



Johannesburg Water

GUIDELINES AND STANDARDS

FOR THE

**DESIGN AND MAINTENANCE OF WATER AND
SANITATION SERVICES**

DECEMBER 2017

DOCUMENT HISTORY AND VERSION CONTROL

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1	29/11/12	Standards Committee	This version superseded the JW Standards Document of 2004.
2	26/03/15 & 17/09/15	Standards Committee	This version captures the amendments made to the JW Standards Document Version 1 of 2013 on: <i>"Specifications: water and sewer pipe material and the fire flow criteria". Metering Guidelines and Specifications</i>

RECORD OF REVISIONS AND AMMENDMENTS: DESCRIPTION

Revisions: Remove existing chapter(s) and substitute with the attached revised chapter(s).

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Chapter	Title	Rev No.	Amdt No.	Page Numbers(s)
7	WATER RETICULATION: <ul style="list-style-type: none"> • Fire Flow Criteria • Material Specification 	1	0	All
8	SANITATION: Material Specification	1	0	All
9: Annexure B	JW Metering Guidelines and Specifications	1	0	All
7	WATER RETICULATION Material Specification <ul style="list-style-type: none"> • Pipes over 315mm but less than 600mm diameter 	1	0	11

It should be noted that this document will be reviewed and revised on a regular basis by the JW Standards Committee.

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1. INTRODUCTION

The standards and guidelines described in this document apply to the water and sewer networks and associated infrastructure, operated and maintained by Johannesburg Water (SOC) Ltd and must be adhered to in all developments, design and maintenance operations. Where specific circumstances prevail which require deviation from these standards and guidelines, for whatever reason, the consent and approval of the **Design Manager: Capital Investment and Infrastructure Delivery**, shall be obtained.

2. POLICIES

2.1 Level-of-Service Policy for Water & Sanitation Services

The sanitation policy recommends the use of a number of generic sanitation technologies. These then may be tailored to meet the affordability and convenience of the customer. This policy adopts the principle that the level-of-service of water supply should be consistent with the selected sanitation technology. Refer to **Annexure A** for the Draft Policy.

The following table outlines the generic water and sanitation service-packages with those in bold representing the preferred options for the different service levels.

Table 1: Acceptable Level of Services for Water and Sanitation Services.

Service Package	Sanitation Option	Water Supply Level
Nominal	Chemical toilets	Communal tank or standpipe or water tanker. May be used under emergency conditions.
Basic level	VIP	Communal standpipes.
Standard Level	Full waterborne sewerage Septic (or conservancy) tanks may be used in sparsely populated areas.	Metered Yard or House connections

2.2 Metering & House Connection

Water metering shall be done in accordance with the latest revision of the **JW Metering Guidelines and Specifications**, attached to this document as **Annexure B**.

3. SERVITUDES AND ENCROACHMENTS

3.1 Servitude Widths

Widths of servitudes must be sufficient to allow operations and maintenance activities within their boundaries. The minimum acceptable width for pipes not exceeding 200mm diameter is 2 metres. For large diameter pipes as well as for trenches deeper than 1.5m, the servitude width shall be calculated using the following formula:

$$W_s = \Phi + 2D$$

Where W_s is the servitude width; Φ is the pipe diameter and D is the trench depth, all in same units.

For special circumstances requiring widths in excess of 10m approval shall be sought from the **Design Manager: Capital Investment and Infrastructure Development**.

In all circumstances, temporary servitudes of greater width may be required to facilitate construction. All servitudes must be acquired before construction commences.

3.2 Servitude registration

Registration of final servitudes is part of the designer's brief and must be completed as soon as possible after construction. To expedite registration of servitudes, the following must be strictly followed:

- **JW's Capital Investment and Infrastructure Development (CAPEX)** must inform the internal Legal Department well in advance of its intention to access the property for its purposes so that the Legal department may obtain access to the property in time. This is to avoid situations where the site is unavailable when the contractor is ready to commence work.
- To assist the **Legal department** to obtain access to the site and to effect registration of the servitude, the following are required.
 - Full and complete details including contact details of the property owner;
 - Full and complete details and contact details of the occupier of the property if different from the owner;
 - A copy of the title deeds of the property;
 - The township establishment status of the township within which the property is located (if applicable);
 - A detailed map depicting the pipeline traversing the property;
 - A draft Surveyor General diagram depicting the pipeline over the property;
 - A budget provision for the compensation or expropriation of the servitude;
 - A budget provision for the costs of survey, registration and all other incidental costs of registering the servitude;
 - Such other information that will assist in the registration of the servitude.

