

TABLE OF CONTENTS

UNIT I – GENERAL REQUIREMENTS

CHAPTER 1 – INTRODUCTION I-1-2

1.1 Purpose of the Water Resources Development Criteria/Standards Manual..... I-1-2

1.2 The Department of Water Resources..... I-1-2

 1.2.1 Development Services..... I-1-2

 1.2.2 Engineering Support Services I-1-3

 1.2.3 General Support Departments I-1-3

1.3 Description and Use of the Development Criteria/Standards Manual I-1-3

1.4 Structure of the Development Criteria/Standards Manual..... I-1-4

1.5 Intent and Implementation..... I-1-4

1.6 Updates to the Development Criteria/Standards Manual..... I-1-4

CHAPTER 2 – GENERAL REQUIREMENTS..... I-2-2

2.1 Purpose..... I-2-2

2.2 Submittal Requirements I-2-2

2.3 Development Services Offered by Water Resources..... I-2-2

 2.3.1 Information..... I-2-2

 2.3.2 Conceptual Approvals..... I-2-3

 2.3.3 Construction Plan Approval I-2-3

2.4 Design Approach..... I-2-3

2.5 Submittal Review and Approval I-2-4

2.6 Utilities/Agencies Coordination I-2-4

2.7 Opinions of Project Cost and Valuation of Trees I-2-4

CHAPTER 3 – EASEMENTS I-3-2

3.1 Purpose..... I-3-2

3.2 Existing Easements I-3-2

3.3 Definitions..... I-3-2

 3.3.1 Fee Simple Title I-3-2

 3.3.2 Sanitary Sewer, Drainage and Potable Water Easements I-3-3

3.3.3 Temporary Construction Easement I-3-3

3.4 Easement Widths..... I-3-3

3.5 Construction Plan Requirements I-3-4

3.5.1 General..... I-3-4

3.6 Easement Plat Criteria I-3-4

3.6.1 General..... I-3-4

3.6.2 Plat Information I-3-4

3.6.2.1 Affected Parcel Information I-3-5

3.6.2.2 Proposed Easement Information..... I-3-5

3.6.2.3 General Information I-3-5

3.6.3 Property Service Connection Easement..... I-3-6

3.6.4 Easements on Railroad Rights-of-Way..... I-3-6

3.6.5 Encroachments I-3-6

3.6.6 Certificates I-3-7

3.6.7 Submission I-3-7

CHAPTER 4 - DRAFTING STANDARDS I-4-2

4.1 General..... I-4-2

4.2 Drafting Media and Standards..... I-4-2

4.3 Lettering I-4-2

4.4 Plan Sheet Layout and Format I-4-2

4.4.1 Title Sheet Requirements I-4-2

4.4.2 Plan Index Sheet Requirements (if required) I-4-3

4.4.3 Typical Details and Drawings I-4-3

4.5 Plan, Profile and Cross-Section Format..... I-4-3

4.5.1 General Criteria..... I-4-3

4.5.2 Plan View..... I-4-4

4.5.3 Profile View I-4-6

4.5.4 Cross-Sections..... I-4-8

4.5.5 General Notes..... I-4-9

4.5.6 Basement Elevations for Sanitary Projects..... I-4-9

4.5.7 Special Plan Sheets I-4-9

4.5.7.1 Collector System or Distribution Maps I-4-9

4.5.7.2 Maintenance of Traffic Plans I-4-9

CHAPTER 5 – FINAL RECORD DRAWINGS I-5-2

5.1 Purpose..... I-5-2

5.2 Documentation and Approval Process I-5-2

5.2.1 General..... I-5-2

5.2.2 Process I-5-2

5.3 Drawing Information..... I-5-2

5.4 Construction Plans I-5-3

5.4.1 Alignment and Elevation Changes I-5-3

5.4.2 Structure Changes I-5-3

5.4.3 General Record Drawing Requirements I-5-4

UNIT II - STORMWATER DESIGN STANDARDS

CHAPTER 1 – INTRODUCTION II-1-2

1.1 Purpose..... II-1-2

1.2 Description and Use II-1-2

1.2.1 Compliance with Other Standards..... II-1-2

1.2.2 Conflicting Standards..... II-1-2

1.2.3 Waivers and Variance from Standards II-1-3

1.3 Definitions and Symbols II-1-3

1.3.1 Definitions..... II-1-3

1.3.2 Symbols..... II-1-8

CHAPTER 2 – SUBMITTALS II-2-2

2.1 Purpose..... II-2-2

2.2 Submittal Content and Format II-2-2

2.2.1 Basic/Preliminary Stormwater Plans II-2-2

2.2.2 Stormwater “Red Flags”..... II-2-2

2.2.3 Drainage Plan Preparation..... II-2-3

2.2.3.1 Site Plan II-2-4

2.2.3.2 Topographic/Planometric Map II-2-4

2.2.3.3 Delineation of Project Watershed..... II-2-5

2.2.3.4 Profiles and Cross-Sections..... II-2-6

2.2.3.5 Detention/Retention Pond Grading Plan II-2-6

2.2.3.6 Existing Improvements and Infrastructure II-2-6

2.2.3.7 Calculations..... II-2-6

2.2.4 Final Drainage Plans II-2-6

2.3 Permits, Fees, and Contracts II-2-6

2.3.1 Local Permits II-2-6

2.3.2 State and Federal Permits II-2-7

2.3.3 Fees II-2-7

2.3.3.1 Permit Application Fees for Local Permits II-2-7

2.3.3.2 Permit Application Fees for Additional Permits II-2-7

2.3.3.3 Additional Fees II-2-7

2.3.4 Contracts II-2-7

CHAPTER 3 – STORM SEWERS, CULVERTS, AND OPEN CHANNELS	II-3-3
3.1 Purpose.....	II-3-3
3.2 General Improvement Location Criteria.....	II-3-3
3.3 Horizontal Alignment Criteria.....	II-3-3
3.3.1 General.....	II-3-3
3.3.2 Placement in Existing Rights-of-Way and Easements.....	II-3-3
3.3.3 Stationing	II-3-4
3.3.4 Minimum Horizontal Separation from Water Lines.....	II-3-4
3.3.5 Minimum Distance from Additional Utilities.....	II-3-4
3.4 Vertical Alignment Criteria.....	II-3-4
3.4.1 Sewer Depths	II-3-4
3.4.2 Minimum Vertical Separation from Water Lines	II-3-4
3.4.3 Sewer Elevations.....	II-3-5
3.5 General Procedures	II-3-5
3.6 Basin Mapping Requirements	II-3-5
3.7 Hydraulic Computations.....	II-3-6
3.7.1 Selecting a Runoff Calculation Method	II-3-6
3.7.1.1 Rational Method	II-3-6
3.7.1.2 Soil Conservation Service (SCS) Technical Release (TR-20) and U.S. Army Corps of Engineers Hydraulic Engineering Circular No. 1 (HEC-1)	II-3-7
3.7.1.3 Other Methods	II-3-7
3.7.2 Off-site Hydrologic Analysis.....	II-3-7
3.7.2.1 Introduction.....	II-3-7
3.7.2.2 Analysis of Impacts of Improvements on Upstream, Downstream and Peripheral Facilities	II-3-7
3.7.2.2.1 When Upstream, Downstream and Peripheral Analysis is not Required.....	II-3-7
3.7.2.2.2 Downstream Analysis Requirements.....	II-3-8
3.7.2.3 Analysis of Runoff Impacts Along Watershed and Project Boundaries	II-3-8
3.8 Hydraulic Design Criteria.....	II-3-8
3.8.1 Rainfall	II-3-8
3.8.1.1 Intensity.....	II-3-8
3.8.1.2 Duration	II-3-9
3.8.1.3 Distribution	II-3-9
3.8.2 Hydraulic Grade Line.....	II-3-9
3.8.3 Headloss in Structures and Appurtenances	II-3-9
3.8.4 Velocity.....	II-3-10
3.8.4.1 Velocity in Storm Sewers.....	II-3-10
3.8.4.2 Velocity in Culverts	II-3-10
3.8.4.3 Velocity in Open Channels	II-3-10

3.8.5	Slopes.....	II-3-10
3.8.5.1	Storm Sewers	II-3-10
3.8.5.1.1	Slope Between Manholes.....	II-3-10
3.8.5.2	Swales	II-3-10
3.8.6	Changes in Sewer Size.....	II-3-10
3.8.7	Minimization of Solids Deposition	II-3-11
3.8.8	Gutter Flow and Inlet Design.....	II-3-11
3.8.8.1	General.....	II-3-11
3.8.8.2	Flow In Gutters	II-3-11
3.8.8.3	Maximum Width of Gutter Flow (T_{MAX}).....	II-3-12
3.8.8.4	Inlet Location and Spacing of Inlets.....	II-3-12
3.8.8.5	Inlet Design Capacity.....	II-3-13
3.9	Sewer Pipe.....	II-3-14
3.10	Manholes.....	II-3-15
3.10.1	Manhole Locations.....	II-3-15
3.10.2	Manhole Spacing.....	II-3-15
3.10.3	Manhole Diameter.....	II-3-15
3.10.4	Flow Channel.....	II-3-16
3.10.5	Bench	II-3-16
3.10.6	Adjustment Rings.....	II-3-16
3.11	Culverts.....	II-3-16
3.12	Open Channels	II-3-17
3.13	Railroad Crossings	II-3-18
3.13.1	Criteria	II-3-18
3.13.2	Railroad Conflict Drawings.....	II-3-19
3.14	Highway Crossings.....	II-3-19
3.15	Casing Pipe and Tunnel Liners	II-3-20
3.15.1	Tunnel Liners.....	II-3-20
3.15.2	Pipe Casing	II-3-20
3.16	Non-Gravity Flow Stormwater Systems	II-3-21
3.16.1	Approval	II-3-21
3.16.2	Justification	II-3-21
3.16.3	Energy Grade Line Computations.....	II-3-21
CHAPTER 4 – DETENTION REQUIREMENTS.....		II-4-2
4.1	Purpose.....	II-4-2
4.2	Types of Runoff Storage Facilities	II-4-2
4.3	Methods for the Determination of Runoff Storage Volume	II-4-2

