

Sewerage Code of Australia

Requirement	Clause
PWC has moved to adopt the Sewerage Code of Australia as the general basis for the design and construction of gravity sewerage infrastructure under its control in the Northern Territory. This document is read as a supplement to the Sewerage Code of Australia to provide details of those modifications and additions to suit the particular requirements of PWC.	PWC Comment
PWC has adopted the 'Planning Guidelines for Water Supply and Sewerage' as issued by the Queensland Department of Environment and Resource Management. PWC has also adopted the WSAA codes and this supplement provides details of those modifications and additions that suit the particular requirements of PWC. This supplement only applies to those areas of the Northern Territory which are: <ul style="list-style-type: none"> (i) Served by a public sewerage system under the direct control of PWC (ii) New schemes or extensions to existing systems to be taken over by PWC (iii) Areas declared as Sewerage Districts under the Northern Territory Water Supply and Sewerage Services Act <p>The requirements of this supplement in respect of the WSAA codes take precedence over the requirements of the Queensland Planning Guidelines.</p>	1.1
After the final paragraph, insert the following:	1.3.1
"Unless noted otherwise for a particular requirement, the term 'Planner' refers to the Designer."	
PWC will not provide a Concept Plan and the designer is required to develop the Concept Plan (including design drawings) for PWC approval.	1.3.2
Replace the existing clause with the following:	1.3.4
Planners and Designers shall consult with stakeholders as necessary. <i>Stakeholders may include, but are not limited to:</i> <ul style="list-style-type: none"> a) <i>Property Owners served (or affected) by the works, including absentee owners;</i> b) <i>Tenants</i> c) <i>Heritage groups;</i> d) <i>Indigenous people groups;</i> e) <i>AAPA</i> f) <i>Native Title holders;</i> g) <i>Municipal councils;</i> h) <i>Gas pipeline owners and/or operators;</i> i) <i>Road, rail and tram owners</i> j) <i>Planning authorities;</i> k) <i>Developers of adjacent works;</i> l) <i>Environmental and community groups; and</i> m) <i>Other utility agencies, including PWC power networks.</i> 	
Preference in design will be given to conventional gravity sewer systems.	1.4
Other types of sewer systems will only be considered if proven to the satisfaction of PWC that a gravity sewer system is not technically feasible.	

Requirement	Clause
Where the distribution infrastructure is required to be constructed as part of the subdivision works, the service life shall be determined by PWC, but shall not less than values shown in Table 1.1.	1.4.1
Add to (a): "Scale drawings in accordance with Section 9.3.1 to allow ease of reading. Additional drawings may be required to avoid cluttering." In Table 1.2 at Pipe Sizing; delete "Calculate the design flow including... ground water infiltration ... min / max velocity at design flow" and insert: "Calculate the design flow in accordance with Clause 3.2 as amended by this supplement. EP for the catchment needs to be identified, as does contributing flows to the catchment from other catchments (and pump stations), plus wet weather dilution factor (D) must be selected. Determine pipe sizes to carry design flow. Determine grade subject to: <ul style="list-style-type: none"> • constraints on minimum and maximum velocity at design flow; and • achievement of self-cleansing conditions at least once per day"	1.4.3
Section a) refers to reticulation, sections b) and c) refer to distribution components	2.1.3
PWC may refer to sewers > DN300 as trunk sewers. Where the designer proposes to stage construction of infrastructure then: <ul style="list-style-type: none"> • obtain approval from PWC for proposal • provide staging plan for the ultimate development 	2.2.1
Provide the Concept Plan to PWC for comment. PWC shall assess the capability of the existing sewerage system infrastructure to service the localised land development proposal.	2.2.2
Undertake the necessary design and prepare Design Drawings compatible with the Concept Plan.	2.2.3
At (a), Use REVISED APPENDIX A attached to this supplement.	2.2.3
At (c), delete the sentence "Design flow determination shall ... specified by the Water Agency".	2.2.3
At (c), delete "180 L/EP/d" and insert "300 L/EP/d".	2.3.1
In the first paragraph, delete "180 L/EP/d" and insert "300 L/EP/d".	2.3.2
At (a), Use REVISED APPENDIX A attached to this supplement. Delete the first paragraph, and insert the following:	2.3.5
"Geotechnical recommendations are required for all proposed gravity sewers in the Northern Region unless determined otherwise by PWC. For Southern Region, the Planner shall consider whether the nature of the ground, with respect to instability and ground water infiltration, requires geotechnical assessment.	2.3.5

