



# **DEPARTMENT OF PUBLIC WORKS**

## **GUIDELINES FOR THE DESIGN OF CIVIL SERVICES FOR PRISONS**

**MARCH 2004**

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**PRISONS**

**NOTE TO CONSULTING ENGINEERS**

The Consultant's attention is specifically drawn to the fact that his/her practice should accept **full responsibility** for the design, detail(s), specifications and drawings. The Department's input is given to ensure basic compliance with minimum statutory-, regulatory-, and legislative requirements, with the basic aim to realise best practice details/specifications in conjunction with the Consultant's expertise.

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**A. CHECKLIST**

<b>PART 1: EXTERNAL WATER MAINS</b>					
<b>No.</b>	<b>ACTIVITY</b>	<b>ACTION/VALUE</b>	<b>DATE</b>	<b>OTHER</b>	<b>COMMENTS</b>
1	Service Provider: - Water Board Local Authority - Bore holes - Other				
	Contact Person: - Name - Tel. No. - Fax. No. - Cell No. - E-Mail				
	Bulk Services Cost: - Payable (Y/N) - Amount				
	Shared services Cost: - Payable (Y/N) - Amount				
	Size, type and pressure class (bar) of water main				
	Position of connection point				
	Static water head at connection point (m)				
	Dynamic water head at connection point (m)				
	Water main connected to: - Reservoir - Bore hole				
	Type of water main: - Gravity - Pumping main				
	Services signed off by local Authority				

**PART 2: INTERNAL WATER RETICULATION**

No.	ACTIVITY	ACTION/VALUE	DATE	OTHER	COMMENTS
1	Pipes: - Type - Pressure class (bar) - Manufacturer				
	Valves: - Type - Manufacturer				
	Control valves: - Type - Manufacturer				
	Special precautions against dolomitic soils (if applicable)*				
	Low level reservoir: - Steel/concrete - Manufacturer - Size - Capacity (kℓ) - Floor level - Top water level - Level indicator - Flow/level control system				
	Water tower - Steel/concrete - Manufacturer - Size - Capacity (kℓ) - Floor level - Top water level - Level indicator - Flow/level control system				
	Pump station: Pumps - No. of pumps - Type - Size & description - System curve - Manufacturer Pump Motors - Operating speed - Size of motor - Manufacturer				
	Pump operating procedure				

**\* Refer to Part 9 : Soil conditions**

**PART 3: FIRE SERVICES**

No.	ACTIVITY	ACTION/VALUE	DATE	OTHER	COMMENTS
1	Fire Risk	Moderate-Risk 100 l/s = 4No. FH @ 25l/s each			
	Total required reservoir capacity				
	No. of reservoirs (tanks)				
	Pipes: - Type - Pressure class (bar) - Manufacturer				
	Combined System (only for multiple reservoirs/tanks) or Separate Systems?				
	Special precautions against dolomitic soils (if applicable)*				
	Valves: - Type - Manufacturer				
	Control valves: - Type - Manufacturer				
	Available static head (m)				
	Available dynamic head (m)				
	Max Hydrant spacing (m)				
	Pump station: Pumps - No. of pumps - Type - Size & description - System curve - Manufacturer Pump Motors - Operating speed - Size of motor - Manufacturer				
	Pump operating procedure				
	Fire service signed off by Local Authority				

\* Refer to Part 9 : Soil Conditions

**PART 4: IRRIGATION RETICULATION**

No.	ACTIVITY	ACTION/VALUE	DATE	OTHER	COMMENTS
1	On site borehole(s): - Investigation (Y/N) - Positive - Negative				
	Borehole data: - Hole depth - Water depth - Casing depth - Casing dia - Delivery				
	Borehole pump(s): - Type - Size (66% of tested delivery) - System curve - Manufacturer				
	Pipes: - Type - Pressure Class (bar) - Size - Manufacturer				
	Special precautions against dolomitic soils (if applicable)*				
	Valves: - Type - Manufacturer				
	Source of irrigation water if not boreholes				
	Connection point(s) for irrigation				
	Irrigation pumps - No. of pumps - Type - Size & description - System curve - Manufacturer				
	Irrigation pump motors - Operating speed - Size of motor - Manufacturer - Irrigation pump procedure				

- Refer to Part 9 : Soil Conditions

**PART 5: AGRICULTURAL**

No.	ACTIVITY	ACTION/VALUE	DATE	OTHER	COMMENTS
1	Climatic Conditions: - Rainfall - Min temp - Max temp - Evapotranspiration	.....mm/a .....°C .....°C .....°C			
	Crops proposed:	..... ..... ..... ..... ..... .....			
	Animal farming proposed:	..... ..... ..... ..... ..... .....			
	Soils investigated:*(Y/N).....				
	Irrigation requirements for:  ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... .....	.....mm/a .....mm/a .....mm/a .....mm/a .....mm/a .....mm/a .....mm/a .....mm/a .....mm/a .....mm/a .....mm/a			
	Irrigated areas required for:  ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... .....	.....ha .....ha .....ha .....ha .....ha .....ha .....ha .....ha .....ha .....ha .....ha			



	Animals /ha for: ..... ..... ..... ..... .....	...../ha ...../ha ...../ha ...../ha ...../ha			
	Crop production per ha of: ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... .....	...../ha ...../ha ...../ha ...../ha ...../ha ...../ha ...../ha ...../ha ...../ha ...../ha ...../ha			
	Animal housing proposed for:       	..... ..... ..... ..... ..... .....			
	Numbers of Animals and poultry proposed of: ..... ..... ..... ..... ..... ..... ..... .....	..... ..... ..... ..... ..... ..... ..... .....			
	Average number of animals or birds to be slaughtered /day: ..... ..... ..... .....	..... ...../d ...../d ...../d ...../d			
	Dairy capacity: Milk produced	..... l/d			

	Vegetables proposed: ..... ..... ..... ..... ..... ..... .....	.....kg/d .....kg/d .....kg/d .....kg/d .....kg/d .....kg/d .....kg/d			
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**NOTE: \* For Soil Conditions refer to Part 9.**

**PART 6: EXTERNAL SEWER MAINS**

<b>No.</b>	<b>ACTIVITY</b>	<b>ACTION/VALUE</b>	<b>DATE</b>	<b>OTHER</b>	<b>COMMENTS</b>
1	Service Provider: - Local Authority - Water Board - Other				
	Contact Person: - Name - Tel. No. - Fax. No. - Cell No. - E-Mail				
	Bulk Services Cost: - Payable (Y/N) - Amount				
	Shared services Cost: - Payable (Y/N) - Amount				
	Sewer flow material: - Yes/No - Cost formula				
	Size and type of sewer main				
	Position of connection point				
	Available pipe capacity				
	Invert levels of manholes along boundary: - Upstream - Downstream				
	Pre-treatment for abattoir effluents - Min effluent standards - Effluent cost formula				
	Sewer reticulation and pre-treatment service signed off by Local Authority				

**PART 7: INTERNAL SEWER RETICULATION AND EFFLUENT TREATMENT**

No.	ACTIVITY	ACTION/VALUE	DATE	OTHER	COMMENTS
1	Dolomitic conditions ((Y/N)*				
	Precautions against dolomitic conditions (if applicable)*				
	Pipes: - Type - Pressure Class (bar) - Supplier				
	Manholes: - Supplier - Material				
	Pump station required (Y/N)				
	Pump capacity required: - Average daily inflow - Peak inflow - Pump capacity				
	Pump station: Pumps - No. of pumps - Type - Size & description - System curve - Manufacturer Pump Motors - Operating speed - Size of motor - Manufacturer				
	Grease separator at kitchens - Type - Manufacturer				
	Petrol and oil separation at vocational and industrial centers - Type - Manufacturer				
	Abattoir Pre-treatment Works - Process - Operation				

**Note : \* Refer to Part 9 : Soil Conditions**

**PART 8: STORM WATER RETICULATION**

No.	ACTIVITY	ACTION/VALUE	DATE	OTHER	COMMENTS
1	Service Provider: - Local Authority - Water Board - Other				
	Contact Person: - Name - Tel. No. - Fax. No. - Cell No. - E-Mail				
	Bulk Services Cost: - Payable (Y/N) - Amount				
	Shared services Cost: - Payable (Y/N) - Amount				
	Special Precautions against dolomitic soils (if applicable)*				
	Pipes: - Type - Class - Supplier				
	General slope of land				
	S/W received from higher-lying land?				
	Storm water discharged to: - Nearest watercourse - Municipal system - Overland - Other				
	Agreement on S/W acceptance with low-lying owner				
	S/W stabilizing ponds required?				

