



WATER SERVICES ASSOCIATION
OF AUSTRALIA

Sewage Pumping Station Code of Australia

Sydney Water Edition – 2012



Sydney
WATER

WSA 04–2005



WATER SERVICES ASSOCIATION
of Australia

Sewage Pumping Station Code of Australia

WSA 04—2005-2.1

**Sydney Water Edition
2012**

Previous edition WSA 04—2001
Previous Sydney Water edition WSA 04 Version 1 2006

CONTENTS

PREFACE	6
INTRODUCTION	9
PART 0: GLOSSARY OF TERMS AND ABBREVIATIONS	
I Glossary of Terms	13
II Abbreviations	20
III Referenced Documents	25
IV Other References	32
PART 1: PLANNING AND DESIGN	
Contents	36
1 General	45
2 Concept Design	53
3 General Design	64
4 Materials Design	72
5 Pumping Station Design	73
6 Pumping System	91
7 Power System	98
8 Control and Telemetry System	104
9 Pumping Station Pipework	117
10 Pressure Main	123
11 Structural Design	139
12 Supporting Systems	150
13 Health and Safety	153
14 Design Review	155
15 Design Documentation and Drawings	156
Appendix A Typical Precommissioning Checklist	161
Appendix B Commissioning Schedule	165
Appendix C AC Voltage Mitigation of Steel Pipelines	166
Appendix D Computer Program for Pressure Main Sizing	167
Appendix E Detailed Design Checklist	171
Appendix SW 1 Standard Pump Pedestal	181
PART 2: PRODUCTS AND MATERIALS	
Contents	186
16 Products and Materials Overview	188
Appendix F Quality Assurance of Products	199

PART 3: CONSTRUCTION

Contents	206
17 General	213
18 Quality	216
19 General Construction	219
20 Products, Materials and Equipment	227
21 Electrical Works	233
22 Telemetry System	246
23 Odour Control System	248
24 Mechanical Installation of Pumps, Valves and Fittings	249
25 Metalwork	251
26 Access Road and Hardstand Areas	253
27 Retaining Walls	255
28 Excavation	258
29 Bedding for Pipes, Bends, Wet-Wells and Maintenance Structures	260
30 Pipe Laying and Jointing	261
31 Wet-Wells and Maintenance Holes (MHS)	267
32 Pipe Embedment and Support	269
33 Fill	272
34 Connection to Existing Gravity Sewers	274
35 Restoration	275
36 Acceptance Testing	277
37 Commissioning	288
38 Tolerances on As-Constructed Work	290
39 Work As-Constructed Details	292
Appendix G Ovality Testing of PVC and GRP Gravity Sewers Default Prover Diameters	293

PART 4: STANDARD DRAWINGS

Contents	296
40 Introduction	297
41 Listing of Standard Drawings	299

STANDARD DRAWINGS



WATER SERVICES ASSOCIATION
of Australia

Sewage Pumping Station Code of Australia

WSA 04—2005-2.1

**Sydney Water Edition
2012**

Part 1: Planning and Design

CONTENTS

PREFACE

1 GENERAL

1.1 SCOPE

1.2 PLANNING

1.2.1 General

1.2.2 Pumping alternatives

1.3 SEWAGE PUMPING STATIONS

1.3.1 Pumping philosophy

1.4 PURPOSE AND APPLICATION

1.5 PLANNING AND DESIGN RESPONSIBILITIES AND INTERFACES

1.5.1 General

1.5.2 Planning responsibilities

1.5.3 Design responsibilities

1.5.4 Consultation with other parties

1.6 SEWER SYSTEM DESIGN APPROACH

1.6.1 Overall objective

1.6.2 System design life

1.6.3 Objectives of design

1.6.4 Design output

2 CONCEPT DESIGN

2.1 LIFE CYCLE CONSIDERATIONS

2.2 FUNCTIONALITY

2.3 MAINTAINABILITY

2.4 RELIABILITY

2.5 DUE DILIGENCE REQUIREMENTS

2.6 MATERIALS DESIGN

2.7 STAGING

2.8 SEPTICITY CONTROL

2.8.1 General

2.8.2 Detention time

2.9 ODOUR CONTROL

2.10 NOISE CONTROL

2.11 SERVICES

2.12 ACCESS

2.13 SECURITY

2.14 SIGNAGE

2.15 SUPPORTING SYSTEMS

2.16 HEALTH AND SAFETY

2.17 COMMISSIONING PLAN

2.17.1 General

2.17.2 Pre-commissioning

2.17.3 Commissioning

3 GENERAL DESIGN

3.1 GENERAL

3.2 DESIGN TOLERANCES

3.3 LEVELS

3.4 UNFORESEEN GROUND CONDITIONS

3.5 IMPACT OF CONSEQUENTIAL DAMAGE

3.6 ENVIRONMENTAL CONSIDERATIONS

- 3.6.1 General
- 3.6.2 Urban salinity
- 3.6.3 Effect on vegetation
- 3.6.4 Contaminated sites
- 3.6.5 Tidal zones

3.7 EASEMENTS

3.8 CROSSINGS

- 3.8.1 General
- 3.8.2 Creeks and drainage reserves
- 3.8.3 Major roads

3.9 FUTURE MAINTENANCE

3.10 AC VOLTAGE MITIGATION OF METALLIC PIPELINES

3.11 OBSTRUCTIONS AND CLEARANCES

- 3.11.1 General
- 3.11.2 Surface obstructions
- 3.11.3 Clearance from structures
- 3.11.4 Underground obstructions and services
 - 3.11.4.1 General
 - 3.11.4.2 Clearance requirements
- 3.11.5 Crossing services
- 3.11.6 Deviation of pressure mains around structures

3.12 DISUSED OR REDUNDANT ITEMS

3.13 SEWAGE QUALITY

- 3.13.1 Septicity
- 3.13.2 Sewage quality/Trade waste management

4 MATERIALS DESIGN

4.1 GENERAL

4.2 CORROSION PROTECTION

- 4.2.1 Protective coatings
- 4.2.2 Concrete surfaces
- 4.2.3 Metallic materials
- 4.2.4 Miscellaneous items
- 4.2.5 Corrosion protection against aggressive environments
- 4.2.6 Cathodic protection
- 4.2.7 Stray current corrosion
- 4.2.8 Protection against contaminated ground

5 PUMPING STATION DESIGN

5.1 INTRODUCTION

5.2 SITE SELECTION, LOCATION AND LAYOUT

- 5.2.1 Site selection
- 5.2.2 Right of occupancy and access
- 5.2.3 Location and layout
- 5.2.4 Site area
- 5.2.5 Site layout and access
- 5.2.6 Landscaping