4.3.1	Atypical Circumstances.....	II-4-2
4.3.2	Detention Basins	II-4-3
4.3.2.1	Serving Watershed Areas Less Than or Equal to Five (5) Acres	II-4-3
4.3.2.2	Serving Watershed Areas Less Than or Equal to 20 Acres	II-4-3
4.3.2.3	Serving Watershed Areas Greater Than 20 Acres.....	II-4-3
4.3.3	Parking Lot and Rooftop Storage	II-4-3
4.3.4	Other Storage Methods.....	II-4-3
4.4	Runoff Storage Requirements and Allowable Release Rates	II-4-4
4.4.1	Conformance with the Requirements of the Stormwater Utility.....	II-4-4
4.4.2	Runoff Storage Requirements	II-4-4
4.4.3	Allowable Release Rates	II-4-4
4.4.3.1	Singular Peak Release Rate.....	II-4-4
4.4.3.2	Graduated Peak Release Rate.....	II-4-4
4.4.3.3	Compensatory Storage for Watersheds 5 Acres or Less in Size	II-4-5
4.4.4	Exceptions.....	II-4-5
4.4.5	Submittal Requirements	II-4-5
4.5	Physical Characteristics for Runoff Storage Facilities.....	II-4-6
4.5.1	General Design Criteria.....	II-4-6
4.5.1.1	For All Detention Basins.....	II-4-6
4.5.1.2	For Dry Bottom Basins	II-4-7
4.5.1.3	For Wet Bottom Basins	II-4-7
4.5.1.4	For Parking Lot Storage	II-4-8
4.5.2	Spillways, Embankments, Levees, and Dams	II-4-8
4.5.2.1	Acceptable Materials.....	II-4-8
4.5.2.2	Spillway Design	II-4-8
4.5.3	Maintenance Requirements	II-4-9
4.5.3.1	General.....	II-4-9
4.5.3.2	Stilling/Sedimentation Basins	II-4-9
4.5.3.3	Exit Ramps (Dry Bottom Basins Only).....	II-4-9
4.5.3.4	Emptying or Draining of Ponds with Permanent Pools	II-4-9
4.5.4	Easements.....	II-4-9
CHAPTER 5 – EROSION CONTROL.....		II-5-2
5.1	Purpose.....	II-5-2
5.2	General Principles	II-5-2
5.3	Erosion Control Plans – Submittals.....	II-5-3
5.3.1	EPA and Indiana “Rule 5” Requirements	II-5-3
5.3.2	Submittals to Water Resources.....	II-5-3

UNIT III - SANITARY SEWER DESIGN STANDARDS

CHAPTER 1 – INTRODUCTION	III-1-2
1.1 Purpose	III-1-2
1.2 Description and Use	III-1-2
1.2.1 Compliance with Other Standards	III-1-2
1.2.2 Conflicting Standards	III-1-2
1.2.3 Waivers and Variance from Standards	III-1-2
1.3 Definitions and Symbols	III-1-2
1.3.1 Definitions	III-1-2
1.3.2 Symbols	III-1-6
CHAPTER 2 – SUBMITTALS	III-2-3
2.1 Purpose	III-2-3
2.2 Public Sewers	III-2-3
2.2.1 Conceptual Approval	III-2-3
2.2.1.1 First Checklist	III-2-3
2.2.1.2 Map Submittal	III-2-3
2.2.1.3 Second Checklist	III-2-4
2.2.1.4 Developer/Owner Notification	III-2-4
2.2.2 Construction Plan Approval for Public Sewers	III-2-4
2.3 Building Sewers	III-2-4
2.3.1 Residential House Taps	III-2-4
2.3.2 Industrial and Commercial Taps	III-2-4
2.3.2.1 Conceptual Approval	III-2-5
2.3.2.1.1 First Checklist and Map Submittal	III-2-5
2.3.2.1.2 Second Checklist	III-2-5
2.3.2.1.3 Notification	III-2-5
2.3.3 Construction Plan Approval	III-2-5
2.4 Pump Stations	III-2-6
2.4.1 Conceptual Approval Process	III-2-6
2.4.2 Construction Plans	III-2-6
2.5 Permits, Fees, and Contracts	III-2-6
2.5.1 Local Permits	III-2-6
2.5.1.1 Tap Permit to a Sewer Main	III-2-6
2.5.1.2 Tap Permit to a Sewer Structure	III-2-6
2.5.2 State Permits	III-2-6
2.5.2.1 SPC-15 Permit	III-2-6
2.5.3 Fees	III-2-7
2.5.3.1 Permit Application Fees for Local Permits	III-2-7
2.5.3.2 Permit Application Fees for State Permits	III-2-7

2.5.3.3	Additional Fees	III-2-7
2.5.4	Contracts	III-2-8
CHAPTER 3 – PUBLIC SEWERS		III-3-3
3.1	Purpose.....	III-3-3
3.2	General Improvement Location Criteria.....	III-3-3
3.3	Horizontal Alignment Criteria.....	III-3-3
3.3.1	General.....	III-3-3
3.3.2	Placement in Existing Rights-of-Way and Easements.....	III-3-3
3.3.3	Stationing	III-3-4
3.3.4	Minimum Horizontal Separation from Water Lines.....	III-3-4
3.3.5	Rear Lot Alignment.....	III-3-4
3.3.6	Minimum Distance from Additional Utilities.....	III-3-4
3.3.7	Location in Relation to Streams and Waterways	III-3-5
3.4	Vertical Alignment Criteria.....	III-3-5
3.4.1	Sewer Depths	III-3-5
3.4.2	Minimum Vertical Separation from Water Lines	III-3-5
3.4.3	Stream and Waterway Crossings	III-3-6
3.4.4	Sewer Elevations.....	III-3-6
3.4.5	Flooding and Ponding Areas.....	III-3-6
3.5	General Procedures	III-3-6
3.6	Sanitary Sewer Service Area Map.....	III-3-7
3.7	Design Flow	III-3-8
3.7.1	General.....	III-3-8
3.7.2	Collector Sewers	III-3-8
3.7.3	Interceptor Sewers.....	III-3-8
3.7.4	Average Daily Flow (ADF).....	III-3-8
3.7.4.1	Development Flows	III-3-8
3.7.4.2	Undeveloped Land for Future Flows.....	III-3-8
3.7.5	Peak Design Flow (PDF).....	III-3-9
3.7.6	Flow Metering.....	III-3-9
3.8	Hydraulic Design Criteria.....	III-3-9
3.8.1	General.....	III-3-9
3.8.2	Hydraulic Grade Line.....	III-3-9
3.8.3	Velocity	III-3-10
3.8.4	Slopes.....	III-3-10
3.8.4.1	Slope Between Manholes.....	III-3-10
3.8.5	Changes in Sewer Size	III-3-10
3.8.6	Minimization of Solids Deposition	III-3-11
3.9	Hydraulic Computations.....	III-3-11

3.10	Sewer Pipe.....	III-3-11
3.11	Manholes.....	III-3-12
	3.11.1 General.....	III-3-12
	3.11.2 Manhole Locations.....	III-3-12
	3.11.3 Manhole Spacing.....	III-3-12
	3.11.4 Manhole Diameter.....	III-3-12
	3.11.5 Flow Channel.....	III-3-13
	3.11.6 Bench.....	III-3-13
	3.11.7 Watertight Bolt-Down Construction.....	III-3-14
	3.11.8 External Drop Inlets.....	III-3-14
	3.11.9 Adjustment Rings.....	III-3-14
3.12	Stubs.....	III-3-14
3.13	Siphons.....	III-3-14
3.14	Floatation.....	III-3-14
3.15	Anchors.....	III-3-14
3.16	Concrete Encasements.....	III-3-15
3.17	Railroad Crossings.....	III-3-15
	3.17.1 Criteria.....	III-3-15
	3.17.2 Railroad Conflict Drawings.....	III-3-16
3.18	Highway Crossings.....	III-3-16
3.19	Casing Pipe and Tunnel Liners.....	III-3-17
	3.19.1 Tunnel Liners.....	III-3-17
	3.19.2 Pipe Casing.....	III-3-17
	CHAPTER 4 – BUILDING SEWERS.....	III-4-2
4.1	Purpose.....	III-4-2
4.2	Prohibition Against Clear Water Discharges.....	III-4-2
4.3	Buildings Served.....	III-4-2
	4.3.1 Maximum Number of Buildings Served.....	III-4-2
	4.3.2 Gravity Sewer Service.....	III-4-2
	4.3.3 Non-Gravity Sewer Service.....	III-4-2
4.4	Connection Permits and Building Sewer Inspection.....	III-4-3
	4.4.1 Connection Permits.....	III-4-3
	4.4.2 Building Sewer Inspection.....	III-4-3
4.5	Building Sewer Responsibility.....	III-4-3