**Note : \* Refer to Part 9 : Soil Conditions**

**PART 9: SOIL CONDITIONS**

<b>No.</b>	<b>ACTIVITY</b>	<b>ACTION/VALUE</b>	<b>DATE</b>	<b>OTHER</b>	<b>COMMENTS</b>
1	Soil investigation (Y/N)				
	Geotechnical Engineer: - Contact Person - Tel. No. - Fax. No. - Cell No. - e-Mail				
	Laboratory: - Contact Person - Tel. No. - Fax. No. - Cell No. - e-Mail				
	Adverse soil conditions: - Dolomitic conditions* - Heaving clay - Collapsing sand - Rock - Steep slopes - Other				
	Soil profile: - Atterberg Limits - Grading modulus				
	Soil Classification				
	In situ material suitable for fill under buildings?				
	Allowable bearing capacity of in situ material				
	In situ material suitable for road building materials? - Base course - Sub base - Selected layers - Fill				
	Position of water table				

\*NOTE: An investigation incorporating drilling of borehole(s) on site is strongly recommended.

	Soil potential for agricultural production: - soil depth - soil moisture retention mm/m - total available soil moisture mm/m - % clay - Sand/loam/clay ratio				
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**NOTE: Refer to Part 10, Roads construction for additional information**

PART 10: ROADS					
No.	ACTIVITY	ACTION/VALUE	DATE	OTHER	COMMENTS
1	Service Provider: - Local Authority - Water Board - Other				
	Contact Person: - Name - Tel. No. - Fax. No. - Cell No. - E-Mail				
	Bulk Services Cost: - Payable (Y/N) - Amount				
	Shared services Cost: - Payable (Y/N) - Amount				
	Road Indicator tests done? (Y/N)				
	Geotechnical Engineer: - Contact Person - Tel. No. - Fax. No. - Cell No. - e-Mail				
	Laboratory: - Contact Person - Tel. No. - Fax. No. - Cell No. - e-Mail				
	Nature of in situ material: - Atterberg Limits - Classification - CBR Values - UCS Values				
	Nearest suitable borrow pit				
	Nearest commercial source				

**NOTE: - Refer to Part 9, Soil Investigation for additional information.**

-The record of decision for the EIA (Environment Impact Assessment) must be placed on record and attached to the documents that will be submitted for final approval.



**B. POPULATION, ACCOMMODATION AND AUXILLIARY DATA AS FAR AS IT AFFECTS DESIGN OF WATER AND SEWERAGE SERVICES.**

**B.1 DATA SUPPLIED BY THE DEPARTMENT**

B1.1	Locality of Prison.
B1.2	Prisoner population.
B1.3	Architectural layout of prison with accommodation areas and population data.
B1.4	Whether it is a prison farm or not.
B1.5	Administration population.
B1.6	<p>Housing requirements for Administration Staff.  <u>NOTE:</u> Unless otherwise indicated the administration housing requirement will be for:</p> <p><b>Normal Prisons:</b> Equal to 70% of Administration Staff.  <b>Prison Farms:</b> Equal to 100% of Administration Staff.</p> <p>Of the housing provided:</p> <ul style="list-style-type: none"> <li>- 40% will be residential with 2 erf sizes of <math>\pm 2000\text{m}^2</math> and the balance of <math>\pm 650\text{m}^2</math></li> <li>- 60% will be single quarters</li> </ul>
B1.7	Sports facilities to be provided with nett area under irrigation.
B1.8	Development parks provided with nett area under irrigation.
B1.9	Undeveloped park area provided (only manual watering, no irrigation).
B1.10	<p>If Prison Farm:</p> <p>(a) Available area for agricultural uses.</p> <p>(b) Any specific requirements of the Department on meat farming and slaughter facilities i.e. cattle and/or pigs and/or sheep and/or poultry.  <u>Note:</u> Unless otherwise indicated, the meat requirement of a prison is:</p> <ul style="list-style-type: none"> <li>- 92,5gm red meat / prisoner / day.</li> </ul> <p>AND 100gm white meat (poultry) / prisoner / day</p> <p>(c) For meat production, base calculations on:</p> <ul style="list-style-type: none"> <li>- cattle carcass of 200kg</li> <li>- pig carcass of 31kg</li> <li>- sheep carcass of 21kg</li> <li>- broiler carcass of 1,3 to 1,6kg</li> </ul> <p>(d) Any specific requirements of the Department on Dairy farming.  <u>Note:</u> Unless otherwise indicated the milk requirements of a prison is:</p> <ul style="list-style-type: none"> <li>- 290ml / prisoner /day</li> </ul> <p>(e) Any specific requirements of the Department on vegetable cultivation ie. which vegetables are priorities.  <u>Note:</u> Unless otherwise indicated, the vegetable requirement of a prison is:</p> <ul style="list-style-type: none"> <li>- 360gm vegetable / prisoner / day of which <math>\frac{1}{3}</math> must be green, <math>\frac{1}{3}</math> yellow and <math>\frac{1}{3}</math> white</li> </ul> <p>(f) Any specific requirements of the Department on egg production:  <u>Note:</u> Unless otherwise indicated, the egg requirement is:</p> <ul style="list-style-type: none"> <li>- 1 egg / prisoner / day</li> </ul> <p>(g) Any specific requirements of the Department on fruit production i.e. which fruit requirement will be preferred.  <u>Note:</u> Unless otherwise indicated, the fruit requirement of a prison is:</p> <ul style="list-style-type: none"> <li>- one fruit / prisoner / day</li> </ul>

	<p>(h) Whether the prison farm must supply any other prisons with food and the corresponding data of the relevant prisons.</p> <p>(i) Any specific requirement of the Department on patrol horses and stables.</p> <p>(j) Any specific requirement of the Department on a dog school, patrol dogs and kennels.</p>
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## **B.2 DATA TO BE OBTAINED BY THE CONSULTANT**

B2.1	The Consultant shall be responsible to obtain all other data to plan, design and specify the water and sewerage systems.
B2.2	The Consultant shall also be responsible to scrutinize the information supplied by the Department and to notify the Department of any anomalies in the data supplied.
B2.3	<p>With reference to prison farms, the Consultant shall conduct a thorough feasibility report on the various farming options taking into account all relevant factors such as climate, rainfall, minimum and maximum temperatures, soil conditions, available irrigation water, pumping requirements etc.</p> <p>Based on the feasibility report and the preferences of the Department, the Consultant shall recommend to the Department:</p> <ul style="list-style-type: none"><li>- The most feasible meat farming operations, the recommended herd sizes and the pasture area under irrigation required.</li><li>- The most feasible vegetable cultivation and the irrigated area required.</li><li>- Whether dairy farming is feasible and the required herd size and pasture area under irrigation required.</li><li>- The most feasible fruit production and the irrigated area required.</li><li>- Where mixed farming is feasible, the optimum herd sizes of cattle and / or pigs and / or sheep and the flock size of egg laying and broiler poultry taking the food requirements of the prison into account .</li><li>- Animal housing required, animal food supply or production, storage required for animal food.</li><li>- The total irrigation water requirement for the farming operations and from where it is to be provided.</li><li>- Safe re-use of treated effluent for irrigation purposes.</li><li>- The type and size(s) of abattoirs required.</li><li>- Pre-treatment or treatment and disposal of abattoir and animal housing effluents.</li><li>- Construction of a full sewage treatment work to simultaneously treat industrial and domestic effluent of the prison as well.</li></ul>

## C. WATER DESIGN STANDARDS

### C.1 AVERAGE DAILY WATER DEMAND FIGURES (EXCLUDING GARDENING EXCEPT WHERE SHOWN)

DESCRIPTION	REFERENCES				
	RED BOOK	SABS 0252	DPW	OTHER	DESIGN VALUE
Prisoners	150 ℓ/p/d	-	375 ℓ/p/d	200 ℓ/p/d	200 ℓ/pr/d
Residential Wardens	900 – 2700 ℓ/erf/d incl. gardening for 500m <sup>2</sup> to 2000m <sup>2</sup> erven	-	-	-	As per fig 9.7 Red Book
Single Quarters	600 – 1000ℓ/u/d	300 – 400ℓ/u/d or 135 – 200 ℓ/p/d	-	150 – 220ℓ/p/d	400 ℓ/u/d
Administration	400 ℓ/100m <sup>2</sup> /d	7 – 10 ℓ/10m <sup>2</sup> /d	4 kℓ/d	70 ℓ /p/d (10m <sup>2</sup> = 1p)	70 ℓ/p/d personnel
Kitchen and dining	65-90 ℓ/seat	8-12 ℓ/meal 26 – 34 ℓ/p/d	41 ℓ/seat	25 - 31 ℓ/p/d	90 ℓ/p/d
Clinic	40-60 ℓ/bed/day	450-550 ℓ/bed/d	3.7 kℓ/d	50 ℓ/bed/d 250 ℓ/bed/d	250 ℓ/bed/d
Laundry	-	10 – 15 ℓ/p/d	7,6 ℓ/pr/d 4 kg/pr/d	15 ℓ/kg and 18kg/p/w =39ℓ/p/d	15 ℓ/pr/d
Admissions/Prisoner holding cells	-	-	12.5 kℓ/d	-	100 ℓ/p/d admitted
Educational	15 – 20 ℓ/p/d	40-50 ℓ/p/d	855 ℓ/d	45 ℓ/p/d	45 ℓ/student/d
Visiting	-	-	768 ℓ/d	10 ℓ/p/d - 20 ℓ/p/d	20 ℓ/visitor/d
State Vehicle Carwash	-	3 – 6 ℓ/p/d	-	200 - 300 ℓ/car	200 ℓ/car
Maintenance	-	100-200 ℓ/p/d	210 kℓ/d	-	1,5% of total water demand
Canteen	-	10-15 ℓ/10m <sup>2</sup> /d	1080 ℓ/d	175 ℓ/p/d	60 ℓ/10m <sup>2</sup> /d
Vocational	-	-	-	300 ℓ/100m <sup>2</sup> /d or 95 ℓ/p/d	100 ℓ/trainee/d
Industrial Manufacturing	-	-	-	220 ℓ/100m <sup>2</sup> /d 300 ℓ/100m <sup>2</sup> /d	400 ℓ/100m <sup>2</sup> /d
Chapel	-	-	-	20 ℓ/p/d	20 ℓ/p/d attending
Logistics including meat processing	-	-	-	100 - 220 ℓ/100m <sup>2</sup> /d	5 ℓ/pr/d