Requirement			Clause
Test points shall be:			2.3.5 (cont)
Proposed Depth of Trench	Test Points	Test Depth	
<3m	<150m apart	Design trench depth plus 1.5m	
>3m	<150m apart	Design trench depth plus 3.0m	
Vertical and horizontal bearing capacity shall be determined for waterlogged conditions.			
Construction considerations, soil classifications, actual groundwater level and maximum seasonal groundwater level shall be identified for each test point"			
After dot points (a) to (e), insert:			2.4.1
"Note that sewers in Darwin are not ventilated and that chemical dosing is not preferred by PWC."			
After the final paragraph, insert the following:			2.5
"The overall design shall:			
<ul style="list-style-type: none"> • Ensure PWC can comply with regulatory, policy and customer agreement requirements in terms of capacity and serviceability, ensuring a closed system with no overflows or odour problems; • Allow for the ultimate development within the project area, including allowance for potential residential and non – residential flows; • Be consistent with the overall design of the entire sewerage system; • Allow for any future extension of the sewerage system as determined by PWC" 			
Delete the existing clause and insert the following:			3.1
"In hydraulic design of sewerage systems, estimate the following flows:			
<ol style="list-style-type: none"> 1. Design Peak Wet Weather Flow (Q_w), for sewer sizing; and 2. Most Probable Peak Dry Weather Flow (Q_m), which is used to verify that self-cleansing conditions exist 3. Q_m (Q_{dmp}) for slime control 			
Seek advice from PWC for the additional flows to be considered from future and existing developments adjacent to project area. Ensure that Design Reports clearly state the additional flows considered.			
Flow Requirements – Specific Applications			
i) Sewer Pipes			
Design for pipe full flow to cope with Q_w from eqn. (1).			
Pipes shall be of a standard size and the minimum size for gravity sewers shall be DN150.			

Requirement	Clause
<p>ii) Overflow Provision at Sewerage Pump Stations</p> <p>Overflow storage is to be provided at sewerage pump stations – refer supplement to WSA 04 – Sewerage Pumping Station Code of Australia.</p> <p>In some cases, topographical considerations may require overflow storage within the sewer catchment at a point upstream of and remote from the sewerage pump station (refer Clause 7.11).</p> <p>iii) Sewerage Pump Stations</p> <p>The designed pumping rate (L) of a pump station is given by the following equation.</p> $L = Q_w \quad \text{Litres/second}$ <p>In the Southern Region, $L \leq 8xQ_a$</p> <p>iv) Special Cases</p> <p>Sewers which receive unusual combinations of trade wastes and other flows will require individual consideration as these may have abnormal ratios of peak to average dry weather flow.</p> <p>Unusual or non-standard sewer sections may also require special consideration.”</p>	3.1 (cont)
<p style="text-align: center;">APPENDIX B OF WSA CODE IS NOT USED</p> <p>Delete the existing clauses and insert the following:</p> <p>“Design Wet Weather Flow</p> <p><i>Separate sewers are designed to provide for the peak dry weather flow, an allowance for infiltration and stormwater ingress.</i></p> <p>For convenience, the design peak wet weather flow (Q_w) is obtained by multiplying the peak dry weather flow (Q_d), by a dilution factor (D), and adding the sum of the pumping rates $\Sigma(L)$ of pumping stations discharging directly into the catchment.</p> <p>Use modelling to:</p> <ol style="list-style-type: none"> 1. determine probable pumped flows where more than five pump stations discharge into the catchment, (refer informative text at Clause 3.2.4 in the code); and 2. determine if increased pump rates are contained within the downstream sewer system when pump station wet well levels are abnormally high (eg. on restart after power outage). 	3.2

Requirement	Clause
<p>Design PWWF, Q_w, shall be determined from the following formula:</p> $Q_w = Dr Q_a + \sum(L) \dots\dots\dots(1)$ <p>where D = Wet Weather Dilution Factor = 3 r = Diurnal Peak Factor (Peak Flow/Average Flow)</p> $r = \left(1.74 + \frac{330}{EP^{0.55}} \right)^{0.5}$ <p>Q_a = Average Dry Weather Flow (ADWF) = EP/288 (based on 300 litres/EP/day)</p> <p>$\sum(L)$ = Sum of all contributing pump flows EP = Equivalent Population of the area (refer REVISED APPENDIX A)</p>	3.2 (cont)