4.6	Hydraulic Design Criteria.....	III-4-4
4.6.1	Plumbing Codes.....	III-4-4
4.6.2	Minimum Slopes.....	III-4-4
4.7	Building Sewer Connection to Public Sewer	III-4-4
4.8	Building Sewer Structures.....	III-4-4
4.8.1	Cleanouts	III-4-4
4.8.2	Grease and Sand Traps	III-4-4
4.8.3	Inspection Manholes	III-4-5
4.9	Building Sewer Pipe.....	III-4-5
CHAPTER 5 – PUMP STATIONS		III-5-3
5.1	Purpose.....	III-5-3
5.2	Submittal Requirements	III-5-3
5.2.1	Conceptual Approval Process	III-5-3
5.2.1.1	Concept Design Plan.....	III-5-3
5.2.1.2	Engineering Report	III-5-4
5.2.2	Final Design Requirements	III-5-5
5.3	Design Approach.....	III-5-7
5.3.1	Approvals.....	III-5-7
5.3.2	Service Level.....	III-5-7
5.3.3	Justification	III-5-8
5.4	Design Criteria	III-5-8
5.4.1	General	III-5-8
5.4.1.1	Protection Against Flooding.....	III-5-8
5.4.1.2	Parking Requirements	III-5-8
5.4.1.3	Compliance with OSHA Safety Requirements.....	III-5-8
5.4.2	Process	III-5-9
5.4.2.1	Wet Well	III-5-9
5.4.2.2	Valves and Valve Vaults	III-5-9
5.4.2.3	Force Mains	III-5-10
5.4.2.3.1	General.....	III-5-10
5.4.2.3.2	Air and Vacuum Relief Valves	III-5-10
5.4.2.3.3	Friction Losses in Force Mains.....	III-5-10
5.4.2.4	System Head Curve.....	III-5-11
5.4.2.5	Buoyancy	III-5-11
5.4.2.6	Force Main Pressure and Water Hammer.....	III-5-11
5.4.2.7	Odor Control.....	III-5-11
5.5	Pumps.....	III-5-12
5.5.1	General.....	III-5-12
5.5.2	Pump Openings.....	III-5-12

5.5.3 Intake..... III-5-12

5.5.4 Pump Guide Rail System III-5-12

5.5.5 Required Pump Information..... III-5-12

5.6 Electrical III-5-13

5.6.1 General III-5-13

5.6.2 Applicable Standards and Codes III-5-14

5.6.3 Pump Control III-5-15

5.6.3.1 Automatic Sequence Operation III-5-15

5.6.3.2 Pump Control Panel III-5-15

5.6.3.3 Control Settings..... III-5-16

5.6.3.4 Level Detection III-5-17

5.6.3.5 Operator Interface III-5-17

5.6.3.6 Pump Interlock III-5-18

5.6.4 Alarm System..... III-5-18

5.6.4.1 Local Alarms III-5-18

5.6.4.2 Telemetry Alarms..... III-5-19

5.6.5 Emergency Power III-5-19

5.7 Metering and Sample Points..... III-5-19

UNIT IV - POTABLE WATER DISTRIBUTION DESIGN STANDARDS

CHAPTER 1 – INTRODUCTION IV-1-2

1.1 Purpose..... IV-1-2

1.2 Description and Use IV-1-2

1.2.1 Compliance with Other Standards..... IV-1-2

1.2.2 Conflicting Standards..... IV-1-2

1.2.3 Waivers and Variance from Standards IV-1-2

1.3 Definitions, Abbreviations, and Symbols IV-1-3

1.3.1 Definitions..... IV-1-3

1.3.2 Abbreviations IV-1-7

1.3.3 Symbols..... IV-1-8

CHAPTER 2 – SUBMITTALS IV-2-3

2.3 Purpose..... IV-2-3

2.4 Public Water Distribution Systems..... IV-2-3

2.2.1 Conceptual Approval IV-2-3

2.2.1.1 First Checklist IV-2-3

2.2.1.2 First Submittal IV-2-3

2.2.1.3 Second Checklist..... IV-2-4

2.2.1.4 Developer/Owner Notification, Presentation of Data IV-2-5

2.2.2 Detailed Plan Submittal..... IV-2-5

2.3	Water Service Taps	IV-2-5
2.3.1	Individual Residential Taps.....	IV-2-5
2.3.2	Individual Industrial, Commercial Taps	IV-2-5
2.3.2.1	Conceptual Approval	IV-2-5
2.3.2.1.1	First Checklist.....	IV-2-6
2.3.2.1.2	First Submittal	IV-2-6
2.3.2.1.3	Second Checklist	IV-2-6
2.3.2.1.4	Developer/Owner Notification, Presentation of Data.....	IV-2-7
2.3.3	Detailed Plan Submittal.....	IV-2-7
2.4	Backflow Prevention	IV-2-7
2.4.1	First Contact.....	IV-2-7
2.4.2	First Submittal.....	IV-2-7
2.4.3	Review of First Submittal.....	IV-2-8
2.4.4	Construction Plan Approval.....	IV-2-8
2.5	Fire Services.....	IV-2-8
2.5.1	First Contact.....	IV-2-8
2.5.2	Review of First Submittal.....	IV-2-9
2.5.3	Construction Plan Approval.....	IV-2-9
2.5.4	Post Construction/Pre Occupancy	IV-2-10
2.6	Permits, Fees, and Contracts	IV-2-10
2.6.1	Local Permits	IV-2-10
2.6.2	State Permits	IV-2-10
2.6.3	Fees	IV-2-11
2.6.3.1	Permit Application Fees for Local Permits	IV-2-11
2.6.3.2	Permit Application Fees for State Permits.....	IV-2-11
2.6.3.3	Additional Fees	IV-2-11
2.6.4	Contracts	IV-2-11
CHAPTER 3 – POTABLE WATER DISTRIBUTION SYSTEMS		IV-3-4
3.1	Purpose.....	IV-3-4
3.2	Basis of Design	IV-3-4
3.3	General Improvement Location Criteria.....	IV-3-4
3.4	Horizontal and Vertical Alignment Criteria	IV-3-4
3.4.1	Relationship to Buildings.....	IV-3-4
3.4.2	Relationship in Streets.....	IV-3-4
3.4.3	Horizontal and Vertical Separation	IV-3-4
3.4.3.1	Minimum Distances from Sanitary and Storm Sewer Lines and Related Structures	IV-3-4
3.4.3.2	Minimum Distance from Storage Tanks	IV-3-5
3.4.3.3	Minimum Distance from Liquid Petroleum and High Pressure Piping.....	IV-3-5
3.4.3.4	Minimum Distances from Other Utilities.....	IV-3-6

3.4.3.5	Minimum Distances from Potential Contamination Sources.....	IV-3-6
3.4.3.6	Alternatives to Minimum Separation	IV-3-6
3.4.4	Waterway Crossings.....	IV-3-7
3.4.4.1	Minimum Separation.....	IV-3-7
3.4.4.2	Above-Water Crossings	IV-3-7
3.4.4.3	Below-Water Crossings.....	IV-3-7
3.4.5	Allowable Pipe Deflection	IV-3-8
3.4.6	Angle of Intersection.....	IV-3-8
3.4.7	Minimum Depth of Cover.....	IV-3-8
3.5	Design Criteria	IV-3-8
3.5.1	Performance Criteria	IV-3-8
3.5.1.1	General.....	IV-3-8
3.5.1.2	Pressure and Flowrate	IV-3-8
3.5.1.3	Velocity.....	IV-3-9
3.5.2	Design Demand	IV-3-9
3.5.3	Data Requirements.....	IV-3-9
3.5.3.1	Topographic	IV-3-9
3.5.3.2	Soils Testing.....	IV-3-10
3.5.3.3	Flow Testing	IV-3-10
3.5.4	Hydraulic Calculations.....	IV-3-10
3.5.4.1	General Requirements.....	IV-3-10
3.5.4.1.1	Roughness Coefficients	IV-3-10
3.5.4.1.2	Minor Losses	IV-3-11
3.5.4.1.3	Friction Losses.....	IV-3-11
3.5.4.1.4	Changes Due to Elevation.....	IV-3-11
3.5.4.2	Translation of Flow Test Results.....	IV-3-11
3.5.4.3	Existing Water Main Conditions.....	IV-3-12
3.5.4.4	Most Remote Tests.....	IV-3-12
3.5.5	Water Main Oversizing	IV-3-12
3.6	Water Main Pipes.....	IV-3-12
3.7	Appurtenances.....	IV-3-13
3.7.1	Valves	IV-3-13
3.7.2	Fire Hydrants.....	IV-3-13
3.7.2.1	Connection to Main	IV-3-13
3.7.2.2	Assembly Configurations.....	IV-3-13
3.7.2.3	Drainage.....	IV-3-13
3.7.2.4	Protection.....	IV-3-14
3.7.2.5	Placement of Hydrants in Sidewalks.....	IV-3-14
3.7.2.6	Location	IV-3-14
3.7.2.6.1	General.....	IV-3-14
3.7.2.6.2	Relation to Potential Contamination Sources	IV-3-14
3.7.2.6.3	Relation to Curb Lines	IV-3-14
3.7.2.6.4	Relation to Sidewalks	IV-3-14
3.7.2.7	Spacing	IV-3-14
3.7.2.8	End Points of Water Mains	IV-3-15
3.7.3	Tracing Wire	IV-3-15