DESCRIPTION	REFERENCES				
	RED BOOK	SABS 0252	DPW	OTHER	DESIGN VALUE
Commercial (shops incl. petrol station)	400 ℓ/100m <sup>2</sup> /d	14 – 18 ℓ/10m <sup>2</sup> /d	-	70 ℓ/p/d	10 ℓ/10m <sup>2</sup> /d
<b>IRRIGATION FOR:</b>				<b>In mm/m<sup>2</sup>/a</b>	<b>In kℓ/ha/a</b>
Vegetables	-	-	8000	264 – 779	2640 – 7790
Pastures	-	-	kℓ/ha/a	650 - 980	6500 - 9800
Sports grounds	1,25 kℓ/ha/d	-	-	1399	13990
Developed parks	1,25kℓ/ha/d	-	-	1407	14070
Undeveloped parks	1,25 kℓ/ha/d	-	-	200	2000
Fruit Trees	-	-	2000 kℓ/ha/a	1329 – 1690 mm/m <sup>2</sup> /a	13290 - 16900 kℓ/ha/a
<b>ANIMAL AND FLOCK HOUSING CLEANING</b>					
Horses stables	-	-	-	-	25 ℓ/horse/d
Pigs	-	-	-	-	100 ℓ/pig/d
Dog kennels	-	-	-	-	90 ℓ/dog/d
Poultry	-	-	-	-	5ℓ/bird/month
<b>ABATTOIRS:</b>					
Cattle	-	-	-	1,31 – 4,19kℓ/u	3500 ℓ/cattle
Pigs	-	-	-	0,52 – 1,68kℓ/u	1400 ℓ/pig
Sheep	-	-	-	0,22 – 0,70kℓ/u	600 ℓ/sheep
Poultry	-	-	-	15 – 30ℓ/u	25 ℓ/bird
Dairy Industry	-	-	-	1,4 - 9,5 kℓ per kℓ milk	7 ℓ/ℓ milk
Egg Production	12 ℓ/b/d	-	-	-	15 ℓ/bird/d
Meat Cattle drinking	50ℓ/cattle/d	-	-	-	50 ℓ/cattle/d
Dairy Cattle drinking	120ℓ/cattle/d	-	-	-	120 ℓ/cattle/d
Horse drinking	50ℓ/horse/d	-	-	-	50 ℓ/horse/d
Pig drinking	-	-	-	31 ℓ/pig/d	31 ℓ/pig/d
Dog drinking	-	-	-	-	20 ℓ/dog/d
Sheep drinking	12ℓ/sheep/d	-	-	-	12 ℓ/sheep/d
Broiler drinking	-	-	-	-	0,35 ℓ/broiler/d
Sewage pre-treatment wash water	-	-	-	-	50% animal of and flock housing & abattoirs & dairy water (10kℓ/d min)

#### GENERAL NOTES:

- Actual irrigation requirements shall be calculated for the specific region based on climatic, rainfall and soil conditions.
- In general 10m<sup>2</sup> of floor space is equivalent to 1 person
- Legend :

p = person  
u = unit  
d = day  
ha = hectare

pr = prisoner  
a = annum = year  
kℓ = kilolitre  
ℓ = litre

## C.2

**GENERAL WATER DESIGN STANDARDS**

<b>DESCRIPTION</b>	<b>RED BOOK</b>	<b>SABS 0252</b>	<b>DPW</b>	<b>DESIGN VALUE</b>
Reservoir capacity (Average Daily Demand): - Gravity feeder main - Pumping feeder main <b>PLUS FIRE STORAGE</b>	48 hours 48 hours	- -	24 hours 48 hours	24 hours 48 hours
Elevated storage capacity (Peak demand)	4 hours	-	Balancing capacity only	Balancing capacity only. Allow for look-out point under elevated storage
Maximum flow velocity: - Pipe diameter < 200Ø - Pipe diameter > 200Ø - Pumping mains - Fire mains	- - - -	- - - -	- - - -	1m/s 1,5–2m/s 2,5m/s 3m/s
Recommended maximum friction losses in gravity pipes	-	-	-	1m/100m
Friction coefficient in Design Formulae: Hazen Williams Colebrook White Manning	- - -	- - -	- - -	115 0,25mm 0,01 – 0,012
Minimum pipe cover: - Trafficable areas - Non-Trafficable areas	- -	- -	- -	1,0m 0,75m
Minimum water pressure - without fire - with fire	- -	- -	- -	24m 15m
Minimum water pressures for irrigation - sprinklers - micro - drip	- - -	- - -	- - -	30m 20m 15m
Maximum water pressure	-	-	-	90m

**General notes:**

- The above values serve as design guidelines and the design engineer must ensure that the actual design is site specific. Changes to the above must be motivated to the Department of Public Works.
- Provide a diesel generator to drive water and fire water pumps in case of a power failure.
- Make sure to follow the directions and specifications of the Department of Public Works when services are installed in dolomitic areas.
- If fire alarm goes off diesel driven pumps shall automatically start to boost pressure until fire engines (if any), take over.

### C.3 TYPICAL WATER DEMAND FOR VARIOUS WATER FITTINGS

DESCRIPTION	REFERENCES					DESIGN VALUE
	RED BOOK	SABS 0252	DPW	BS 572	OTHER	
HWB TAP 15mm	16-23 l/min	5-25 l/min	9 l/min	36 l/min	14-18 l/m	20 l/min (0.33 l/sec)
Bath	22-31* l/min	20-40 l/min	23 l/min	66 l/min	27-68 l/m	30 l/min (0.50 l/sec)
Shower	-	8-30 l/min	18 l/min	6 l/min	23-26 l/min	18 l/min (0.30 l/sec)
Water closet: : tank : flush	16-23* l/min	3-7 l/min 65-110l/min	23 l/min 30 l/20s	- 138 l/min	23-36 l/min 136 l/min	16 l/min (0.27l/sec) 90 l/min (1,50 l/sec)
Urinal : tank : flush	16-23* l/min	- 10-60 l/min	5 l/min 15 l/20s	9 l/min -	27l/min 68-114 l/min	16 l/min (0.27 l/sec) 63l/min (1,05 l/sec)
Bidet	-	5 -12 l/min	-	-	-	12 l/min (0.2 l/sec)
Washing machine & laundry	22-31* l/min	6-35 l/min	16-18 l/min	42 l/min	23-68 l/min	42 l/min (0.70 l/sec)
Dishwashing machine	22-31* l/min	-	-	-	-	26 l/min (0.43 l/sec)
Irrigation stand pipes & garden hose	22-31l/min	10-35l/min	-	-	23 l/min	25 l/min (0.42 l/sec)

#### General Notes:

- 1) As a limited number of showers and hand-wash basins are provided in the prisons, these facilities are used for a prolonged time in the morning and afternoon. The above figures can be utilised to check the calculation of peak flows from fixture units values (see tables in Appendix X and Y)
- 2) \* These figures are extrapolated from the two figure supplied in the Red Book.

#### C.4 FIRE WATER DEMAND: CATEGORY MODERATE-RISK

DESCRIPTION	REFERENCES				
	RED BOOK	SABS 0252	DPW	OTHER	DESIGN VALUE
Design fire flow for trunk mains	6 000 ℓ/min	-	-	-	6 000 ℓ/min
No. of Hydrants discharging	All within 270m radius	-	-	-	All within 270m radius
Design fire flow for reticulation mains	1 500 ℓ/min	-	-	-	1 500 ℓ/min @ 15m water pressure
Minimum hydrant flow rate	1 500 ℓ/min @ 15m water pressure	1 200 ℓ/min	-	480 ℓ/min	1 500 ℓ/min @ 15m water pressure
Minimum dia of main for fire hydrants	75mm	75mm	-	-	75mm
Hydrant spacing	180m max.	-	-	-	180m max.
Fire hose reels	-	30 ℓ/min	-	120 ℓ/min	30 ℓ/min
Duration of design fire flow	4 Hours	-	-	-	4 hours
Required reservoir storage capacity for Fire only	1 440 kℓ	9 kℓ to 1day average	-	-	1 440 kℓ
Standby power	-	-	-	-	Diesel generator for water and fire water pumps

#### General Notes:

1. The final design must adhere to the requirements of the Local Authority, except where the standards of DPW exceed those required by the Local Authority.
2. Hydrants shall be provided at all strategic positions.
3. Provision shall be made for a booster pump connection from the Local Authority.
4. Fire hose reels shall be 30m long with an effective length of 25m.