5.3 INLET MH

- 5.3.1 Location
- 5.3.2 Design
- 5.3.3 Pumping station wet-well stop valve

5.4 WET-WELL DESIGN

- 5.4.1 General
- 5.4.2 Sizing

- 5.4.3 Pumping control volume and pump starts
- 5.4.4 Control levels
- 5.4.5 Detention time
- 5.4.6 Benching
- 5.4.7 Washers
- 5.5 WET-WELL VENTILATION
 - 5.5.1 Natural ventilation
 - 5.5.2 Forced ventilation
 - 5.5.3 Not used
- 5.6 OVERFLOW CONTAINMENT
 - 5.6.1 General
 - 5.6.2 Emergency storage
 - 5.6.2.1 General
 - 5.6.2.2 Configurations
 - 5.6.2.3 Design
 - 5.6.2.4 Access and cover arrangements
 - 5.6.2.5 Type of construction
 - 5.6.3 Future storage provisions
 - 5.6.4 Emergency relief system
- 5.7 LADDERS AND PLATFORMS
- 5.8 WET-WELL ACCESS COVERS
- 5.9 SAFETY SYSTEMS
- 5.10 GRIT COLLECTION
- 5.11 SCREENS
- 5.12 MIXERS

6 PUMPING SYSTEM

- 6.1 STAGING
- 6.2 HYDRAULIC DESIGN
- 6.3 PUMP EQUIPMENT
- 6.4 PUMP SELECTION
- 6.5 TRIPLE-PUMP PUMPING STATIONS
- 6.6 SUBMERSIBLE PUMPS
 - 6.6.1 General
 - 6.6.2 Impeller selection
 - 6.6.3 Motor selection
 - 6.6.4 Standard discharge connection
 - 6.6.5 Motor cables
 - 6.6.6 Pumpset lifting equipment
- 6.7 ANCILLARY EQUIPMENT
 - 6.7.1 Flushing valves
- 6.8 PUMP STARTERS AND VARIABLE SPEED DRIVES
 - 6.8.1 General
 - 6.8.2 Single and double speed starters
 - 6.8.3 Soft starters
 - 6.8.4 Variable speed drives
- 6.9 HARMONICS AND RADIO FREQUENCY INTERFERENCE
- 6.10 EMERGENCY STOP

7 POWER SYSTEM

- 7.1 GENERAL
- 7.2 POWER SUPPLIES
 - 7.2.1 General
 - 7.2.2 Security of supply
 - 7.2.3 Primary supply

- 7.2.4 Duplicate supply
- 7.2.5 Emergency power
- 7.2.6 On-site generator
- 7.2.7 Mobile generator
- 7.2.8 High voltage/Low voltage switching
- 7.2.9 Power factor correction
- 7.3 POWER AND CONTROL CUBICLE
 - 7.3.1 Design
 - 7.3.2 Low voltage switchboards
 - 7.3.2.1 Standards
 - 7.3.2.2 Construction
 - 7.3.2.3 Rated diversity factor
 - 7.3.2.4 Degree of protection
 - 7.3.2.5 Rated insulation and operating voltages
 - 7.3.2.6 Creepage distances
 - 7.3.2.7 Rated impulse withstand voltage
 - 7.3.2.8 Rated short-time current
 - 7.3.2.9 Internal arcing fault protection
 - 7.3.3 Meter requirements
 - 7.3.4 Lighting

8 CONTROL AND TELEMETRY SYSTEM

- 8.1 GENERAL
- 8.2 OPERATING LEVELS AND SETTINGS
- 8.3 PUMPING CONTROL
 - 8.3.1 Control design
 - 8.3.2 Control switches
 - 8.3.3 Control systems
 - 8.3.4 Emergency back-up control
 - 8.3.5 Pump starts and interlocks
- 8.4 ALARMS
 - 8.4.1 General
 - 8.4.2 Locally displayed alarms
 - 8.4.3 Remote alarms
- 8.5 ALARM, STATUS MONITORING AND CONTROL TELEMETRY
 - 8.5.1 General design principles
 - 8.5.2 Reliability
 - 8.5.3 Alarm creation function
 - 8.5.4 Status monitoring function
 - 8.5.5 Control function
- 8.6 TELEMETRY HARDWARE
 - 8.6.1 General
 - 8.6.2 Software
 - 8.6.3 Inputs and outputs
 - 8.6.4 Telemetry communications
 - 8.6.5 Communication validation
- 8.7 OPERATING LEVELS AND DEFAULT SETTINGS
 - 8.7.1 General
 - 8.7.2 Cut-in and cut-out levels
 - 8.7.3 Alarm levels
- 8.8 EQUIPMENT AND DEVICES
 - 8.8.1 General
 - 8.8.2 Flow measurement
 - 8.8.3 Flowmeter cabling
 - 8.8.4 Suction safety switch

- 8.8.5 Level sensors
- 8.8.6 Float-switch
- 8.8.7 Site access monitoring
- 8.8.8 Protection devices
 - 8.8.8.1 Fuse and fuse-links
 - 8.8.8.2 Moulded-case circuit-breakers
 - 8.8.8.3 Miniature circuit-breakers
 - 8.8.8.4 Residual current devices
 - 8.8.8.5 Thermal-overload relays
 - 8.8.8.6 Electronic motor protection relays
 - 8.8.8.7 Thermistor and RTD motor protection devices
- 8.8.9 Switching devices
 - 8.8.9.1 Switches
 - 8.8.9.2 Selector switches
- 8.8.10 Contactors
- 8.8.11 Push-buttons
- 8.8.12 Emergency stop-buttons
- 8.8.13 Time-switches
- 8.8.14 Control devices
 - 8.8.14.1 Control relays
 - 8.8.14.2 Time-delay relays and timers
- 8.8.15 ELV control transformers
- 8.8.16 Current transformers
- 8.9 INSTRUMENTATION (DISPLAYS)
- 8.10 WIRE NUMBERING CONVENTION
- 8.11 SYSTEMS INCORPORATING PROGRAMMABLE CONTROLLER / TELEMETRY RTU
 - 8.11.1 Digital inputs and outputs
 - 8.11.2 Analog inputs and outputs
 - 8.11.3 Address codes for communication link devices
- 8.12 SYSTEMS INCORPORATING RELAY CONTROL
 - 8.12.1 General
 - 8.12.2 Loop tag definition guidelines

9 PUMPING STATION PIPEWORK

- 9.1 PUMP DISCHARGE PIPEWORK
 - 9.1.1 General
 - 9.1.2 Sizing
 - 9.1.3 Type
- 9.2 VALVE APPLICATIONS
 - 9.2.1 Stop valves
 - 9.2.2 Non-return valves
 - 9.2.3 Scour
 - 9.2.4 Sewage air-release valves
- 9.3 VALVE CHAMBER
 - 9.3.1 General
 - 9.3.2 Design
 - 9.3.3 Dismantling joints
 - 9.3.4 Pipework support
 - 9.3.5 Pressure main tapplings
 - 9.3.6 Access covers
- 9.4 EMERGENCY BYPASS ARRANGEMENT
 - 9.4.1 Condition monitoring and maintenance