3.7.4	Polyethylene Wrap (Polywrap).....	IV-3-15
3.7.5	Air Release Valves	IV-3-15
3.7.6	Blow-Off Assemblies.....	IV-3-15
3.7.7	Temporary Test Risers	IV-3-16
3.8	Sizing Water Service Lines and Meters.....	IV-3-16
3.9	Services 2” and Less	IV-3-16
3.9.1	Corporation Stops.....	IV-3-17
3.9.2	Curb Stops.....	IV-3-17
3.9.3	Service Lines.....	IV-3-17
3.9.4	Meter Placement.....	IV-3-17
3.9.5	Meter Pit Installations	IV-3-17
3.9.6	Remote Capabilities	IV-3-17
3.10	Services Greater Than 2”	IV-3-17
3.10.1	Connection to Water Main	IV-3-17
3.10.2	Meter Placement.....	IV-3-17
3.10.3	Meter Pit Installations	IV-3-18
3.10.4	Remote Capabilities	IV-3-18
3.11	Anchorage	IV-3-18
3.11.1	General.....	IV-3-18
3.11.2	Restrained Joint Requirements.....	IV-3-18
3.11.3	Types of Joint Restraint.....	IV-3-18
3.12	Jacking and Boring.....	IV-3-19
3.12.1	Casing Pipe	IV-3-19
3.12.2	Protection at Ends	IV-3-20
3.12.3	Spacers	IV-3-20
3.13	Infrastructure Crossings	IV-3-20
3.13.1	Highway Crossings	IV-3-20
3.13.2	Railroad Crossings	IV-3-21
CHAPTER 4 – BACKFLOW PREVENTION		IV-4-3
4.1	Purpose.....	IV-4-3
4.2	Regulatory Authority.....	IV-4-3
4.3	Submittal and Approvals.....	IV-4-3
4.4	Backflow Prevention Required.....	IV-4-3
4.4.1	By Order of IDEM or Water Resources	IV-4-3
4.4.1.1	Order by IDEM	IV-4-3
4.4.1.2	Order by Water Resources	IV-4-3
4.4.2	New Construction.....	IV-4-3

4.4.2.1	Cross Connection Hazard Facilities	IV-4-4
4.4.2.2	Spec Buildings	IV-4-4
4.4.2.3	Facilities with Soft Drink Machines.....	IV-4-4
4.4.2.4	Facilities with Secondary Source of Supply.....	IV-4-4
4.4.2.5	Facilities with Fire Protection Services	IV-4-4
4.4.3	Existing Facilities that Propose Modifications	IV-4-4
4.4.3.1	Installation of Customer Service Line	IV-4-4
4.4.3.2	Modifications to Customer Service Line.....	IV-4-4
4.4.3.3	Modification to Customer Service Meter	IV-4-5
4.4.4	Existing Facilities Where a Cross Connection has Occurred	IV-4-5
4.5	Backflow Prevention Exemption.....	IV-4-5
4.6	Types of Backflow Prevention	IV-4-5
4.6.1	General.....	IV-4-5
4.6.2	Isolation Valves.....	IV-4-5
4.6.3	Air Gap (AG).....	IV-4-5
4.6.4	Atmospheric Vacuum Breaker (AVB).....	IV-4-6
4.6.5	Pressure Vacuum Breaker (PVB).....	IV-4-6
4.6.6	Double Check Valves (DC).....	IV-4-7
4.6.7	Reduced Pressure Principle Backflow Prevention (RP).....	IV-4-7
4.7	Appropriate Uses of Devices.....	IV-4-7
4.8	Acceptable Manufacturers, Models of Backflow Prevention Devices.....	IV-4-8
4.9	Installation Requirements.....	IV-4-8
4.10	Inspection Requirements	IV-4-9
4.11	Inspection Results Reporting.....	IV-4-9
4.12	Disconnection/Removal/Bypassing of Backflow Protection	IV-4-9
CHAPTER 5 – FIRE SERVICES	IV-5-2
5.1	Purpose.....	IV-5-2
5.2	Submittals and Approvals	IV-5-2
5.3	General Requirements	IV-5-2
5.4	Separation from Other Water Supply Lines	IV-5-2
5.5	Bypass of Meters.....	IV-5-3
5.6	Appurtenances.....	IV-5-3

5.6.1 General.....IV-5-3
 5.6.2 Backflow Prevention Device.....IV-5-3
 5.6.3 Indicator Valve.....IV-5-3
 5.6.4 Fire Booster Pump.....IV-5-3
 5.6.5 On-Site Water StorageIV-5-3

UNIT V - MATERIALS

CHAPTER 1 - INTRODUCTION..... V-1-2

1.1 Purpose..... V-1-2
 1.2 Description and Use V-1-2
 1.2.1 Compliance with Other Standards..... V-1-2
 1.2.2 Conflicting Standards..... V-1-2
 1.2.3 Waivers and Variance from Standards V-1-2
 1.3 Definitions and Symbols V-1-2
 1.3.1 Definitions..... V-1-2
 1.3.2 Abbreviations..... V-1-3
 1.3.2 Symbols..... V-1-4
 1.4 Additional References..... V-1-4

CHAPTER 2 – CERTIFICATION OF MATERIALS V-2-2

2.1 Purpose..... V-2-2
 2.2 Material Certification and Testing..... V-2-2
 2.3 Material Markings V-2-3
 2.4 Submittals..... V-2-3
 2.4.1 Design Submittals V-2-3
 2.4.2 Construction Submittals V-2-3
 2.4.3 Additional Submittals (Submittals as Requested by Water Resources)..... V-2-3
 2.5 Non-Standard Product Acceptance Process..... V-2-4
 2.5.1 General..... V-2-4
 2.5.2 Experience Requirements..... V-2-4
 2.5.3 Submittal Requirements V-2-4
 2.5.4 Evaluation Fees V-2-5
 2.6 Pilot Projects V-2-5

CHAPTER 3 – COMMON MATERIAL REQUIREMENTS V-3-3

3.1 Purpose..... V-3-3

3.2	Trench Bedding and Backfill	V-3-3
3.2.1	Bedding for Rigid Pipes	V-3-3
3.2.2	Bedding for Flexible Pipes.....	V-3-4
3.2.3	Bedding for Precast Structures.....	V-3-4
3.2.4	Backfill.....	V-3-4
3.2.4.1	Backfill Within Public Right-of-Way.....	V-3-4
3.2.4.2	General Backfill	V-3-4
3.2.4.3	Special Backfill.....	V-3-5
3.2.4.4	Flowable Fill.....	V-3-5
3.3	Concrete	V-3-5
3.3.1	Concrete Within Public Right-of-Way	V-3-5
3.3.2	General Use Concrete.....	V-3-6
3.3.2.1	Concrete Reinforcing	V-3-6
3.3.2.2	Curing Materials	V-3-6
3.3.2.3	Admixtures.....	V-3-6
3.4	Asphalt	V-3-7
3.4.1	Asphalt Within Public Right-of-Way	V-3-7
3.4.2	General Use Asphalt	V-3-7
3.5	Base Material	V-3-8
3.5.1	Base Material Within Public Right-of-Way	V-3-8
3.5.2	General Use Base Material.....	V-3-8
3.6	Casing	V-3-8
3.7	Lawn Surfaces.....	V-3-9
3.7.1	Seed.....	V-3-9
3.7.2	Fertilizer	V-3-9
3.7.3	Sod.....	V-3-10
3.7.4	Hydroseed	V-3-10
3.7.5	Top Soil.....	V-3-10
3.8	Rip Rap	V-3-10
3.8.1	Revetment Riprap.....	V-3-10
3.8.2	Hand-Laid Riprap	V-3-11
3.8.3	Grouted Riprap.....	V-3-11
3.8.4	Precast Cement Concrete Riprap.....	V-3-11
3.9	Erosion Control	V-3-11
3.9.1	Geogrid	V-3-11
3.9.2	Straw Bales	V-3-12
3.9.3	Silt Fences.....	V-3-12
3.9.4	Gabions and Mattress Linings.....	V-3-12
3.9.5	Erosion Control Blankets	V-3-13
3.10	Flap Gates	V-3-13
3.10.1	Rubber Duckbill Flapgates.....	V-3-13

3.10.2	Metal Top-Hinged Flapgates.....	V-3-14
CHAPTER 4	– GRAVITY STORM SEWER MATERIALS	V-4-3
4.1	Purpose.....	V-4-3
4.2	Drainage Facilities.....	V-4-3
4.2.1	General.....	V-4-3
4.2.2	Gravity Storm Sewers	V-4-3
4.2.2.1	Rigid Pipes	V-4-3
4.2.2.2	Flexible Pipes.....	V-4-4
4.2.3	Open Culvert Facilities.....	V-4-4
4.2.3.1	Rigid Pipes.....	V-4-4
4.2.3.2	Flexible Pipes.....	V-4-5
4.3	Sewer Pipe Installation Depths.....	V-4-6
4.4	Joints and Fittings	V-4-6
4.4.1	Joints	V-4-6
4.4.1.1	RCP Joints.....	V-4-6
4.4.1.2	Reinforced Concrete Box Joints.....	V-4-6
4.4.1.3	CMP Joints.....	V-4-6
4.4.1.4	HDPE Joints.....	V-4-7
4.4.1.5	PVC Joints	V-4-7
4.4.2	Fittings	V-4-7
4.4.2.1	RCP and Reinforced Concrete Box Fittings.....	V-4-7
4.4.2.2	CMP Fittings.....	V-4-7
4.4.2.3	HDPE Fittings.....	V-4-7
4.4.2.4	PVC Fittings.....	V-4-8
4.5	Manholes.....	V-4-8
4.5.1	Precast Manholes	V-4-8
4.5.1.1	Adjusting Rings	V-4-8
4.5.1.2	Manhole Steps.....	V-4-8
4.5.1.3	Mortar for Jointing Manholes.....	V-4-9
4.5.2	Monolithic (Cast-in-Place) Manholes.....	V-4-9
4.6	Manhole Frames and Covers.....	V-4-9
4.6.1	Cast Iron Frames and Covers	V-4-10
4.6.2	Ductile Iron Frames and Covers.....	V-4-10
4.7	Concrete Catchbasins and Box Inlets.....	V-4-10
4.7.1	Castings.....	V-4-11
4.8	Underdrains.....	V-4-11
4.9	End Treatments	V-4-12
4.9.1	End Sections for RCP	V-4-12
4.9.2	End Sections for Box Sections and Structural Plate Arches.....	V-4-12