## C.5 MATERIAL STANDARDS – WATER RETICULATION

<b>DESCRIPTION</b>	<b>RED BOOK</b>	<b>SABS 0252</b>	<b>DPW</b>	<b>DESIGN VALUE</b>
Low level reservoir	-	-	-	Reinforced concrete
Elevated Reservoir	-	-	-	Reinforced concrete or Sectional steel
Underground pipes: - Diameter ≤75mm - Diameter > 75mm - Dolomite areas	- - -	- - -	- - -	HDPE Class 10 UPVC Class 9 Welded HDPE class 10
Exposed pipes (not for internal building reticulation)	-	-	-	Heavy duty hot dipped galvanized mild steel pipe
Valves:	-	-	-	Refer to general standards of the DPW
Bends for: - HDPE pipe  - uPVC pipe  - Steel pipe (above ground)	- - -	- - -	- - -	Welded HDPE class 10  UPVC class 9 with rubber ring push-in fitting  Heavy duty hot dipped galvanized steel with screwed-and-socketted or welded connections
Tees	-	-	-	Cast iron or ductile iron with flange adaptors
End caps	-	-	-	Cast iron or ductile iron with flange adaptors
Connections and couplings - Ordinary areas  - Dolomitic areas	- - -	- - -	- - -	As above to fit type of pipe  Welded-on and other fittings as specified in NOTE 1
Concrete in anchor blocks	-	-	-	Class 15MPa/19mm

### General Notes:

1. All work to be done in dolomite areas must conform to the standards as set out in the Guidelines for Dolomite, Department of Public Works.
2. Pressure pipes and fittings shall have a working pressure of 9 bar minimum.
3. Valves and specialized fittings shall be purchased from a reknown supplier.
4. Pipe classes shall also conform to the design requirements dictated by the supplier's water pressure and the specific site.

## D. SEWERAGE DESIGN STANDARDS

### D.1 AVERAGE DAILY SEWAGE DESIGN FIGURES

DESCRIPTION	METHOD	DESIGN VALUE
Prisoners	90 % of 200 ℓ/p/d	180 ℓ/p/d
Residential Housing	SABS 0250 : 3 bedrooms	900 ℓ/house/d
Single Quarters	90 % of 400 ℓ/u/d	360 ℓ/u/d
Administration	95 % of 70 ℓ/p/d	66,5 ℓ/p/d
Kitchen	90 % of 90 ℓ/pr/d	81 ℓ/pr/d
Clinic	90 % of 250 ℓ/bed/d	225 ℓ/bed/d
Laundry	95 % of 15 ℓ/pr/d	14,3 ℓ/pr/d
Prisoner admissions and holding cells	95 % of 100 ℓ/p/d	95 ℓ/p/d (admitted)
Educational	95 % of 45 ℓ/p/d	42,8 ℓ/student/d
Visiting	95 % of 20 ℓ/p/d/	19 ℓ/visitor/d
Maintenance	90 % of 1,5 % of water intake/d	1,35% of total water intake/d
Canteen	95 % of 60 ℓ/10m <sup>2</sup>	57 ℓ/10m <sup>2</sup>
Logistics incl meat processing	0,85 x 5 ℓ/pr/d	4,3 ℓ/pr/d
Vocational	70 % x 100 ℓ/p/d	70 ℓ/trainee/d
Industrial manufacturing	70 % of 400 ℓ/100m <sup>2</sup> /d	280 ℓ/100m <sup>2</sup> /d
Commercial incl petrol station	85 % of 10 ℓ/10m <sup>2</sup> /d	8,5 ℓ/10m <sup>2</sup> /d
Abattoirs		
- Cattle	85 % of 3,5 kℓ/cattle	3,0 kℓ/cattle
- Pigs	85 % of 1,4 kℓ/pig	1,2 kℓ/pig
- Sheep	85 % of 0,6kℓ/sheep	0,5 kℓ/sheep
- Poultry	85 % of 25 ℓ/bird	21,3 ℓ/bird
Dairy industry	85 % of milk produced	0,85 kℓ/kℓ milk
Egg Production	90 % of 15 ℓ/bird/d	13,5 ℓ/bird/d
Chapel	95 % of 20 ℓ/p/d attending	19 ℓ/p/d
Animal Housing		
- Horse stables	Cleaning stables once/month	20 ℓ/horse/d
- Pigs	95 % of 100ℓ/pig/d	95 ℓ/pig/d
- Dog kennels	Roodeplaat dog school data	85 ℓ/dog/d
- Poultry	95 % of 5ℓ/bird/d	4,8 ℓ/bird/d
Pre-treatment wash water	45% of animal and flock housing cleaning & abattoir and dairy water use (9,5 kℓ/d min)	9,5kℓ/d (min)

## D.2 GENERAL DESIGN STANDARDS – SEWER RETICULATION

DESCRIPTION	<i>RED BOOK</i>	<i>SABS 0252</i>	<i>DPW</i>	<i>DESIGN AVERAGE</i>
Maximum distance between manholes (no curves between manholes allowed)	-	-	-	80m
Peak factor	-	-	-	Refer note (1)
Recommended minimum flow velocity:	-	-	-	0.7 m/s
Recommended minimum pipe gradients				
- For first 8 connections	-	-	-	1:80
- 150 dia Pipes	-	-	-	1:150
- 200 dia Pipes	-	-	-	1:200
- 250 dia Pipes	-	-	-	1:250
Friction loss coefficient in Design Formulae:				
Manning	-	-	-	n = 0,012
Colebrook White	-	-	-	K <sub>s</sub> = 0,6mm
Minimum pipe cover:				
- Trafficable areas	-	-	-	1,0m
- Non-Trafficable areas	-	-	-	0,6m
Minimum pipe size	-	-	-	150mm
Flow depth at peak	-	-	-	67%
Infiltration rate				
- 150 dia Pipes	-	-	-	0,012 ℓ/s/100m length
- 200 dia Pipes	-	-	-	0,016 ℓ/s/100m length
- 250 dia Pipes	-	-	-	0,020 ℓ/s/100m length
				OR 15% of design flow, whichever is the greater.

### NOTE:

1. Minimum pipe diameter applies only on site outside buildings. (Pipe diameters inside building shall be 100mm dia).
2. Manhole depths shall be as shallow as possible within the specification.

### D.3 MATERIAL STANDARDS – SEWER RETICULATION

DESCRIPTION	RED BOOK	SABS 0252	DPW	DESIGN STANDARD
Underground pipes - Ordinary areas	-	-	-	uPVC Heavy duty class 34, to SABS 791
- Dolomitic areas	-	-	-	HDPE Class 6
Manholes	-	-	-	1m dia Precast concrete with dolomitic aggregate and security lockable manhole covers in ordinary areas.
	-	-	-	HDPE manholes in dolomite areas with security lockable manhole covers.
Connections and Couplings - Ordinary areas	-	-	-	Rubber ring and socket
- Dolomitic areas	-	-	-	All welded construction

NOTES:

#### **Sewer Pumps**

1. All pump installations shall be supplied with a standby pump of capacity equal to that of the largest duty pump.
2. Standby pumps shall be automatically activated when necessary.
3. Duty and standby pumps shall alternate on a daily basis.
4. All pumps to have non-clogging type impellers.
5. Dry sump pump stations shall be provided. Submersible pumps shall be allowed only in special circumstances and with prior approval of the Department of Public works.
6. Special applications for screw pump stations will be considered.
7. Pump capacity shall be adequate to handle peak flow plus 20%.
8. Operating speed of pumps shall be in the range of 900 to 1450 rpm, unless a life cycle cost analysis proves that pumps with a higher operating speed is more beneficial.

#### **Pump stations**

1. All sumps are to be adequately ventilated.
2. Stainless steel handrails shall be provided to all platforms and stairs.
3. The size of the sump shall be such that the pumps will not activate more than 8 times per hour.
4. Emergency capacity of 4 hours average flow or 1½ hour average flow plus standby diesel electrical generator set must be provided.
5. All pump stations and electrical equipment shall be protected against storm water infiltration and floods.

6. The inlet to the pump station shall be equipped with two stone catching pits, which can be alternatively used while the other one is been cleaned out.
7. The inlet to the pump station shall further be protected with a course vertical screen to safeguard the macerator and pump installation against large floating materials.
8. All pump stations shall be fitted with macerators (munchers) to protect and reduce clogging of the pumps (one for each pump).