10 PRESSURE MAIN

- 10.1 DESIGN
 - 10.1.1 General

10.2 LOCATION OF PRESSURE MAINS

- 10.2.1 General
- 10.2.2 Road reserves
- 10.2.3 Railway reserves
- 10.2.4 Alignment
- 10.2.5 Changes in direction
- 10.2.6 Easements

10.3 HYDRAULIC DESIGN

- 10.3.1 Total mean head
- 10.3.2 Mean static head
- 10.3.3 Friction head loss in pumping station and pressure main
- 10.3.4 Head loss in fittings and valves
- 10.3.5 Velocity in pressure mains
- 10.3.6 Sizing of pressure mains

10.4 DESIGN PRESSURES

- 10.4.1 General
- 10.4.2 Maximum design pressure
- 10.4.3 Surge
- 10.4.4 Maximum design pressure range

10.5 SELECTION OF PIPE AND FITTINGS PRESSURE CLASS

- 10.5.1 General
- 10.5.2 Maximum allowable operating pressure
- 10.5.3 Maximum cyclic pressure range - Thermoplastics pipes and fittings
- 10.5.4 Minimum pressure class
- 10.5.5 Other considerations

10.6 PLASTICS PIPES

- 10.6.1 Temperature de-rating of plastic pipes and fittings
- 10.6.2 Fatigue design for thermoplastics pipes
- 10.6.3 Fatigue design for thermoplastic fittings
- 10.6.4 Fatigue design for thermosetting pipes and fittings
- 10.6.5 Combined effects of fatigue and temperature

10.7 METALLIC PIPES AND FITTINGS

10.8 PIPELINE MATERIALS

10.9 PRESSURE MAIN VALVES AND SCOURS

- 10.9.1 General
- 10.9.2 Stop valves
- 10.9.3 Gas release valves
- 10.9.4 Non-return valves
- 10.9.5 Scours

10.10 ODOUR AND SEPTICITY CONTROL

10.11 RECEIVING SYSTEM

- 10.11.1 General
- 10.11.2 Discharge MHs

11 STRUCTURAL DESIGN

11.1 DIFFICULT GROUND CONDITIONS

- 11.1.1 Foundation design and ground water control
- 11.1.2 Geotechnical assessment

11.2 STRUCTURES

- 11.2.1 Design loads and forces
- 11.2.2 Concrete structures
 - 11.2.2.1 General
 - 11.2.2.2 Concrete strength
 - 11.2.2.3 Minimum cover
 - 11.2.2.4 Crack control requirement for serviceability

- 11.2.2.5 Areas to be designed as liquid retaining surfaces
- 11.2.3 Steel structures
- 11.2.4 Foundations
- 11.2.5 Pumping station walls
- 11.2.6 Base slab
- 11.2.7 Top slab
- 11.2.8 Emergency storage structures
- 11.3 PRESSURE MAINS
 - 11.3.1 General
 - 11.3.2 Products and materials
 - 11.3.3 Structural computations
 - 11.3.4 External forces
 - 11.3.4.1 General
 - 11.3.4.2 Pipe cover
 - 11.3.4.3 Trench design
 - 11.3.4.4 Pipe embedment
 - 11.3.5 Specific geotechnical considerations
 - 11.3.5.1 Pressure mains in engineered and/or controlled fill
 - 11.3.5.2 Pressure mains in non-engineered fill
 - 11.3.5.3 Filling along route of pressure main
 - 11.3.5.4 Mine subsidence
 - 11.3.5.5 Slip areas
 - 11.3.5.6 Water-charged ground
 - 11.3.6 Above ground crossings
 - 11.3.7 Bulkheads and trenchstops
 - 11.3.8 Trenchless technology
 - 11.3.9 Pressure main anchorage
 - 11.3.9.1 General
 - 11.3.9.2 Thrust blocks
 - 11.3.9.3 Anchor blocks
 - 11.3.10 Restrained elastomeric seal joint pressure mains
 - 11.3.11 Restraint requirements for special situations
 - 11.3.11.1 Above ground pressure mains with unrestrained flexible joints
 - 11.3.11.2 Steel mains with welded joints, buried
 - 11.3.11.3 Steel mains with welded joints, above ground
 - 11.3.11.4 Ductile iron or steel mains with flanged joints

12 SUPPORTING SYSTEMS

- 12.1 SERVICES
 - 12.1.1 General
 - 12.1.2 Water
 - 12.1.3 Telephone/Telemetry lines
 - 12.1.4 General lighting and power
 - 12.1.5 Drainage
 - 12.1.6 Water closet
- 12.2 MATERIALS HANDLING
 - 12.2.1 Lifting equipment
 - 12.2.2 Handling and storage of hazardous material
- 12.3 SECURITY
- 12.4 FIRE CONTROL

13 HEALTH AND SAFETY

- 13.1 GENERAL
- 13.2 HAZARDS
- 13.3 HEALTH AND SAFETY
 - 13.3.1 General

- 13.3.2 Working at heights
- 13.4 CONFINED SPACES

14 DESIGN REVIEW

15 DESIGN DOCUMENTATION AND DRAWINGS

- 15.1 DOCUMENTATION
- 15.2 DESIGN DRAWINGS
 - 15.2.1 General
 - 15.2.2 Real property information
 - 15.2.3 Pumping station and emergency storage
 - 15.2.4 Structures
 - 15.2.5 Pressure mains and sewers
 - 15.2.6 Longitudinal sections (profiles)
 - 15.2.7 Title block notation and standard notes
 - 15.2.8 Other
 - 15.2.9 Electrical and telemetry
- 15.3 DRAFTING STANDARDS
 - 15.3.1 General
 - 15.3.2 Scale
 - 15.3.3 Recording of as-constructed information

APPENDIX A TYPICAL PRECOMMISSIONING CHECKLIST

APPENDIX B TYPICAL COMMISSIONING SCHEDULE

APPENDIX C AC VOLTAGE MITIGATION OF STEEL PIPELINES

- C1 INTRODUCTION
- C2 INDUCTIVE COUPLING HAZARD
- C3 CONDUCTIVE COUPLING HAZARD
- C4 CAPACITIVE COUPLING HAZARD
- C5 MITIGATION

APPENDIX D pressure main calculator

- D1 PRESSURE MAIN CALCULATOR
- D2 NOMENCLATURE
- D3 PRINCIPLES AND CRITERIA
 - D3.1 Design flows
 - D3.2 Detention time
 - D3.3 Minimum internal diameter of pressure main
 - D3.4 Maximum internal diameter of pressure main
 - D3.5 Minimum pumping rate
 - D3.6 Maximum pumping rate
 - D3.7 Pump control volume (cut-in / cut-out volume) and pump starts
- D4 INSTRUCTIONS
 - D4.1 Data entry
 - D4.2 Internal diameter of pressure main
 - D4.3 Pumping rate and detention time
 - D4.4 Wet-well control volume / actual starts / detention time
 - D4.5 Printing
 - D4.6 New calculation
 - D4.7 Reset