4.9.3	End Sections for CMP.....	V-4-12
4.9.4	End Sections for PVC and HDPE	V-4-12
CHAPTER 5 – SANITARY SEWER MATERIALS.....		V-5-3
5.1	Purpose.....	V-5-3
5.2	Sanitary Sewer Pipe	V-5-3
5.2.1	General.....	V-5-3
5.2.2	Gravity Sanitary Sewers	V-5-3
5.2.2.1	Rigid Pipes.....	V-5-3
5.2.2.2	Flexible Pipes.....	V-5-4
5.2.3	Pressurized Force Mains	V-5-4
5.2.3.1	Rigid Pipes.....	V-5-4
5.2.3.2	Flexible Pipes.....	V-5-4
5.3	Sewer Pipe Installation Depths.....	V-5-4
5.4	Joints and Fittings	V-5-5
5.4.1	Joints	V-5-5
5.4.1.1	RCP Joints.....	V-5-5
5.4.1.2	Ductile Iron Joints.....	V-5-5
5.4.1.3	HDPE Joints.....	V-5-5
5.4.1.4	PVC Joints	V-5-6
5.4.1.4.1	Gravity PVC Joints	V-5-6
5.4.1.4.2	Pressure PVC Joints.....	V-5-6
5.4.2	Fittings	V-5-6
5.4.2.1	RCP Fittings.....	V-5-6
5.4.2.2	Ductile Iron Fittings.....	V-5-6
5.4.2.3	HDPE Fittings.....	V-5-6
5.4.2.4	PVC Fittings.....	V-5-6
5.5	Manholes.....	V-5-7
5.5.1	Precast Manholes	V-5-7
5.5.1.1	Adjusting Rings	V-5-7
5.5.1.2	Manhole Steps.....	V-5-7
5.5.1.3	Mortar for Jointing Manholes.....	V-5-8
5.5.2	Monolithic (Cast-in-Place) Manholes.....	V-5-8
5.6	Manholes Frames and Covers	V-5-8
5.6.1	Cast Iron Frames and Covers	V-5-8
5.6.2	Ductile Iron Frames and Covers.....	V-5-8
5.7	Tracing Wire	V-5-9
5.8	Sanitary Sewer Lift Station Components.....	V-5-9
5.8.1	Submersible Pumps.....	V-5-9
5.8.2	Electrical Components	V-5-9
5.8.3	Valves	V-5-9

5.8.4	Miscellaneous Equipment	V-5-9
CHAPTER 6 – POTABLE WATER DISTRIBUTION MATERIALS.....		V-6-3
6.1	Purpose.....	V-6-3
6.2	Required Certifications	V-6-3
6.3	Water Main Pipe	V-6-3
6.3.1	General.....	V-6-3
6.3.2	Water Mains.....	V-6-3
6.3.2.1	Ductile Iron Pipe (DI)	V-6-4
6.3.2.2	Prestressed Concrete Cylinder Pipe (PCCP)	V-6-4
6.3.2.3	Polyvinyl Chloride (PVC) Pipe.....	V-6-4
6.3.2.4	High Density Polyethylene (HDPE) Pipe.....	V-6-4
6.3.3	Service Lines.....	V-6-5
6.4	Joints and Fittings	V-6-5
6.4.1	Joints	V-6-5
6.4.1.1	Ductile Iron Joints.....	V-6-5
6.4.1.2	PCCP Joints	V-6-5
6.4.1.3	PVC Joints	V-6-5
6.4.1.4	HDPE Joints.....	V-6-5
6.4.1.5	Copper Joints	V-6-6
6.4.2	Fittings	V-6-6
6.4.2.1	Ductile Iron Fittings.....	V-6-6
6.4.2.2	PCCP Fittings.....	V-6-6
6.4.2.3	PVC Fittings.....	V-6-6
6.4.2.4	HDPE Fittings.....	V-6-7
6.4.2.5	Copper Fittings.....	V-6-7
6.4.2.6	Brass Fittings.....	V-6-7
6.5	Fire Hydrants.....	V-6-7
6.6	Mainline Valves	V-6-8
6.6.1	Resilient Seat Gate Valves	V-6-8
6.6.2	Butterfly Valves	V-6-8
6.7	Restraint Devices.....	V-6-9
6.8	Casing Spacers	V-6-9
6.9	Casing End Seals.....	V-6-10
6.10	Curb Stops.....	V-6-10
6.10.1	1½” to 2” in Diameter	V-6-10
6.10.2	Less than 1½” in Diameter	V-6-10
6.11	Corporation Stops.....	V-6-11

6.11.1 1½” to 2” in Diameter V-6-11
 6.11.2 Less than 1½” in Diameter V-6-11
 6.12 Saddles V-6-11
 6.13 Valve and Curb Boxes V-6-11
 6.14 Water Meters V-6-12
 6.15 Water Meter Ford Boxes V-6-12
 6.16 Silver Solder V-6-12
 6.17 Tracing Wire V-6-12
 6.18 Polywrap V-6-12
 6.19 Backflow Prevention Devices V-6-12

UNIT VI – STANDARD DRAWINGS

STRUCTURES:

Manhole Structure

- STR-1-1 Standard 48” Manhole (page 1)
- STR-1-2 Standard 48” Manhole (page 2)
- STR-2 Standard 60” Manhole
- STR-3 Standard 72” Manhole
- STR-4 Standard 84” – 96” Manhole
- STR-5 Non-Metered Control Manhole
- STR-6 Metered Control Manhole

Manhole Specific

- STR-10 Poured in Place Base 48” and Less
- STR-11 Standard Manhole Poured in Place Base 54”-96”
- STR-12 Pipe Connection to Manhole For Pipes Less Than 36” in Diameter and Smaller
- STR-13 Pipe Connection to Manhole for Pipes Larger Than 36” in Diameter
- STR-14 Poured Channel Shapes I
- STR-15 Poured Channel Shapes II
- STR-16 Standard Outside Drop for Manholes
- STR-17 Standard Manhole Step
- STR-18 Precast Concrete Riser Rings
- STR-19 Casting Adjustment
- STR-20 Cast-in-Place Section Alternative to Adjusting Rings

Stormwater Specific

- STR-26 Precast 30” Round Inlet
- STR-27 Field created 30” Round Inlet
- STR-28 Precast 33” Round Inlet
- STR-29 Field created 30” Round Inlet
- STR-30 24” Inlet
- STR-31 2’ x 2’ Inlet

- STR-32 2' x 3' Inlet
- STR-33 30" x 30" Inlet
- STR-34 Standard Catch Basin
- STR-35 Trench Drain Type I
- STR-36 Trench Drain Type II

Water Specific

- STR-40-1 Air Release Structure Type "A"
- STR-40-2 Air Release Structure Type "B"
- STR-42-1 Blow-Off Installation - Temporary
- STR-42-2 Blow-Off Installation – Permanent
- STR-43 Valve Box
- STR-44 Curb Box
- STR-45 Water Meter Box

CASTINGS

Sanitary Specific

- C 1-1 24" Sanitary Manhole Casting
- C 2-1 Watertight Sanitary Manhole Casting
- C 2-2 Watertight Sanitary Manhole Casting
- C 3-1 Standard Cleanout Casting
- C 3-2 Standard Cleanout Casting

Stormwater Specific

- C 4-1 24" Storm Manhole Casting
- C 5-1 Watertight Storm Manhole Casting
- C 5-2 Watertight Storm Manhole Casting
- C 6-1 24" Manhole Casting
- C 7-1 24" Beehive Casting
- C 8-1 30" x 30" Beehive Grate
- C 8-2 30" x 30" Beehive Grate
- C 9-1 2' x 2' Alley Casting
- C 9-2 2' x 2' Alley Casting
- C 10-1 2' x 2' Curb and Gutter Casting
- C 10-2 2' x 2' Curb and Gutter Casting
- C 10-3 2' x 2' Curb and Gutter Casting
- C 10-4 2' x 2' Curb and Gutter Casting
- C 10-5 2' x 2' Curb and Gutter Casting
- C 10-6 2' x 2' Curb and Gutter Casting
- C 11-1 2' x 3' Curb and Gutter Casting
- C 11-2 2' x 3' Curb and Gutter Casting
- C 11-3 2' x 3' Curb and Gutter Casting
- C 11-4 2' x 3' Curb and Gutter Casting
- C 11-5 2' x 3' Curb and Gutter Casting
- C 12-1 33" Round Curb and Gutter Casting
- C 12-2 33" Round Curb and Gutter Casting
- C 12-3 33" Round Curb and Gutter Casting

MISCELLANEOUS STORMWATER DETAILS

- SW-1 Swale Underdrain
- SW-2 Curb Underdrain

- SW-3 Waterway Cross-Sections
- SW-4 Silt Fence
- SW-5 Silt Check Type I – Straw Bales

MISCELLANEOUS SANITARY DETAILS

- SAN-1 Building Sewer Connection Layout
- SAN-2 Building Adaptor and Cleanout
- SAN-3 Standard Sanitary Cleanout
- SAN-4 Shallow Service Connection
- SAN-5 Deep Service Connection
- SAN-6 Cut-in Wye Method
- SAN-7 Saddle Connection