## E. STORM WATER RETICULATION

### E.1 GENERAL DESIGN STANDARDS

<b>DESCRIPTION</b>	<b>RED BOOK</b>	<b>SABS 0252</b>	<b>DPW</b>	<b>DESIGN</b>
Maximum distance between manholes	-	-	-	At all bends
Design recurrence interval: - Ponding - General site storm water design - Design for flooding of buildings	- - -	- - -	- - -	1:2 Years 1:5 Years 1:100 Years
Recommended pipe size: - Within security areas - Outside security areas	- -	- -	- -	200mm dia Maximum 450mm dia Minimum
Friction loss coefficient in Design Formulae: Manning  Colebrook White	-  -	-  -	-  -	N = 0,012 for HDPE N = 0,013 for concrete  K <sub>s</sub> = 0,6mm for HDPE K <sub>s</sub> = 1,5mm for concrete
Minimum pipe cover: - Trafficable areas - Non-Trafficable areas	- -	- -	- -	1,0m 0,6m
General manhole depth	-	-	-	As shallow as possible within the specifications.
Manhole gratings	-	-	-	To be solidly locked with bar and padlock

**E.2 MATERIAL STANDARDS – STORM WATER RETICULATION**

<b>DESCRIPTION</b>	<b>DESIGN STANDARD</b>
Pipes - Ordinary areas - Dolomitic areas	<ul style="list-style-type: none"> <li>- Concrete pipe with rubber joints</li> <li>- HDPE Class 6 with welded joints</li> </ul>
Manholes - Ordinary areas  - Dolomitic areas	<ul style="list-style-type: none"> <li>- Precast concrete rings with dolomitic aggregate and security lockable s/w grids. Or Plastered brick manholes with security lockable s/w gratings.</li> <li>- Pre-fabricated HDPE manholes with security lockable s/w grids.</li> </ul>
Storm water grids	Heavy duty hot dipped galvanized steel or bitumen dipped cast iron

## APPENDIX X

### TABLE OF FIXTURE UNITS

FIXTURE DESCRIPTION	FIXTURE UNITS FOR	
	WATER SUPPLY	SEWAGE DISCHARGE
WC	10,0	10,0
HWB	2,0	2,0
Shower	4,0	3,0
Urinal	10,0	10,0
Laundry	4,0	3,0
Sink	4,0	3,0
Sink (kitchen)	4,5	4,0
Wash trough	4,0	3,0
Dentist HWB	2,0	1,0
Bath	4,0	4,0
Bidet	4,0	3,0
Drinking fountain	1,5	1,0
Dishwasher	2,0	2,0
Floor wash outlet	1,0	1,0

Reference:

1. National Plumbing Code (American and Canadian Plumbing Code)
2. Gebouedienste : BKS



## APPENDIX Y

**TABLE OF TOTAL SIMULTANEOUS FLOW VERSUS TOTAL FIXTURE UNITS**

<b>TOTAL NO. OF FIXTURE UNITS</b>	<b>PEAK DEMAND (Incorporating statistical simultaneous use factor)</b>
20	2,2 l/s
40	3,0 l/s
60	3,4 l/s
80	3,8 l/s
100	4,3 l/s
150	5,0 l/s
200	5,7 l/s
250	6,2 l/s
300	6,7 l/s
350	7,2 l/s
400	7,7 l/s
450	8,3 l/s
500	8,9 l/s
600	9,8 l/s
700	10,6 l/s
800	11,3 l/s
900	12,1 l/s
1000	12,8 l/s
1200	14,4 l/s
1400	16,0 l/s
1600	17,5 l/s
1800	19,1 l/s
2000	20,6 l/s
2200	22,1 l/s
2400	23,6 l/s
2600	25,0 l/s
2800	26,5 l/s
3000	28,0 l/s
3500	31,3 l/s
4000	34,5 l/s
4500	37,8 l/s
5000	41,0 l/s

**NOTE :**

1. **Intermediate values shall be interpolated**
2. **The above table is based on WC's and URINALS with flush valves.**

References:

1. National Plumbing Code ASA A.40.8 of 1955
2. Fig 2.3, 2.4, 2.5, 3.1a, 3.1b and 3.1c of BKS "Ontwerp van Gebouwdienste"

**F. TYPICAL EXAMPLE OF THE WATER DEMAND AND SEWAGE FLOW CALCULATIONS FOR A 3000 PRISONER NEW GENERATION PRISON NEAR ROODEPLAAT IN THE PRETORIA AREA (EXCLUDING FIRE REQUIREMENTS)**

**NOTE:** This example is only provided to illustrate the application of the Guidelines.

The Consultant shall take full responsibility for his own calculations for any specific site.

**F.1 POPULATION, BUILDING OCCUPANCY AND USAGES REQUIRED:**

The following data will be supplied by the Department. (If all is not available, guidelines are provided for the purpose of a preliminary design):

ITEM NO	DESCRIPTION	NUMBER/UNITS/AREA	NUMBER/UNITS/AREA CALCULATION GUIDELINES
1	Prisoners	3000 pr	-
2	Prison type	Prison farm	-
3	Admin personnel	580p	-
4	Residential housing	2 x 2000 m <sup>2</sup> erf 230 x 650 m <sup>2</sup> erf	-
5	Single quarters	348 single qrts	-
6	Clinic beds	60 beds	2% of prisoners, 2 beds min
7	Chapel	2 x 250 p/week	250 p building
8	Prison admissions	30 pr/week	1% of prisoners
9	Visitors	240 p/week	80% of 10% of prisoners
10	Educational	600 pr/d	20% of prisoners
11	Vocational	600 pr/d	20% of prisoners
12	Kitchen and dining	meals for 3000 pr/d	Prisoners
13	Laundry	3000 pr/d	-
14	Canteen	580 pr/d	Admin staff
15	Car wash	45 equiv cars/d	1,5% of prisoners, 9 min
16	Maintenance	1,5% of water intake/d	Min 1 kl/d
17	Logistics	2400m <sup>2</sup>	0,8m <sup>2</sup> /p, 200m <sup>2</sup> min
18	Industrial manufacturing	1472m <sup>2</sup>	-
19	Irrigation (excl agricultural)	-	-
19.1	Sports grounds	0,8 ha	Irrespective of prison size
19.2	Developed parks	2 ha	0,67 ha/1000 pr with 0,1 ha min
19.3	Undeveloped parks	0,5 ha	0,15 ha/1000 pr with 0,1 ha min
19.4	Commercial	100m <sup>2</sup>	Irrespective of prison size

## F.2 FOOD PRODUCTION: GENERAL

The following shall be investigated by the Consultant, recommendations supplied to the Department where-after the Department will make the necessary decisions.

ITEM NO.	DESCRIPTION	REQUIREMENTS APPROVED	COMMENTS
1(a)	Meat production approved.	Cattle + Pigs + Sheep + Poultry	
1(b)	Percentage of each to be supplied.	Cattle 30% Pigs 10% Sheep 10% Poultry 50%	
2	Abattoirs required	Class E cattle and poultry abattoir	
3(a)	Vegetable production.	Green beans (or peas) Yellow carrots (or pumpkin) White potatoes (or onions)	
3(b)	Percentage of each to be supplied.	Beans 33% Carrots 33% Potatoes 33%	
4.	Dairy industry	Required	
5.	Egg production	Required	
6.	Red meat abattoir	Required	
7.	Poultry abattoir	Required	
8.	Patrol horses	5 required	
9.	Dogs	Required	
10.	Fruit production	Peaches & citrus & apples	
11.	Effluent treatment	Only pre-treatment required	

### F.3 CALCULATED FOOD PRODUCE REQUIREMENTS

Based on the data supplied in F1 and F2 the following shall be calculated by the Consultant.

ITEM NO.	DESCRIPTION	CALCULATED PRODUCE	CALCULATIONS DETAILS
1.	Meat production: Cattle Pigs Sheep Poultry	168kg /d 54kg /d 54kg /d 300kg /d	Based on unit meat consumption & no. of prisoners.
2.	Vegetable production: Beans & peas (green) Carrots & pumpkin (yellow) Potatoes & onions (white)	360kg /d 360kg /d 360kg /d	Based on unit vegetable consumption for prison.
3.	Dairy industry	870 l/d	Based on unit milk consumption.
4.	Egg production	3 000/day	Based on unit egg consumption.
5.	Average red meat slaughter rate: Cattle Pigs Sheep	0,84/d 1,74/d 2,57/d	Based on total red meat consumption and carcass weight.
6.	Average poultry slaughter rate	200/d	Based on total white meat consumption.
7.	Peaches Citrus Apples	510 kg/d 975 kg/d 750 kg/d	Based on total fruit consumption. Fruit cultivated and available for 9 months/y.

#### **F.4 CALCULATED ANIMAL HERD, POULTRY FLOCK AND ORCHARD SIZES**

The Consultant shall calculate the animal herd and poultry flock sizes to provide the necessary meat on a sustainable basis taking all agricultural facts into consideration as well as the orchard sizes.