Peak Dry Weather Flow (PDWF), Q_d , is obtained by the formula:

$$Q_d = r Q_a$$

SIZING AND GRADING OF SEWERS

Manning's formula should be used for hydraulic calculations of flow in pipes and channels. For most sewers, uniform flow is assumed.

$$v = \frac{1}{n} R^{2/3} \left[\frac{h}{l} \right]^{1/2}$$

Where: v is measured in metres/second

n = measure of roughness of the pipe used in Manning's formula

R = hydraulic mean radius of flowstream (in metres)

h = friction head (in metres)

l = pipe length (in metres)

Q = 1000 va Litres/second

For circular pipes flowing full, these formulae become:

$$v = \frac{1}{n} \left[\frac{d}{4000} \right]^{2/3} \left[\frac{h}{l} \right]^{1/2}$$

$$Q = \frac{4000\pi}{n} \left[\frac{d}{4000} \right]^{8/3} \left[\frac{h}{l} \right]^{1/2}$$

Most Probable Peak Dry Weather Flow

The most probable peak dry weather flow (Q_m), which is used to verify that self-cleansing conditions exist for the sewer (generally only significant in cases where sewer grade is relatively flat), is obtained from the following equation:

$$Q_m = 0.75 \times Q'_d$$

Q'_d = the peak dry weather flow from a hypothetical EP, which is the sum of the EP of the areas draining by gravity plus the sum of the EP for each of contributing pump station catchment."

Requirement	Clause
<p>Delete the second sentence of the last paragraph ("Location in plan shall be referenced ...").</p> <p>After the final paragraph, insert the following:</p> <p>"The Designer is to obtain all survey data required to prepare the design of the sewerage reticulation scheme as specified herein, and to enable the design to be audited by PWC.</p> <p>Coordinates to be specified to MGA. Pine Creek and west of Pine Creek falls within Zone 52. East of Pine Creek falls within Zone 53.</p> <p>Where data supplied by PWC for existing infrastructure is found to be incorrect during survey, notify PWC of the measured level(s)."</p>	4.2.2
<p>Add:</p> <ul style="list-style-type: none"> (u) contaminated soils (refer also Clause 4.2.4.4) (v) sites that have previously been disturbed and re-filled <p>After the final paragraph, insert the following:</p> <p>"Sewers shall be located to serve all lots with the minimum length and depth of sewer, plus the minimum inconvenience to land owners. However, overriding consideration shall be given to the requirement for PWC access to the sewers for the purposes of operations and maintenance. Sewers shall be located in public land in preference to private land unless no significant cost penalty is involved. However sewers may not be located in private land if future repair and maintenance work would be likely to cause disruption to the lifestyle and amenity of the landowner.</p> <p>The location of sewers shall be as follows, listed in order of decreasing preference:</p> <ol style="list-style-type: none"> 1. Nature strip (i.e. footpath) area within the road reserve, at the distance from the property boundary specified in the service allocation plan or a service corridor; 2. Parks, drainage reserves, walkways etc, subject to approval by relevant agencies; 3. Road pavement (shoulder or emergency lane preferred), subject to approval by relevant agencies; 4. Land owned by PWC, subject to PWC approval; 5. Areas that would be inundated by a storm surge; 6. Private property requiring an easement; 7. Areas of acid sulphate soil; and 8. Areas that would be inundated by a 1 in 100 flood" 	4.2.3
<p>Add:</p> <ul style="list-style-type: none"> m) areas under control of an aboriginal land council; and n) areas where Native Title has been granted <p>After the final paragraph, insert the following:</p> <p>"Before construction commences, Aboriginal Areas Protection Authority (AAPA) clearances shall be obtained, including a set of clearances in the name of the Power and Water Corporation."</p>	4.2.4.1

