

Guidelines for Design of Wastewater Reticulation and Pumping Stations

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GENERAL

Scope of this manual

The guidelines are intended to establish a degree of uniformity for design, drawings, specifications, and construction of all wastewater projects.

Designs should aim for high standards, design and original construction to achieve long life, low maintenance, and few breakdowns. Installations must be functional but should maintain suitable aesthetic and environmental standards including landscaping.

These guidelines will apply directly to most situations within the wastewater network, and for special cases, the same general principles should be applied.

Standards and Specifications

References to the standard documents and drawings to be used for design are included in the Appendices.

These include:

- external standards currently used
- internal standards
- common reference material
- Wastewater reticulation and general standards drawings

PLANNING AND FLOW ASSESSMENT

Overview

This covers aspects of estimation of flow requirements, and the pipeline route assessment that is required before pipeline design can proceed, Watercare's Project Delivery Manual and the documents linked to it will provide additional guidance for the design process.

Pipeline Route

Catchment definition

Catchment boundaries to any part of a newly reticulated area will generally be defined by the natural topography. Provision is also required to accommodate flow pumped or otherwise discharged to the catchment from adjacent areas. Full development of the catchment is to be assumed unless there is a reason for part of the area to remain permanently undeveloped.

Pipeline routes

Main sewer pipeline routes are to be located so as to provide gravity service to as much as possible of the areas of potential development within the catchment. Provision should be made to pick up connections from likely local reticulation, even if at the initial stage a connection is not specifically requested.

As far as is practical, pipe bridges should be avoided unless they can be incorporated into a pedestrian or road bridge. However the timing of major bridge construction may compromise the practicality of this.

Inverted siphons should be avoided wherever possible.

Pipeline routes are to be designed to provide gravity service to as much as possible of the areas of potential development within the catchment.

Notice plan and resource consent procedures

Watercare Services has rights under the Auckland Metropolitan Drainage Act 1960, and the Local Government Act, to lay sewers through public and private property. The processes for notification of proposed works and resolution of objections are set out in those Acts.

Geotechnical investigation

A full geotechnical investigation along any proposed sewer route or at a pipe bridge or pumping station site is required to provide construction information and to identify potential difficulties for design, construction, and during normal operation of the system.

- trench excavation and backfilling with excavated material
- embankment construction materials and ground settlement
- trench stability and unusual strata
- bridge and pipe bearing capacities

- groundwater and slope stability issues
- pumping station load bearing and buoyancy
- any other geotechnical issues

These matters should be considered at the stage of general route assessment and if necessary, some preliminary investigation may be prudent.

Flow Assessment

Purpose

This section gives the general basis for assessment of design flows in Watercare sewers.

Sewer pipelines are to be provided for collection and transport of wastewater only. Except where existing properly recognized combined sewers are involved, stormwater shall not be either directly or indirectly connected to sewers.

Design flows

There are two methods for determining design dry weather and peak flows. The static model derives flows from projected population (or population equivalents for commercial areas) and a per capita flow rate. The dynamic model utilizes these same basic figures together with a number of additional parameters.

Static Model

Design flows are to be based on the population and zoning for full or staged development of the catchment area. It provides a good first estimate of flow requirements.

Population density

Residential zoning	Area measured	Population density, p/ha
Normal residential	Gross area including streets, schools, small reserves	25 to 30
Normal residential	Small areas, streets only	30 to 40
High density residential	As defined by zoning	>40

Basic Flow Parameters

Flow category	Flow ratio	Flow rate l/p/d
Yearly average flow (YAF)		300
Dry weather flow (DWF)	0.6 x YAF	180
Peak flow (WWF) < 40 p/ha	5 x DWF	900
Population > 40 p/ha		540

Industrial zones

This applies where gross area including streets is greater than 400 ha.

Industry type	Flows	Flow rate l/sec/100ha
Light or dry industry	YAF	25
	workday av 1.4 x YAF	35
	peak flow 2 x YAF	50
Wet industry, hospitals etc		to be specifically assessed

Dynamic flow model

Hydraulic model

Dry weather and design peak flows for a particular pipeline or pumping station may be derived from the *Hydroworks* dynamic hydraulic model of the existing Watercare sewer network. This is particularly useful if the network incorporates on-line or off-line storage for peak flows.

Greenfield areas

Where modelling is to be utilised for greenfield or redeveloped areas, the following parameters will be specified by the Wastewater Planning section:

- catchment runoff characteristics
- population density projections
- design storm duration
- infiltration provision
- any other relevant items.

Where the sewer has been modelled, the pipeline is to provide capacity to accommodate a five year return storm period (or other defined period).

Under this condition, pipe surcharging will be permitted provided:

- water levels in manholes do not rise to within one metre of the lowest manhole lid level
- no overflows are caused in the reticulation manholes or from property services.

PIPELINE DESIGN

Purpose

This sets out the investigation and process for the design of rising mains and gravity sewer pipelines and structures, to provide the capacities, gradients, and velocities required for satisfactory operation.

General

Unless there is good reason to the contrary, all gravity sewers should be laid straight to line and level between manholes.

Occasions may arise where laying on a horizontal curve to avoid an obstacle, may have particular benefit, and this may be acceptable provided that the radius of curvature is within the pipe manufacturer's allowable deflection at the joints.

Rising mains can follow the most convenient route with the relevant provision for pipeline thrust at changes in grade or direction.

Pipe capacity, gravity sewers and rising mains

Maximum pipe capacity of a gravity pipeline is to be taken as pipe running full with no surcharge. When network flow modelling is utilised, some additional capacity may be permitted where it is clear that this will not lead to surcharging to less than a metre below ground level, or overflows from public or private parts of the sewer network.

Pipe capacity is to be calculated using Colebrook-White equations. Roughness factors k (mm), are based on Table 3 in *Charts for Hydraulic Design of Channels and Pipes*, Hydraulic Research Wallingford, 6th Edition 1990.

In general, the following figures are used for mature sewers in normal condition. Both new pipe and mature pipe figures should be used for defining pumping head requirements.

Gravity Sewer

Material	Friction factor, k mm	
	New pipe	Mature pipe
Concrete, CLS	0.15	1.5
Plastic (PVC, PE)	0.03	0.3

Rising mains

Material	Mean velocity	Friction factor, k mm	
		New pipe	Mature
CLS or Plastic	1.0 m/sec	0.03	0.30
	1.5 m/sec	0.03	0.15
	2.0 m/sec	0.03	0.06

Gravity Sewer Gradient and Velocity

Minimum gradients are to be set by pipe diameter and minimum desirable

velocities. All three of these conditions should be met.

Flow condition	Velocity to be achieved
Dry weather flow (DWF) in early stage of development	velocity to exceed 0.60m/sec at least once a day
Full pipe	velocity not less than 0.75m/sec where possible, not less than 0.9m/sec
Flow at 10% full pipe capacity	velocity not less than 0.6m/sec

Where pipes carry trade wastes, special measures may be required to prevent build-up of hydrogen sulphide or sediment.

Losses in Manholes and Bends

For manholes on bends or with junctions, a minimum loss of head as shown in the table should be allowed. Velocity is that for the sewer flowing full, losses are shown in millimetres for angles and velocities given, for bend centreline radius ≥ 3 . For R/d of 2, increase losses by 50%.