4. REINSTATEMENT

Works within municipal road reserves must be carried out in accordance with the requirements of the Johannesburg Roads Agency and, in particular, their code of practice. Similarly, Gautrans and the South African National Roads Agency must be consulted when water or sewer services will affect provincial or national roads. Wayleaves must be acquired before construction commences. Where work is executed within municipal paved areas the reinstatements are to be done as described in the “**Extract from City of Johannesburg Metropolitan Municipality: Public Road and Miscellaneous byelaws**” in **Annexure C**.

Where works are within other areas, the area must be reinstated to its original state. Sufficient funds must be made available within the project budget to reinstate all areas. Particular attention must be given to environmental impact of the works, how these will be mitigated and what reparation methods will be required.

5. SUBMISSION AND APPROVAL OF DOCUMENTS AND PLANS

- Where new works are to be taken over by Johannesburg Water or to be done by private developers, the following documents must be submitted to the **Senior Manager: Investment Delivery** or **Senior Manager: Development Control** respectively for checking and approval before construction commences.
 - **Preliminary Design Report (PDR)** outlining the proposed engineering solutions and the associated costs, social and environmental implications.
 - **Detailed Design Report (DDR)** containing detailed design calculations and drawings, operation and maintenance manuals/plans and construction costs, among others. The report and drawings should be signed by the Consultant’s professionally registered Engineer or Technologist (Pr Eng or Pr Tech Eng).
 - **Tender documents and all the relevant drawings** must be submitted at least 10 days prior to advertising.
 - **Construction drawings** must be approved prior to commencement of construction.
 - The drawings must show accurate contours. If mass earthworks are considered part of the development before the installation of water and sewer lines, the altered ground levels must be shown.
 - All nodes, manholes and other services structures must be numbered.
 - For sewerage reticulation systems, erven that cannot be serviced in total must be stated, with the part of erf that cannot be serviced hatched. A minimum of 80% of the erf area must be drained.
 - Longitudinal sections, clearly showing all features of the lines must be submitted.
 - At least three (3) benchmarks per township are required. Benchmarks erected/placed prior to construction for design or contract purposes are acceptable. The benchmarks provided must be shown in tabular format.
 - All drawings must be on the Johannesburg Water’s title block.
 - **The Senior Managers: Investment Delivery or Manager Development Control for in house capital projects and private developments** respectively shall submit one set of approved drawings to the **Senior Manager: Networks Operations** prior to construction commencement.

- **As-built drawings and close-out report** shall be submitted within two months after project completion. These are also to be signed by a registered professional engineer or technologist.
- No colour drawings will be accepted. All drawings, including notes are to be in black.
- **Refer to Annexure D** for more details on drawing requirements and standards.

6. “AS-BUILT” DRAWINGS

It is vital that proper ‘as-built’ drawings are produced and submitted for all work carried out for Johannesburg Water. These drawings ensure that the records can be updated to enable future planning, operation and protection of these assets.

All works that alter the existing networks or assets of Johannesburg Water require record drawings to be submitted. These include new capital works, extensions to the network, relocations and upgrades.

The as-built record drawing must be submitted within two months of project completion according to the following guideline:

- For private developers – prior to the issuing of Section 82 or Regulation 38 certificates.
- Capital projects by external Consultants and JW Design Section - as part of the final close-out report before the final payment certificate.

Completion certificates will not be issued and final payment for professional fees will not be processed until full “as-built” drawings have been submitted and approved.

The following “as-built” drawings must be submitted to the **Senior Manager: Investment Delivery (for capital projects)** and **Manager: Development Control (for private developments)**:

- Electronic copy of the drawings, in AutoCAD or Shape file formats on a DVD, including pen settings file.
- Excel or similar database of all attributes including coordinates, levels, pipe diameters and hydraulic design results.
- One set of drawings on transparent plastic film.
- The size and scale shall be such that the drawing is clearly legible.
- Colour drawings are not acceptable, only black lines on white.
- New work shall be represented in bold lines to clearly differentiate it from existing services.
- The benchmark data must also be shown on the “As Built” Layout.
- The JW title block must be used (See typical standard drawing in **Annexure D**), and should contain the following key information, among others:

Network Projects

Other Projects

<p>Township Name and Extension Project Description Project or Contract number</p>

<p>Name of Facility Drawing Description Project or Contract number</p>
--

The drawings shall consist of a complete set of the relevant drawings duly amended to show the engineering details of the works as constructed, and certified by the responsible person as being correct, within accepted tolerances, by endorsing the drawing as follows;

AS BUILT DRAWING	
And final inspection by	
..... (print name) (signature)
..... (print Prof. Reg. No.) (date)

❖ The words “As Built” may be replaced by “Record”.