SW D5 DESIGN OPTIMISATION

APPENDIX E DETAILED DESIGN CHECKLIST

APPENDIX SW 1 STANDARD PUMP PEDESTAL

SW1.1 GENERAL

SW1.2 PURPOSE

SW1.3 DESIGN

SW1.4 STANDARD DIMENSIONS

TABLES

TABLE 1.1	TYPICAL ASSET DESIGN LIFE
TABLE 3.1	CLEARANCES BETWEEN PRESSURE MAINS AND UNDERGROUND SERVICES
TABLE 5.1	NOT USED
TABLE 8.1	NOT USED
TABLE 8.2	NOT USED
TABLE 8.3	NOT USED
TABLE SW 9.1	NUMBER, SIZE AND TYPE OF CONNECTION
TABLE 10.1	PRESSURE DE-RATING FACTORS FOR PLASTIC PIPES AT ELEVATED TEMPERATURES
TABLE 10.2	FATIGUE DE-RATING FACTORS FOR THERMOPLASTIC PIPES
TABLE 10.3	SCOUR SIZES
TABLE 11.1	REQUIREMENT FOR BULKHEADS

FIGURES

FIGURE 1	SYSTEM DISAGGREGATION DIAGRAM
FIGURE 1.1	CONCEPT DESIGN FLOWCHART
FIGURE 2.1	SPS OVERFLOW RISK REDUCTION DECISION DIAGRAM
FIGURE 2.2	TYPICAL PRE-COMMISSIONING AND COMMISSIONING PROCESS
FIGURE 2.3	TYPICAL HANDOVER TO WATER AGENCY
FIGURE 3.1	DEFLECTION AT JOINTS
FIGURE 3.2	DEFLECTION USING SOC-SOC BENDS
FIGURE 3.3	DEFLECTION USING SOC-SOC CONNECTORS
FIGURE SW 5.1	TYPICAL EMERGENCY STORAGE – CONFIGURATION 1
FIGURE SW 5.2	TYPICAL EMERGENCY STORAGE – CONFIGURATION 2
FIGURE SW 5.3	TYPICAL EMERGENCY STORAGE – CONFIGURATION 3
FIGURE SW 5.4	TYPICAL EMERGENCY STORAGE – CONFIGURATION 4
FIGURE 8.1	NOT USED
FIGURE 10.1	TYPICAL SURGE WAVE
FIGURE 10.2	TYPICAL FATIGUE CYCLE



WATER SERVICES ASSOCIATION
of Australia

Sewage Pumping Station Code of Australia

WSA 04—2005-2.1

**Sydney Water Edition
2012**

Part 2: Products and Materials

CONTENTS

16 PRODUCTS AND MATERIALS OVERVIEW

16.1 PURPOSE

16.2 SCOPE

16.3 RESPONSIBILITIES

16.3.1 Water Agency

16.3.2 Designer

16.3.3 Constructor

16.3.4 Purchaser

16.4 PRODUCT AND MATERIAL STANDARDS AND SPECIFICATIONS

16.4.1 Product standards

16.4.2 Product Specifications

16.4.3 Product Specifications—Alternatives

16.5 QUALITY ASSURANCE

16.5.1 Default requirement

16.5.2 Additional information on quality assurance

16.5.3 Innovative products and materials

16.6 SELECTION GUIDE FOR PIPELINE SYSTEMS

16.7 ADDITIONAL PRODUCT AND MATERIAL INFORMATION

APPENDIX F

F1 GENERAL

F2 QUALITY ASSURANCE OPTIONS

F2.1 ISO 9000 quality management system certification

F2.2 Product certification

F2.2.1 General

F2.2.2 Product certification – Type 1

F2.2.3 Product certification – Type 3

F2.2.4 Product certification – Type 5

F2.3 Supplier's declaration of conformance

F2.4 Second party verification

F3 FACTORS INFLUENCING SELECTION OF QUALITY ASSURANCE OPTIONS

F3.1 General factors

F3.2 Likelihood of manufacturing non-conformance

F3.3 Likelihood of failure of pipeline system from a product non-conformance

F3.4 Consequences of failure

F3.5 Product specification

F3.6 Project magnitude / management

F3.7 Innovative products

F4 SELECTING THE QUALITY ASSURANCE OPTION

F4.1 General factors

F4.2 Product certification

F4.2.1 General

F4.2.2 Type 1

F4.2.3 Type 3

F4.2.4 Type 5

F4.3 ISO 9000 quality management system certification

F4.4 Supplier's declaration of conformance

F4.5 Second party verification

TABLES

TABLE 16.1 PRINCIPAL PRESSURE MAINS AND COMPONENTS

TABLE 16.2 PRECAUTIONS, LIMITATIONS, ADVANTAGES AND
DISADVANTAGES



WATER SERVICES ASSOCIATION
of Australia

Sewage Pumping Station Code of Australia

WSA 04—2005-2.1

**Sydney Water Edition
2012**

Part 3: Construction

CONTENTS

- 17 GENERAL
 - 17.1 SCOPE
 - 17.2 INTERPRETATION
- 18 QUALITY
 - 18.1 QUALITY ASSURANCE
 - 18.1.1 General
 - 18.1.2 Quality management system
 - 18.1.3 Quality system
 - 18.1.4 Project management plan
 - 18.1.5 Inspection and test plans
 - 18.1.6 Quality tests
 - 18.1.7 Quality audits
 - 18.1.8 Traceability
 - 18.1.9 Quality records
 - 18.1.10 Inspection
 - 18.2 PERSONNEL QUALIFICATIONS
- 19 GENERAL CONSTRUCTION
 - 19.1 GENERAL
 - 19.2 ORDER OF CONSTRUCTION, TESTING AND COMMISSIONING
 - 19.2.1 Pumping stations
 - 19.2.2 Inlet works, emergency storage and ERS
 - 19.2.3 Pressure mains
 - 19.3 CONTRACT INTERFACES
 - 19.4 CUSTOMER FOCUS
 - 19.4.1 General
 - 19.4.2 Resolution of complaints
 - 19.5 PROTECTION OF PEOPLE, PROPERTY AND ENVIRONMENT
 - 19.5.1 Safety of people
 - 19.5.2 Protection of other services
 - 19.5.3 Disused / Redundant sewers and pressure mains
 - 19.5.4 Road reserves or other thoroughfares
 - 19.5.4.1 Treatment of pavements and other surfaces
 - 19.5.4.2 Traffic management
 - 19.5.4.3 Cleanliness of roads, paths, accesses and drainage paths
 - 19.5.4.4 Storage of products, materials and equipment
 - 19.5.4.5 Obstruction of street drainage
 - 19.5.5 Private and public properties
 - 19.5.6 Protection of the environment and heritage areas
 - 19.5.6.1 General
 - 19.5.6.2 Collection and disposal of wastes
 - 19.5.6.3 Protection of adjacent lands and vegetation
 - 19.5.6.4 Control of water pollution
 - 19.5.6.5 Acid sulphate and contaminated soils
 - 19.5.6.6 Control of noise and atmospheric pollution
 - SW 19.5.6.7 Equipment and machinery used in bush fire prone areas
 - SW 19.5.6.8 Recycled, reused and waste materials
 - 19.6 AFFECTED PARTY NOTIFICATIONS
 - 19.7 ALTERATION OF EXISTING SERVICES
 - 19.8 SURVEY MARKS
 - 19.9 CONSTRUCTION TOLERANCES
 - 19.10 LATENT CONDITIONS
- 20 PRODUCTS, MATERIALS AND EQUIPMENT
 - 20.1 AUTHORISED PRODUCTS AND MATERIALS
 - 20.2 REJECTED PRODUCTS AND MATERIALS

