete cylinder pipe or ductile iron pipe.

K. "Modification." Reconstruction of any existing Tucson Water facilities that are in conflict with the proposed roadway construction. All new materials are used.

L. "Project limits." The limits of proposed construction as defined by the controlling agency.

M. "Relocated." Existing CTSs are relocated when in conflict with the proposed roadway construction. Relocation consists of furnishing and installing new components at a new location. Existing components are salvaged and returned to Tucson Water.

N. "Water System Modifications Design." An engineered design for reconstruction and replacement of water mains in conflict with proposed roadway or other improvements.

1.3 Applicability

Plans for new pipe or a connection to existing pipe shall be reviewed by the Corrosion Control Unit for corrosion prevention and monitoring requirements if the pipe meets the following criteria of material and size:

- Welded steel pipe, concrete cylinder pipe, prestressed concrete cylinder pipe, or ductile iron pipe,

- Transmission mains (sixteen-inch in diameter and larger).

8-11.2.0 Design Requirements, Corrosion Control

2.1 General Requirements Corrosion Test Stations

A. Corrosion Test Station Maximum Spacing

All corrosion test stations used for potential, current, or resistance measurements shall be at enough locations to facilitate data collection. The locations shall be a maximum of 1,000 feet apart.

B. Electrical Continuity
All pipelines shall be electrically continuous between corrosion test stations through joint bonding wires, bonding clips, or welded joints. All welded steel pipe will be concrete mortar lined and exterior coated.

C. Locations and Type Requirements
Locations and type requirements of corrosion test stations shall include, but not be limited to, the following:

1. Type I corrosion test stations are required at a maximum of 1,000 foot intervals and are required at rectifier installations;

2. Type II corrosion test stations are required at pipe casing installations where metallic casings are required;

3. Type III corrosion test stations may be required at foreign, cathodically protected, pipeline crossings.

4. Type IV corrosion test stations are required at electrically isolating joints; and,

5. Type V corrosion test stations are required at galvanic anode installations. No anodes shall be directly connected to the pipe.

D. Locations of Isolating Joints
Isolating Joints (and therefore Type IV corrosion test stations) are required in the following locations:Changes in pipeline materials, i.e. ductile iron pipe, concrete cylinder pipe, welded steel pipe, etc.;

2. Connections to existing piping, i.e. old and new piping;

3. Inlet and outlet piping of plant facilities;

4. Laterals from transmission mains; and,

5. Taps to existing ductile iron pipe, welded steel pipe, concrete cylinder pipe and prestressed concrete cylinder pipe.

2.2 Corrosion Reports

Corrosion Reports shall be required in accordance with the flowchart in Exhibit 11-1.

A. Corrosion Pre-Design Report

1. If no more than four hundred nintey-nine feet is required for modifications and if required by Tucson Water, the designer shall include a corrosion pre-design report as part of the preliminary design.

2. This report must be submitted for approval by the 50% design stage of the project and shall include analysis of electrochemical soil and groundwater samples collected by the geotechnical firm.

3. The designer shall perform a corrosivity study along the proposed water main route and shall develop corrosion prevention and monitoring design requirements and recommendations based upon the corrosivity study.

4. The Corrosion Pre-Design Report shall include the following:
   - Field soil resistivity measurements;
   - Soil and groundwater sample analyses;
   - Stray DC earth current and foreign line cathodic protection system activity; and,
   - Identification of potential corrosion problems.

B. Corrosion Pre-Design Survey Report

1. If more than four hundred nintey-nine feet is required for modifications and if required by Tucson Water, the designer shall include a corrosion pre-design survey in the preliminary design. This report must be submitted for approval by 50% of the project design stage.

2. The designer shall perform a corrosion survey along the proposed water main route. The designer shall develop corrosion prevention and monitoring design requirements and recommendations based upon the corrosion survey. The corrosivity study, corrosion prevention, monitoring, design requirements, and recommendations shall be documented in the “Corrosion Pre-Design Survey Report.”

3. The Corrosion Pre-Design Survey Report will include:
   - Field soil resistivity measurements;
   - Stray DC earth current and foreign line cathodic protection system activity; and,
   - Identification of potential corrosion problems.

8-11.3.0 Soil Test Requirements, Corrosion Control

3.1 Field Soil Resistivity Measurements

A. Soil Resistivity Measurement Method

Soil resistivity shall be measured and recorded to various depths by the four-pin Wenner method in accordance with ASTM G57 at 1,000-foot maximum intervals along the entire length of the proposed water main route. Included shall be measurements in wash areas and changes in terrain.

B. Depths of the Measurements
The depths of the measurements at each test location shall be at five-foot increments from grade to the depth of the pipe invert. The data shall then be analyzed for each five-foot layer using the Barnes layer analysis method, where applicable.

C. Placement of Soil Pins
Placement of soil pins for soil resistivity testing shall avoid all underground metallic structures. Where it is not possible to avoid underground metallic structures, the soil pins shall be either parallel to or perpendicular to the existing underground metallic structures.

3.2 Soil and Groundwater Sample Collection and Analyses

A. Soil Borings
Soil borings for soil and groundwater sample collection shall be performed at a maximum of 2,000-foot intervals along the entire length of the proposed water main route and shall be made as follows:

- For pipe seventy-two-inch and less in diameter, two soil samples shall be collected, one at the planned crown of the pipe and one at the planned invert of the pipe.

- For pipe greater than seventy-two-inch in diameter, three soil samples shall be collected; one at the planned crown of the pipe, one at the planned spring line of the pipe and one at the planned invert of the pipe.

When groundwater is encountered, a sample of ground water shall be collected by bail for laboratory analysis.

B. Soil Analysis
Soil samples shall be analyzed in a laboratory approved by Tucson Water. Analyses shall quantify the following constituents and characteristics using either of the indicated analyses methods:

Test Parameter	ASTM Method	EPA Method
Moisture Content	D-2216	Loss @ 105 C
Conductivity	D-1125	120.1
pH	D-2976	SW 846-9045B
Chloride Ion Concentration	D-512	300.0
Sulfate Ion Concentration	D-516	300.0
Sulfide Ion Concentration		EPA 376.1376.1
Type Classification	USDA Std	USDA Std

C. Groundwater Analysis
When available, groundwater samples shall also be analyzed in a State-certified laboratory and shall quantify the following constituents and characteristics using either of the indicated analyses methods:

Test Parameter	ASTM Method	EPA Method
Conductivity	D-1125	120.1
pH	D-2976	150.1
Chloride Ion Concentration	D-512	300.0
Sulfate Ion Concentration	D-516	300.0

8-11.4.0 Laboratory Data Evaluation

All field and laboratory data obtained the study shall be used to develop corrosion prevention and monitoring design recommendations. General guidelines for interpreting the data are as follows:

A. Soil Moisture Content
The higher the moisture content of soil, the greater the anticipated corrosivity of the soil. Soil moisture contents can range from 1% in very dry sands to 40% in clays holding large quantities of water. Typical values are 10% to 15%. Contents in excess of 20% are considered very high.