These drawings shall become the property of Johannesburg Water.

7. WATER RETICULATION

All pipes, fittings, valves, hydrants, structures, etc., must comply with JW series of standard drawings. The designer must still be satisfied that these will adequately perform their intended function. **Refer to Annexure D for a list of these standard drawings.**

7.1 Design Guidelines

7.1.1 Design Consumption/Demand Criteria

The following tables indicate an estimate of typical daily water consumption. Figures have been verified with the estimated demands given in the Guidelines for Human Settlement Planning and Design (commonly referred to as the “Red Book”). It may be that current usage figures are higher where metering and billing are not enforced. However, these figures will give realistic quantities for economic design of bulk supply and reticulation.

Table 2: Average Water Demand

Description of Consumer	Demand
<i>Low cost housing schemes (5 persons per unit**)</i>	
Standpipes not more than 200m apart	30 l /capita/day
Yard connections	250 l /unit/day
House connections	300 l /unit/day
<i>Other Consumers – by zoning*</i>	
Low income ≤500 m ²	600 l /unit/day
Residential I : >500 m ² – 1750 m ²	800 l /unit/d – 2600 l / unit/d
Residential II & III (per 500 m ² of gross floor area)	800 l / unit/d – 2700 l / unit/d
Residential IV (per 500 m ² of gross floor area)	2900 l /d
Business and commercial per 500 m ² of the floor area	1650 l /d
Industrial Developments	See Table 4

**The designer must confirm the average number per household for low cost housing or low income group to take into account the increasing backyard dwellings.

*The categories of Residential Zones are as follows (Guidelines for Human Settlement Planning and Design, 2003, latest revision):

- Residential I – consists of dwelling houses at the rate of one dwelling unit plus an outbuilding per erf;
- Residential II & III – made up of multiple dwelling unit buildings up to and including three (3) storey buildings, excluding the basement;
- Residential IV – comprises of multiple dwelling unit buildings of four storeys and more.

Table 3: Specific Water Consumers

Description of Consumer	Demand
Schools: Day	20 l /pupil/day
Boarding	See Table 4
Community Halls	70 l /person/day
Bus Stations	15 l /user/day
Clinics	250 l /bed/day
Hospitals – Without Laundry	50 l /visitor/day
- With Laundry	450 l /bed/day
	600 l /bed/day

Table 4: Detailed Consumption rates for various users

Description of Consumer Group	Demand
<i>Agricultural holdings</i>	3,6kl/ha
<i>Residential Development</i>	
10 Units/ha	12kl/ha
20 Units/ha	18kl/ha
30 Units/ha	22,5kl/ha
40 Units/ha	25kl/ha
50 Units/ha	27,5kl/ha
60 Units/ha	30kl/ha
70 Units/ha	31kl/ha
80 Units/ha	32kl/ha
<i>Office Development</i>	
FAR up to 0,5	0,40kl/100m ² gross floor area
FAR over 0,5 and up to 0,75	0,38kl/100m ² gross floor area
FAR over 0,75 and up to 1,0	0,34kl/100m ² gross floor area
FAR over 1,0 and up to 1,25	0,28kl/100m ² gross floor area
FAR over 1,25 and up to 1,50	0,23kl/100m ² gross floor area
FAR over 1,50 and up to 2,0	0,20kl/100m ² gross floor area
<i>Commercial Development</i>	
FAR up to 0,5	0,30kl/100m ² gross floor area
FAR over 0,5 and up to 0,75	0,28kl/100m ² gross floor area
FAR over 0,75 and up to 1,0	0,26kl/100m ² gross floor area
FAR over 1,0 and up to 1,25	0,06kl/100m ² gross floor area
FAR over 1,25 and up to 1,50	0,17kl/100m ² gross floor area
FAR over 1,50	0,15kl/100m ² gross floor area
<i>Industrial Development</i>	
FAR up to 0,5	10kl/ha gross site area
FAR over 0,5 and up to 0,75	13,75kl/ha gross site area
FAR over 0,75 and up to 1,2	18,75kl/ha gross site area
FAR over 1,2 and up to 2,0	25kl/ha gross site area
Bakeries & Restaurants	0,85 kl/100m ² floor area
Panel Beaters	0,60 kl/100m ²
Hostels, Boarding Houses, Retirement Centres	0,77 kl/100m ² floor area
Butcheries	1,0 kl/100m ² floor area
Stadiums	0,22 kl/1000 spectators
Laundries	8 kl/100m ² floor area
Nurseries	0,13 kl/100m ² floor area
Garages	0,40 kl/100m ² floor area
Churches	30 l/visitor

7.1.2 Peak Factors & Peak Flow Velocity

In general the peak factor may be taken as 4 times the average daily demand. However, the onus is on the designer to use this figure with care. On a regional basis this figure will reduce. For a specific site with high usage at peak times it may well rise to a much higher value.