- 20.3 ELECTRICAL EQUIPMENT
- 20.4 PUMPS
- 20.5 TRANSPORTATION, HANDLING AND STORAGE OF PRODUCTS AND MATERIALS
- 20.6 DELIVERY AND STORAGE OF ELECTRICAL EQUIPMENT
- 20.7 DELIVERY INSPECTION OF PRODUCTS AND MATERIALS
- 20.8 FASTENERS
- 20.9 WORKS INSPECTION AND TESTING
 - 20.9.1 Switchboards
 - 20.9.2 Pumps
 - 20.9.3 Motors
- 20.10 CONCRETE WORKS
 - 20.10.1 Delivery
 - 20.10.2 Transportation of concrete
 - 20.10.3 Formwork
 - 20.10.4 Reinforcement
 - 20.10.5 Placement
 - 20.10.5.1 General
 - 20.10.5.2 Placement in water
 - 20.10.6 Slump
 - 20.10.7 Compaction
 - 20.10.8 Stripping
 - 20.10.9 Curing
 - 20.10.10 Repair of blemishes
- 20.11 SUPPLY OF WATER TO THE WORKS
- 20.12 ON-SITE STOCKPILES
- 21 ELECTRICAL WORKS
 - 21.1 COMPLIANCE WITH AUTHORITIES, STATUTES, REGULATIONS AND STANDARDS
 - 21.2 SCOPE OF WORK
 - 21.3 SUPPLY AUTHORITY REQUIREMENTS AND METERING
 - 21.4 CONSUMER MAINS
 - 21.4.1 Point of supply
 - 21.4.2 Cable size
 - 21.4.3 Maximum demand
 - 21.4.4 Calculations to be submitted
 - 21.4.5 Mains in reserves
 - 21.4.6 Mains requirements
 - 21.4.7 Lead-in pole and overhead mains construction
 - 21.4.7.1 Lead-in pole
 - 21.4.7.2 Poles
 - 21.4.7.3 Installation of poles
 - 21.4.7.4 Aerial cables
 - 21.4.8 Underground cable installation
 - 21.4.8.1 General
 - 21.4.8.2 Location
 - 21.4.8.3 Excavation and bedding
 - 21.4.8.4 Underground cable marking
 - 21.4.8.5 Cable installation on poles
 - 21.4.8.6 Road crossings
 - 21.5 EARTHING
 - 21.5.1 General
 - 21.5.2 Earth circuits
 - 21.5.3 Labelling
 - 21.6 SWITCHBOARD INSTALLATION
 - 21.6.1 General
 - 21.6.2 Equipment mounting
 - 21.6.3 Thermal derating of equipment
 - 21.6.4 Labelling

- 21.6.4.1 General
- 21.6.4.2 Incoming mains and pump and motor detail labels
- 21.6.4.3 Main labels
- 21.6.4.4 Cubicle labels
- 21.6.4.5 Danger notices
- 21.6.4.6 Asset and equipment number labels
- 21.7 CIRCUITS
 - 21.7.1 Main circuits
 - 21.7.2 Control circuit wiring
- 21.8 CABLING
 - 21.8.1 General
 - 21.8.2 Conduits
 - 21.8.3 Cable protection
 - 21.8.4 Cable trays
 - 21.8.5 Junction boxes
- 21.9 INSTALLATION OF PUMP CABLES
 - 21.9.1 Numbering of pumps
 - 21.9.2 Installation
- 21.10 INSTALLATION OF LEVEL SENSORS
 - 21.10.1 General
 - 21.10.2 Wet-well level sensor probes
- 21.11 TERMINATIONS
 - 21.11.1 General
 - 21.11.2 Glands
 - 21.11.3 Mains and pump terminations
- 21.12 PAINTING
 - 21.12.1 General
 - 21.12.2 Paint materials
 - 21.12.3 Surface preparation
 - 21.12.4 Painting and finish
- 21.13 INSTALLATION IN VALVE PITS
 - 21.13.1 General
 - 21.13.2 Cables
- 21.14 NOTIFICATION OF ELECTRICAL WORK
- 22 TELEMETRY SYSTEM
 - 22.1 COMPLIANCE WITH AUTHORITIES, STATUTES, REGULATIONS AND STANDARDS
 - 22.2 SCOPE OF WORK
 - 22.3 HARDWARE INSTALLATION
 - 22.4 PLC PROGRAMMING
 - 22.5 SCADA DATABASE CONFIGURATION
- 23 ODOUR CONTROL SYSTEM
- 24 MECHANICAL INSTALLATION OF PUMPS, VALVES AND FITTINGS
 - 24.1 GENERAL
 - 24.2 FLANGED JOINTS
 - 24.3 INSTALLATION OF PUMPING UNITS
 - 24.3.1 General
 - 24.3.2 Machinery alignment
 - 24.3.3 Unit numbers
 - 24.3.4 Test tapping points
 - 24.4 GAUGES AND RECORDERS
 - 24.4.1 Pressure gauges
 - 24.4.2 Pressure recorder
- 25 METALWORK
 - 25.1 STEELWORK
 - 25.2 ALUMINIUM ALLOY COMPONENTS
 - 25.3 STAINLESS STEEL COMPONENTS