B. Conductivity
For a given corrosion cell with a fixed potential difference between the anode and cathode, the higher the conductivity the greater the corrosion rate. Conductive readings greater than 350 micro ohms are considered very high and corrosion prevention shall be evaluated.

C. pH
Acidic soils and groundwater are more conducive to corrosion of ferrous materials than are alkaline soils and groundwater. Where the pH of soils and groundwater is less than 5.0, protective measures shall be implemented to prevent corrosion of ferrous components.

D. Chloride Ion Concentration
Breakdown of passive film on mortar embedded steel with subsequent corrosion of the steel and accelerated corrosion of other metallic pipe (steel, cast iron and ductile iron) can occur if chlorides are present at the steel or metal surface. The threshold for passive film breakdown and accelerated corrosion activity is approximately one pound of chloride ions per cubic yard of soil. Chloride ions usually reach metallic surfaces by groundwater transmission. Many soils have chloride ion concentrations less than ten parts per million. Chloride ion concentrations greater than fifty parts per million are considered significant and corrosion prevention shall be considered.

E. Sulfide Ion Concentration
The presence of any detectable sulfide ions in soil samples indicates anaerobic conditions that may cause deterioration of the pipeline by microbiologically influenced corrosion. Corrosion prevention shall be applied under these conditions.

F. Sulfate Ion Concentration
Naturally occurring sulfates of sodium, potassium, calcium, and magnesium are sometimes contained in soils or dissolved in groundwater. These sulfates have been known to chemically attack concrete and mortar. The sulfates react with the calcium aluminate hydrates to form sulfurluminates. This attack has been most common in partially buried pipe where capillary action may build up high sulfate concentrations at the ground level.

G. Cement Concentrations
AWWA C301-84 specifies that the cement for concrete and mortar work used for concrete pressure pipe shall conform to ASTM C150 types II or I. Under known levels of sulfate ion concentrations, specific cements shall be used as follows in parts per million (ppm):

- ASTM C150, Type I Less than 150 ppm
- ASTM C150, Type II From 150 ppm to 500 ppm
- ASTM C150, Type IV From 500 ppm to 1500 ppm
- ASTM C595, Type IS From 1500 ppm to 2500 ppm
- ASTM C595, Type IP From 2500 ppm to 4000 ppm

H. Soil Resistivity
Soil resistivity is a parameter commonly used to evaluate the corrosivity of soil. Resistivity is essentially the inverse of conductivity and is measured in units of ohm-centimeters. Corrosivity is often an inverse function of resistivity with low resistivity soils being more corrosive than high resistivity soils. Resistivity is also related to concentrations of salts with low resistivities indicating high concentrations of salt. Resistivities less than 3,000 ohm-centimeters are considered corrosive and corrosion prevention is required.

8-11.5.0 Field Data Evaluation

A. Corrosion Prevention Study
The corrosion prevention study shall include field investigations to detect and identify stray DC earth current activity, foreign (to the project being designed) line cathodic protection systems, and other situations that may result in corrosion problems. These field investigations shall be conducted concurrently with field soil resistivity measurements and soil and groundwater sample collections.

B. Direct Current Activity Survey
The entire proposed water main route shall be surveyed for stray direct current activity. The survey shall include structure-to-soil potential measurements (or earth gradient measurements where points of contact on existing structures are limited) on existing structures in the immediate area of the proposed water main. These measurements shall be made at as many points as practicable. The maximum intervals between test points shall not exceed 1,000 feet.

Test points may include fire hydrants, power poles, ground rods, and foreign pipelines.

C. Utility Survey
The entire proposed water main route shall be surveyed with respect to crossings of foreign pipelines and paralleling utility systems. Information on cathodic protection systems on foreign lines shall be collected including the locations of foreign line test stations, rectifier DC outputs, and foreign line coating condition. This information shall be used to produce preliminary estimates of requirements for interference bonding and other interference mitigation techniques. Locations with availability of commercial electric power shall also be identified and documented in the event impressed current cathodic protection should be required.

D. Alternating Current Power Lines
Where pipelines are to be installed parallel to high voltage alternating current power lines, the conditions shall be evaluated for potential problems from induced alternating current. Consideration shall be given to personnel safety during construction and access to pipeline appurtenances during operation. Ground systems for mitigating induced alternating current systems shall be compatible with the proposed corrosion prevention system.

8-11.6.0 Corrosion Report Content Standard

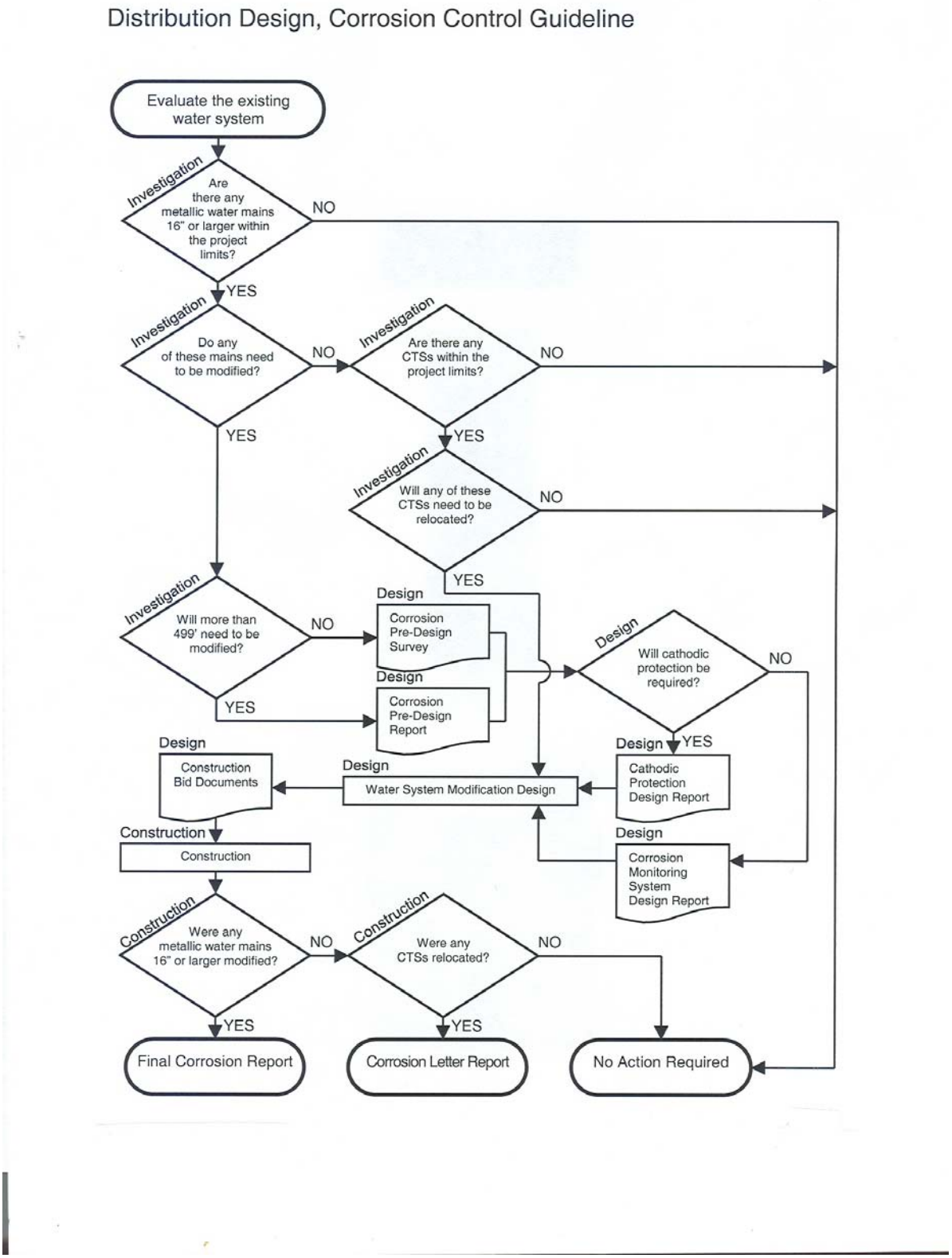
Upon completion of all testing, a written report shall be submitted which includes all data, data analyses and a general description of the corrosion prevention recommendations. The report shall include recommendations for the following items as appropriate for the proposed water main route:

- Pipe of material other than that planned for use
- Non-standard concrete and mortar
- Other pipeline and utility locations crossing or near proposed mains
- Dielectric coating materials
- Electrical isolation recommendations
- Cased crossings
- Treatments for connecting water mains and services
- Stray current control devices
- Cathodic protection system type(s) incorporating a minimum usable life of 20 years
- Anode requirements incorporating a minimum usable operating life of 20 years
- Other special or non-standard design considerations
- Induced alternating current mitigation requirements

8-11.7.0 Exhibits

Exhibit 11-1, Distribution Design, Control Guideline Flowchart

Exhibit 11-1, Distribution Design, Control Guideline Flowchart



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BACKFLOW PREVENTION AND CROSS-CONNECTION CONTROL

8-12.1.0 General

8-12.0.0 BACKFLOW PREVENTION AND CROSS-CONNECTION CONTROL

8-12.1.0 General

1.1 Purpose

This section describes the standards and requirements for backflow prevention and cross-connection control for the protection of Tucson Water's distribution systems.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

Additional and more specific definitions are included in Tucson Ordinance No. 9976, Backflow Prevention and Cross-Connection Control.

1.3 Applicability

City facilities and Tucson Water customers who have the potential of cross-contaminating the Tucson Water system are required to install a backflow prevention method and then to have any assemblies tested annually.

Backflow prevention and cross-connection control projects are to adhere to a separate document entitled Code, City of Tucson, Arizona, (Ordinance No. 9976, effective July 01, 2004).

All information not specifically stated in the Code (standard details, etc.) is available from Tucson Water or is on the Tucson Water web site at:

http://www.ci.tucson.az.us

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SPECIAL SPECIFICATIONS & STANDARD SPECIFICATIONS AND DETAILS

8-13.0.0 SPECIAL SPECIFICATIONS & STANDARD SPECIFICATIONS AND DETAILS

8-13.1.0 General

1.1 Purpose

This section describes the standards and requirements for the Special Specifications portion of the contract for public water projects and for Tucson Water's Standard Specifications and Details.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 Applicability

The requirements listed herein apply to all types of public water projects.

8-13.2.0 Construction Specifications

Construction specifications are text documents that describe legal, administrative and project construction requirements and address the following major topics:

- Document Relationships
- Standard General Conditions of the Construction Contract
- Standard Specifications
- Special Specifications

2.1 Document Relationships

This subsection on document relationships will address the following major topics:

- Construction Documents
- Bid Document
- Bid Package
- Contract Documents

A. Construction Documents

Project construction requirements are contained in the following construction documents:

1. Standard General Conditions of the Construction Contract

2. Construction Specifications, which include:
   a. Standard Specifications
   b. Special Specifications

B. Bid Document
   1. Construction specifications, which include the Standard Specifications and the Special Specifications, are just one part of a document referred to as the bid document.

   2. For a complete list of items in the Bid Document, refer to Exhibit 13-1, List of Items Defining the Contract Documents, page 13-11 at the end of this standard.

   3. The bid document is prepared during the design of the project.

C. Bid Package
   1. The bid document and plans are referred to as the bid package.

   2. The plans include the Project Plans and the Standard Specifications and Details, by reference.

   3. The bid package is prepared during the design of the project.

D. Contract Documents
   1. Additional items are also prepared during the bidding period and during the construction period. All of these items and those listed above are referred to as the Contract Documents.

   2. For a complete list of items in the Contract Documents, refer to Exhibit 13-1, List of Items Defining the Contract Documents, page 13-11 at the end of this standard.

   3. This standard does not address the entire list of items that constitute the Contract Documents.

2.2 Standard General Conditions of the Construction Contract

This subsection addresses the following topics regarding Standard General Conditions, of the Construction Contract:

- Sections
- Subsections
- Procurement Department Revisions

The Standard General Conditions are not to be revised without approval by the Procurement Department.

A. Sections

The following sections within the Standard General Conditions, of the Construction Contract, contain legal, administrative and construction requirements:

Section 0101 - Abbreviations And Terms
Section 0102 - Bidding Requirements And Conditions
Section 0103 - Award And Execution Of Contract
Section 0104 - Scope Of Work
Section 0105 - Control Of Work
Section 0106 - Control Of Material
Section 0107 - Legal Relations & Responsibility To Public
Section 0108 - Prosecution And Progress
Section 0109 - Measurement And Payment
Section 0110 - Project Signs

B. Subsections
For a detailed list of subsections of the Standard General Conditions, of the Construction Contract, refer to Exhibit 13-2, Table of Contents, Standard General Conditions, Tucson Water Contract, page 13-13.

C. Procurement Department Revisions
1. Before proposing a section revision, thoroughly review the Standard General Conditions to verify that these existing documents appear inadequate for the needs of the project.

2. Each section shall be cross-referenced numerically to the section being revised in the Standard General Conditions.

3. Each section shall state the purpose of the revision.

4. The Procurement Department must approve all revisions to the contract Standard General Conditions.

2.3 Standard Specifications

This subsection contains the following major topics:
- Purpose
- Source Documents
- Revision Process - Tucson Water Standard Specifications

A. Purpose
1. Standard specifications of construction are specifications of a general nature approved for repetitive use describing details of construction that are applicable to a variety of works.