<b>ITEM</b>	<b>DESCRIPTION</b>	<b>CALCULATED NUMBER</b>	<b>CALCULATION DETAILS</b>
1.	Meat cattle	463	Based on 307/a slaughtered
2.	Dairy cattle	144	Based on milk requirement
3.	Patrol horses	5	-
4.	Pig herd	43	Based on 636/a slaughter
5.	Dogs	20	Based on one dog/100m perimeter fence +10%
6.	Sheep herd	1 250	Based on 939/a slaughter
7.	Broilers	12 000	Based on 73 050/a slaughter
8.	Poultry layers	3 000	Based on 1 egg/layer/d
9.	Peach orchards	2,6 ha	Based on 30 t/ha Fruit produced
10.	Citrus orchards	3,0 ha	Based on 30 t/ha Fruit produced
11.	Apple orchards	0,8 ha	Based on 30 t/ha Fruit produced

## **F.5 CALCULATED IRRIGATION AREAS REQUIRED**

The Consultant shall calculate the irrigation areas to produce the necessary food requirements for the prison complex utilising the previous data as well as the climatic, rainfall, temperature and soil conditions of the actual site.

<b>ITEM</b>	<b>DESCRIPTION</b>	<b>CALCULATED IRRIGATION AREAS</b>	<b>CALCULATIONS DETAIL</b>
1.	Meat and dairy cattle.	132 ha	3,5 cattle / ha.
2.	Patrol horses	1,4 ha	3,5 horses/ha
3.	Sheep herd.	139 ha	9 sheep / ha.
4.	Fruit orchards	6,4 ha	Calculated area
5.	Vegetable lands : Beans and peas Carrots and pumpkin Potatoes and onions	0,084 ha 0,204 ha 0,800 ha	Calculated area Calculated area Calculated area

**F.6 ANNUAL AVERAGE DAILY WATER DEMAND:**

ITEM NO.	DESCRIPTION	NO OF UNITS	UNIT CONSUMPTION (SECTION C1)	ANNUAL AVERAGE DAILY DEMAND ( kℓ/d)
1.	Prisoners	3 000 pr	200ℓ/pr/d	600
3.	Admin Personnel	580p	70ℓ/p/d	41
4.	Residential Housing	2x2000m <sup>2</sup> erf 230x650m <sup>2</sup> erf	2 700ℓ/erf/d 950ℓ/erf/d	5 219
5	Single Quarters	348u	400ℓ/u/d	139
6.	Clinic	60 beds	250ℓ/bed/d	15
7.	Chapel	500p	20ℓ/p/d	10
8.	Prisoner Admissions	30pr/w	100ℓ/pr/d	3
9.	Visitors	240p	20ℓ/p/d	5
10.	Educational	600pr	45ℓ/pr/d	27
11.	Vocational	600pr	100ℓ/pr/d	60
12.	Kitchen & Dining	3 000pr	90ℓ/pr/d	270
13.	Laundry	3 000pr	15ℓ/pr/d	45
14.	Canteen	580p - 100m <sup>2</sup>	60ℓ/10m <sup>2</sup> /d	1
15.	State vehicle wash	45 equiv.cars	200ℓ/car/d	9
16.	Maintenance incl. Washing pre-treatment works, slabs, etc	1,5% total water intake/d excl farming	1,5% total of water intake/d excl farming	24
17.	Logistics	3 000pr	5ℓ/pr/d	15
18.	Industrial Manufacturing	1 472m <sup>2</sup>	400ℓ/100m <sup>2</sup> /d	6
19.	Commercial (shops including petrol stations)	100m <sup>2</sup>	10ℓ/10m <sup>2</sup> /d	-
20.	Irrigation:			
20.1	Vegetables:			
	Beans or peas	0,084ha	482mm/a	1
	Carrots or pumpkin	0,204ha	346mm/a	2
	Potatoes or onions	0,800ha	554mm/a	12
20.2	Pastures	272,4ha	900mm/a	6 712
20.3	Fruit Orchards	6,4ha	1 650mm/a	289
20.4	Sports Grounds	0,8ha	1 399mm/a	31
20.5	Developed Parks	2ha	1 407mm/a	77
20.6	Undeveloped Parks	0,5ha	200mm/a	3
21.	Abattoirs:			
21.1	Red Meat			
21.1.1	Cattle	307/year	3,5kℓ/u	3
21.1.2	Pigs	636/year	1,4kℓ/u	2
21.1.3	Sheep	939/year	0,6kℓ/u	2
21.2	Poultry	200birds/day	25ℓ/bird	5
22.	Drinking			
22.1	Meat cattle	463 cattle	50ℓ/cattle/day	23
22.2	Dairy cattle	144 cattle	120 ℓ/cattle/day	17
22.3	Patrol horses	5 horses	50 ℓ/horse/day	-
22.4	Pigs	43 pigs	31ℓ/pig/day	1
22.5	Dogs	20 dogs	20 ℓ/dog/day	1
22.6	Sheep	1 250 sheep	12ℓ/sheep/day	15
22.7	Poultry	15 000 birds	0,35ℓ/bird/day	5
23.	Animal and Poultry Housing and cleaning			
23.1	Horse stables	5 horses	25 ℓ/horse/d	-
23.2	Pigs	43 pigs	100 ℓ/pig/d	4
23.3	Dog kennels	20 dogs	90 ℓ/dog/d	2

23.4	Broilers	12 000 birds	5l/bird/month	2
24.	Poultry Layers	3 000 hens	5l/hen/month	1
25.	Dairy industry	870l/d milk	7l/ l milk	6
26.	Sewage pre-treatment wash water	Water use 27kℓ/d	50% of 27kℓ/d	14
Total average annual water intake of prison farm				8 724 kℓ/d
Average annual water intake based on number of prisoners				2 908 ℓ/pr/d
Total average annual water intake excluding farming & effluent pre-treatment				1 608 kℓ/d
Average annual water intake based on number of prisoners				536 ℓ/pr/d
Average intake excluding site irrigation, housing, farming and effluent pre-treatment				1 134 kℓ/d
Average annual water intake based on number of prisoners				378 ℓ/pr/d

**NOTE:** Water demands exclude water required for fire fighting



**F.7 ANNUAL AVERAGE SEWAGE FLOW:**

ITEM NO.	DESCRIPTION	NO OF UNITS	UNIT FLOW (SECTION D1)	ANNUAL AVERAGE FLOW (kℓ/d)
1.	Prisoners	3 000pr	180ℓ	540
3.	Admin Personnel	580p	66ℓ/p/d	38
4.	Residential housing	232h	900ℓ/p/d	209
5.	Single quarters	348u	360ℓ/u/d	125
6.	Clinic	60beds	225ℓ/b/d	14
7.	Chapel	500p	19ℓ/p/d	10
8.	Prisoner Admissions	30pr/w	95ℓ/pr/d	3
9.	Visitor	240 visitors	19ℓ/visitor/d	5
10.	Educational	600 students	43ℓ/student/d	26
11.	Vocational	600 trainees	70ℓ/trainee/d	42
12.	Kitchen and dining	3 000pr	81ℓ/pr/d	243
13.	Laundry	3 000pr	14ℓ/pr/d	42
14.	Canteen	100m <sup>2</sup>	57ℓ/10m <sup>2</sup> /d	1
17.	Logistics	3 000pr	4ℓ/pr/d	12
18.	Industrial Manufacturing	1 472m <sup>2</sup>	280ℓ/100m <sup>2</sup> /d	4
19.	Commercial (shops incl. petrol stations)	100m <sup>2</sup>	8,5/10m <sup>2</sup> /d	-
20.	Maintenance cleaning at sewage pre-treatment works and drains	1,2 % of total water intake/d excl farming	80% of maintenance water usage	19
21.	Abattoirs:			
21.1	Red Meat			
21.1.1	Cattle	307/u/y	3,0kℓ/cattle	3
21.1.2	Pigs	636/u/y	1,2kℓ/pig	2
21.1.3.	Sheep	939/u/y	0,5kℓ/sheep	1
21.2	Poultry	200 birds/d	21ℓ/bird	4
23.	Animal and poultry housing and cleaning			
23.1	Horse stables	5 horses	20 ℓ/horse/d	-
23.2	Pigs	43 pigs	95 ℓ/pig/d	4
23.3	Dog kennels	20 dogs	85 ℓ/dog/d	2
23.4	Broilers	12 000 birds	4,5 ℓ/bird/month	2
24.	Poultry layers	3 000 hens	4,5 ℓ/hen/month	1
25.	Dairy industry complete	870 ℓmilk/d	6 ℓ/ℓ milk	5
26.	Pre-treatment wash water	Water use 27 kℓ/d	45% of 27 kℓ/d	12
Total average annual sewage flow.				1 369kℓ/d
Average annual sewage flow based on number of prisoners.				456ℓ/pr/d
Total average annual sewage flow including housing but excluding farming and pre-treatment works				1 335kℓ/d
Average annual sewage flow based on number of prisoners.				445kℓ/d
Total average annual sewage flow for prison complex excluding farming operations, housing and pre-treatment works.				1 001kℓ/d
Average annual sewage flow based on number of prisoners.				334ℓ/pr/d

## F.8 PEAK WATER DEMAND:

(Based on a 3 000 prisoner prison farm with three clusters of 1 000 prisoners each.)