- 25.4 FASTENERS
- 26 ACCESS ROAD AND HARDSTAND AREAS
 - 26.1 GENERAL
 - 26.2 SUBGRADE
 - 26.3 BASECOURSE
 - 26.4 SPRAYED BITUMINOUS SEALING
 - 26.5 ASPHALTIC CONCRETE
 - 26.6 TIMBER GUARDRAIL
 - SW 26.7 REINFORCED CONCRETE
- 27 RETAINING WALLS
 - 27.1 RETAINING WALLS - TIMBER CANTILEVER
 - 27.1.1 General
 - 27.1.2 Handrails
 - 27.2 RETAINING WALLS - CONCRETE - CRIB WALL
 - 27.2.1 General
 - 27.2.2 Foundations
 - 27.2.3 Cribfill and backfill
 - 27.2.4 Drainage
 - 27.2.5 Handrails
 - SW 27.3 RETAINING WALLS – CONCRETE – CAST IN-SITU
 - SW 27.4 RETAINING WALLS – CONCRETE – BLOCK-WORK
- 28 EXCAVATION
 - 28.1 SAFETY
 - 28.2 LIMITS OF EXCAVATION
 - 28.3 EXCAVATION ACROSS IMPROVED SURFACES
 - 28.4 EXCAVATION IN ROOT ZONES
 - 28.5 BLASTING
 - 28.6 SUPPORT OF EXCAVATIONS
 - 28.7 DRAINAGE AND DEWATERING
 - 28.8 FOUNDATIONS AND FOUNDATION STABILISATION
 - 28.9 SURPLUS EXCAVATED MATERIAL
- 29 BEDDING FOR PIPES, BENDS, WET-WELLS AND MAINTENANCE STRUCTURES
 - 29.1 TRENCH FLOOR PREPARATION
 - 29.2 BEDDING MATERIALS
 - 29.3 PLACEMENT OF BEDDING
 - 29.4 SPECIAL PIPE SUPPORT FOR NON-SUPPORTIVE SOILS
 - 29.5 BEDDING FOR PIPES, VALVES AND FITTINGS
 - 29.6 BEDDING FOR CONCRETE STRUCTURES
 - 29.7 BEDDING FOR MAINTENANCE SHAFTS AND VARIABLE BENDS
- 30 PIPE LAYING AND JOINTING
 - 30.1 INSTALLATION OF PIPES
 - 30.1.1 General
 - 30.1.2 Cleaning, inspection and joint preparation
 - 30.1.3 Polyethylene
 - 30.1.4 Laying
 - 30.2 HORIZONTAL AND VERTICAL DEFLECTION OF GRAVITY SEWERS AND PRESSURE MAINS
 - 30.2.1 General
 - 30.2.2 Methods of deflection
 - 30.3 HORIZONTAL AND VERTICAL SEPARATION OF CROSSING PIPELINES
 - 30.4 FLOTATION CONTROL
 - 30.5 THRUST AND ANCHOR BLOCKS AND RESTRAINED JOINTS FOR PRESSURE MAINS
 - 30.6 MARKING TAPES
 - 30.6.1 Non-detectable marking tape
 - 30.6.2 Detectable marking tape
 - 30.7 VALVES AND SURFACE FITTINGS

- 30.7.1 Installation
- 30.7.2 Scours for pressure mains
- 30.8 BORED PIPES UNDER ROADS, DRIVEWAYS AND ELSEWHERE
- 30.9 BRIDGE CROSSINGS
- 30.10 TRENCH STOPS FOR PRESSURE MAINS
- 30.11 BULKHEADS FOR PRESSURE MAINS
- 30.12 CORROSION PROTECTION OF CAST IRON FOR PRESSURE MAINS
- 30.13 AQUEDUCTS
- 30.14 LOCATION MARKERS
- 30.15 FLANGED JOINTS
- 30.16 WELDING OF STEEL PRESSURE MAINS
 - 30.16.1 General
 - 30.16.2 Field welding of flanges
- 31 WET-WELLS AND MAINTENANCE HOLES (MHS)
 - 31.1 GENERAL
 - 31.2 WET-WELL AND MH BASES
 - 31.3 TRENCH DRAINAGE AROUND WET-WELLS AND MHS
 - 31.4 PRECAST CONCRETE SYSTEMS
 - 31.5 CAST IN-SITU CONCRETE WET-WELLS AND MHS
 - 31.6 BENCHING AND CHANNELS
 - 31.7 INTERNAL COATING OF CONCRETE WET-WELLS AND MHS
 - 31.8 COVERS
 - 31.9 CONNECTIONS TO WET-WELLS AND MHS
 - 31.10 MH DROPS
- 32 PIPE EMBEDMENT AND SUPPORT
 - 32.1 GENERAL
 - 32.2 EMBEDMENT MATERIALS
 - 32.3 COMPACTION OF EMBEDMENT
 - 32.3.1 General
 - 32.3.2 Methods
 - 32.3.3 Compaction trials/Pre-qualification of embedment compaction method
 - 32.3.3.1 General
 - 32.3.3.2 Test method
 - 32.3.3.3 Interpretation and applicability
 - 32.3.4 Compaction control
 - 32.4 SPECIAL BEDDING AND EMBEDMENTS/GEOTEXTILE SURROUND AND PILLOW
 - 32.5 REMOVAL OF TRENCH SUPPORTS
 - 32.6 CONCRETE EMBEDMENT AND ENCASEMENT
- 33 FILL
 - 33.1 TRENCH FILL
 - 33.2 GENERAL
 - 33.3 MATERIAL REQUIREMENTS
 - 33.4 COMPACTION OF TRENCH FILL
 - 33.5 EMBANKMENT FILL
 - 33.6 DRIVES AND TUNNEL FILL
- 34 CONNECTION TO EXISTING GRAVITY SEWERS
- 35 RESTORATION
 - 35.1 GENERAL
 - 35.2 PAVEMENTS
 - 35.3 LAWNS
 - 35.4 GRASSED AREAS
 - 35.5 BUSHLAND
 - 35.6 PROVISION FOR SETTLEMENT
 - 35.7 MAINTENANCE OF RESTORED SURFACES
- 36 ACCEPTANCE TESTING

- 36.1 PIPELINES
 - 36.2 VISUAL EXTERNAL INSPECTION
 - 36.3 COMPACTION TESTING
 - 36.3.1 General
 - 36.3.2 Minimum compaction
 - 36.3.3 Embedment compaction testing
 - 36.3.3.1 Applicable pipe sizes
 - 36.3.3.2 Frequency and location of embedment tests
 - 36.3.3.3 Retesting
 - 36.3.4 Trench fill compaction testing
 - 36.3.4.1 Trafficable test zone
 - 36.3.4.2 Non-trafficable test zone
 - 36.3.4.3 Test method
 - 36.3.4.4 Frequency and location of tests
 - 36.3.4.5 Retesting
 - 36.3.5 Other fill compaction testing
 - 36.3.5.1 General
 - 36.3.5.2 Trafficable test zone
 - 36.3.5.3 Non-trafficable test zone
 - 36.3.5.4 Frequency and location of tests
 - 36.3.5.5 Retesting
 - 36.4 AIR PRESSURE AND VACUUM TESTING OF GRAVITY SEWERS
 - 36.4.1 General
 - 36.4.2 Air testing methods for sewers
 - 36.4.2.1 Vacuum testing
 - 36.4.2.2 Low pressure air testing
 - 36.4.3 Testing of concrete emergency storage and maintenance structures
 - 36.4.3.1 General
 - 36.4.3.2 Test method
 - 36.5 HYDROSTATIC PRESSURE TESTING OF PRESSURE MAINS
 - 36.5.1 General
 - 36.5.2 System test pressure
 - 36.5.3 Maximum allowable loss
 - 36.5.4 Test procedure
 - 36.5.5 Satisfactory pressure test
 - 36.5.6 Failure of test
 - 36.6 INFILTRATION TESTING
 - 36.7 DEFLECTION (OVALITY) TESTING OF FLEXIBLE GRAVITY SEWERS
 - 36.7.1 General
 - 36.7.2 Ovality proving tools
 - 36.7.3 Flexible sewers \leq DN 300
 - 36.8 CCTV INSPECTION
 - 36.9 ELECTRICAL WORKS
- 37 COMMISSIONING
- 37.1 GENERAL
 - 37.2 PUMPING STATION
 - 37.2.1 Requirements
 - 37.2.2 Pre-commissioning
 - 37.2.3 Commissioning
 - 37.2.4 Handover
 - 37.3 ODOUR CONTROL SYSTEM
 - SW 37.4 COMMISSIONING REPORT**
- 38 TOLERANCES ON AS-CONSTRUCTED WORK
- 38.1 HORIZONTAL TOLERANCES
 - 38.1.1 Sewers, mains, valves, in-line structures, pumping stations, roads
 - 38.2 VERTICAL TOLERANCES
 - 38.2.1 Sewers, pressure mains, structures, pumping stations, roads