Table 5: Flow Velocities

Pipe	Preferred velocity	Maximum Velocity
Diameter ≤ 160mm	0,7m/s	1,0m/s –3,5m/s*
Diameter ≥ 200mm	1,0m/s	1,5m/s –2,5m/s*
Feeder pipes to reservoirs	1,5m/s	2,0m/s
Special Fittings	-	6,0m/s

*Generally, higher velocities can be accommodated in smaller bore pipelines where water-hammer is not problematic, or may be controllable. The designer must investigate each project and decide on the least life cycle cost scenario. This may include studies of varying pipe diameters versus velocity, inclusion of surge tanks, number and size of pumps versus operation times, etc.

7.1.3 Water Pressure & Minimum Head

Design water pressure should ideally be between 2.5 bar and 9.0 bar with an absolute minimum static pressure of 2.0 bar. Requests for allowance of higher pressures will be evaluated on individual merit and approval to exceed will be granted by the Design Manager, Capital Investment and Infrastructure Development. The minimum residual head shall be 1.5 bars at any connection. The specific pressures relating to each site must be investigated by the designer. A balance must be reached between the pressure supplied to consumers, the hardware required to achieve this, the zonal pressures and the class of pipe used.

Table 6: Flow Velocities

Design Flow	Minimum Pressure (bar) Reticulation Mains	Minimum Pressure (bar) Trunk Mains	Maximum Pressure (bar) At any point
Q _{D(W)}	2	2.5	9
Q _{D(W+F)}	See below	See below	See below

7.1.4 Fire Flow Criteria

Table 7: Fire Flow Criteria

Fire Risk Category / Area	Total Fire Flow (L/s)	Min. Flow For Each Hydrant (L/s)	Minimum Residual Pressure at Fire node (m)	Duration of Fire (Hours)	Spacing of Hydrants
High Risk CBD and high risk Business/ Commercial/Industrial	100	25	20	4	180m max
Moderate Risk 1 Business, Commercial, Industrial, Residential Zone IV.	50	25	15	4	180m max
Moderate Risk 2 Residential Developments Zone II and III,	25	25	15	2	180m max.
Low Risk Single Residential Housing (Low Cost Housing, Residential Zones I)	15	15	15	1	240m max. on mains \geq 110 mm in diameter
Special Sports complexes, Hospitals and other Strategic Locations.	Fire flow requirement to be determined by a qualified Professional Engineer.				
Agricultural Holdings		No Requirement		No Requirement	

**It should be noted that the above figures are a guide only and the fire requirements should be confirmed by a Professional Engineer.*

7.1.4.1 Fire Flow – Minimum Pipe Diameter

The diameter of a pipe supplying water to a fire hydrant shall not be less than 110mm NB.

References:

- SANS 10090 – Community Protection against Fires
- Guidelines for Human Settlement Planning and Design, 2003, latest revision.

7.1.5 Pipe Location

Pipes must preferably be located 2m from the erf boundary. No mid-block pipes will be allowed. Pipes must be located in open areas, road reserve or municipal land where they can be easily accessed at all times. Generally, water pipes should be located on the high side of roadways to allow for the sewer to be located on the lower side of the road. Where possible, water and sewer lines should not be placed on the same side of the road.

Table 8: Minimum and Maximum Cover to Pipes

Area	Minimum cover (mm)	Maximum cover (mm)
Gravel roads	1000	1500
All other areas	800	1500

These minimum depths may need to be increased in particular circumstances. The designer must be certain that the combination of loading, pipe depth, pipe strength and bedding type will be satisfactory. Depths of cover for leads must be such that the pipelines are not compromised by excess loading.

7.2 Material Specification

7.2.1 Pipe Materials

All pipes used must conform to SANS 1200 L and all other standards referred to in SANS 1200 L. This will include the use of uPVC, mPVC, steel and HDPE pipes. Table 9 below lists the materials to be used in new works. Other materials, as mentioned above, may be allowable where connecting to, or making alterations to, existing systems of the same material is made or by approval by the **Johannesburg Water's Design Manager**.