MISCELLANEOUS WATER DETAILS

- W-1 Typical Valve Placement –Main Lines
- W-2 Typical Valve Placement – Cul-de-Sac Sets
- W-3 Butterfly Valve Installation
- W-10 Fire Hydrant Assembly Type I
- W-11 Fire Hydrant Assembly Type II
- W-12 Fire Hydrant Assembly Type III
- W-13 Fire Hydrant Assembly Type III Modified
- W-14 Fire Hydrant Assembly Type IV
- W-15 Fire Hydrant Assembly Type IV Modified
- W-16 Fire Hydrant Assembly Type V
- W-17 Standard Hydrant Setting
- W-18 General Location of Fire Hydrant (Reference to Curb & Sidewalk)
- W-19 General Location of Fire Hydrant (Reference to Street Corners & Mid-Block Sets)
- W-20 Block-Outs in Sidewalks for Fire Hydrants
- W-21 Fire Hydrant Guard Posts for Type I, IV & V Hydrant Assemblies
- W-22 Fire Hydrant Guard Posts for Type II & III Hydrant Assemblies
- W-30 Air Gap – Backflow Prevention
- W-31 Atmospheric Vacuum Breaker - Backflow Prevention
- W-32 Pressure Vacuum Breaker – Backflow Prevention
- W-33 Double Check Valve – Backflow Preventer
- W-34 Reduced Pressure Principle Backflow Preventer
- W-40 Service Installations
- W-41 Round Way Connection
- W-42 Typical Channel Crossing
- W-43 Restraining Methods
- W-44 Restraint of Elbows
- W-45 Restraint of Tees
- W-46 Restraining Valves on Dead Ends
- W-47 Restraining Valves (Non-Dead End) and Reducers
- W-48 Typical Jacked and Bored Casing Pipe
- W-49 Casing Spacers (Typical)
- W-50 Casing End Seals

BACKFILLS AND SEPARATION

- BS-1 Recommended Utility Placement in Public Right-of-Way
- BS-2 Recommended Utility Placement in Back to Back Easement

- BS-3 Recommended Utility Placement in Existing Perimeter Easement
- BS-4 General Rigid Conduit Bedding Detail
- BS-5 General Flexible Pipe Bedding Detail
- BS-6 Ductile Iron Pipe Trench Section
- BS-7 Water Line Separation

PUMP STATIONS

Pump Station Layout

- PS-1 General Pump Station Layout
- PS-2 Typical Duplex Pump Station I
- PS-3 Typical Duplex Pump Station II
- PS-4 Typical Duplex Pump Station III

Miscellaneous Pump Station

- PS-10 Typical Valve Vault
- PS-11 Typical Duplex Control Panel
- PS-12 Typical Lift Station Antenna Mounting Details
- PS-13 Typical Lift Station P&ID and PLC/Radio Combination Panel Installation

UNIT VII - STANDARD SPECIFICATIONS

CHAPTER 1 - INTRODUCTION VII-1-2

- 1.1 Purpose..... VII-1-2
- 1.2 Description and Use VII-1-2
 - 1.2.1 Compliance with Other Standards..... VII-1-2
 - 1.2.2 Conflicting Standards..... VII-1-2
 - 1.2.3 Waivers and Variance from Standards VII-1-2
- 1.3 Definitions and Symbols VII-1-2
 - 1.3.1 Definitions..... VII-1-2
 - 1.3.2 Abbreviations VII-1-3
- 1.4 Additional References VII-1-4

CHAPTER 2 – GENERAL EXCAVATION VII-2-3

- 2.1 Description VII-2-3
- 2.2 Underground Facilities and Other Utility Structures VII-2-3
- 2.3 Protecting Underground and Surface Structures VII-2-3
- 2.4 Alignment and Grade VII-2-3
- 2.5 Survey Lines and Grades..... VII-2-3
- 2.6 Clearing..... VII-2-3

2.6.1	Brush Removal and Disposal	VII-2-4
2.6.1.1	Material to be Removed.....	VII-2-4
2.6.1.2	Limits of Removal	VII-2-4
2.7	Removal of Excavated Material	VII-2-4
2.8	Manner of Piling Excavated Material.....	VII-2-4
2.9	Surface Removal	VII-2-5
2.9.1	Care of Surface Material for Reuse	VII-2-5
2.10	Width of Excavation	VII-2-5
2.11	Excavation Below Grade.....	VII-2-5
2.12	Trench Excavation for Change in Grade	VII-2-5
2.13	Subsurface Exploration	VII-2-5
2.14	Short Tunnels or Jacking.....	VII-2-6
2.15	Trenching by Machine or by Hand.....	VII-2-6
2.16	Trenches to be Dry	VII-2-6
2.17	Base Stabilization.....	VII-2-6
2.18	Dewatering.....	VII-2-6
2.19	Dust Control.....	VII-2-7
2.20	Deviations Occasioned by Other Structures or Utilities	VII-2-7
2.21	Interruptions to Utilities	VII-2-7
2.22	Interference with and Protection of Streets.....	VII-2-7
2.23	Construction in Easements (Permanent and Temporary)	VII-2-8
2.24	Bedding and Backfill Requirements for Underground Conduits.....	VII-2-8
2.24.1	General Requirements.....	VII-2-8
2.24.2	Backfilling Compaction	VII-2-8
2.24.2.1	Water Jetting for Compaction	VII-2-8
2.24.2.1.1	Jet Holes for Backfill	VII-2-8
2.24.2.1.2	Water Jetting	VII-2-9
2.24.3	Payment for "Special Backfill"	VII-2-9
2.25	Barricades, Guards and Safety Provisions.....	VII-2-10

2.26 Traffic and Utility Controls VII-2-10

2.27 Flow of Drains and Sewer Maintained VII-2-10

2.28 Property Protection VII-2-10

2.29 Interruption of Water Service VII-2-10

2.30 Braced and Sheeted Trenches VII-2-10

 2.30.1 Placement of Sheetting VII-2-10

 2.30.2 Contractor’s Responsibility for Sheetting VII-2-10

 2.30.3 Payment for Sheetting VII-2-11

CHAPTER 3 – STORM AND SANITARY SEWER INSTALLATION AND TESTING VII-3-3

3.1 Laying Pipe VII-3-3

3.2 Sewer Line Connections VII-3-3

3.3 Service Risers (Deep Connections) VII-3-3

3.4 Method of Payment VII-3-4

 3.4.1 General VII-3-4

 3.4.2 Payment for Pipe VII-3-4

 3.4.3 Payment for Tees, Wyes and Service Risers VII-3-4

3.5 Manholes for Sanitary and Storm Sewers VII-3-4

 3.5.1 Description VII-3-4

 3.5.2 Manhole Construction Details VII-3-5

 3.5.2.1 Dewatering VII-3-5

 3.5.2.2 Bedding VII-3-5

 3.5.2.3 Cast-in-Place Bases VII-3-5

 3.5.2.4 Lift Holes and Joints VII-3-5

 3.5.2.5 Placing of Castings VII-3-6

 3.5.2.5.1 In Paved Streets VII-3-6

 3.5.2.5.2 In Unpaved Streets or Alleys VII-3-6

 3.5.2.5.3 Within Cultivated and Non-Cultivated Areas VII-3-6

 3.5.2.5.4 Reducing Cones VII-3-6

 3.5.2.5.5 Adjusting Rings VII-3-6

 3.5.3 Channels and Inverts VII-3-6

 3.5.4 Pipe-Manhole Connection VII-3-7

 3.5.5 Controls and/or Flow Measuring Manhole VII-3-7

 3.5.6 Payment for Manholes VII-3-7

3.6 Catch Basins, Inlets, and Special Structures VII-3-7

 3.6.1 Description VII-3-7

 3.6.2 Material VII-3-7

 3.6.3 Construction Methods VII-3-8

 3.6.3.1 Concrete VII-3-8

 3.6.3.2 Precast Reinforced Concrete Sections VII-3-8

	3.6.3.3 Placing of Castings.....	VII-3-8
	3.6.3.4 Cleaning.....	VII-3-8
	3.6.4 Payment for Catch Basins, Inlets and Special Structures.....	VII-3-8
3.7	Building Service Sewer.....	VII-3-8
	3.7.1 Fittings and Plugs.....	VII-3-9
	3.7.2 Construction Details for Building Service Sewers.....	VII-3-9
	3.7.2.1 Width of Excavation.....	VII-3-9
	3.7.2.2 Pipe Laying and Jointing.....	VII-3-10
	3.7.2.3 Sewer Line Connections.....	VII-3-10
	3.7.2.4 Cleanouts.....	VII-3-10
	3.7.3 Inspections.....	VII-3-10
3.8	Tests for Sanitary Sewer.....	VII-3-10
	3.8.1 Sewer Pipe Test.....	VII-3-10
	3.8.2 Pipe Joints Test.....	VII-3-11
	3.8.3 Low Pressure Air Test (Gravity Sewers).....	VII-3-11
	3.8.3.1 Air Test for Acceptance.....	VII-3-11
	3.8.3.2 Payment.....	VII-3-11
	3.8.4 Deflection Test (Mandrel Test).....	VII-3-11
	3.8.4.1 Payment.....	VII-3-12
	3.8.5 Test for Flexible Conduits.....	VII-3-12
	3.8.6 Water Test of Sewer.....	VII-3-12
	3.8.6.1 Amount of Test.....	VII-3-12
	3.8.6.2 Section Test.....	VII-3-12
	3.8.7 Infiltration Tests.....	VII-3-12
	3.8.8 Exfiltration Tests.....	VII-3-13
	3.8.9 Infiltration/Exfiltration Tests for Sanitary Sewers.....	VII-3-13
	3.8.10 Water Test Procedures.....	VII-3-14
	3.8.10.1 Bulkhead.....	VII-3-14
	3.8.10.2 Fill.....	VII-3-14
	3.8.10.3 Maintain Water Level.....	VII-3-14
	3.8.10.4 Pump Out.....	VII-3-14
	3.8.10.5 Repair.....	VII-3-14
	3.8.10.6 Payment.....	VII-3-14
	3.8.11 Testing Force Main.....	VII-3-14
	3.8.11.1 Procedure.....	VII-3-14
	3.8.11.2 Repair.....	VII-3-15
	3.8.11.3 Payment.....	VII-3-15
3.9	Underground Conduit Constructed in Tunnels.....	VII-3-15
	3.9.1 Permits.....	VII-3-15
	3.9.2 Materials.....	VII-3-15
	3.9.3 Excavation and Laying.....	VII-3-15
	3.9.4 Method of Construction.....	VII-3-15
	3.9.5 Use of Casing Pipe.....	VII-3-16
	3.9.6 Boring of Pipe.....	VII-3-16
	3.9.7 Jacking of Pipe.....	VII-3-16
	3.9.8 Measurement and Payment.....	VII-3-16