Requirement	Clause										
<p>Add the following after final paragraph:</p> <p>"Note that trees and some landforms, particularly in desert areas, can form part of an aboriginal sacred site. If there is any doubt, then the advice of the Aboriginal Areas Protection Authority should be sought, and if necessary, an AAPA certificate obtained and paid for by the developer.</p> <p>Developers should be aware that significant delays may occur should AAPA certificates not be obtained in time to commence construction. Power and Water will not accept any site that has been the subject of destruction of sacred sites until all outstanding issues resulting from that destruction have been finalised and final AAPA certification issued.</p> <p>Severe penalties apply under NT law for destruction of sacred sites."</p>	4.2.4.3										
<p>At the end of the clause, add the following:</p> <p>"In coastal areas subject to storm surge, the weir crest of any ERS (refer to Clause 7.9) shall be set at least 0.5m above the storm surge level."</p>	4.2.4.5										
<p>Delete the first paragraph ("Where required by state or territory...") and the second paragraph ("Easement widths and placement..."), then insert:</p> <p>"An easement over private property is not the preferred location for a sewer and may only be used as temporary solution pending future permanent sewer within a road reserve.</p> <p>Where a sewer must be located within private property, an easement shall be provided in favour of PWC. All easements in favour of PWC shall be in accordance with the PWC Policy 'Minimum Easement Dimensions, Conditions and Restrictions for Water and Sewerage Infrastructure'.</p> <table border="1" data-bbox="1715 1224 2451 1413"> <thead> <tr> <th>Gravity Sewers (depth to invert)</th> <th>Minimum Easement Width (m)</th> </tr> </thead> <tbody> <tr> <td>≤ 1.5m</td> <td>3</td> </tr> <tr> <td>>1.5m to ≤4.0m</td> <td>6</td> </tr> <tr> <td>>4.0m to ≤8.0m</td> <td>10</td> </tr> <tr> <td>Trunk Sewer ≥ DN300</td> <td>10</td> </tr> </tbody> </table> <p>The easement is generally to be centrally located over the sewer.</p> <p>Sewers located within private land may be subject to increased easement requirements to the satisfaction of PWC, where:</p> <ul style="list-style-type: none"> • the sewer/s are not parallel to the property boundary • there is a shared alignment for services approved by the relevant authorities • there more than one PWC asset within the easement <p>Refer also Clause 4.3.4"</p>	Gravity Sewers (depth to invert)	Minimum Easement Width (m)	≤ 1.5m	3	>1.5m to ≤4.0m	6	>4.0m to ≤8.0m	10	Trunk Sewer ≥ DN300	10	4.2.5
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>4.0m to ≤8.0m	10										
Trunk Sewer ≥ DN300	10										

Requirement	Clause								
<p>After the final paragraph, insert the following:</p> <p>“Where sewers are in road reserves, the alignment shall conform to that nominated on the service allocation plan and by gaining approval from PWC and the relevant road authority or Council. Refer also ‘Service Allocations in Road Reserves’ in Section 4 of Volume 2 of the Power Supply Volumes of PWC’s Standard Drawings (drawing numbers SO2-4-1-XX).</p> <p>Where sewers are in road reserves, the alignment shall generally be 1.5m from the property boundary.</p> <p>Where sewers are less than the following distances from the property boundary, easements in favour of PWC shall be provided over the adjacent portion of the property.</p> <table border="1" data-bbox="1715 768 2451 926"> <thead> <tr> <th data-bbox="1715 768 2086 835">Gravity Sewers (depth to invert)</th> <th data-bbox="2086 768 2451 835">Minimum Distance to Property Boundary (m)</th> </tr> </thead> <tbody> <tr> <td data-bbox="1715 835 2086 863">≤ 4.0m</td> <td data-bbox="2086 835 2451 863">1.5</td> </tr> <tr> <td data-bbox="1715 863 2086 890">>4.0m to ≤8.0m</td> <td data-bbox="2086 863 2451 890">3.0</td> </tr> <tr> <td data-bbox="1715 890 2086 926">Trunk Sewer ≥ DN300</td> <td data-bbox="2086 890 2451 926">3.0</td> </tr> </tbody> </table> <p>Where sewers cross roadways they shall generally be at right angles to the roadway (or near right angles where it is necessary to avoid other services or to avoid acute changes in direction of sewers). Sewers crossing roadways at a shallow angle to the roadway shall not be permitted.</p> <p>Where a sewer main is required to cross multi lane carriageway or a major road, including all roads controlled by DPI, or an intersection or roundabout, PWC may specify extra protection methods or different pipe materials to minimise the requirement for future maintenance.</p> <p>Such requirements may include enclosing the sewer in a bored or jack sleeved pipe or culvert.</p> <p>Where the length of the crossing is greater than the permitted maximum between access chambers and it is not possible to install an intermediate access chamber, PWC shall be consulted regarding the size of the sewer and the material to minimise the requirement for future maintenance.</p> <p>PWC may elect to install a larger diameter sewer for the road crossing to improve maintenance access.”</p>	Gravity Sewers (depth to invert)	Minimum Distance to Property Boundary (m)	≤ 4.0m	1.5	>4.0m to ≤8.0m	3.0	Trunk Sewer ≥ DN300	3.0	4.3.2
Gravity Sewers (depth to invert)	Minimum Distance to Property Boundary (m)								
≤ 4.0m	1.5								
>4.0m to ≤8.0m	3.0								
Trunk Sewer ≥ DN300	3.0								