Head loss (mm)

Velocity m/sec	Angle				Additional for junction
	0°	30°	60°	90°	
0.6	0	10	20	20	10
0.9	10	10	20	20	10
1.2	10	20	20	30	10
1.4	20	20	30	30	20
1.6	20	30	40	50	20
General	$0.13(v^2/2g)$	$0.19(v^2/2g)$	$0.26(v^2/2g)$	$0.32(v^2/2g)$	

For R/d of 2, increase losses by 50%. Where bends are formed of chords instead of curves, an increased loss may also need to be provided for. R/d should preferably be kept at 3 or over where possible. Values under 2 are undesirable.

To achieve reasonably good hydraulic conditions for CLS and PE lobsterback bends and to minimise losses, the bends should have a nominal radius of at least 3 x pipe diameter, with no more than 22.5 degrees deflection in any one joint.

Rising main velocity

For a single fixed speed duty pump, the rising main should be sized to give a velocity of 1.0 to 1.5 m/sec at the design peak flow.

For a large station that is pumping to match the incoming flow, aim for a velocity of 0.8 to 1.2 m/sec at peak dry weather diurnal flow. If necessary the station control system can be programmed to provide a short period of high flow each day, to flush the rising main.

Special Hydraulic Conditions

Where the sewer changes in size and at junctions, pipe soffits are normally matched in level (with extra drop where necessary). This is to maintain airflow through the pipelines and minimise corrosion and air-locking,

Where the velocity in the sewer increases through changes in grade and particularly if the size of the sewer is decreased, allowance for the increased velocity head must be made by dropping the sewer invert. The profile of the water surface at maximum flow should be checked to ensure it falls below pipe soffit at top of the steeper grade. (See Camp SWJ, 1946 & Fair and Geyer p407).

Drawdown will occur in certain circumstances e.g. above a drop manhole, or above a point where appreciable increase in velocity occurs. The velocity due to drawdown may affect the necessity for drop invert noted in the preceding paragraph.

Below a length of sewer with high velocity it is possible for a hydraulic jump to be formed and in large sewers, these conditions may require investigation. Steep slopes at the inlet to inverted siphons may lead to air entrapment under some conditions so that it periodically blows back and causes damage.

Rising mains

The rising main is to be kept as short as is practical so that retention time and subsequent septicity, odour, and corrosion problems are minimised.

Pump running costs and pipeline capital costs are to be optimised in length and sizing of the pipeline.

Where possible, the gradient is to be made continuously rising with the rising main discharge at the highest point, to keep the pipe full and to allow the escape of gas accumulated while the pumps are not running. At other high points in the pipeline sewage type air release valves may be required to prevent the pipe air-locking with accumulated sewer gas.

The pipeline should be laid in deliberately rising or falling grades, without any level sections. This is to ensure that all air can be removed from the pipe in preparation for pipe pressure testing. This requires special attention for PE pipelines.

Provision may be required to protect pipes and fittings from water hammer pressures during normal and emergency (power failure) stopping and starting of pumps. The proposed rising main configuration should be tested using the "HyTran" or similar water hammer program. Anti vacuum valves may be required to combat negative pressures and to reduce peak pressures.

If a wide range of flow rates are to be accommodated it may be practical and economical to utilise dual rising mains. At low flows, duty can be alternated daily to minimize septicity issues. Dual mains will also provide valuable backup capacity in the event of pipeline failure or damage.

Pipe bridges

Several forms of sewer pipe bridge have been utilised in the network.

- Rubber ring joint concrete pipes on cradles on top of or between concrete beams
- Concrete lined steel pipes spanning between piers

- Concrete pipe with prestressing cables in the pipe wall, spanning between piers

Most recent bridges comprise a CLS pipe on concrete piers. Particular attention is required for the joints from the bridge pipes to the adjacent pipelines, to allow for thermal movement, pipeline settlement, and the joint between different pipeline materials.

Full structural design may be required for the abutments, piers, and the bridge spans.

A headwall will generally be required at the abutment to ensure that the pipe is fully buried as soon as it leaves the bridge.

Safety barriers are usually required at both ends of the bridge to prevent pedestrian access and the risk of falling off the pipe. A standard design is available.

A pipe bridge may be incorporated into a pedestrian or road bridge. Maintenance clearance between the pipe and the bridge needs to be maintained.

Inverted siphons

Inverted siphons are expensive and a problem to operate and maintain. They compromise sewer ventilation so they are to be utilised only where there is no practical alternative. A pipe bridge is usually more economical, but may not be feasible for reasons of aesthetics, traffic or other practicalities.

A siphon on a sewer where flow rate is governed by gravity sewer flow and diurnal variations should comprise more than one barrel, and these barrels may be of different sizes.

The siphon entry structure should be configured to assist in maintaining of self cleaning velocity within the siphon at normal flows. Where flow rate is dominated by the periodic discharge from a pumping station, a single siphon barrel may be acceptable provided that there is sufficient storage provided at the pumping station to provide a good flushing flow and duration of flush.

Flushing

An effective means of flushing to prevent build-up of sediment in the siphon is to be provided. This may also provide a useful degree of flushing to the sewer downstream of the siphon.

An internal bypass is required in the siphon structure to guard against overflow if the penstock fails to open during flushing. The bypass can also assist with accelerating the downstream sewer flow in the siphon before the flush is released.

Air pressures and ventilation

The full pipe of the siphon prevents through air flow. Hence provision must be made for inlet and outlet ventilation for the sewers downstream and upstream, with odour control as necessary.

Rapid changes in flow rate or water level, as during siphon flushing or rising main start-up, can give rise to excessive air pressures in a section of pipeline between a rising main and a siphon or between two siphons. Special provisions will be required for air pressure management and odour containment.

Submarine pipelines

These will require a number of resource consents under the Resource Management Act. Appropriate access should be provided to any manholes in a tidal area.

Tunnels

The tunnelling method adopted should take account of modern methods and materials, pipe maintenance, replacement when a pipe fails irreparably, safety of personnel in unlined, unfilled tunnels, precast lining possibilities, discounted cash flow costing (including maintenance and/or replacement costs) as well as all other features common to tunnels and tunnelling.

Standard Method

The original method used for wastewater tunnels has been to lay a long-life pipe in the tunnel and back fill with a 1:20 cement/graded scoria mix, using a Placey gun or similar equipment, to fill all voids and to prevent any settlement of the ground above the tunnel. However, in sound rock tunnels, concrete pipes (which cannot float) of 450mm diameter or less have had pipes covered only sufficiently to prevent damage from rock fall. In such instances, the mouth of the tunnel should be sealed off.

Concrete groundwater cut-offs are normally provided at 300 m intervals along the tunnel and at the portals to prevent water draining off the country permanently and to prevent water running along through the backfill.

[?needs updating?]

Directional drilling

[?to be written?]

Pipe Jacking, Microtunnelling, Pipe Thrusting

These methods are alternatives to tunnelling. Thrusting requires a degree of latitude in the outfall position which depends on the precise application used. Particular design is required for each case and it will usually pay to leave the tenderer with a choice of approved methods to suit their own methods and equipment.

[?needs expansion?]

Manholes

Purpose

This section summarises requirements for manhole positioning, spacing, and location, and some of the considerations for manhole design.

Junctions

Connections to Watercare sewers from local network operator's sewers will be permitted only at manholes. Private connections to Watercare manholes are not permitted.