2. They are included in the contract documents by reference in the Standard General Conditions.

B. Source Documents

The following are source documents that contain additional requirements for these standards:

1. Standard Specifications for Public Improvements, current Edition, City of Tucson/Pima Co.:
   - Division 100 – General Provisions (not part of contract)
   - Division 200 – Grading
   - Division 300 – Subgrade, Subbases and Bases
   - Division 400 – Surface Treatments and Pavements
   - Division 500 – Drainage Facilities
   - Division 600 – Structures
     - Section 510 – Potable Water Systems
     - Section 511 – Reclaimed Water Systems
   - Division 700 – Traffic Control Facilities
   - Division 800 – Roadside Development
   - Division 900 – Incidentals
   - Division 1000 – Materials

2. Standard Specifications and Details, Tucson Water:
   - Section 0200 – Sitework
   - Section 0300 – Concrete And Reinforcing Steel
   - Section 1200 – Pumps
   - Section 1400 – Piping, Valves And Appurtenances

   For a list of subsections of the Tucson Water standards, see Exhibit 13-2, Table of Contents, Standard General Conditions, Tucson Water Contract, p. 13-13 at the end of this section.

C. Revision Process, Tucson Water Standard Specifications

Revisions to the Standard Specifications must meet the same requirements and review as applied to the original document.

Revisions to the Standard Specifications that would be applicable to all or most projects should be accomplished using the same process as in Section 8-02, Administration of Water Design Standards Manual.

2.4 Special Specifications, Project Specific

This subsection contains the following major topics:

- Purpose
- Revision Process - Tucson Water Special Specifications
- Format Requirements
- Content Requirements

A. Purpose

Special Specifications encompass conditions that are unique to a specific project, and shall be used to interpret, clarify, and supplement the standard specifications. When a special specification becomes standard for each project, the special specification should be incorporated into the standard specification.

B. Revision Process, Tucson Water Special Specifications

1. Revisions to the Standard Specifications that would be applicable to all or most projects should be accomplished using the same process as in Section 8-02, Administration of Water Design Standards Manual.

2. If the revisions are only applicable to a particular project, they can be listed in the Special Specifications for this project's document.

3. Before proposing a new special specification or a revision, thoroughly review all existing special specifications to verify that these existing documents appear inadequate for the needs of the project thus requiring use of the Special Specifications, or revisions to existing Special Specifications.

4. Each section shall be cross-referenced numerically to the section being revised in the standard specifications.

5. Each section shall state the purpose of the revision.

6. The Construction Section of Tucson Water must approve each revised section of the standard specifications that will be included in the Special Specifications.

7. Obtain additional approvals as required in Section 8-04.

C. Format Requirements

1. Master Format

The format of the Special Specifications shall be consistent with The CSI, 1995 edition of MasterFormat (trademark).

2. Section Format

a. Section Names

Each section of the Special Specifications shall be named and numbered in accordance with the CSI format. For section names to be used for water projects, refer to Exhibit 13-4, Section Names Format, Special Specifications, For Water Projects, page 13-19, at the end of this standard.

The section name and number shall appear centered at the top of the first page of each section.

b. Section Part Names
Each section of the Special Specifications shall be divided into the following parts; however, if a part is not used, the words "(Not Used)" shall appear to the right of the part name:
PART 1 - GENERAL
PART 2 - MATERIALS (Not Used)
PART 3 - CONSTRUCTION DETAILS
PART 4 - METHOD OF MEASUREMENT
PART 5 - BASIS OF PAYMENT

c. Subsection Format
The subsection format shall be in accordance with Exhibit 13-5, Subsection Format, Special Specifications, page 13-25, at the end of this standard.

d. End of Section
At the end of each section, the words "END OF SECTION ____ (type in appropriate section number)" shall appear centered below the last paragraph.

e. Section Page Footnotes:
Footnotes at the end of each Section in the Special Specifications shall appear as follows:

Left:	date of last page revision, i.e., 032202
Center:	section and page number, i.e., 01440-2
Right:	section name, i.e., Work Restrictions

D. Content Requirements
1. Table of Contents
A table of contents is required and shall be in accordance with Exhibit 13-6, Table of Contents Format, Special Specifications, page 13-27 at the end of this standard.

2. Mandatory Sections
The following shall be required in all Special Specifications:
01110 Summary of Work
01140 Work Restrictions
01310 Project Management And Coordination
01320 Construction Progress Documentation

3. Mandatory Subsections
The following subsections are required in each section of the Special Specifications:
a. a list of the section contents including a list of related sections,
b. the submittal requirements for the section, and
c. any new definitions applicable only to the section.

8-13.3.0 Construction Details

This subsection contains the following major topics:

- General
- Standard Details
- Sections & Details
- Submittals by Contractor

3.1 General

Construction details are drawing documents that visually depict project construction requirements.

A. Construction Details

Project construction requirements are contained in the following details:

- Standard Details
- Sections & Details, Project Specific
- Submittals by Contractor

B. Construction Plans

1. Sections & details are one part of a bound document referred to as the plans.

2. The plans are prepared during the design of the project.

3. For requirements of water plans, refer to Section 8-07.

3.2 Standard Details

This subsection contains the following major topics:

- Purpose
- Source Documents
- Revision Process, Tucson Water Standard Details

A. Purpose

1. Standard details of construction are drawings of a general nature approved for repetitive use showing details of construction that are applicable to a variety of works.

2. They are included by reference in the Standard General Conditions. They are not to be drawn on the plan sheets.

B. Source Documents

The following are source documents also contain additional requirements for these standards:

1. Standard Details for Public Improvements, current Edition, City of Tucson/Pima Co.

2. Standard Specifications and Details, Tucson Water, which includes a section titled Standard Water Details.

C. Revision Process, Tucson Water Standard Details
Revisions to the Standard Details must meet the same requirements and review as applied to the original document.

1. Revisions to the Standard Details that would be applicable to all or most projects should be accomplished in accordance with Section 8-02, Administration of Water Design Standards Manual.

2. If the changes are only applicable to this project, changes can be included on the plans for the project.

3. Before proposing a new or revised detail, thoroughly review all the standard details to verify that these existing documents appear inadequate for the needs of the project; thus, requiring use of the new or revised detail.

4. Each detail shall be cross-referenced numerically to the detail being revised, if applicable, in the standard details.

5. Each new or revised detail shall state the purpose of the revision.

6. The Construction Section of Tucson Water must approve each new or revised section of the standard details.

3.3 Sections & Details, Project Specific

A. Sections & Details

1. Project specific Sections & Details are unique to the project, may apply to numerous sheets within the project and are not included as part of any standard details.

2. A “Section Indicator Cross Referencing” system shall be defined.

B. Sections & Details, Sheet Specific

1. Sheet specific Sections & Details are unique to the plan sheet on which they appear and are not included in any standard details.

2. They usually are a unique detail to a specific project location.

3.4 Submittals by Contractor

A. Drawings Received from the Contractor
Working drawings/cut sheets are furnished by the Contractor during construction for detailed control of the work and are not to be included in the plans.

B. Submittal Requirements

1. Working/shop drawings and associated submittal requirements are described in the Water Department project construction contract, Standard General Conditions (General Provisions), Section 0105.0200.