3.10	Concrete Cradle and Encasement.....	VII-3-16
3.10.1	Application.....	VII-3-16
3.10.2	Measurement and Payment	VII-3-16
CHAPTER 4 – WATER MAIN INSTALLATION AND TESTING		VII-4-3
4.1	Handling Pipe and Accessories	VII-4-3
4.1.1	Care.....	VII-4-3
4.1.2	Care of Pipe Coating and Lining.....	VII-4-3
4.1.3	At Site of Work and Bell Ends, How Faced.....	VII-4-3
4.2	Alignment and Grade	VII-4-3
4.3	Excavation and Preparation of Trench and Tunnels.....	VII-4-3
4.3.1	Description.....	VII-4-3
4.3.2	Width	VII-4-4
4.3.3	Pipe Foundation	VII-4-4
4.3.4	Bell Holes Required.....	VII-4-4
4.3.5	Braced and Sheeted Trenches	VII-4-4
4.4	Pipe Laying	VII-4-4
4.4.1	Materials Inspection	VII-4-4
4.4.2	Unsuitable Conditions for Laying Pipe	VII-4-4
4.4.3	Pipe to be Clean	VII-4-4
4.4.4	Manner of Handling Pipe and Accessories into Trench	VII-4-5
4.4.5	Laying the Pipe	VII-4-5
4.4.6	Preventing Trench Water from Entering Pipe	VII-4-5
4.4.7	Cutting Pipe	VII-4-5
4.4.8	Bell Ends to Face Direction of Laying.....	VII-4-5
4.4.9	Backfill Material	VII-4-5
4.4.9.1	Type “A” Backfill	VII-4-5
4.4.9.2	Type “B” Backfill	VII-4-6
4.4.9.3	Type “C” Backfill	VII-4-6
4.4.9.4	Backfill Zones.....	VII-4-6
4.4.9.4.1	Pipe Zone.....	VII-4-6
4.4.9.4.2	Backfill Zone	VII-4-6
4.4.9.4.3	Restoration Zone.....	VII-4-6
4.4.9.5	Rock and Boulder Exclusion.....	VII-4-7
4.4.9.6	Deficiency of Backfill	VII-4-7
4.4.10	Compaction	VII-4-7
4.4.11	Boring, Tunneling and Jacking	VII-4-7
4.4.11.1	Highway Crossing.....	VII-4-7
4.4.11.2	Railroad Crossing	VII-4-8
4.4.11.3	Boring	VII-4-8
4.4.11.4	Tunnel Liners.....	VII-4-8
4.4.11.5	Ends of Casing Pipes and Tunnels Bulkheaded.....	VII-4-9
4.5	Jointing Pipe.....	VII-4-10
4.5.1	Preparation of Pipe Ends.....	VII-4-10

4.5.2 Making Up Slip-Joints VII-4-10

4.5.3 Making Up Mechanical Joints..... VII-4-10

4.6 Setting Valves, Valve Boxes, Fittings, and Blow-Offs VII-4-10

4.6.1 Valves VII-4-10

4.6.2 Valve Boxes VII-4-10

4.6.3 Back-Siphonage to be Prevented..... VII-4-10

4.7 Setting Fire Hydrants VII-4-11

4.7.1 Anchorage for Fire Hydrants..... VII-4-11

4.7.2 Cleaning VII-4-11

4.8 Plugging Dead Ends..... VII-4-11

4.9 Anchorage of Bends, Tees and Plugs..... VII-4-11

4.9.1 Restrained Joints VII-4-11

4.9.2 Material for Reaction Blocking VII-4-11

4.9.3 Metal Harness VII-4-11

4.10 Restoration and Clean-Up VII-4-12

4.10.1 Restoration of Working Area in General..... VII-4-12

4.10.2 Maintenance of Surface..... VII-4-12

4.10.3 Replacement of Drainage and Sewer Lines and Structures VII-4-12

4.10.3.1 Drainage or Sewer Pipe or Structure Replacement VII-4-12

4.11 Cleaning up VII-4-12

4.12 Hydrostatic Tests VII-4-12

4.12.1 Time For Making Test..... VII-4-12

4.12.2 Pressure During Test..... VII-4-12

4.12.3 Duration of Pressure Test..... VII-4-13

4.12.4 Procedure VII-4-13

4.12.5 Expelling Air Before Test VII-4-13

4.12.6 Correction Due to Failure of Test..... VII-4-13

4.12.7 Leakage VII-4-13

4.12.7.1 Permissible Leakage VII-4-13

4.12.7.2 Variation from Permissible Leakage..... VII-4-14

4.13 Disinfection of Mains..... VII-4-14

CHAPTER 5 – CONCRETE INSTALLATION AND TESTING..... VII-5-4

5.1 Portland Cement..... VII-5-4

5.2 Aggregate VII-5-4

5.3 Water..... VII-5-4

5.4 Storage of Material..... VII-5-4

5.5	Concrete Quality and Working Stresses	VII-5-4
5.5.1	Concrete Quality	VII-5-4
5.5.2	Concrete Proportions and Consistency	VII-5-4
5.5.2.1	Method of Mixing	VII-5-4
5.5.2.2	Measurement of Materials	VII-5-5
5.5.2.3	Weight of Materials	VII-5-5
5.5.3	Removal of Water from Excavation	VII-5-5
5.5.4	Cleaning Forms and Equipment	VII-5-5
5.5.5	Inspection	VII-5-5
5.5.6	Transporting Concrete	VII-5-5
5.5.6.1	Control	VII-5-5
5.5.6.2	Method of Handling	VII-5-5
5.5.6.3	Dumping Concrete	VII-5-6
5.5.6.4	Use of Chute	VII-5-6
5.5.7	Placing Concrete	VII-5-6
5.5.7.1	Care of Handling	VII-5-6
5.5.7.2	Puddling and Vibration	VII-5-6
5.5.7.3	Unusual conditions of Puddling	VII-5-6
5.5.7.4	Continuous Placement	VII-5-7
5.5.7.5	Record	VII-5-7
5.5.8	Construction Joints and Stoppages	VII-5-7
5.5.8.1	Limits of Placement	VII-5-7
5.5.8.2	Leveling	VII-5-7
5.5.8.3	Vertical Stops	VII-5-7
5.5.8.4	Elapse Time Between Placements	VII-5-7
5.6	Depositing Against Other Concrete	VII-5-8
5.7	Protecting and Curing	VII-5-8
5.8	Design of Forms	VII-5-8
5.9	Form Ties	VII-5-8
5.10	Removal of Forms	VII-5-8
5.11	Making, Placing and Curing Concrete	VII-5-9
5.11.1	Making, Placing and Curing Concrete in Warm Weather	VII-5-9
5.11.2	Making, Placing and Curing Concrete in Cold Weather	VII-5-9
5.11.2.1	Equipment for Covering and Heating	VII-5-9
5.11.2.2	Temperature of the Concrete	VII-5-9
5.11.2.3	Temperature Records	VII-5-9
5.11.2.4	Protection of Temperatures	VII-5-10
5.11.2.5	Open Areas of Exposure	VII-5-10
5.11.2.6	Exposure Time	VII-5-10
5.11.2.7	Moisture Control	VII-5-10
5.11.2.8	Fire Protection	VII-5-10
5.11.2.9	Heating Appliances	VII-5-10

5.11.2.10	Heating of Materials	VII-5-11
5.11.2.11	Anti-Freeze Compounds	VII-5-11
5.11.2.12	Accelerators	VII-5-11
5.11.2.13	Preparation of Forms.....	VII-5-11
5.11.2.14	Removal of Forms.....	VII-5-11
5.12	Concrete Reinforcing Steel	VII-5-12
5.12.1	Scope of Work	VII-5-12
5.12.1.1	Steel Placement.....	VII-5-12
5.12.1.2	Size	VII-5-12
5.12.2	Quality.....	VII-5-12
5.12.2.1	Age and Kind of Stock.....	VII-5-12
5.12.2.2	Specifications of Steel.....	VII-5-12
5.12.2.3	Alternate Steel “a”	VII-5-12
5.12.2.4	Alternate Steel “b”	VII-5-13
5.12.2.5	Certification of Steel	VII-5-13
5.12.3	Deformations.....	VII-5-13
5.12.4	Welded Steel Wire Fabric	VII-5-13
5.12.5	Drawings and Schedule.....	VII-5-13
5.12.6	Fabricating Reinforcement.....	VII-5-13
5.12.6.1	Forming	VII-5-13
5.12.6.2	Uniform Size Bars	VII-5-13
5.12.7	Placing Reinforcement	VII-5-14
5.12.7.1	Clean Bars Required	VII-5-14
5.12.7.2	Position of Rods.....	VII-5-14
5.12.7.3	Excess Exposure of Steel.....	VII-5-14
5.12.7.4	Heating of Bars Not Permitted	VII-5-14
5.12.7.5	Placement of Metal	VII-5-14
5.12.8	Splices and Offsets in Reinforcements.....	VII-5-14
5.12.8.1	Splicing Locations to be Approved by Engineers	VII-5-14
5.12.8.2	Lab Allowance for Column Bars	VII-5-14
5.13	Testing for Concrete Acceptance	VII-5-15
5.13.1	Materials Tests	VII-5-15
5.13.2	Cement	VII-5-15
5.13.3	Fine Aggregate (for use in Cement Concrete).....	VII-5-15
5.13.4	Coarse Aggregate (for use in Cement Concrete).....	VII-5-15
5.13.5	Concrete Tests.....	VII-5-15
5.13.6	Advance Concrete Tests.....	VII-5-15
5.13.7	Field-Cured Control Tests.....	VII-5-16
5.13.7.1	Specimens.....	VII-5-16
5.13.7.2	Specimens in Question.....	VII-5-16
5.13.8	Reinforcing Metal	VII-5-16
CHAPTER 6 – STREET PAVING AND NEW SURFACES.....		VII-6-2
6.1	Portland Cement (PC) Concrete Pavement Surface	VII-6-2
6.1.1	Street Surface	VII-6-2
6.1.2	Driveway and Alley Approaches.....	VII-6-2