Junctions are normally designed to reduce turbulence in the major sewer to a minimum, and flows will join at or below the level of DWF. Major or

special junctions require special investigation and design. Typical manhole junctions are shown in the standard manhole drawings. Smaller laterals may be graded more steeply over the last portion of their length to avoid the use of a drop pipe, however, they must enter the larger sewer directed downstream.

Before finalising construction plans, the proposed junction details shall be agreed with the relevant local authority. Unless the site requires otherwise, a satellite manhole is to be provided on the reticulation at a distance of between 2m and 15m of the Watercare manhole.

Location and spacing

Manholes are to be positioned at changes in;

- pipe size
- gradient
- direction
- at junctions.

Manhole spacing should not exceed:

Pipe size	Maximum spacing
225 to 300mm diameter	120 metres
325 to 875mm diameter	180 metres
900mm and larger	240 metres

Spacing may be increased if the expense of additional manholes is not warranted, for instance in tunnels.

Manholes should where possible be located on public or private roads, clear of gutters, open drains and low points and the mainstream of traffic. Access is easier if they are in the verges.

Where manholes must be located on private property, they should be located to cause as little inconvenience to the property owners as possible. In undeveloped land, the effect on future use should be considered, e.g. locations near (but not on) property boundaries are preferred in residential sites. Likely house sites should be avoided.

In all cases manhole location must allow practical connections from the local reticulation system.

Manhole design

Note:

All new manholes shall be fitted with a stainless steel safety grille supported by the manhole frame and capable of carrying a 100 kg point load anywhere. The grille shall have a square pattern and with openings not exceeding 150 mm x 150 mm.

The grille does not require to be locked in place separately.

Standard Manholes

In general manholes are to be built to one of the Watercare standard designs. Refer to Appendix B for standard and reference drawings.

The precast 1500mm diameter manhole chamber should be utilized for all manholes where the depth from lid level to benching exceeds 1.5 metres. Where headroom of 1.3 metres is not available, a cast-in-situ R type

structure should be used.

To accommodate safe manhole entry and rescue practices, the relative positions of access lid, landings and benching are to be laid out to provide direct vertical access from lid level to benching.

Manhole channels, benching, connections, drop connections, and any other components are to be configured to minimise turbulence in sewer flow and the likelihood of debris accumulation.

Manhole hardware

All sewer manholes should have the Watercare 700mm ring type frame and cover. Where the whole of the concrete top of the manhole is to be at or above ground level, an inverted frame should be used.

Where there is a reasonable risk of a manhole lid being submerged by stormwater flow, a "sealed" lid may be utilized. A ventilated lid is available for special sites, eg. immediately downstream from a siphon or rising main, where they are designed to induce air flow into the sewer. For manholes that are unavoidably in high speed traffic areas or where turning traffic can displace the standard lids, the AMD pattern Non-roc frame and lid may be required.

Connections to a manhole

The standard manhole drawings outline the requirements for manhole detailing. It is important that there is one flexible joint very close to the manhole and another within 600mm. Mechanical shear bands may be used to join cut pipes, but these joints do not allow sufficient rotation to be considered as a flexible joint.

Special manholes

As far as is practicable, the standard manhole design and features should be adapted to provide configuration for unusual manholes. In particular, for large changes in direction on large pipes, it may be acceptable for the ends of the bend to extend outside the manhole chamber. In this circumstance, the chamber should be in the middle of the bend.

Sealing plastic pipes at manholes

Polyethylene and other plastic pipes expand measurably with changes in pressure from pump operation, and shorten significantly after installation by directional drilling methods. Where a PE pipe is to be sealed into a chamber or manhole, purpose made electrofusion chamber connections or an equivalent are to be used to prevent groundwater leakage. This applies where a pipe is being terminated at a manhole, or a pipeline which passes through a structure (eg. air valve or scour valve chamber).

New connections

New connection requests

Requests from LNOs for new wastewater pipe services and connections will be dealt with promptly. In any case, new main sewer services will be provided within five years of a planning request, and only if no alternative connection can be provided.

Connection costs

In planning the layout of new reticulation services and connections to

existing sewers, the overall network capital and operational costs to the community are to be considered.

Junctions on existing pipelines

Reticulation connections will be accepted only from LNOs and not directly from property owners. Connections will be at manholes only and will be made via a satellite manhole from which there will be a single connection to the Watercare manhole.

Connection details will generally follow standard Watercare details shown in APPENDIX B Standard and Reference Drawings.

Connections to Watercare's manhole and other work on live sewer pipelines will be undertaken either by Watercare's staff or by trained and qualified contractors under direct Watercare supervision.

Sewer Ventilation

Purpose

A through flow of air in all sewers is required to minimise condensation and corrosion, and to reduce odour problems. This is particularly important in sections of the network where the sewage is "old" and anaerobic.

Where foul air is extracted from the sewer, there may need to be provision for odour control by dispersion, a biofilter, or by other means.

Gravity Sewers

Ordinarily, ventilation requirements for air displaced by rising and falling of flow levels in pipes will be provided by standard manhole lids and via terminal vents on the reticulation connections.

Air flow tends to be carried through the sewers by the water flow, and this foul air needs to be extracted at the downstream end of a ventilation "compartment" ie. at a pumping station, siphon inlet or other obstruction to the free air flow in the pipeline.

At a pumping station sewer air flow is extracted from the wet well as part of the normal wet well exhaust ventilation. Passive or fan assisted vent stacks and air inlets may be needed at strategic manholes to maintain air flow in longer sections of pipeline, depending on the relative age and tendency of the sewage to produce sulphides.

The ventilation system should aim to provide an air velocity of at least 0.2m/sec through the equivalent of 75% of the cross-sectional area of the sewer.

Rising mains

An air inlet (with a non-return flap) is to be provided at the discharge manhole at the top of a rising main to facilitate air flow through the sewer and to accommodate air movements arising from with rapid flow changes from pump operation.

Siphons

The full pipe of the siphon prevents through air flow. Hence provision must be made for air inlet and outlet ventilation for the sewers downstream and upstream, with odour control as necessary.

Other structures

Purpose

This section covers miscellaneous structures associated with the sewer network and pumping stations.

Emergency overflows

Pumping stations

Provision for overflows from pumping stations on the separate system will be made only at specifically designated sites, designed as detailed in the section on pumping station emergency provisions

Separate and Combined system

The existing combined sewer system incorporates a number of overflows. Most of the network and all new systems will be separated (wastewater only) without overflows on the sewers except as these provide for emergency overflow protection for pumping stations.

Any pumping station overflows, and new or upgraded overflows on the combined system, must include appropriate provisions to retain debris within the sewer and to protect the receiving environment.

Operational storage tanks

Basis of design capacity

Emergency storage tanks are intended to provide storage at a pumping station equivalent of up to four hours of dry weather flow. This was to accommodate equipment breakdown and to allow shutdowns for critical maintenance and wet well cleaning.

More recently there is a move to utilise the storage as part of the operational volume of the sewer to smooth peaks of excess inflow without causing an overflow. The volume required can be estimated from network modelling.

Operational features

Form – concrete tank for awkward shape, cylindrical fibreglass tank (rapid installation)

Flow through tank from inlet to overflow to maximise settlement

Gravity draining

Pumped emptying

Ventilation

Slope to minimise sedimentation

Baffled overflow

[?still to be written?]