2. GIS Database Information Tracking. Detailed equipment design information shall be submitted for each project. The GIS VMDB and Synergen work order fields are updated to describe features such as the number of turns on valves, size and location of facilities, and other equipment details, for the purposes of proper operation, and incorporating data into the MMP.

C. Certain Submittals Not Required
Submittals are not required for products contained in the approved material list, Appendix A, Tucson Water Standard Specifications and Details.

8-13.4.0 Exhibits

Exhibit 13-1, List of Items Defining the Contract Documents

Exhibit 13-2, Table of Contents, Standard General Conditions, Tucson Water Contract

Exhibit 13-3, Table of Contents, Tucson Water Standard Specifications and Details

Exhibit 13-4, Section Names Format, Special Specifications, For Water Projects

Exhibit 13-5, Subsection Format, Special Specifications

Exhibit 13-6, Table of Contents Format, Special Specifications

Exhibit 13-1, List of Items Defining the Contract Documents

- ITEMS DURING DESIGN PERIOD
  1. Advertisement For Bids, a.k.a. – Announcement, Notice Inviting Sealed Bids, Notice Of Invitation For Bid, Notice Of Intention To Receive Sealed Bids

  2. Bid Document
     - Cover Page
     - Interior Cover Page
     - Notice
     - Notice Of Invitation For Bid
     - Table of Contents
     - Construction Agreement
     - Forms, for low bidder
       - Substitute Securities
       - Consent Of Surety To Final Payment…
       - Escrow Instructions And Agreement
       - General Contractor's Certification…
       - SubContractor's Statement…
       - Contract Bonds
       - Payment Bond
       - Performance Bond
       - Standard General Conditions (a.k.a. General Provisions)
       - Construction Specifications
       - Special Specifications
       - Standard Specifications, And Supplemental Specifications (revisions since publication of Standard Spec.)

     - Bid Opening Submittal (required bid pages)
       - Invitation for Bid Amendment, No. 2, MWBE Provisions (signed)
         - MWBE Affidavit (signed)
       - Invitation for Bid amendment, No. 1, Standard Conditions (signed)
         - Item 1 – refund of deposit
         - Item 2 – mod. To Standard Conditions, Section 0108.0900
         - Item 3 – mod. To Standard Conditions, Section 0105.0400
       - Proposal, including
         - Bid Summary Sheet and/or Bid Schedule, a.k.a. bid sheets, bid form
         - Bid Security (check or surety bond (signed), with power of attorney form (signed) for signing official)
       - Forms, to be signed
         - Non-Collusion Affidavit
         - Receipt of Addenda, a.k.a. certification
         - Receipt of Bid Document (form not provided)

  3. Plans (Project Plans, Standard Details (included by reference)
     Note: All references to "days" are "calendar days."

- ITEMS DURING BIDDING PERIOD
  1. Invitation for Bid Amendments, a.k.a. Contract Amendment, Contract Supplement (after advertisement, before bid opening)

  2. Bid Opening

  3. Notice of Intent to Award, to be sent within 60 days after bid opening

  4. Items from the Successful Bidder
     a. MWBE Items
        Bidder's Statement of Proposed MWBE Plan (submit within one day after bid opening)
        Affidavit of Good Faith Efforts, MWBE (submit within 1 day of bid)

     b. Certificates Of Insurance, within 10 days of Notice of Intent to Award

     c. Bonds
        Payment Bond, with power of attorney form (signed) for signing official, within 10 days of Notice of Intent to Award
        Performance Bond, with power of attorney form (signed) for signing official, within 10 days of Notice of Intent to Award
        Return of Bid Bond, within one day of receipt of Payment Bond and Performance Bond

     d. Substitute Securities
        Consent Of Surety To Final Payment…
        Escrow Instructions And Agreement (Substitute Securities)
        General Contractor's Certification As To Substitute Securities
        SubContractor's Statement As To Substitute Securities

  5. Items regarding Notice of Award
     a. Notice of Award
        (acceptance of bid and all requested documents), by certified letter
     b. Contract Agreement (executed)
        By Contractor, within 10 days of Notice of Intent to Award
        By City, within 45 days of Notice of Intent to Award

     c. Affirmative action items, due prior to Notice To Proceed
        Federal Minority Employment Utilization Report
        City Affirmative Action Questionnaire
        Affirmative Action Plan, or submit annually

- ITEMS DURING CONSTRUCTION PERIOD
  1. Working Drawings
  2. Supplemental Agreement a.k.a., Change Authorization/Change Order

Exhibit 13-2, Table of Contents, Standard General Conditions, Tucson Water Contract

Exhibit 13-3, Table of Contents, Tucson Water Standard Specifications and Details

SITEWORK

CONCRETE AND REINFORCING STEEL

PUMPS

PIPING, VALVES AND APPURTENANCES

PIPING, VALVES AND APPURTENANCES (cont.)

STANDARD WATER DETAILS

SD 105 GENERAL CONSTRUCTION NOTES
SD 106 GENERAL SEWER/WATER CROSSING DETAILS
SD 107 DRAINAGE FACILITY CROSSING DETAILS
SD 108 JOINT USE TRENCH
SD 110 CUSTOMER NOTIFICATION
SD 115 PIPE BEDDING AND TRENCH BACKFILL
SD 300 VALVE BOX INSTALLATION
SD 305 VALVE NUT EXTENSION
SD 309 WATER SERVICE NOTES
SD 310 WATER SERVICE CONNECTIONS 3/4 INCH AND 1 INCH SINGLE
SD 311 1 INCH SPLIT SERVICE CONNECTIONS
SD 312 WATER SERVICE CONNECTIONS 1-1/2 INCH AND 2 INCH SINGLE
SD 313 STANDARD LARGE TURBINE, COMPOUND, ELECTRIC METER INSTALLATIONS
SD 314 STANDARD LARGE METER ENCLOSURE
SD 315 NOTES FOR BORING SERVICE LINES
SD 316 SERVICE RENEWALS AND TIE OVERS
SD 317 PURGING OF SERVICE LINES
SD 318 METER BOXES
SD 330 AIR RELEASE VALVE INSTALLATION 3/4 INCH OR 1 INCH
SD 331 AIR RELEASE VALVE INSTALLATION 2 INCH
SD 335 STANDARD VAULT
SD 340 SYSTEM INSTALLATION OUTSIDE PUBLIC RIGHT-OF-WAY
SD 350 SYSTEM ABANDONMENT
SD 400 DRIVE VALVE ASSEMBLY
SD 405 MODIFIED DRAIN VALVE ASSEMBLY
SD 500 FIRE HYDRANT INSTALLATION
SD 600 RESTRAINED JOINTS
SD 610 CONCRETE THRUST BLOCKS
SD 650 UTILITY TRENCH PAVEMENT PATCH
SD 700 CORROSION MONITORING SYSTEM NOTES
SD 701 TEST LEAD PLACEMENT
SD 702 PIPE JOINT BONDING
SD 703 EXOTHERMIC WELDING
SD 704 FLANGE INSULATING KIT
SD 705 CORROSION TEST STATION BELOW GRADE INSTALLATION
SD 706 CORROSION TEST STATION ABOVE GRADE INSTALLATION