Table 9: Preferred Materials for Water Pipes

Type of Pipe	Minimum Size, Type and Class* of Pipe	
<i>Connections to individual stands</i>		
Connection pipe serving one erf	25mm outside diameter HDPE, class 16, PE 100 SDR 11 to SANS 4427	
Connection pipe serving 2 erven	32mm outside diameter HDPE, class 16, PE 100 SDR 11 to SANS 4427	
Connection pipe serving 3 erven	40mm outside diameter HDPE, class 16, PE 100 SDR 11 to SANS 4427	
Connection pipe serving 6 erven	63mm outside diameter HDPE, class 16, PE 100 SDR 11 to SANS 4427	
<i>Distribution mains in residential areas</i>		
Pipe Diameter range	Pipe Material and class	Preferred Coupling
110mm	mPVC class 16, to SANS 966 - Part 2	<i>Spigot and socket ends for running lengths and an end restraint coupling (e.g. ultra-lock) or similar approved by JW at change of direction.</i>
	High-impact mPVC Class 16 to SANS 1283	<i>Shouldered-ended collars and couplings (spheroidal graphite, grade 42 pressed on collars, suitably coated for water application) coupled with fusion bonded powdered epoxy, spheroidal graphite, grade 42 clamps.</i>
	HDPE Class 16, PE100 SDR 11 to SANS ISO 4427;	<i>Butt welding or electro fusion to SANS 0269.</i>
	OPVC class 16 to SANS 16422	<i>SAPPMA or ISO approved welders.</i>
		<i>Spigot and socket ends only. Thrust/anchor blocks designed to suit, must be provided at change of direction.</i>

160mm to 315mm diameter	mPVC Class 16 to SANS 966 Part 2	<i>Spigot and socket ends only. Thrust/anchor blocks designed to suit, must be provided at change of direction.</i>
	High-impact mPVC Class 16 to SANS 1283	<i>Shouldered-ended collars and couplings (spheroidal graphite, grade 42 pressed on collars, suitably coated for water application) coupled with fusion bonded powdered epoxy, spheroidal graphite, grade 42 clamps.</i>
	HDPE Class 16, PE100 SDR 11 to SANS ISO 4427;	<i>Butt welding or electro fusion to SANS 0269. SAPPMA or ISO approved welders.</i>
	OPVC class 16 to SANS 16422	<i>Spigot and socket ends only. Thrust/anchor blocks designed to suit, must be provided at change of direction.</i>
Over 315mm but less than 600mm diameter [#]	Preferred option: Steel pipes Class B to SANS 719.	<i>Welded steel – internal lining cement mortar lining</i>
	<i>Note: The Other options below to be used where there are high stray currents due to railway traction lines/overhead or underground power lines, dolomitic areas etc</i>	
	Other options on approval by JW: OPVC class 16 to SANS 16422	<i>Spigot and socket ends only.</i> <ul style="list-style-type: none"> • <i>Thrust/anchor blocks designed to suit, must be provided at change of direction</i> • <i>Laterals and bends to be steel with suitably approved corrosion protection coating’.</i>
Other option on approval by JW: HDPE Class 16, PE100 SDR11 to SANS ISO 4427	<i>Butt welding to SANS 0269.</i> <ul style="list-style-type: none"> • <i>Any bend to be extruded ,with stub and flange, and <u>not</u> segmented</i> • <i>SAPPMA or ISO approved welders.</i> • <i>Laterals to be steel with suitably approved corrosion protection coating</i> 	
600mm diameter and above	Steel pipes grade 42 to SANS 719.	<i>Welded steel – internal lining with a solvent-free epoxy lining or similar approved by JW (welded), Refer to Annexure F for Detailed specifications on Coatings.</i>

*The Class 12.5 rating of connection pipes is to ensure the sufficient durability and structural performance of the pipe rather than to withstand possible internal pressures. For distribution mains in the CBD areas, high-impact mPVC Class 16 pipes with shouldered-end couplings approved by JW are preferred from a technical and operational point of view.

Pipe material specification for dolomitic areas is not specified above. Approval for the proposed pipe material, jointing methods should be in line with the recommendations of SANS 1936 and other related SANS specifications and will be subject to approval by JW.

NB: No house connections are allowed directly from 200mm diameter pipes and above without prior approval from JW.

The designer must still be satisfied that the pressure rating of the pipes will be suitable for the specific site. Allowance may need to be made in zones controlled by pressure controlling devices or in zones of direct feed where maximum operating pressure cannot be guaranteed. The classes indicated in Table 9 are the minimum acceptable to JW.

7.2.2 Bedding & Backfill

Bedding, backfill and compaction are to be done according to SANS 1200 LB and all other standards referred to in SANS 1200 LB. Also refer to the standard drawings listed in **Annexure D**. The choice of bedding must be sufficient to ensure the adequate protection of the pipeline.