Pipeline Specification

Purpose

This section provides guidelines for selection of materials and specifications for pipeline construction

Pipe materials

Concrete pipes

Larger sized sewers will normally be reinforced concrete, rubber ring jointed pipes, made to NZS 3107:1978, *Specification for precast concrete drainage and pressure pipes*, but with a sacrificial 25mm additional thickness on the inside. These thick walled pipes are designate classes U, V, and W, which have strength equivalent to standard classes X, Y, and Z, or the more recent equivalent classes 2, 3, and 4. Higher strength pipes up to Class 10 (2.5Z) can be manufactured as required.

Consideration should be given to utilising concrete additives to achieve durability, in place of the additional wall thickness on pipes made with the standard concrete mix.

Special pipe design is required where a concrete pipe is to be installed by thrusting or jacking.

CLS and plastic pipes

Rising mains and other pressure pipelines will most commonly utilise concrete lined steel or polyethylene pipe. Polyethylene is usually the only suitable material where a pipeline is to be installed by directional drilling.

ABS and mPVC plastic pipes are not suitable for rising mains because the frequent pressure changes with pump operation require a severe down-rating of the pipe pressure capability to accommodate fatigue of the pipe material.

Maximum safe span date for CLS pipes being used for a pipe bridge can be obtained from the Steelpipe NZ catalogue.

Note: Care has to be exercised in choosing the pipe material for rising mains and bends in particular. In areas with combined sewer/stormwater reticulation a number of pipe failures have occurred believed to be due to the high grit content abrading the lining in CLS pipes and the steel pipe itself. The use of CLS in such circumstances is to be avoided.

Pipe strength and bedding

Concrete pipes

For concrete pipes, the design of trenching, bedding haunching and backfilling of pipelines is carried out in accordance with AS/NZS 3725:1989, *Loads on Buried Concrete Pipes*.

Pipe classes and bedding requirements can also be determined using the CPAA computer program "Pipe Class v1.1", which also allows consideration of traffic and construction loads.

The design process requires an understanding of the trench soil type, and

the feasibility of bedding the pipes to provide Type H and Type HS support. Bedding details are shown on Drawing 2000244-021. (Type HS1 and HS2 bedding is not feasible in soft soil conditions e.g. in peat soils.)

Plastic pipes

Design of thermoplastic pipelines (ABS, uPVC, mPVC, oPVC, or polyethylene) and GRP pipes, should be based on the pipe strength and bedding requirements that are determined from AS/NZS 2566 Part 1:1998 "*Buried flexible pipelines*" and its "*Part 1: Structural design commentary*". Standard pipe bedding details are shown on drawing 2001979-080.

For pressure pipes, particular provision should be made for derating the pipe strength to allow for fatigue that arises from repeated variation in pressure eg. from a pump stopping and starting. This can severely reduce the allowable working pressure.

Bedding cut-offs

On steep gradients, concrete cut-offs are provided in the granular bedding and surrounds to prevent a flow of groundwater scouring out the bedding material and causing a nuisance in the discharge area. They are also provided at the ends of tunnels and where the sewer runs on to an embankment. In pressure sewers, other cut-offs may be required, depending on the gradient and length of the pipelines. On steep grades the use of an alternative to granular bedding should be considered.

It may be prudent to install cut-offs in long lengths of PE or CLS pipeline that has granular bedding, to facilitate localisation of any leakage.

Pressure pipelines

CLS and PE lobsterback bends

Bends in larger diameter steel or PE pipes are generally fabricated from a number of segments, as lobsterback bends. To achieve reasonably good hydraulic conditions and to minimise losses the bends should have a nominal radius of at least 3 x pipe diameter, with no more than 22.5° deflection in any one joint.

Thrust blocks

Provision for thrust is required at all gibault type jointed fittings, eg. bends, meters, and valves, where a differential thrust can arise.

Continuously welded steel and PE pipelines should be anchored at the ends but do not generally need thrust blocks at intermediate changes in direction.

Pipeline flanges

CLS pipelines

The general standard for flanges is BSEN 1092 which has similar drilling dimensions to BS 4504 which it replaces. Most facilities can utilise PN 10 rated flanges but high head facilities may require PN16 flanges.

The pipes and pumps installed in many of the existing facilities were built with BS 10 Table D or E flanges. Where an existing facility is being upgraded with new pipe fittings or equipment there may need to be a pipe special with a BS 10 flange on one end and BSEN 1092 flange on the other to match the new equipment. Alternatively if the new work is a minor

change, the new equipment may have flanges to match the existing.

Polyethylene pipelines

Flanges joints between PE fittings and to steel fittings generally involve a flange stub with a mild steel or stainless steel backing ring. The internal diameter of PE pipes varies significantly with the pipe pressure rating (SDR), and this diameter is unlikely to be a good match to a steel pipe or valve flange. For a particular nominal pipe size, the bolt PCD in the PE pipe backing ring is usually more than the PCD on a standard fitting flange. Detailed design is required in this area.

Rising main test pressures

CLS pipelines

The final test on a rising main usually requires the whole pipeline to be water filled and tested to a pressure set by the designer and shown in the specifications. In general the minimum test pressure will be 1.25 times the maximum likely operating pressure.

Polyethylene pipelines

The test pressure should not be less than 1.5 times working pressure, nor greater than 1.5 times the rated pressure at the lowest point of the pipe. If ambient temperature is above 20 degrees Celsius the maximum pressure shall be reduced accordingly.

The test pressure needs to be high enough at highest point to fully test joints. The contractor will need to plan the jointing and testing of the pipeline so that relevant pressure tests can be achieved in each section of the pipeline without exceeding the maximum allowable pressure at any point in the pipeline. Some guidance should be given by the designer, in the particular clauses of the specification.

Cathodic protection

Cathodic protection is applied to all welded steel pipes. Detailed design at fittings, chambers, actuated valves, bridge supports, pumping stations and similar sites should eliminate all sources of current leakage to earth.

Pipeline and manhole rehabilitation

Purpose

The following are guidelines for rehabilitation of pipelines and manholes.

Cured in place liners

[?to be written?]

Slip lining

[?to be written?]

Mortar repairs

Large pipes [?to be written?]

Manholes [?to be written?]

Construction specification specific requirements

Purpose

This section identifies items of design and that may need to be considered and specifically defined in the construction contract documents.

Polyethylene pipeline test pressures

WASTEWATER PUMPING STATIONS

Purpose

These design guidelines have been developed for use by staff and consultants working on wastewater projects. The guidelines are intended to establish a degree of uniformity for design, drawings, and specifications for all wastewater projects.

Designs should aim for high standards, design and original construction to achieve long life, low maintenance, and few breakdowns. Installations must be functional but should maintain suitable aesthetic and environmental standards including landscaping.

These guidelines will apply directly to most situations within the wastewater network, and for special cases, the same general principles should be applied.

General

Siting and access

By their nature, pumping stations are often sited on creek banks or in coastal areas. Siting of stations is to be made as unobtrusive as possible with the appearance and aesthetics being appropriate for the location.

All weather 24 hour vehicle access is required for operation and maintenance activities in the station.

Sufficient land area should be acquired to provide space for biofilter, emergency storage, mobile generating plant (in case of a power shut down) and to keep at arms length from other buildings, roads and facilities.

Compliance with the Building Act is required.