SD 707	SPLICING DETAIL
SD 708	PERMANENT REFERENCE ELECTRODE INSTALLATION
SD 709	JUNCTION BOX
SD 710	TYPES OF CORROSION TEST STATIONS
SD 800	BORING AND CASING
SD 900	CONCRETE CYLINDER PIPE TAP
SD 1610	COMBINATION BLOCK WALL AND FENCE ENCLOSURE AND GATES
SD 1615	FENCE INSTALLATION
SD 1620	SODIUM HYPOCHLORITE ADDITION FACILITIES
SD 1700	CONSTRUCTION SITE SIGN
SD 1705	CONSTRUCTION SITE SIGN (RECLAIMED)
SD 1800	AIR GAP SEPERATION INSTALLATION
SD 1801	BACKFLOW PREVENTION FOR POTABLE WATER FIRE HYDRANT OR STANDPIPE WATER SERVICE
SD 1802	REDUCED PRESSURE ASSEMBLY (RPA) INSTALLATION
SD 1803	PRESSURE VACUUM BREAKER ASSEMBLY (PVB) INSTALLATION
SD 1805	DOUBLE CHECK VALVE ASSEMBLY (DCVA) INSTALLATION
SD 1850	PLAN SYMBOLS

APPENDIX

A.	APPROVED LIST OF MATERIALS AND COMPONENTS
B.	RELATED SPECIFICATIONS
C.	ABBREVIATIONS AND TERMS
D.	METRIC CONVERSION CHART

Exhibit 13-4, Section Names Format, Special Specifications, For Water Projects

Construction Specifications Institute (CSI)
1995 edition of MasterFormat

Division 1 - General Requirements
- 01100 Summary
  - 01110 Summary Of Work
    - 01111 Summary Of Work, By Contract Documents *
    - 01112 Summary Of Work, By Owner *
    - 01113 Description Of Provisions For Future Construction *
    - 01114 Construction Sequence *
  - 01140 Work Restrictions (Access, Coordination, Traffic, Utilities)
  - 01180 Project Utility Sources

- 01200 Price And Payment Procedures
  - 01210 Allowances
  - 01230 Alternates (Procedures For Alternate Bids)
  - 01250 Contract Modification Procedures
  - 01270 Unit Prices
  - 01290 Payment Procedures

- 01300 Administrative Requirements
  - 01310 Project Management And Coordination
    - Coordination, Meetings, Site Administration
  - 01320 Construction Progress Documentation
    - Progress Reporting
    - Progress Schedules
    - Scheduling Of Construction
    - Survey And Layout Data
  - 01330 Submittal Procedures
    - Certificates
    - Field Test Reports
    - Shop Drawings, Product Data, Samples
    - Source Quality Control Reports
  - 01350 Special Procedures

- 01400 Quality Requirements
  - 01410 Regulatory Requirements (Codes, Fees)
  - 01420 References (Abbreviations, Definitions, Reference Standards)
  - 01430 Quality Assurances
    - Fabricator, Installer, Manufacturer Qualifications
    - Manufacturer's Field Services, Testing Agency Qualifications
  - 01450 Quality Control
    - Contractor's Quality Control, Field Quality Control, Field Samples
    - Source Quality Control, Testing Laboratory Services
- 01500 Temporary Facilities And Controls

- 01510 Temporary Utilities
- 01530 Temporary Construction Related To Access By Owner
- 01535 Temporary Construction Related To General Access *
- 01560 Temporary Barriers

- 01600 Product Requirements
  - 01640 Owner-Furnished Products
- 01700 Execution Requirements
  - 01720 Surveying, Construction Layout
  - 01750 Manufacturer's Field Services For Startup
  - 01770 Final Site Review
  - 01780 Final Site Survey, Closeout Documentation
- 01800 Facility Operation
- 01900 Facility Decommissioning

Division 2 - Site Construction

- 02050 Basic Site Materials And Methods
  - 02055 Soils
  - 02060 Aggregate
  - 02065 Cement And Concrete
  - 02080 Utility Material (Hydrants, Manholes, Meters, Piping, Valves)

- 02100 Site Remediation
- 02200 Site Preparation
  - 02230 Tree Pruning
  - 02240 Dewatering
  - 02260 Excavation Support
  - 02280 Grade Adjustments For Existing Sewer Structures

- 02300 Earthwork
  - 02315 Trenching, Excavation, Fill And Backfilling
  - 02330 Soil Embankment
  - 02370 Erosion And Sedimentation Control

- 02400 Tunneling, Boring, And Jacking

- 02500 Utility Services
  - 02510 Water Distribution
    - Disinfection
    - Fire Suppression
    - Water Supply
  - 02520 Wells
    - Monitor Wells
    - Recharge Wells
    - Water Supply
    - Well Abandonment
  - 02580 Electrical And Communication Structures
  - 02590 Site Grounding

02600 Drainage And Containment

02700 Bases, Ballasts, Pavements, And Appurtenances
- 02740 Flexible Pavement
- 02750 Rigid Pavement

02800 Site Improvements And Amenities
- 02810 Irrigation Systems
- 02820 Fences And Gates
- 02830 Retaining Walls
- 02860 Screening Devices

02900 Planting
- 02905 Transplanting
- 02910 Plant Preparation
- 02930 Exterior Plants
- 02935 Plant Maintenance

02950 Site Restoration And Rehabilitation
- 02955 Restoration Of Underground Piping

Division 3 - Concrete

03000 Water Systems *
- 03001 Portland Cement Concrete *
- 03002 Concrete Structures *
- 03003 Steel Reinforcement *

03050 Basic Concrete Materials And Methods
03100 Concrete Forms And Accessories
03200 Concrete Reinforcement
03300 Cast-In-Place Concrete
03400 Precast Concrete
03600 Grout
03900 Concrete Restoration And Cleaning

Division 4 - Masonry

04000 Water Systems *
- 04001 Masonry *

04050 Basic Masonry Materials And Methods
04400 Stone

Division 5 - Metals

05000 Water Systems *
- 05001 Metals *
- 05002 Workmanship *

05050 Basic Metal Materials And Methods
05500 Metal Fabrications
05600 Hydraulic Fabrications

Division 6 - Wood And Plastics

Division 7 - Thermal And Moisture Protection
- 07050 Basic Thermal And Moisture Protection Materials And Methods
- 07100 Dampproofing And Waterproofing
- 07200 Thermal Protection
- 07300 Shingles, Roof Tiles, And Roof Coverings
- 07400 Roofing And Siding Panels
- 07500 Membrane Roofing
- 07600 Flashing And Sheet Metal
- 07700 Roof Specialties And Accessories
- 07800 Fire And Smoke Protection
- 07900 Joint Sealers

Division 8 - Doors And Windows
- 08050 Basic Door And Window Materials And Methods
- 08100 Metal Doors And Frames
- 08500 Windows
- 08700 Hardware