8 SANITATION

8.1 Design Guidelines

8.1.1 Design Flow Criteria

Table 10: Average Sewer Discharge for different consumers

Description of Consumer Group	Discharge
<i>Low income development*</i>	300 l/stand/day
<i>Other Consumers – by zoning**</i>	
Lower income ≤500m ²	500 l/unit/day
Residential I: >500 m ² – 1750 m ²	700 – 1350 l/unit/d
Residential II & III erven	700 – 2300 l/unit/d
Residential IV erven per 500 m ² floor area	2500 l/d
Business and commercial per 500 m ² floor area	1200 l/d
Other	See Table 11 & Table 12

****The description of Residential Zones is as given in section 7.1.**

*The designer must confirm the average number per household for low cost housing or low income group to take into account the increasing backyard dwellings.

Table 11: Specific Sewer Discharges

Description of Consumer Group	Discharge
Schools	15 l/pupil/day
Community Halls	50 l/person/day
Churches	20 l/visitor/day
Bus Stations	10 l/user/day
Clinics	200 l/bed/day
	40 l/visitor/day
Hospitals – Without Laundry	0,30 kl/bed/day
- With Laundry	0,45 kl/bed/day

For other sewer discharges, refer to **Table 12 below**.

Table 12: Return Flows from Various Sewer Contributors

Description of Consumer Group	Average Daily Sewage Discharge
<i>Agricultural holdings</i>	2,2kl/holding
<i>Residential Development</i>	
10 Units/ha	9kl/ha
20 Units/ha	13kl/ha
30 Units/ha	17kl/ha
40 Units/ha	19kl/ha
50 Units/ha	21kl/ha
60 Units/ha	23kl/ha
70 Units/ha	25kl/ha
80 Units/ha	26kl/ha
<i>Office Development</i>	
FAR up to 0,5	0,30kl/100m ² gross floor area
FAR over 0,5 and up to 0,75	0,30kl/100m ² gross floor area
FAR over 0,75 and up to 1,0	0,28kl/100m ² gross floor area
FAR over 1,0 and up to 1,25	0,24kl/100m ² gross floor area
FAR over 1,25 and up to 1,50	0,20kl/100m ² gross floor area
FAR over 1,50 and up to 2,0	0,17kl/100m ² gross floor area
<i>Commercial Development</i>	
FAR up to 0,5	0,20kl/100m ² gross floor area
FAR over 0,5 and up to 0,75	0,18kl/100m ² gross floor area
FAR over 0,75 and up to 1,0	0,16kl/100m ² gross floor area
FAR over 1,0 and up to 1,25	0,13kl/100m ² gross floor area
FAR over 1,25 and up to 1,50	0,11kl/100m ² gross floor area
FAR over 1,50	0,10kl/100m ² gross floor area
<i>Industrial Development</i>	
FAR up to 0,5	0,16kl/100m ² floor area or 8kl/ha gross site area
FAR over 0,5 and up to 0,75	0,12kl/100m ² floor area or 9kl/ha gross site area
FAR over 0,75 and up to 1,2	0,10kl/100m ² floor area or 12kl/ha gross site area
FAR over 1,2 and up to 2,0	0,09kl/100m ² floor area or 15kl/ha gross site area
Single Dwellings	0,9kl/day
Flats	0,6kl/day
Bakeries & Restaurants	0,65 kl/100m ² floor area
Panel Beaters	0,45 kl/100m ²
Hostels, Boarding Houses, Retirement Centres	0,55 kl/100m ² floor area
Butcheries	0,7 kl/100m ² floor area
Stadiums	0,22 kl/1000 spectators
Laundries	6 kl/100m ² floor area
Nurseries	0,05 kl/100m ² floor area
Garages	0,22 kl/100m ² floor area

A general guideline to calculate discharge is to assume that the discharge, in fully developed areas, is approximately 80% of the water consumption in the area. Consumption figures for other specific consumers are listed in **Table 3**.

For newly developed areas the ultimate development potential must be considered. Current densification indicates a move towards 40 units per hectare, and more. Outfall sewers must cater for all possible developments upstream. All work to comply with JW's Master plan.

Addition of all the individual flows for the design area gives the Average Daily Dry Weather Flow (ADDWF).

Applicable design Peak factors are as given in Table 13 depending on the land zoning. An additional 15% of ADDWF shall be allowed for any other extraneous flows to give the Peak Daily Wet Weather Flow (PDWWF).