Ensure adequate services such as water (adequate pressure for washdown), power, and telephone can be made available, and that radio access is available for Scada communications.

General configuration

General configuration of the station will be controlled by:

- site and vehicle access
- direction, depth and level of the incoming sewer and rising main
- pump type and configuration
- service access within the station
- electrical services, switchboard, and control locations
- flow storage and overflow provisions
- likely odour control requirements.

As much as possible of the station is to be below ground level. This reduces the exposure to public view and vandalism. Direct access to as much as possible of the wet well should be available for cleaning and maintenance, without having to enter a building.

Switchgear and control equipment is to be housed in a building or a cabinet

that is suitable for all-weather maintenance access.

Truck access is required to enable pumps and other equipment to be removed from the station.

Where practical the station site should be purchased. Where a site is within a local authority reserve, it should be designated as a main sewer facility.

Station structure

The substructure of the building, both wet well and dry well will usually be constructed from reinforced concrete. Design should be on the basis of a water retaining structure.

Provision will be required to protect the station structure from flotation both during construction and for normal operations, when the water table rises to ground level. A part of the floor may be extended to pick up backfill loading, or the station may be tied down to piles.

Pumps installed in existing facilities

Watercare has the following styles of pumps currently installed in the wastewater transmission system:

- Horizontal belt driven
- Vertical direct coupled
- Vertical shaft driven
- Submersible wet-well mounted
- Submersible dry-well mounted

In most recent installations submersible pumps either wet or dry mounted have generally been selected.

Of these submersible pumps, generally at smaller stations the pumps are mounted directly in the wet-well and at larger stations the pumps are installed in a dry well. The break over pump duties from wet to dry mounted pumps are in the order of flow rates over 150 l/sec or pumping heads over 40 meters.

The brands of submersible pumps currently installed in Watercare pump stations include Flygt, Hydrostal and KSB. Other reputable brands that may be considered would be ABS and Tsurumi. By far the majority of submersible pumps at WSL facilities are Flygt pumps.

Future Installations

Submersible pumps either wet or dry mounted depending on the particular site requirements and duty will continue to be the preferred pumps for wastewater pumping stations.

Submersible pumps are preferred as they;

- are relatively compact and simple,

- they have no shaft/motor couplings and drive-shafts to align and maintain,
- they are more cost effective than separate pumps, motors and drive arrangements with lower capital, maintenance and operating costs,
- it would be unlikely that an equivalent sized dry mounted submersible could not be used to replace a drive-shaft or direct coupled vertical pump in the available footprint area,
- wet-well mounted submersible pumps require no suction pipework and valving,
- even in dry mounted installations they can be installed below flood level as motors and cables are sealed, and

the size of above ground pump station buildings is minimised as the pumps are installed below ground level with pump access provided through hatches at ground level

Pump selection

Purpose

The following guidelines outline requirements for the selection of pumps, pump motors, and control systems. Design capacity

Design capacity is to be the peak flow as defined in Flow Assessment. The installed pumping capacity is to be the peak flow expected during the life of the pumps (25 years for conventional dry well or dry mounted submersible pumps, and 10 years for submersible pump installations)

Factors to be considered in defining station and individual pump capacity requirements include:

- anticipated catchment expansion
- anticipated network changes and possible service to adjacent catchments
- anticipated changes to population and population density
- capacity restrictions in the receiving sewer
- consequences of overflow from excess inflow
- number of pumps and size of individual pumps
- standardisation of machines and rotation of pump duties

Careful consideration is required in applications where a station will initially be operating with flows and heads well below the expected final design duty for a period of time (could be years) while a catchment area develops. Temporary measures may need to be implemented to ensure that the pumps can operate within their design specification without damaging the pumps.

Standby capacity equal to the largest duty pump is to be installed in addition to the design capacity. Control of the standby unit is to be designed so that it comes into automatic operation should a duty pump fail.

Standby capacity is reduced when a pump is removed for periodic maintenance. At sites where the consequence of an overflow is critical, consideration should be given to having a standby pump in the stores, ready for installation. System curves should be calculated for both wet well

level at the mid point of the normal operating range, and additionally for the wet well flooded up to overflow level. Rising main friction should be calculated both for new pipe factors and as a mature pipe. (See Pipeline Design for suggested friction factors).

Pumps should be specified to meet a duty point which allows for the required duty plus, say, 5% allowance for pump wear.

Pump manufacturer and local agent requirements

Pumps must be sourced from reliable and well recognised manufacturers with New Zealand representation from reputable local agents that can;

- provide adequate local support including technical assistance, maintenance/repair service personnel and spares holdings,
- local agents must give an indication of stock holdings of key spares and consumables and provide expected lead times for delivery of other items,
- the local agents must provide an undertaking to carry key spares for the expected life of the pumps.

Pump selection

The following items need to be considered when specifying and selecting new pumps;

- The available footprint of a station. A station with wet well mounted submersibles will require a smaller area than one with separate wet well and dry well
- The pump physical dimensions, weight and the depth of the pump well need to be considered when making the decision to use wet-well or dry-well mounted submersible pumps. Lifting large and heavy pumps in and out of a wet-well is more hazardous in comparison to lifting the same pumps into a dry-well facility with full access to the pump level
- Pumps must be specifically designed for pumping wastewater with the ability to pass rags and solids without blocking etc. The ability to pass a solid sphere of 80mm diameter is a minimum guide. In catchments with particularly high loadings of rag then pumps with a chopping ability or some form of macerator may need to be considered
- Pump construction materials must be compatible for wastewater applications with good resistance to corrosion and abrasive wear in the wetted areas. With the exception of normally accepted wearing parts the pumps must be of a suitable construction to provide a 25 year (dry mounted) or 10 year (wet mounted) service life in a wastewater environment
- Whole of life costs are more important than a low initial purchase price. Whole of life costs include pump efficiency for the required duty range to minimise energy consumption, the costs of routine maintenance, the costs of spare parts for high wear components such as seals, wear plates, impellers, volutes etc.
- The method of pump cooling for dry mounted submersibles i.e. pumped product passing through water jackets, glycol (or similar)

closed cooling jackets and pumped cooling water systems with heat exchangers etc.

- Provision and clear access for lifting pumps in and out of the station wet well or dry well
- Pump cable management is particularly important with wet well mounted pumps. The pump power and control cables need to be able to be easily and safely disconnected from the field power supply junction box when removing or reinstalling pumps
- Pump motor electrical voltages and frequencies to be to WSL standards and are generally 3 phase
- Pump protection devices for items such as seal failures or over heating need to be compatible with WSL control systems
- Pump sizing should consider electrical requirements are compatible with commercially available mobile generators for back-up power during electricity supply outages. Or allowance for a permanent generator maybe required
- Pumps should have the ability for straight forward onsite adjustment of clearances between wear plates and impellers to maintain pumps at optimum operating efficiencies
- The hydraulic design of the wet well needs to be checked, modelled and approved by the pump supplier to ensure the flows to each pump are within design specifications and that flows to pumps are not affected by flows to adjacent pumps
- Wet well floor designs are to be such that build ups of solids around pump suction areas are eliminated. As well as minimising solids accumulations in general this will avoid shock loads on pumps with slumping of solids accumulations into the pump suction causing shock loads on the pump system
- Discharge non-return valves (swing-checks or actuated plug valves) should be installed as close as practicable to the pump to prevent large volumes in pipework between the pump and valve rushing back through the pump on shut-down.