ITEM	DESCRIPTION OF WATER FITTINGS	NO OF FITTINGS	FIXTURE UNIT DESIGN (APPENDIX X)		ANNUAL AVE DEMAND (l/s)	PEAK FACTOR	PEAK DEMAND (l/s)
			FITTING FIXTURE UNITS	TOTAL UNITS			
1.	<b>For prisoner clusters</b> For each prisoner cluster of 1 000 prisoners:						
	WC	28	10	280	-	-	-
	HWB	28	*	*	-	-	-
	Shower	16	*	*	-	-	-
	Urinal	0	10	0	-	-	-
	Laundry	8	4	32	-	-	-
	Sinks	6	4	24	-	-	-
	Wash trough	8	4	32	-	-	-
	Total	94	-	368	-	-	-
	Peak flow for each cluster (Appendix Y)	-	-	-	-	-	7,38
	<i>*Showers and HWB are used for prolonged periods and they will therefore not be subject to a peak reduction (See Section C3)</i>						
	Hand wash basin: 28x 0,33 l/s	-	-	-	-	-	9,24
	Shower flow : 16x 0.3l/s	-	-	-	-	-	4,80
	Total peak flow requirement for each cluster	-	-	-	-	-	21,42
	Total peak flow requirement for 3 prisoner clusters	-	-	-	-	-	64,26
	Average flow demand for 3 prisoner clusters alone =3000 x 200l/pr/d	-	-	-	6,94	-	-
	Peak factor for prisoner clusters	-	-	-	-	9,25	-

ITEM	DESCRIPTION OF WATER FITTINGS	NO OF FITTINGS	FIXTURE UNIT DESIGN (APPENDIX X)		ANNUAL AVE DEMAND (ℓ/s)	PEAK FACTOR	PEAK DEMAND (ℓ/s)
			FITTING FIXTURE UNITS	TOTAL UNITS			
2.	<b>For total administration:</b>						
	WC	55	10	550			
	Bath	4	4	16			
	HWB	103	2	206			
	Shower	7	4	28			
	Urinal	5	10	50			
	Laundry	9	4	36			
	Sink	25	4	100			
	Trolley						
	Wash	1	4	4			
	Wash trough	1	4	4			
	Dentist HWB	1	2	2			
	Total	211		996			
	Peak Flow (Appendix Y)						12,77
	Average water demand of administration excluding the prison, industrial water and site irrigation 1242 – 3000 x 0.2 – 114 - 75 = 417 kℓ/d				4,83		
	Thus peak factor for administration complex					2,64	

ITEM	DESCRIPTION	ANNUAL AVERAGE DEMAND (kℓ/d)	ANNUAL WATER DEMAND (ℓ/s)	PEAK FACTOR	PEAK DEMAND (ℓ/s)		
3.	<b>For houses and single quarters:</b> 2 x 2 000m <sup>2</sup> erf 230 x 650m <sup>2</sup> erf 348 single quarters	5 219 139	4,20	-	-		
	Total annual average demand	363					
	No of equivalent erven = 363	-				5,1	-
	Peak factor housing (Red Book fig 9.9)	-				-	21,43
Peak Flow	-	-	-	-			
4.	<b>For industrial general:</b>						
	- Vocational	60	-	-	-		
	- Vehicle wash	9	-	-	-		
	- Maintenance	24	-	-	-		
	- Logistics	15	-	-	-		
	- Industrial	6	-	-	-		
- Manufacturing	-	-	-	-	-		
- Commercial	-	-	-	-	-		
Total annual average demand	114	1,32			-		
Peak Factor	-	-	4,5	-	-		
Peak Flow	-	-	-	-	5,99		
5.	<b>For site irrigation:</b>						
	- Sports grounds	31	-	-	-		
	- Developed parks	77	-	-	-		
	- Undeveloped parks	3	-	-	-		
	Total annual average demand	111	1,28	-	-		
Peak Factor (for irrigation over 6 h/d for 200d/y)	-	-	7,3	-			
Peak Flow	-	-	-	-	9,34		
6.	<b>For Abattoirs:</b>						
	- Cattle abattoir	3	-	-	-		
	- Pigs abattoir	2	-	-	-		
	- Sheep abattoir	2	-	-	-		
	- Poultry abattoir	5	-	-	-		
Total annual average demand	12	0,14	-	-			
Peak Factor (for slaughtering 222/d/y over 6h/d period)	-	-	6,6	-			
Peak Flow	-	-	-	-	0,92		

ITEM	DESCRIPTION	ANNUAL	ANNUAL	PEAK	PEAK
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		<b>AVERAGE (kℓ/d)</b>	<b>AVERAGE DEMAND (ℓ/s)</b>	<b>FACTOR</b>	<b>WATER DEMAND (ℓ/s)</b>
7.	<b>For dairy industry &amp; animal housing cleaning</b>				
	Horse stables	-	-	-	-
	Pigs	4	-	-	-
	Dog kennels	2	-	-	-
	Broilers	2	-	-	-
	Poultry layers	1	-	-	-
	Dairy industry	6	-	-	-
	Total annual average demand	15	0,17	-	-
	Peak Factor (for cleaning average 300d/y over 2h/d)	-	-	14,6	-
	Peak Flow	-	-	-	2,48
8.	<b>For animal and poultry drinking:</b>				
	Meat cattle	23	-	-	-
	Dairy Cattle	17	-	-	-
	Patrol horses	-	-	-	-
	Pigs	1	-	-	-
	Dogs	1	-	-	-
	Sheep	15	-	-	-
	Poultry	5	-	-	-
	Total annual average demand	62	0,72	-	-
	Peak Factor (drinking over cumulative period of 2h/d)	-	-	12,0	-
	Peak Flow	-	-	-	8,64
9.	<b>For Sewage pre-treatment wash water</b>	14	0,16	9,4	1,5
	Peak factor				
	Peak flow (2 hoses)				
10.	<b>For irrigation farming:</b>				
	Beans or peas	1	-	-	-
	Carrots or pumpkin	2	-	-	-
	Potatoes or onions	12	-	-	-
	Pastures	6712	-	-	-
	Fruit Trees	289	-	-	-
	Total annual average demand	7016	81,20	-	-
	Say irrigate over 6h/day for 200d/y over 8h/d				
	Peak Factor	-	-	5,5	-
	Peak Flow	-	-	-	446,6
11.	<b>Total water peak demand for main building:</b>				
	Average flow prison clusters	-	6,94	-	-
	Average flow administration	-	4,83	-	-
	Average flow industrial areas in building	-	1,32	-	-
	Total average flow building	-	13,09	-	-
	Total no of fixtures in				

ITEM	DESCRIPTION	ANNUAL AVERAGE (kℓ/d)	ANNUAL AVERAGE DEMAND (ℓ/s)	PEAK FACTOR	PEAK WATER DEMAND (ℓ/s)
	building excl prisoner h/w basins and showers = 3x368 + 996 = 2100 Peak demand (Appendix Y) excl h/w basins and showers		-		21,35
	Peak demand h/w basins 3 x 9,24 ℓ/s		-		27,72
	Peak demand showers 3 x 4,80 ℓ/s		-		14,40
	Total peak demand main building	-	-	-	63,47
	Peak demand general industrial areas	-	-	-	5,99
	Total peak demand for prison complex	-	-	-	69,46
	Peak factor prison	-	-	5,31	-
12.	<b>Total peak demand for prison farm</b>				
12.1	Prison complex	-	13,09	4,83	69,46
12.2	Housing	-	4,20	5,1	21,43
12.3	Abattoirs	-	0,14	6,6	0,92
12.4	Dairy, animal and poultry housing	-	0,17	14,6	2,48
12.5	Animal and poultry drinking	-	0,72	12,0	8,64
12.6	Pre-treatment wash water	-	0,16	9,4	1,5
12.7	For site irrigation	-	1,28	7,3	9,34
12.8	For irrigation farming	-	81,20	7,3	446,60
	Total peak flow for prison farm	-	100,96	5,55	560,37
13.	<b>Peak water demand of prison excluding farming operations</b>				
	Annual average demand = 100,80 – 82,23	-	18,57	-	-
	Peak demand = 558,87 – 458,64	-	-	-	100,23
	Peak factor	-	-	5,40	-

<b>Total Peak Water Demands</b>	
Total peak water demand of prison farm	48 416 kℓ/d
Average peak demand per prisoner	16 139 ℓ/pr/d
Total peak demand excluding farming and pre-treatment	8 660 kℓ/d
Average peak demand per prisoner	2 889 ℓ/pr/d
Total peak demand excluding farming, housing, site irrigation and effluent pre-treatment	6 001 kℓ/d
Average peak demand per prisoner	2 000 ℓ/pr/d