8.1.2 Peak Factor

Table 13: Peak Factors

Zoning	Peak Factor
Low income areas	2.5
Other Residential	2,3
Business	1,3
Commercial	1,5
Industrial 1	1,8
Industrial 2	2,3
Industrial 3	2,1
Clinics, Restaurants, Laundromats & Hotels	3

8.1.3 Hydraulic Design – Gravity Systems

(a) *Flow Velocities*

Table 14: Velocities

Type of Pipe	Minimum full-flow Velocity	Maximum Velocity
Gravity	0,7m/s	3m/s or checked with the pipe manufacturer

(b) *Minimum Diameters*

- Minimum pipe diameter shall be 160mm with 110mm connections in residential developments.
- A minimum diameter of 200mm with 110mm connections is applicable for CBD developments

(c) *Maximum Depth of Flow*

Pipes are to be designed to flow 67% full at peak discharge, Peak Daily Wet Weather Flow (PDWWF). For major outfall sewers, operational procedures and ability to clean the pipe must be considered when choosing pipe diameter.

(d) *The Capacity of Sewers*

The capacity of a sewer must be calculated according to either of the following equations:

$$(i) \quad Q = A \frac{R^{2/3} \sqrt{S}}{n} \quad \text{Manning formula}$$

$$(ii) \quad Q = 1.49 \log \frac{1.49 R}{k_s} A \sqrt{RS} \quad \text{Chezy equation}$$

where: A = cross-sectional area of flow/conduit (m²);
 R = hydraulic radius (m)
 S = gradient (assuming uniform flow)
 n = Manning's roughness coefficient *
 k_s = absolute roughness of conduit (m)

* It is the designer's duty to use the appropriate Manning's roughness coefficient which depends on the pipe material used as well as its age.

8.1.4 Layout Design

(a) *Pipe Location*

Pipes must preferably be located 1.5 m from the erf boundary. If this cannot be achieved the distance of the sewer from the erf boundary must be clearly shown on all layout drawings, including "As Built" drawings. Mid-block sewers shall be avoided as much as practically possible. Special permission shall be obtained from **JW's Design Manager or Manager: Development Control** for the installation of mid-block sewers where this cannot be avoided.

Pipes must be located in open areas, road reserve or municipal land where they may be easily accessed at all times. Generally, sewers shall be located on the lower side of the road. In road reserves, sewers must be installed between the stormwater drain and the erf boundary, where applicable.

Table 15: Minimum Cover for Pipes

Area	Minimum Cover (mm)
Trafficked areas	1400 (below final road level)
Other areas	1000

These minimum depths may need to be increased in particular circumstances. The designer must be certain that the combination of loading, pipe depth, pipe strength and bedding type will be satisfactory. Depths of cover for house connections must be such that the pipelines are not compromised by excess loading. If the above cover cannot be achieved and upon approval by **JW's Design Manager**, the pipe shall be protected by a concrete slab placed over the pipe, isolated from the pipe crown by a minimum of 150 mm thick soil cushion.

The highest possible invert level of the municipal sewer (HILS) at the erf connection point may be calculated as follows:

$$HILS = LGL - 0.3 - \frac{L}{60} - \emptyset$$

Where:

- LGL = minimum ground level on erf (to enable drainage of even the lowest point of the erf)
- 0.3 = minimum cover required at the head of the erf connection
- L = length of the erf connection
- \emptyset = diameter of municipal sewer (to enable soffit-to-soffit connection)

(b) Sewer gradients

The following minimum sewer gradients must be adhered to in the design of sewers. Designers must ensure that there is sufficient gradient to clear pipes at the top of the system. It is generally accepted that sewers must have a steeper gradient (minimum 1:80) closer to the upper end of the sewer.

Sewers laid at gradients steeper than 1:12 shall be anchored at the joints with properly designed anchor blocks. Concrete of strength 15MPa (1:3:6) shall be used for anchor blocks.

Table 16: The acceptable minimum grades for particular sewer sizes

Pipe Size	Minimum Gradient*
110 mm diameter erf connections	1:60
160 mm diameter	1:140
200 mm diameter	1:200
≥300 mm diameter	1:350

* Steeper gradients may be necessary where the depth of flow is too low ($d/D \leq 20\%$).

(c) Manholes

Manholes must be placed at every change in gradient, junctions and horizontal direction. The maximum spacing of manholes is 80 m. A larger spacing may be accepted for outfall sewers of diameters greater than 600mm, subject to approval by **JW's Design Manager** of each proposed installation. For sewers crossing a road, there must be at least one manhole within the road reserve. Backdrop and/or ramp junction manholes shall not be used in sewer systems. Option of two manholes close to each other is preferred to backdrop manholes.

8.1.5 Pumping Systems

(a) Pipelines

(i) Minimum diameters

The minimum internal diameter of a rising main should be 100 mm.