THESE HAVE MOVED TO DESIGN CAPACITY PARAGRAPH Pump control

[?to be written?]

General configuration and system concept matters (not electrical details)

Fixed speed, , or variable speed control.????

Pumping station layout

Purpose

These guidelines outline the requirements for pump station layout.

Wet well configuration

Wet well volume

The operating volume of the wet well will be set by the requirement to limit the frequency of the worst case flow pump cycles. For most stations with fixed speed pumps the number of starts should not exceed 10 per hour. For large pumps, this should be restricted to 4 to 6 starts per hour.

The start level for the first duty pump should be below the level of the incoming sewer. In very large stations some of the pump start control points can be above the sewer invert, but the wet well level should not cause the gravity flow in the sewer to be backed up.

Pump stop levels are controlled by the lowest level at which the pump can safely operate without ingesting air into the pump.

Shape and features

The wet well should be shaped to minimize eddies and dead spots where grit or buoyant debris can accumulate or where vortices at the pump intakes can lead to airlocking. Vertical corners should have at least 200mm chamfers to minimize fat buildup. Pump intakes should be clear of areas where there is entrained air from the incoming flow.

The hydraulic design of the wet well needs to be checked, modelled and approved by the pump supplier to ensure the flows to each pump are within design specifications and that flows to pumps are not adversely affected by flows to adjacent pumps. For bigger stations, duplicate wet wells should be considered to facilitate cleaning and maintenance operations without shutting down the station.

Lighting should be provided, fixed above the maximum overflow level. Materials and fittings should be resistant to the corrosive wet well atmosphere.

The walls and ceiling of the wet well should be painted with a white high-build epoxy paint to assist cleaning operations and maximize the effect of lighting.

Features in a small station

Particular provision is required for:

- pump lifting
- flexible motor cable connections to fixed wiring
- lifting chains and cable supports
- pumps should be clear of the incoming flow,
- smooth hydraulic flow and minimal accumulation of sediment and debris.
- ladder access to the wet well floor.

Station pipework and fittings

Purpose

These guidelines outline the requirements for pipework and fittings.

Incoming sewer isolation

The sewer flow into the wet well is to be provided with a penstock or other type of valve, to provide drip-tight shutoff. The valve is to be configured to minimize turbulence in the incoming flow, and is to be clockwise closing. There must be no restrictions through the bore of the penstock which could cause a build-up of rag or debris. This is particularly relevant at stations with small incoming sewers. Where practical stoplog slots in the station inlet manhole or some other provision should be made to facilitate maintenance of the penstock.

Pump intakes

Wet well design should avoid turbulence around bellmouth or submersible pump intakes to minimize the tendency to induce air to the pumps.

Valves

Each pump requires a separate inlet isolation gate valve (dry-mounted pumps) and discharge non-return and isolation gate valves. This is to provide for pump isolation without interference with other equipment.

Non return valves should normally have an extended spindle and lever or some other means to allow the valve to be held open for backflushing a pump.

Discharge non-return valves (swing-checks or actuated plug valves) should be installed as close as practicable to the pump to prevent large volumes in pipework between the pump and valve rushing back through the pump on shut-down.

All gate valves shall have non-rising spindles, be metal seated, and be clockwise closing.

Pump mounting

To enable the pump to prime properly, they must be mounted at a level where the top of the volute is completely below the lowest start level. The plinths need to be rigid enough to anchor the pumps firmly against the anticipated level of vibration. Some models of pump have a purpose made inlet and support unit, which simplifies pump installation.

Pipework

Station pipework should be designed to allow valves and other major components to be removed with minimal dismantling, and so that the station can remain in operation when a pump is removed.

Where it is practical, the discharge pipework and valves are to be isolated from pump vibration. Valves and pipework need to be well anchored to take the thrust loads arising when a pump has been removed or when a reflux valve slams shut.

Where practical, particularly in stations with small pumps, provision should be made for a blockage in one pump to be backwashed by another pump.

If cathodic protection is to be applied to a CLS rising main, an insulated joint will be required in the pipework to prevent the protection system from earthing through station facilities.

Rising main drain

Pipework and a valve should be provided to facilitate draining of the rising main directly to the wet well. This should be sized to allow the pipe to be emptied quickly enough to allow maintenance work to be completed.

Air release pipework

Independent air release pipework is required for each pump to facilitate priming. Depending on the pump configuration, this can be connected to the pump casing behind the impeller, or to the discharge pipework adjacent to the pump. The pipework may incorporate an electrically actuated isolation valve to close when the pump is operating. An air break is required where the air release pipe discharges into the wet well, to prevent back siphoning.

Cooling dry well submersible pumps

If dry well submersible pumps are to be cooled by diverting flow from the pumped sewage, then air release pipework should run from the top of the cooling jacket to the air break in the wet well.

Flow measurement

Unless it is very short, the rising main should be able to be isolated from the other station equipment. A magnetic flowmeter is required on the rising main, in or close to the station, with appropriate pipework to achieve accurate performance from the meter.

Rising main valves

Provision may be required for pump back-washing. Water-hammer protection through anti vacuum or air valves may be required to ensure that negative pressures do not occur in the main. Provision may be required to drain the rising main directly to the wet well, especially for a large capacity main.

Bypass pumping

Where it is practical, provision is made when the station pipework is isolated, to connect temporary pumping between the wet well and the rising main. This is feasible on smaller stations where capacity and head are within the range that could be handled with temporary pumps.

Rising main isolation

A gate valve, downstream of the station equipment and the flowmeter, is required to enable the rising main to be isolated from the station. The bypass pumping connection should be downstream of this valve so that it can be utilized when the main is otherwise isolated from the station.

Noise control

The station structure and particularly the doors and the ventilation system, should be designed to minimise noise breakout from the facility. Noise levels during normal operation of the station must be within Local Authority requirements (which may vary with the particular location and the activities on adjacent properties).

Noise control provisions may include:

- solid structural materials
- sealed doors
- provision of sound attenuation panels on walls or ceilings
- special baffling at air inlet and exhaust openings.

Particular attention may be required to control noise from air release and anti vacuum valves that are installed outside the pumping station building.

Station control

Purpose

Control of the pumps and monitoring of equipment is provided through the station PLC. Information from the PLC is then communicated with the Control room at Newmarket via the radio SCADA system.

In some stations there is a facility to allow station output to be regulated from the Control Room.

Technical design

For technical details and specific design, refer to the Electrical and SCADA design manuals

Pump control principles

[?to be written?]

Instrumentation

[?to be written?]

Alarm systems

[?to be written?]

Ventilation

Purpose

Fresh air and exhaust ventilation is provided to protect the equipment from condensation and corrosion, and to provide for safe personnel access to wet well and dry well spaces.

Wet well and dry well ventilation systems must be totally separate, with no connections between the two spaces. In the event of a power failure, the normal ventilation system should provide passive ventilation sufficient to prevent build-up of unsafe or corrosive conditions particularly in the dry well.

Ventilation fans generally operate continuously, and this may be monitored. To provide a satisfactory security of service, all fans (except very small domestic type units) should have three phase motors.

The ventilation system may need acoustic provisions on some inlets and outlets to minimise fan noise and noise breakout from other equipment.