38.2.2 Grade

38.3 VERTICALITY (“PLUMB”)

38.4 TOLERANCES ON FINISHED SURFACE STRUCTURES AND FITTINGS

38.5 CAST IN-SITU CONCRETE STRUCTURES AND SLABS

39 WORK AS-CONSTRUCTED DETAILS

39.1 GENERAL

39.2 ELECTRICAL WORKS

39.2.1 Electrical Contractors Installation Drawings

39.2.2 Principal Supplied Installation Drawings and Equipment Schedules

APPENDIX G OVALITY TESTING OF PVC AND GRP GRAVITY SEWERS DEFAULT PROVER DIAMETERS

G1 GENERAL

G2 DEFAULT PROVER DIAMETERS

TABLES

TABLE 21.1	CONTROL CIRCUIT WIRING INSULATION COLOUR CODING
TABLE 26.1	TIMBER GUARDRAIL DEFAULT CONSTRUCTION DIMENSIONS
TABLE 27.1	RETAINING WALL DEFAULT CONSTRUCTION DIMENSIONS
TABLE 27.2	TIMBER HANDRAIL DEFAULT CONSTRUCTION DIMENSIONS
TABLE 30.1	METHODS OF ACHIEVING CURVED PIPELINES
TABLE 32.1	MAXIMUM PARTICLE SIZE
TABLE 36.1	ORDER OF ACCEPTANCE TESTING OF CIVIL ITEMS
TABLE 36.2	MINIMUM COMPACTION OF EMBEDMENT AND TRENCH / EMBANKMENT / OTHER FILLS
TABLE 36.3	PRESSURE AND VACUUM AIR TESTING ACCEPTANCE TIMES FOR 7 KPA PRESSURE CHANGE
TABLE 36.4	CONCRETE MH TESTING FREQUENCY
TABLE 36.5	MINIMUM TEST TIMES FOR CONCRETE STRUCTURES
TABLE 38.1	SEWER GRADE TOLERANCES
TABLE G1	PROVER OUTSIDE DIAMETER FOR PVC AND GRP PIPES
TABLE G2	MAXIMUM ALLOWABLE SHORT-TERM PIPE DEFLECTIONS



WATER SERVICES ASSOCIATION
of Australia

Sewage Pumping Station Code of Australia

WSA 04—2005-2.1

**Sydney Water Edition
2012**

Part 4: Standard Drawings

CONTENTS

40 INTRODUCTION

40.1 GENERAL

40.2 DRAWING COMMENTARY AND USING STANDARD DRAWINGS AND OTHER DRAWINGS IN CONJUNCTION WITH THE CODE

41 LISTING OF STANDARD DRAWINGS

LISTING OF STANDARD DRAWINGS

DRAWING NUMBER	ACTIVITY	TITLE
PLANNING AND CONCEPT DESIGN		
SPS-1100	Concept Plan	Typical Catchment Plan
SPS-1101	Not used	
SPS-1102	Not used	
SPS-1103	Not used	
SPS-1104-V	Pressure Main Concept Design	Sections and Static Head Calculation
SPS-1105-S	Pumping Station Concept Design	Typical Hydraulic Profile
PUMPING STATION LAYOUT		
SPS-1200	Not used	
SPS-1201	Not used	
SPS-1202	Not used	
SPS-1203	Not used	
SPS-1204	Not used	
SPS-1205	Not used	
SPS-1206-S	Typical Site Plan – Sydney Water	Conceptual Site Layout
SPS-1207-S	Typical Site Plan – Sydney Water	Site Access Arrangements
PUMPING STATION ARRANGEMENT		
SPS-1300	Not used	
SPS-1301	Not used	
SPS-1302	Not used	
SPS-1303	Not used	
SPS-1304	Not used	
SPS-1305	Not used	
SPS-1306	Not used	
SPS-1307	Not used	
SPS-1308-V	Water Supply	DN 50 Reduced Pressure Zone Device – Arrangement & Details
SPS-1309	Not used	
SPS-1310	Not used	
SPS-1350-S	Wet-Well, Valve Chamber & Inlet Maintenance Hole	General Arrangement Plan
SPS-1351-S	Wet-Well, Valve Chamber & Inlet Maintenance Hole	General Arrangement Section
SPS-1352-S	Valve Chamber	General Arrangement
SPS-1353-S	Valve Chamber Covers	Typical Arrangement
SPS-1354-S	Valve Chamber Covers	Support Beam Details

DRAWING NUMBER	ACTIVITY	TITLE
SPS-1355-S	Valve Chamber Covers	Cover & Hinge Details
SPS-1356-S	Valve Chamber Covers	Additional Details
SPS-1357-S	Inlet Maintenance Hole Hinged Access Cover	Typical Arrangement (non-trafficable)
STRUCTURES		
SPS-1400	Not used	
SPS-1401	Not used	
SPS-1402	Not used	
SPS-1403	Not used	
SPS-1404	Not used	
SPS-1405-V	Discharge MH	Arrangement and Cross Section for Pressure Mains \leq DN 375
SPS-1406-S	Emergency Storage Structure	General Arrangement (Trafficable)
SPS-1407-S	Emergency Storage Structure	Details (Trafficable)
SPS-1408-S	Emergency Storage Structure	General Arrangement (Non-Trafficable)
SPS-1409-S	Emergency Storage Structure	Details (Non-Trafficable)
SPS-1410-S	Inlet MH	Plans \leq 6m Depth
SPS-1411-S	Inlet MH	Section \leq 6m Depth
SPS-1412-S	Emergency Relief System	Wet-Well Inlet Sewers DN 150 to DN 250
SPS-1413-S	Emergency Relief System	Wet-Well Inlet Sewers DN 300 to DN 450
SPS-1414-S	Inlet MH (Grit Collection)	General Arrangement
SPS-1415-S	Emergency Bypass Connection Security Enclosure	General Arrangement
SPS-1416-S	Emergency Bypass Connection Security Enclosure	Details
SPS-1417-S	Emergency Bypass Connection With Bunded Area	Arrangement and Details
SEW-1300-V	Maintenance Holes	Sewers \leq DN 300 Precast Types P1 & P2
SEW-1301-V	Maintenance Holes	Sewers \leq DN 300 Cast Insitu Types C1 & C2
SEW-1302-V	Maintenance Holes	Pipe Connection Details
SEW-1303	Maintenance Holes	Sewers \leq DN 300 Changes in Level Details
SEW-1304-V	Maintenance Holes	For Sewers \leq DN 300 Typical Channel Arrangements
SEW-1305	Maintenance Holes	Typical Channel Details
SEW-1306-V	Maintenance Holes	Alternative Drop Connections
SEW-1307-V	Maintenance Holes	Step Irons & Ladders
SEW-1308-V	Maintenance Holes	Typical MH Cover Arrangements
SEW-1309-V	Maintenance Holes	Sewers DN 375 to DN 750