Division 9 - Finishes
- 09050 Basic Finish Materials And Methods
- 09100 Metal Support Assemblies
- 09500 Ceilings
- 09600 Flooring
- 09700 Wall Finishes
- 09800 Acoustical Treatment
- 09900 Paints And Coatings

Division 10 - Specialties
- 10200 Louvers And Vents
- 10240 Grilles And Screens
- 10270 Access Flooring
- 10520 Fire Protection Specialties
- 10670 Storage Shelving
- 10700 Exterior Protection
- 10750 Telephone Specialties

Division 11 - Equipment
- 11200 Water Supply And Treatment Equipment
  - 11210 Supply And Treatment Pumps
    - 11211 Vertical Turbine Booster Pumps *
    - 11212 Vertical Turbine Lineshaft Well Pump & Motor *
    - 11213 Centrifugal Booster Pump & Motor *
    - 11214 Submersible Pumps *
- 11280 Hydraulic Gates And Valves
- 11600 Laboratory Equipment

Division 12 - Furnishings

Division 13 - Special Construction
- 13080 Sound, Vibration, And Seismic Control
- 13100 Lightning Protection
- 13110 Cathodic Protection

- 13200 Storage Tanks
  - 13220 Filter Underdrains And Media
- 13400 Measurement And Control Instrumentation
- 13500 Recording Instrumentation

- 13700 Security Access And Surveillance
- 13850 Detection And Alarm

- 13900 Fire Suppression

Division 14 - Conveying Systems
- 14000 Water Systems *
  - 14001 Ductile Iron Pipe
  - 14002 Concrete Cylinder Pipe
  - 14003 High Density Polyethylene Pipe
  - 14004 Polyvinyl Chloride Pipe
  - 14005 Galvanized Steel Pipe
  - 14006 Thrust Restraint
  - 14007 Taps Into Waterlines
  - 14009 Tapping Sleeve And Valve
  - 14010 Resilient-Seated Gate Valve
  - 14011 Butterfly Valve
  - 14013 Air Release Valve
  - 14014 Regulating Valve
  - 14016 Copper Service Materials
  - 14025 Valve Nut Extension
  - 14026 Valve Box And Cover
  - 14030 Fire Hydrants
  - 14031 Hydrostatic Pressure Testing Of Water Facilities
  - 14033 Reclaimed Waterlines
  - 14040 Fittings, Flexible Couplings And Repair Clamps
  - 14046 Water Meters
  - 14047 Pressure Gauges
  - 14048 Sodium Hypochlorite Addition Facilities
  - 14050 Measurement And Payment
  - 14100 Steel Pipe
    - 14101 Steel Pipe, Modified

- 14600 Hoists And Cranes
- 14800 Scaffolding
- 14900 Transportation

Division 15 - Mechanical
- 15050 Basic Mechanical Materials And Methods
- 15100 Building Services Piping
- 15200 Process Piping
- 15300 Fire Protection Piping
- 15400 Plumbing Fixtures And Equipment
- 15500 Heat-Generation Equipment
- 15600 Refrigeration Equipment
- 15700 Heating, Ventilating, And Air Conditioning Equipment
- 15800 Air Distribution
- 15900 Hvac Instrumentation And Controls
- 15950 Testing, Adjusting, And Balancing

Division 16 - Electrical
- 16050 Basic Electrical Materials And Methods
- 16100 Wiring Methods
- 16200 Electrical Power
- 16500 Lighting
  - 16520 Site Lighting
- 16700 Communications

"*" - Added By Tucson Water

Exhibit 13-5, Subsection Format, Special Specifications

SECTION 01140

WORK RESTRICTIONS

PART 1 – GENERAL

1.01 SUMMARY OF SECTION CONTENTS

A. Section includes:
   1.01 Summary of Section Contents
   1.02 Submittals for This Section
   1.03 Definitions for This Section
   1.04 Interruption Of Utility Services
   1.05 Vehicular Traffic
   1.06 Construction In The Vicinity Of Schools And Bus Routes

B. Related Sections
   1. Section 0107.0800, Public Convenience And Safety
   2. Section 0107.2100, Contractor's Responsibility For Utility Property And Services
   3. Section 0108.0500, Limitation of Operations
   4. Section 0202.0101(A), Maintenance and Protection of Traffic

1.02 SUBMITTALS FOR THIS SECTION (not used)

1.03 DEFINITIONS FOR THIS SECTION (not used)

1.04 INTERRUPTION OF UTILITY SERVICES

A. Purpose of Revision – increase responsibilities regarding interruption of service.

B. Modify Contract Standard General Conditions, Section 0107.2100, Contractor's Responsibility For Utility Property And Services, to include:

   1. Maintain in continuous service all existing culverts, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and all other utilities encountered along the line of work, unless other arrangements satisfactory to owners of said utility and perform all work to their satisfaction.

   2. Do not impair operation of existing sewer systems. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.

1.05 VEHICULAR TRAFFIC

A. Purpose of Revision – quantify limits of road blockage.

B. Modify Contract Standard General Conditions, Section 0108.0500, Limitation of Operations, to include:

1. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours unless special arrangements have been made.

2. Provide continuous access for livestock through farm areas. Do not cut off ready access to portions of farmlands in which livestock are pastured. Maintain existing fences required to restrain livestock. Keep gates closed and secured.

1.06 CONSTRUCTION IN THE VICINITY OF SCHOOLS AND BUS ROUTES

A. Purpose of Revision – add responsibilities regarding work near schools.

B. Modify Contract Standard General Conditions, Section 0108.0500, Limitation of Operations, to include:

1. The Contractor shall exercise caution during construction in the vicinity of schools or school bus routes. Safe access to schools and school bus routes must be maintained at all times.

2. The allowable length of open trench shall be limited to 200 feet for a period of one day in the vicinity of schools and school bus routes.

3. The Contractor shall notify any effected school at least two (2) weeks prior to construction adjacent to the school. All reasonable accommodation in construction methods and schedules shall be made to avoid adverse impact to school operations and/or school bus routes.

PART 2 – MATERIALS (not used)

PART 3 – DETAILS OF CONSTRUCTION (not used)

END OF SECTION

Exhibit 13-6, Table of Contents Format, Special Specifications

(PROJECT NAME)

SPECIAL SPECIFICATIONS

TABLE OF CONTENTS

02400 Tunneling, Boring, And Jacking

02500 Utility Services
- 02510 Water Distribution
  - 02511 Disinfection *

02800 Site Improvements And Amenities
- 02810 Irrigation Systems

Division 14 – Conveying Systems

14000 Water Systems *
- 14001 Ductile Iron Pipe
- 14006 Thrust Restraint
- 14007 Taps Into Waterlines
- 14009 Tapping Sleeve And Valve
- 14010 Resilient-Seated Gate Valve
- 14011 Butterfly Valve
- 14013 Air Release Valve
- 14031 Hydrostatic Pressure Testing Of Water Facilities
- 14100 Steel Pipe
  - 14101 Steel Pipe

TABLE OF CONTENTS

RECLAIMED WATER SYSTEM DESIGN STANDARDS

8-14.0.0 RECLAIMED WATER SYSTEM DESIGN STANDARDS

8-14.1.0 General

1.1 Purpose

This section describes the design standards and requirements for public and private reclaimed water system projects.