**NOTE:** Peak demands exclude fire flows

## F 9. PEAK SEWAGE DISCHARGE

(Based on a 3000 prisoner prison with three clusters for 1000 prisoners each)

ITEM NO	DESCRIPTION OF SEWERAGE	NO OF UNITS	LOAD FACTOR		YEAR AVE DEMAND (l/s)	PEAK FACTOR	PEAK DEMAND (l/s)
			FIXTR UNITS	TOTAL UNITS			
1.	<b>For Prison Complex</b>						
	For each prisoner cluster of 1000 prisoners :						
	WC	28	10	280	-	-	-
	HWH	28	*	*	-	-	-
	Shower	16	*	*	-	-	-
	Urinal	0	10	0	-	-	-
	Laundry	8	2	16	-	-	-
	Sinks	6	3	18	-	-	-
	Wash Trough	8	3	24	-	-	-
	Total	94	-	338	-	-	-
	Peak discharge/ cluster (Appendix Y) <i>*Showers and HWB are used for prolonged periods and they will not be subject to a peak reduction.</i>	-	-	-	-	-	7,08
	<i>Showers 28x0,33l/s</i>	-	-	-	-	-	9,24
	<i>HWB 16x0,3l/s (See Section C3)</i>	-	-	-	-	-	4,80
	Total peak sewage discharge for cluster	-	-	-	-	-	21,12
	Total peak discharge for prisoner complex (= 3 clusters)	-	-	-	-	-	63,36
	Average sewage discharge for prisoners only (Section F7) 3000 x 180 l/pr/d	-	-	-	6,25	-	-
	Peak sewage factor for prisoner complex	-	-	-	-	10,14	-

ITEM NO	DESCRIPTION OF SEWERAGE	NO OF UNITS	LOAD FACTOR		YEAR AVE DEMAND (l/s)	PEAK FACTOR	PEAK DEMAND (l/s)
			FIXTR UNITS	TOTAL UNITS			
2.	<b>For total admin</b>						
	WC	55	10	550	-	-	-
	Bath	4	3	12	-	-	-
	HWB	103	2	206	-	-	-
	Shower	7	3	21	-	-	-
	Urinal	5	10	50	-	-	-
	Laundry	9	2	18	-	-	-
	Sink	25	3	75	-	-	-
	Trolley wash	1	3	3	-	-	-
	Wash trough	1	3	3	-	-	-
	Dentist HWB	1	1	1	-	-	-
	Floor wash outlet	1	1	1	-	-	-
	<b>Total</b>	<b>212</b>	<b>-</b>	<b>940</b>	<b>-</b>	<b>-</b>	<b>-</b>
	Peak discharge (Appendix Y)	-	-	-	-	-	12,37
	Average daily sewage discharge of administration excluding clusters and industrial water (See Section F7) =1001-540-42-12-4=403kl/d	-	-	-	4,66	-	-
	Peak factor administration	-	-	-	-	2,80	-



ITEM NO	DESCRIPTION OF SEWERAGE	AVE YEAR FLOW (kℓ/d)	AVE YEAR FLOW (ℓ/s)	PEAK FACTOR	PEAK FLOW (ℓ/s)	
3.	<b>For houses and single quarters:</b>					
	Annual average flow from houses (232 houses)	209	2,42	-	-	
	Annual average flow from single quarters (348u)	125	1,45	-	-	
	Total average flow	334	3,87	-	-	
	Peak factor for 580u = 1,5x 2,5	-	-	3,75	-	
	Total peak flow from housing	-	-	-	14,51	
4.	<b>For industrial general:</b>					
	Vocational	42	-	-	-	
	Logistics	12	-	-	-	
	Industrial Manufacturing	4	-	-	-	
	Commercial	-	-	-	-	
	Maintenance of sewers	19	-	-	-	
	Total average sewage flow	77	0,89	-	-	
	Typical peak factor	-	-	5,0	-	
	Therefor peak sewage flow	-	-	-	4,45	
5.	<b>For Abattoirs:</b>					
	Cattle abattoir	3	-	-	-	
	Pig abattoir	2	-	-	-	
	Sheep abattoir	1	-	-	-	
	Poultry abattoir	4	-	-	-	
	Total annual average sewage discharge	10	0,12	-	-	
	Peak factor for abattoir (for flow over 8h over 222d/y)	-	-	4,9	-	
	Therefor peak sewage flow	-	-	-	0,79	
6.	<b>For dairy industry, animal and poultry housing &amp; cleaning:</b>					
	Horse stables	-	-	-	-	
	Pigs	4	-	-	-	
	Dog kennels	2	-	-	-	
	Broilers	2	-	-	-	
	Poultry layers	1	-	-	-	
	Dairy industry	5	-	-	-	
	Total average flow	14	0,16	-	-	
		Peak factor for cleaning over 300d/y over 2h/d	-	-	14,6	-
		Therefor peak sewage flow	-	-	-	2,37

ITEM NO	DESCRIPTION OF SEWERAGE	AVE YEAR FLOW (kℓ/d)	AVE YEAR FLOW (ℓ/s)	PEAK FLOW (ℓ/s)	PEAK FACTOR
7.	<b>For pre-treatment wash water</b>	12	0,14	-	-
	Peak factor (calculated)	-	-	10,7	-
	Peak sewage flow	-	-	-	1,50
8.	<b>Total sewage peak flow for the prison complex including administration and industrial general:</b>				
	Total average sewage flow excluding housing, farming and pre-treatment	1001	11,59	-	-
	Total No. of fixtures units in prisoner complex excluding hand wash basins and showers = 3x338 = 1014 Total fixture units administration = 940 Total No. of fixtures units in prison=1954				
	Therefore peak flow Building plus Administration excluding prisoner hand wash basins and showers	-	-	20,26	-
	Peak flow hand wash basins and showers = 3x14,04	-	-	42,12	-
	Peak flow industrial general	-	-	4,45	-
	Total peak sewage discharge from building complex	-	-	66,83	-
	Therefor peak factor	-	-	-	5,77
9.	<b>Total sewage peak flow for complete prison including housing, farming and pre-treatment works:</b>				
	Total average sewage flow	1369	15,84	-	-
	Total sewage peak flow from building complex	-	-	66,83	-
	Total sewage peak flow from housing	-	-	14,51	-
	Total sewage peak flow from Abattoirs	-	-	0,79	-
	Total sewage peak flow from animal housing cleaning	-	-	2,37	-
	Total sewage peak pre-treatment	-	-	1,50	-
	Total peak sewage flow for prison farm	-	-	86,00	-
	Therefor overall sewage peak factor	-	-	-	5,43

ITEM NO	DESCRIPTION OF SEWERAGE	AVE YEAR FLOW (kℓ/d)	AVE YEAR FLOW (ℓ/s)	PEAK FLOW (ℓ/s)	PEAK FACTOR
10.	<b>Total sewage peak flow for prison complex including housing but excluding farming operations &amp; pre-treatment</b>				
	Total average sewage flow	1335	15,45	-	-
	Total peak flow from building complex	-	-	66,83	-
	Total peak flow from housing	-	-	14,51	-
	Total peak flow from prison complex	-	-	81,34	-
	Therefor peak factor	-	-	-	5,26

<b>Total Peak Sewage Flows</b>	
Peak sewage flow for prison farm	7 430 kℓ/d
Average peak demand per prisoner	2 477 ℓ/pr/d
Peak sewage flow excluding farming and pre-treatment	7 028 kℓ/d
Average peak sewage flow per prisoner	2 343 ℓ/pr/d
Peak sewage flow excluding farming, housing and pre-treatment	5 774 kℓ/d
Average peak sewage flow per prisoner	1 925 ℓ/pr/d

**F.10 SUMMARY OF DESIGN CALCULATIONS OF WATER DEMAND AND SEWAGE FLOW FOR A 3000 PRISONER PRISON FARM**

ITEM	WATER DEMAND IN ℓ/pr/d			SEWAGE FLOW IN ℓ/pr/d		
	AVERAGE DEMAND	PEAK DEMAND	PEAK FACTOR	AVERAGE FLOW	PEAK FLOW	PEAK FACTOR
Flows for prison complex only excluding site irrigation, housing, farming and pre-treatment works	378	2 000	5,29	334	1 925	5,76
Flows for prison complex including housing and site irrigation but excluding farming and pre-treatment works	536	2 889	5,39	445	2 343	5,27
Total flows for prison farm	2 908	16 139	5,55	456	2 477	5,43

**NOTE:**

1. The above calculations illustrate only the applications of the Guidelines and the Consultant shall make his own detailed calculations for the specific prison.
2. As administration staff, sports facilities, parks, farming operations etc cannot be scaled linearly, the water demand and sewage flow can only be extrapolated **over a very limited area** with reference to the number of prisoners.
3. Water demand figures exclude fire requirements.