DRAWING NUMBER	ACTIVITY	TITLE
SEW-1311-V	Maintenance Holes	Depth to Invert 6m to 15m
SEW-1312-V	Maintenance Holes	Depth to Invert >15m
SEW-1313-V	Maintenance Holes	MH Connection Details PE and Profile Wall PP Pipe
SEW-1314-V	Maintenance Shafts	Typical Installation
SEW-1315	Maintenance Shafts	MS & Variable Bend Installations
SEW-1316-V	Maintenance Shafts	TMS and Connection Installations
SEW-1317	Maintenance Shafts	Typical MS Cover Arrangements
WET-WELL APPURTENANCES		
SPS-1500	Not used	
SPS-1501	Not used	
SPS-1502	Not used	
SPS-1503	Not used	
SPS-1504	Not used	
SPS-1505	Hydraulic Level Sensor	Stilling Tube
SPS-1506	Not used	
SPS-1507	Not used	
SPS-1508-V	Miscellaneous Details	Survey Label Plate, Pump Label Plate, Valve Spindle Access, Signage
SPS-1550-S	Wet-Well Access Hatches	Typical Arrangement Plan & Section
SPS-1551-S	Wet-Well Access Hatches	Typical Arrangement Sections
PRESSURE MAINS		
SPS-1600	Design	Typical Pressure Main Characteristic Curve
SPS-1601-V	Pipe Installation, Support and Trench Fill	Pressure Mains ≤DN 300
SPS-1602-V	Scour Arrangement	Pump and Gravity
SPS-1603	Not used	
SPS-1604	Not used	
SPS-1605	Not used	
SPS-1606	Not used	
SPS-1607-S	Gas Release Arrangement	Manual Air Release Arrangement
SPS-1608-S	Hydraulic Design	Pipe Absolute Roughness Versus Mean Velocity Chart

DRAWING NUMBER	ACTIVITY	TITLE
EMBEDMENT / TRENCHFILL AND SUPPORT SYSTEMS		
SEW-1200	Soil Classification Guidelines And	Allowable Bearing Pressures for Bulkheads
SEW-1201	Embedment and Trenchfill	Typical Arrangements
SEW-1202	Standard Embedment	Flexible & Rigid Pipes
SEW-1203	Special Embedment	Inadequate Foundations Requiring Over Excavation & Replacement
SEW-1204	Special Embedment	Support Utilising Piles
SEW-1205-V	Special Embedment	Concrete & Stabilised Supports
SEW-1206	Trench Drainage	Bulkheads & Trenchstop
SEW-1207-V	Trench Drainage	Typical Systems
SEW-1208	Verticals & Near Verticals	Exposed & Concealed Methods
SEW-1250-S	Standard Trench Details	Rigid Pipes (VC & RC)
SEW-1251-S	Standard Trench Details	Flexible Pipes (GRP, PP & PVC)
WAT-1200	Soil Classification Guidelines And	Allowable Bearing Pressures for Anchors and Thrust Blocks
WAT-1201	Embedment & Trenchfill	Typical Arrangement
WAT-1202-V	Standard Embedment	All Pipe Types
WAT-1203	Special Embedments	Inadequate and Poor Foundation
WAT-1204-V	Special Embedments	Concrete, Geotextile and Cement Stabilised Systems
WAT-1205	Thrust Block Details	Concrete Blocks
WAT-1207-V	Thrust and Anchor Blocks	Gate Valves and Vertical Bends
WAT-1208-V	Restrained Joint System	DN 100 to DN 375 DI Mains
WAT-1209	Trench Drainage	Bulkheads and Trenchstop
WAT-1210	Trench Drainage	Typical Systems
WAT-1211-V	Buried Crossings	Under Obstructions
WAT-1212-V	Buried Crossings	Major Roadways
WAT-1213-V	Buried Crossings	Railways
WAT-1214-V	Buried Crossings	Bored & Jacked Encasing Pipe Details
WAT-1254-S	Anchorage Details	Stop Valve Installations up to DN 750 DICL Mains
WAT-1255-S	Buried Crossings	Under Minor Obstructions
SPECIAL CROSSINGS / STRUCTURES ARRANGEMENTS		
SEW-1400	Buried Crossings	Syphon Arrangement
SEW-1401	Buried Crossings	Railways
SEW-1402	Buried Crossings	Major Roadways
SEW-1403	Not used	
SEW-1406	Not used	
SEW-1407	Not used	

DRAWING NUMBER	ACTIVITY	TITLE
SEW-1451-S	Ventilation Systems	Educt Vent Shaft Base Block Details
INSTALLATION PRACTICES/ STRUCTURES		
WAT-1300	Valve and Hydrant Identification	Identification Markers & Marker Posts
WAT-1303-V & WAT-1304-V	Typical Surface Fitting Installation	Sluice Valves
WAT-1307-V	Typical Appurtenance Installation	Scour Arrangements
WAT-1310	Aerial Crossings	Aqueduct
WAT-1311	Aerial Crossings	Aqueduct Protection Grille
WAT-1312	Aerial Crossings	Bridge Crossing Concepts
WAT-1313	Flanged Joints	Bolting Details
FABRICATION DETAILS		
WAT-1400	Typical Steel Pipe Jointing	Butt Welding of Joints
WAT-1401-V	Typical Steel Pipe Jointing	Rubber Ring Joint Spigot Bands
WAT-1402	Typical Steel Pipe Jointing	Welded Pipe Collars
WAT-1403-V	Typical Steel Fabrication	Bends
WAT-1408-V	Joint Corrosion Protection	Cement Mortar Lined Steel Pipe DN 300 to DN 1200
WAT-1409	Hydrant Installation Fittings	PE Assemblies