6.1.3	Strength of Concrete	VII-6-2
6.2	Asphalt Pavement Surface.....	VII-6-2
6.2.1	Application.....	VII-6-2
6.2.2	Authority	VII-6-2
6.2.3	Driveway and Alley Approaches.....	VII-6-2
6.2.4	Subgrade	VII-6-3
6.3	Brick Pavement Surface	VII-6-3
6.4	Concrete Sidewalks, Driveways, Curb, Cub and Gutters	VII-6-3
6.4.1	Replacement.....	VII-6-3
6.4.2	Matching and Jointing.....	VII-6-3
6.5	Restoration of Surfaces Outside Immediate Working Areas	VII-6-3
6.6	Payment.....	VII-6-3
6.6.1	Pavement and Driveways	VII-6-3
6.6.2	Payment for Concrete Walk, Curb and Gutters	VII-6-4
6.7	Replacing Existing Unimproved Street and Alley Surface.....	VII-6-4
6.7.1	Definition of Unimproved Surfaces	VII-6-4
6.7.2	Conduits Under Unimproved Surfaces.....	VII-6-4
6.7.3	Omission of Asphalt.....	VII-6-4
6.7.4	Payment.....	VII-6-5
CHAPTER 7 – RESTORATION OF SURFACES AND LANDSCAPING		VII-7-2
7.1	Restoration of Surfaces	VII-7-2
7.1.1	General.....	VII-7-2
7.1.2	Temporary Surface over Trench.....	VII-7-2
7.1.3	Removal of Pavement, Sidewalk, Driveway and Curb.....	VII-7-2
7.1.4	Seeding and Sodding.....	VII-7-2
7.1.4.1	Preparation of Seed Bed.....	VII-7-2
7.1.4.2	Hydroseeding	VII-7-3
7.1.4.3	Replacement of Sodded Areas	VII-7-3
7.1.4.4	Payment	VII-7-4
7.1.5	Disposal of Surplus Excavated Material	VII-7-4
7.1.6	Cleanup	VII-7-4
7.2	Trees.....	VII-7-4
7.2.1	Professional Service	VII-7-4
7.2.2	Removal and Replacement.....	VII-7-5
7.2.3	Guidelines for Trenching around Trees.....	VII-7-5
7.2.3.1	Upper Limits.....	VII-7-5
7.2.3.2	Lower Limits.....	VII-7-5
7.2.3.3	Dripline Protection.....	VII-7-5
7.2.3.4	Removal.....	VII-7-5
7.2.3.5	Replacement of Trees	VII-7-5

CHAPTER 8 – MISCELLANEOUS SPECIFICATIONS VII-8-2

8.1 Safety VII-8-2

 8.1.1 Barricades, Guards, and Safety Provisions..... VII-8-2

 8.1.2 Existing Underground Structures VII-8-2

 8.1.3 Structure Protection..... VII-8-2

 8.1.4 Protection of Property and Surface Structures..... VII-8-2

 8.1.5 Caution in Excavation VII-8-3

8.2 Wage Rates VII-8-3

 8.2.1 Prevailing Wage VII-8-3

 8.2.2 Wage Schedule..... VII-8-3

 8.2.3 Posted Wage Schedule VII-8-3

8.3 Nondiscrimination in Employment VII-8-3

 8.3.1 General..... VII-8-3

 8.3.1.1 Discrimination VII-8-3

 8.3.1.2 Intimidation..... VII-8-4

 8.3.1.3 Individual Penalty VII-8-4

 8.3.1.4 Contractor Penalty VII-8-4

 8.3.1.5 Local Code..... VII-8-4

8.4 Rock Excavation VII-8-4

 8.4.1 Classification of Rock VII-8-4

 8.4.1.1 Payment for Removal..... VII-8-4

 8.4.2 Rock Excavation in Trenches..... VII-8-5

 8.4.2.1 Limit of Removal from Trenches..... VII-8-5

 8.4.2.2 Bedding in Rock VII-8-5

 8.4.3 Measurement for Payment..... VII-8-5

 8.4.4 Payment..... VII-8-5

8.5 Blasting VII-8-6

 8.5.1 Operation of Blasting VII-8-6

 8.5.1.1 Requirements VII-8-6

 8.5.1.2 Material Storage and Handling VII-8-6

 8.5.1.3 Safety Precautions..... VII-8-6

8.6 Riprap..... VII-8-6

 8.6.1 Payment..... VII-8-6

 8.6.2 Removal and Placement Riprap VII-8-7

LIST OF EXHIBITS

UNIT I

- I-1-1 Development Criteria/Standards Manual Comment Form

- I-2-1 Required Permits
- I-2-2 Utility and Public Works Agencies

- I-3-1 Consent and Release
- I-3-2 Sample Sanitary Sewer, Drainage and Potable Water Easement Plat
- I-3-3 Sample Release of Easement Plat
- I-3-4 Sample Easement Encroachment Plat
- I-3-5 Certificate of Sanitary Sewer, Drainage and Potable Water Easement
- I-3-6 Certificate of Release of Sanitary Sewer, Drainage and Potable Water Easement
- I-3-7 Encroachment Agreement

UNIT II

- II-2-1 Basic Submittal/ Stormwater Red Flags
- II-2-2 Drainage Plan Submittal Review Checklist
- II-2-3 Minimum Drainage Plan Construction Plan Requirements Checklist

- II-3-1 Intensity-Duration-Frequency Table
- II-3-2 Intensity-Duration-Frequency Curves
- II-3-3 Depth-Duration-Frequency Table

- II-5-1 IAC 327 15-5 “Rule 5”

UNIT III

- III-2-1 First Checklist
- III-2-2 Area Map
- III-2-3 Sanitary Sewer Service Area Map
- III-2-4 Second Checklist
- III-2-5 Sanitary Sewer Facilities Review Checklist
- III-2-6 Minimum Construction Plan Requirements Checklist
- III-2-7 IDEM Local Permitting Forms

- III-3-1 Wastewater Flows
- III-3-2 Peaking Factors
- III-3-3 Minimum Allowable Slopes

UNIT IV

- IV-2-1 First Checklist for Water Main Extension or Site Plan

IV-2-2A	Area Map Example
IV-2-2B	Offsite Mapping Example
IV-2-2C	USGS Map Example
IV-2-2D	Master Plan Map Example
IV-2-3	Second Checklist for Water Main Development or Site Plan
IV-2-4	Water Main Extension Detailed Plan Requirements Checklist
IV-2-5	Minimum Construction Plan Requirements Checklist
IV-2-6	Water Main Extension Calculation Submittal Requirements Checklist
IV-2-7	Backflow Prevention Detail Example
IV-2-8	Checklist for Backflow Prevention Submittal
IV-2-9	Fire Service Riser Detail
IV-2-10	Checklist for Fire Service Submittal
IV-2-11	IDEM Local Permitting Forms
IV-3-1	Maximum Joint Deflection Full-Length Pipe
IV-3-2	Small Water Meter Spacing (Sizes 5/8" x 3/4", 3/4" x 1")
IV-3-3	Standard Compound and Turbo Water Meter Spacing (Sizes 1 1/2", 2", 3", 4", 6")
IV-3-4	Ford Type Pit Installation Details for Positive Displacement, Standard Compound, and Turbo Meters (Sizes 5/8", 5/8" x 3/4", 3/4", 1", 1 1/2", and 2")
IV-3-5	Fire Line Water Meter Spacing (Sizes 4", 6", 8", and 10")
IV-3-6	Meter Pit Cover Requirements
IV-3-7a	Length of Restraint – Wrapped Ductile Iron Pipe
IV-3-7b	Length of Restraint – Polywrapped Ductile Iron Pipe
IV-3-8	Restraint of Elbows
IV-3-9	Restraint of Tees
IV-3-10	Restraining Valves on Dead Ends
IV-3-11	Restraining Valves (Non-Dead End) and Reducers
IV-3-12	Number and Size of Restraining Rods For Use With Various Degrees of Elbows and Diameters of Pipe
IV-3-13	Tie Rods, Nuts, and Washers
IV-3-14	Bent Eye Bolts
IV-4-1	Summary Checklist for Backflow Preparation Requirements, New Construction
IV-4-2	Potential Cross Connection Hazards by Facility

UNIT V

V-2-1	Non-Standard Product Evaluation Form
V-4-1	Cover and Gauge Requirements for Corrugated Steel and Aluminum Pipe
V-4-2	Installation Depths for Various Classes of RCP
V-4-3	Installation Depths for HDPE
V-4-4	Installation Depths for PVC
V-5-1	Installation Depths for Various Classes of RCP
V-5-2	Installation Depths for HDPE
V-5-3	Installation Depths for PVC