(ii) Velocities

The minimum velocity should be 0.7 m/s whereas a velocity of 2.0 m/s should not be exceeded.

(iii) Gradients

Wherever practically possible, the alignment of the rising main should be such that air and scour valves are avoided.

(iv) Stilling chambers

Stilling chambers should be provided at the heads of all rising mains. They should be designed such that the liquid level always remains above the soffit of the pipe level of the rising main where it enters the stilling chamber. Stilling chambers should preferably be ventilated.

(b) Pump stations

Refer to Annexure G for the design guidelines and specifications.

8.2 Material Specification

8.2.1 Pipe Materials

The following pipe materials are acceptable for sewers:

- uPVC Heavy Duty Class 34 to SANS 791 or solid (sandwiched) walled uPVC class 400 to SANS 1601 for sizes up to 400mm diameter.
- HDPE sewer pipes for all sizes above 400mm diameter.
*Except in special circumstances, smaller diameters (but >200mm) of HDPE sewer pipes may be used.
- *Reinforced* concrete pipes containing dolomitic aggregates can be used for sewers larger than 400mm. The pipes should have an approved sacrificial lining inside as per SANS 677. Other specifications are as contained in SANS 1200 LD.

8.2.2 Manholes

Manholes and chambers shall be constructed as specified in SANS 1294. General guidelines are as follows. These are found in more detail on the standard drawings.

- Manhole channels to be precast fibre cement even if uPVC pipes are used in reticulation.
- Manholes shall be precast concrete with dolomitic aggregate or fibre-cement rings (min. 1,05m nominal diameter).
- Manholes must be coordinated to Lo27 and levels to be AMSL.
- Step irons shall be Calcamite steel-plastic-coated or Copolymer Polypropylene, fixed to structures with suitable epoxy adhesive.
- Approval from Johannesburg Water's **Design Manager** must be obtained for the use of lightweight prefabricated manholes. This may only be granted in special circumstances.
- Benching in manholes shall be concrete of minimum strength of 20 MPa at 28 days.
- Manholes deeper than 3 m shall be a minimum of 1.5 m in diameter.
- **Refer to Annexure I for details on the minimum slope in manhole floors.**
- Provide for sealing of manholes for water tightness with an approved sealant to prevent ingress of storm water
- HDPE manholes shall be approved for Dolomitic areas.

8.2.3 Bedding & Backfill

Specifications as set out in SANS 1200 LB must be followed for the bedding and backfill of sewer pipes. Bedding, backfill and pipe strength shall be sufficient to ensure that pipelines are not overstressed from all superimposed loading.

- All bedding material must be of selected granular material with a PI less than 6, and free from organic matter, clay or stones larger than 20mm.

- Subsoil drains are to be provided where ground water is a problem. The designer shall ensure that the design is sufficient to meet the requirements.
- Backfill material must be homogeneous and must be compacted in 150mm layers to 93% Modified AASHTO density.
- Density tests must be carried out on the backfill.
- Refer to standard drawings in **Annexure D** for bedding and backfill details.

8.2.4 Erf Connections

- All connections shall be a minimum of 110mm internal diameter. Erf connections must be provided from the main sewer to a distance of 0.5 m inside the erf boundary.
- Direct connections to 160mm pipes will be allowed in residential areas, but industrial connections will only be allowed into a manhole on the sewer main. An inspection chamber must be constructed on the property boundary for commercial park developments in front of the manhole where the connection is made. Connections to sewers of more than 160 mm diameter are only allowed through manholes. **Refer to Annexure D for a standard detailed drawing.**

8.3 Tests and Inspections

8.3.1 Pipelines and appurtenances

The onus is on the Engineer to ensure that the works are properly carried out. Without absolving the engineer of this responsibility, JW shall require the following tests and inspections during the construction phase:

- Inspection on completion of the excavation prior to laying the pipe.
- Inspection of prescribed bedding and the compaction of surrounding material up to the centre line level of the pipe.
- Air or water tests, as prescribed in the standard specification SANS 1200, are to be conducted after the placing and compaction of the backfilling. Contractors must pressure test the pipeline prior to backfilling, at their own expense, to avoid excavation of the final backfill.
- Density tests must be conducted on bedding and backfill material. Correlated DCP tests will be acceptable unless otherwise specified.
- Inspection of the construction of the manholes and completion of the backfill.
- CCTV inspections are to be conducted on all sections of the pipe. The CCTV video and reports are to be submitted as part of the as-built information.
- A percolation test, as prescribed in **Annexure H**, must be conducted on sites where septic tanks and French drain systems are to be installed.

9: ANNEXURES

Annexure A: Sanitation Policy (Draft)