Dry well

In a structure with separate motor and pump levels, the general intention is to draw fresh air into the building at the upper level, on the side of the room opposite to the access to the lower level. Foul air is then extracted from the lower level near the pumps, on the side distant from the stairway. Thus one way air flow is encouraged through the whole of the space.

In a single level space, air should be drawn across the room with inlet to outlet on opposite sides of the building. In a multi-level structure, air should be introduced to each upper floor, and exhausted from the lowest level near the pumps or floor drainage sump.

Air flow rate

Provide six to ten air changes per hour for the whole dry well volume.

Wet well and storage tank

In addition to the wet well itself, the exhaust system also serves to ventilate the incoming sewer and any emergency storage tank that is part of the station or on the system near the station.

Foul air should be extracted from above the incoming sewer at a level that is above maximum water level. Where the maximum water level at overflow is well above the normal operating level, the ducting may have inlets at two levels.

Wet well ventilation is to provide for three components.

- Foul air brought in by the sewer flow
- Fresh air that is to be introduced continuously to minimise condensation and to provide safe working environment for cleaning and inspection work
- Air flow that is to be drawn through the emergency storage tank to minimize condensation and corrosion.

Air flow rate

The following table summarises the air flow rates for different purposes.

Purpose	Air flow rate
Fresh air inlet (continuous)	Six air changes per hour of the volume above first pump start level
Sewer air exhaust	At least sufficient to produce an air velocity of 0.2 m/sec through the equivalent of 75% of the cross sectional area of the incoming sewer.
Storage tank	Two changes of air per hour
Total exhaust (continuous)	The greater of: <ul style="list-style-type: none"> • Sewer and storage tank exhaust plus fresh air inlet • 12 changes per hour of the wet well volume

The fresh air inlet may be boosted during man entry, especially during wet well cleaning, with a fan controlled from the wet well light switch.

Foul air should be extracted from close to the incoming sewer. An auxiliary opening in the ducting may be needed to ensure air flow when the wet well is flooded to overflow level. Check that the system can operate safely and that the door is not held shut by air pressure when the incoming sewer is drowned.

To maximise circulation of fresh air, the inlet should be as far away as is practical from the exhaust point.

If there is a passive air inlet, this should have a non-return flap to prevent the escape of foul air. Provision may also be required to prevent fresh air being drawn directly from the station overflow in preference to ventilating the incoming sewer properly.

Discharge of foul air

Vent stack

Sufficient dilution and discharge velocity are required to disperse odorous air. The top of the vent stack should be shaped to provide an exit velocity of 10 to 12 metres/sec. This form of discharge is more suitable for small stations with “fresh” sewage, or where a high level stack and high air flow rate is available.

Biofilter

This provides effective foul air treatment where land space is available, or properties are too close to achieve sufficient dispersion from a vent stack.

Configuration of the biofilter, fan and ducting will depend on the topography of the site, the site flood levels, underdrain discharge levels, and maximum water levels in the wet well. Design should follow guidelines given in the *Manual for Wastewater Odour Control*, NZWWA, 1999, and can be based on sample designs referred to in Appendix B.

Odour masking

Otherwise odour masking is only utilised as a temporary measure for a particular short term problem.

Spray systems utilising deodorants and masking agents such as “Ecolo” and “Air Repair” may be utilised in marginal sites where there are

complaints about a vent stack, but where a biofilter is not justified.

Ventilation systems and materials

Ducting should be designed to be free draining to ensure that it cannot accumulate moisture from condensation (particularly from vent stacks) or from high water levels in the wet well.

Wet well ventilation components for fans, ducting, grills, and all fixings and support units shall be fabricated from corrosion resistant materials, such as 316 stainless steel, PVC, polyethylene or other suitable material that is not likely to be attacked by the wet well atmosphere.

Galvanised ducting and fittings may be suitable for use in the dry well ventilation system.

Building services

Purpose

The following guidelines indicate the minimum requirements for building services design.

Water supply

A supply is needed for wet well and dry well washdown purposes and for domestic wash and toilet facilities. The service is sized to suit wet well washdown requirements

A reduced pressure zone (RPZ) backflow prevention valve is installed before any leads to washdown facilities or biofilter irrigation system. The domestic service (hand washing and toilet) is taken off upstream (protected side) of the RPZ valve.

Provision is needed to drain leakage from the valve, and it should be accessible for regular testing. It should be located where any leakage can be readily observed, and should not be in the wet well space.

Security system

A security system is to be installed in each station and at selected critical facilities. This system utilises the telephone system (rather than the Scada radio network). Smoke alarms are also installed in most stations, and this also reports through the security system, to the control room.

Telephone

Telephone service is required in all stations, for both voice communication and for the security system data transmission.

Emergency provisions

Purpose

The following guidelines outline the minimum requirements around design for emergency provisions.

Overflows

Provision is required at each pumping station or in the reticulation upstream, for a controlled overflow from the sewer, in the event that the pumping station cannot pump the incoming flow, and all storage is fully utilised.

The overflow structure should be capable of taking the full flow of the sewer without causing surcharge to a level that causes uncontrolled overflow from manholes or other points in the system.

Scum baffles are required, to minimise the escape of buoyant material. A non return flap or other provision may be required to prevent the escape of foul air from the sewer, and to prevent short circuiting of the pumping station wet well ventilation system.

The level of treatment at an overflow will depend on the sensitivity of the receiving waters and on aesthetic considerations. Active screening may be required at some sites.

Storage tanks

The total storage provided at a pumping station and in the sewers upstream, should be equivalent of four hours of dry weather flow, sufficient to accommodate breakdowns without causing an overflow,

This volume also allows shutdowns for wet well cleaning and for other critical maintenance. Where this volume cannot be provided by the reticulation, an emergency storage tank may be provided to serve the catchment, sited either at the station or on the incoming sewers.

System configuration

Emergency storage must be able to fill automatically before the sewer overflow level is reached. No power operated valves or pumps should be necessary to divert flow to the storage volume. It should also operate automatically when the station inlet penstock is closed.

A tank can be either an integral part of the station structure, or an entirely separate structure. As a separate facility, a storage tank is usually a concrete structure shaped to fit the site constraints, although a cylindrical fibreglass tank may be suitable.

Peak flow attenuation

Where a storage facility is to be utilised for network peak flow attenuation, its design parameters should be set by dynamic modelling of the sewer. The capacity should not however be less than would be required for emergency breakdown storage.

Tank configuration

- The inlet to storage, and the overflow provisions must be capable of taking the full capacity of the incoming sewer without causing an overflow from the reticulation.
- The inlet level to storage should be slightly below the overflow weir, so that the level falls as soon as the pumping station resumes operation. This allows the tank level sensor to indicate the start and finish of an overflow event.
- The inlet should also allow the station wet well to be isolated from the sewer by closing the wet well inlet penstock.
- If the level difference between the incoming sewer and the overflow from the station is sufficient, the tank can be set up to drain by gravity back to the station wet well.
- Emptying of the tank can then be controlled with a motorised valve that is activated through the station PLC when there is pumping capacity available.
- Where gravity drainage is not practical, a small sewage pump can be installed in a sump in the tank, to pump back to the wet well. The pump is to be controlled by the station PLC, to operate when station pumping capacity is available.
- The tank emptying rate should be sufficiently below pumping capacity to allow draining while normal sewer flow is maintained.