1.2 Definitions

Section 8-18 contains a list of definitions, abbreviations, and acronyms.

1.3 General Requirements

A. New Golf Courses and Turf Facilities
It is the policy of the Mayor and Council of the City of Tucson that all new golf courses and turf facilities of ten acres or more are required to use reclaimed water. (See Mayor and Council Water Policies.) The purpose of the reclaimed water system is to facilitate the reduction of potable water use.

B. Water Pressure
The customer is responsible to regulate the pressure on the private property side of the water meter to that required by the customer's facilities.

C. Rate of Flow
Tucson Water will deliver reclaimed water to the customer's on-site storage facility or the distribution system, but does not guarantee the flow rate to these facilities.

1.4 Applicability

The requirements contained herein apply to the Tucson Water all reclaimed water system and to private systems as noted herein.

8-14.2.0 Reclaimed Water System Design Requirements

In addition to the requirements in this section, designers should consult the "Reclaimed Water Policy Manual" available at the Tucson Water Reclaimed Water /Backflow Prevention Section counter, as well as the Mayor and Council Water Policies.

The reclaimed water system is completely separate from the potable water system. The reclaimed water system has different pressure zones, high water elevations, operating pressures, and elevation boundaries. The reclaimed water service areas are totally separate from the potable water system's water service areas.

2.1 Pipeline Conveyances for Reclaimed Water

A. ADEQ Criteria for Pipeline Conveyances
For a reclaimed water system pipeline, the ADEQ's pipeline conveyance criteria are listed in the AAC R18-9-602.

B. Tucson Water Criteria for Pipeline Conveyances
All applicable potable water design standards listed in this manual also apply to reclaimed water pipeline conveyances unless otherwise noted in this section.

2.2 Discharge of Reclaimed Water

Should reclaimed water need to be discharged from a pipeline for any reason, including repairs or maintenance, contact Tucson Water's Environmental Performance Unit because permits may be required from ADEQ or Pima County Wastewater Management.

2.3 Private Plumbing Requirements

A. Interior Use of Reclaimed Water

1. Residential Buildings, Use Within Not Allowed
Interior use of reclaimed water is not allowed in residential buildings.

2. Non-Residential Buildings, Limited Use
For non-residential buildings, use of reclaimed water is limited to the following fixtures, which are listed in Appendix J of the Uniform Plumbing Code:
- toilets,
- urinals, and
- trap primers for floor drains and floor sinks.

3. Tank-Type Toilets, Warning Sign
Where tank-type toilets are flushed with reclaimed water, a permanent sign (such as plastic or stainless steel) shall be installed inside the tank to warn that the water within the tank is not a suitable emergency supply. The wording shall be:

RECLAIMED WATER – DO NOT DRINK

B. Exterior Use of Reclaimed Water, New Reclaimed Water Systems

1. Valves, Locking Feature
All valves, except fixture supply control valves, shall be equipped with a locking feature.

2. Hose Bibs
Hose bibs are not allowed on the reclaimed water piping.

3. Quick Couplers, Commercial Areas
Quick couplers that differ from those used on the potable water system shall be used on the reclaimed water piping.

4. System Separation Testing, Cross-Connections
Prior to the initial initiation of service, a dye test, pressure test, or visual inspection of reclaimed water pipe in open trenches will be performed by Tucson Water to ensure that there are no cross-connections with the potable water system.

2.4 Backflow Prevention for Potable Water Supplies

On any premises where reclaimed water is used, all potable water supplies shall have appropriate backflow prevention. (Section 8-12)

2.5 Private On-site Storage

A. Minimum Storage Capacity
All golf courses that have reclaimed water service are required to have usable on-site storage equivalent to a minimum of one peak day's use. Tucson Water will deliver reclaimed water to this impoundment, but will not guarantee the impoundment's refill rate.

B. Automated Controls
All golf courses that have reclaimed water service are required to have automated controls designed and constructed in accordance with Tucson Water requirements (See Section 8-10).

C. Lining of Reclaimed Water Impoundments
For lining reclaimed water impoundments, all golf courses receiving reclaimed water will meet the requirements in AAC R18-9-713 C. 1.

D. Requirements, Discharge of Reclaimed Water into Impoundment
All facilities that initiate reclaimed water deliveries to a surface impoundment after January 1, 2005 shall have an air gap separation between the impoundment and the reclaimed delivery pipeline.

2.6 Private On-Site Plan Review

A. Residential Plan Review
1. Tucson Water encourages plans for private on-site residential turf and landscape irrigation that will be using reclaimed water to be submitted to the Reclaimed Water/Backflow Prevention Section for review.

2. The Reclaimed Water User Agreement, which must be signed by the financially responsible party prior to initiation of service,

requires that a copy of the conceptual plans of the on-site reclaimed water system be kept on-site.

3. Customers are encouraged to call the Tucson Water Reclaimed Water/Backflow Prevention Section for an open trench inspection of all reclaimed water pipe. If the Reclaimed Water/Backflow Prevention Section has not conducted an open trench inspection, a dye test or pressure test will be required prior to initiation of reclaimed water service.

B. Commercial Plan Review
The Tucson Water Reclaimed Water/Backflow Prevention Section will review the private plumbing plans for reclaimed water at commercial premises for all uses other than turf and landscape irrigation.

2.7 Water Meters

Reclaimed water meters shall be turbo type meters, unless turbo meters are not available from the manufacturer in the required size.

2.8 Utility Separation

Reclaimed water pipes must meet the requirements of Section 8-08.4, Sewer Separation Requirements, which say, in part:

Reclaimed water pipes located adjacent to potable water pipes shall comply with the separation criteria established for pressure sanitary sewer lines. Where reclaimed water pipes are installed in the vicinity of sanitary sewer lines, the reclaimed water pipes shall be considered potable with respect to clearances.

2.9 Identification Marking

A. Painting of Appurtenances
All air/vacuum relief valves, valves, pressure reducing valves, pumps, pump control valves, meter box lids, interiors of meter boxes, and any other appurtenances to the reclaimed water system will be painted purple (Pantone No. 512) or have purple color integral to the material.

B. Painting of Equipment
All mechanical equipment which is appurtenant to the reclaimed water system shall be painted purple to match the Mylar wrapping tape.

C. Signs for Valves
All flanged side outlets, drain valve assemblies, blow-off valve assemblies, and combination air / vacuum release valves shall have a sign attached to provide a warning not to discharge reclaimed water.

3.0 Adding Potable Water

A. Adding Potable Water, Air Gap
To add water from a potable system to a nonpotable system, an air gap is required between the two systems.

B. Adding Potable Water, Water Meter
Water meters shall be installed at locations where potable water is added to the reclaimed water system.