- The tank must be accessible for cleaning
- There must be provision for cross flow ventilation, which may need to be increased when the chamber is being cleaned. A continuous flow of fresh air can usually be allowed to enter via the overflow of through an unsealed hatch, and be extracted through the wet well ventilation system.

Debris retention

- Scum boards should be provided at the tank inlet and at the overflow, to retain buoyant material in the sewer or in the tank.
- The tank floor and baffle walls are designed to keep most of the sediment near the inlet and outlet, to minimise clean out requirements.
- An overflow either from the tank or from elsewhere in the network, is still required to deal with a major station failure or grossly excessive inflow.

Emergency power supply

Provision is required at each station to locate and connect a mobile standby generator into the switchboard, to operate the control system, the pumps and all ancillary services.

Cable access to the switchboard should be arranged so that it is clear of the control room doorway and so that station security can be maintained during a period when a standby power supply is in use.

Permanently installed standby generation or fuel storage is not required at any of the pumping stations.

Last amended: January 2013

APPENDIX A Standard and Reference Documents

- AS/NZS 3725:1989, Loads on Buried Concrete Pipes
- NZ Water and Wastes Association, Manual for Wastewater Odour Control, Second Edition 2000
- Concrete Pipe Association of Australia, Concrete Pipe Selector, version 4.0, CPAA 2000

APPENDIX B Standard and Reference Drawings

Manholes

Drawing	Sht	Current title	Proposed title
2000244	001	Standard wastewater manholes Manhole type C, S and R	Wastewater reticulation standard Rectangular manhole Manholes type C, S and R
2000244	002	Standard wastewater manholes Junctions	Wastewater reticulation standard Rectangular manhole Junctions
2000244	003	Standard wastewater manholes Cover position, step irons and ladders Details	Wastewater reticulation standard Rectangular manhole Cover position, step irons and ladders details
2000244	004	Standard wastewater manholes Guard rail, hand rail, safety chain & bar	Wastewater reticulation standard Rectangular manhole Guard rail, hand rail, safety chain & bar
2000244	005	Standard wastewater manholes Precast risers and lid Details	Wastewater reticulation standard Precast manhole shaft risers and lid Details
2000244	011	Standard circular wastewater manholes For lines 375 N.B. to 900 N.B. Geometry and design notes	Wastewater reticulation standard Circular manhole for lines 375 NB to 900 NB Geometry and design notes
2000244	012	Standard circular wastewater manholes For lines 375 N.B. to 900 N.B. Dimensions for construction	Wastewater reticulation standard Circular manhole for lines 375 NB to 900 NB Construction dimensions
2000244	013	Standard circular wastewater manholes For lines 375 N.B. to 900 N.B. Reinforcement and steelwork	Wastewater reticulation standard Circular manhole for lines 375 NB to 900 NB Reinforcement and steelwork
2000244	014	Standard circular wastewater manholes For lines 375 N.B. to 900 N.B. Details of pipe connections	Wastewater reticulation standard Circular manhole for lines 375 NB to 900 NB Junction details
2000244	015	Standard circular wastewater manholes For lines 375 N.B. to 900 N.B. Platform details for dia 1540 manhole	Wastewater reticulation standard Circular manhole for lines 375 NB to 900 NB Deep manhole platform details
2000244	019	Standard circular wastewater manholes For lines 375 N.B. to 900 N.B. Alternative precast base type 2	Wastewater reticulation standard Circular manhole for lines 375 NB to 900 NB Alternative precast base type 2
2000244	022	Watercare type manhole riser Dia 1540 x 153 thick wall General arrangement	Wastewater reticulation standard Circular manhole 1540 dia x 153 thick wall Manhole riser dimension and joint detail
2000244	023	Watercare type manhole lid 1540 dia manhole lid x 200 thick Details	Wastewater reticulation standard Circular manhole 1540 dia Manhole lid 200 thick, dimension and reinforcement

Manhole hardware

2000244	006	Standard wastewater structures Manhole hardware	Wastewater reticulation standard Manhole hardware Stock no. and application
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2000244	007	Standard wastewater structures 700 dia manhole frames covers and reducing ring Casting details	Wastewater reticulation standard 700 dia manhole frames covers and reducing ring Casting details
2000244	008	Standard wastewater structures 500 dia manhole frames and covers Casting details	Wastewater reticulation standard 500 dia manhole frames and covers Casting details
2000244	009	Standard wastewater structures Lamphole frame and cover Casting details	Wastewater reticulation standard Lamphole frame and cover Casting details
2000244	010	Standard wastewater structures Cast iron drop plates Casting details	Wastewater reticulation standard Cast iron drop plates Casting details
2000244	016	Standard wastewater structures 500 dia manhole frames and covers Casting details – slotted ventilation cover	Wastewater reticulation standard 500 dia manhole frames and covers Casting details – slotted ventilation cover
2000244	017	Standard wastewater structures 500 dia manhole frames and covers 200mm dia manhole inlet flap	Wastewater reticulation standard 500 dia manhole frames and covers 200mm dia manhole inlet flap

Hatch covers

2003160	001	Wastewater reticulation Standard access hatch cover Overall layout and component list	Wastewater reticulation standard Access hatch cover Overall layout and component list
2003160	002	Wastewater reticulation Standard access hatch cover Assembly details	Wastewater reticulation standard Access hatch cover Assembly details
2003160	003	Wastewater reticulation Standard access hatch cover Frame and details	Wastewater reticulation standard Access hatch cover Frame and details
2003160	004	Wastewater reticulation Standard access hatch cover Cover and details	Wastewater reticulation standard Access hatch cover Cover and details
2003160	005	Wastewater reticulation Standard access hatch cover Hinge details	Wastewater reticulation standard Access hatch cover Hinge details
2003160	006	Wastewater reticulation Standard access hatch cover Clamps details	Wastewater reticulation standard Access hatch cover Clamps details
2003160	007	Wastewater reticulation Standard access hatch cover Stays details	Wastewater reticulation standard Access hatch cover Stays details

Pipe laying

2000244	021	Standard pipe bedding Details Concrete and ceramic pipes	Reticulation standard Concrete and ceramic pipes in trench Typical bedding, backfill and reinstatement details
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2001979	097	Standard CLS & plastic pipe installation Pipes in trench Typical bedding, backfill and reinstatement details	Reticulation standard CLS & plastic pipe pipes in trench Typical bedding, backfill and reinstatement details
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Handrails

2001979	047	Watercare Services water reticulation Standard handrail for non public areas Elevation and fixing details side wall mounting	Water reticulation standard Handrail for non public areas Elevation and fixing details side wall mounting
2001979	048	Watercare Services water reticulation Standard handrail for public areas with children under 6 Elevation and fixing details side wall mounting	Water reticulation standard Handrail for public areas with children under 6 Elevation and fixing details side wall mounting
2001979	049	Watercare Services water reticulation Standard handrail for non public areas Elevation and fixing details top surface mounting	Water reticulation standard Handrail for non public areas Elevation and fixing details top surface mounting
2001979	050	Watercare Services water reticulation Standard handrail for public areas with children under 6 Elevation and fixing details top surface mounting	Water reticulation standard Handrail for public areas with children under 6 Elevation and fixing details top surface mounting

Flowmeters

2001979	020	Watercare Services water reticulation Standard magflow meters Magflow meter – earthing details	Water reticulation standard Magflow meter Installation details in steel pipeline
2001979	071		Water reticulation standard Magflow meter – buried installation Installation details