Requirement	Clause
<p>After the final paragraph, insert the following:</p> <p>"The Designer is responsible for obtaining all approvals for sewers proposed to cross railway reserves. The design of the sewer shall satisfy the requirements of the rail owner and PWC.</p> <p>PWC may specify extra protection methods or different pipe materials to minimise the requirement for future maintenance.</p> <p>Where the length of the crossing is greater than the permitted maximum between access chambers and it is not possible to install an intermediate access chamber, PWC shall be consulted regarding the size of the sewer and the material to minimise the requirement for future maintenance.</p> <p>PWC may elect to install a larger diameter sewer for the rail crossing to improve maintenance access."</p>	4.3.3
<p>In the second paragraph, delete "1.0m" and insert "1.5m".</p> <p>After the second paragraph, insert the following:</p> <p>"Sewers larger than DN225 will not normally be permitted to pass through private residential property.</p> <p>No sewers of more than 3m depth shall pass through any private residential property.</p> <p>No sewer shall pass through any property less than 800 m² in size.</p> <p>Locating sewers along more than one boundary of a lot shall be avoided wherever possible.</p> <p>For all proposals involving the installation of sewers in property requiring an easement in favour of PWC, 'in principle' approval shall be obtained from PWC before detailed design commences.. Designers shall not assume PWC will permit such installations.</p> <p>All proposals involving the installation of sewers in property not requiring an easement, such as Crown Land, shall be approved in principle by the land owner and PWC before detailed design commences. Designers shall not assume PWC will permit such installations.</p> <p>The circumstances in which PWC may consider the installation of a sewer requiring an easement or in property not requiring an easement, such as Crown Land, include:</p> <ul style="list-style-type: none"> (a) situations in which the depth of sewer required to service the land becomes excessive due to the need to locate that sewer in the road reserve; (b) situations in which there becomes a need to duplicate sewers, or construct excessive length of sewers to service the land; (c) provision of temporary sewer for a land locked situation, pending future permanent servicing from a sewer located in the road reserve; and (d) to avoid the need for construction of a sewerage pumping station." 	4.3.4

Requirement	Clause
Curved sewers and/or horizontal bends are not permitted.	4.3.5
Delete reference to Table 4.1.	
Refer to PWC drawings W2-2-01A, W2-2-01D, W2-2-02 and W2-2-03 regarding permissible changes in direction at maintenance holes on sewers up to DN300.	
After the final paragraph, insert the following: "In addition, a MH is not required at the upstream end of the dead end, provided the length of the resulting dead end sewer is not more than 100m. A terminal maintenance shaft shall be provided at the upstream end of the dead end where properties are connected to the sewer or where the length of the resulting dead end sewer exceeds 10m."	4.3.6
Delete Table 4.1	Table 4.1
Delete Clause 4.3.7	4.3.7
Curved sewers and/or horizontal bends are not permitted.	
Refer to PWC Power Networks for minimum clearances.	4.4.3
Delete Table 4.2 and insert Table 4.2(NT) as follows:	4.4.5.2

TABLE 4.2(NT)
CLEARANCES BETWEEN SEWERS AND OTHER UNDERGROUND SERVICES

Utility (Existing Service)	Minimum Horizontal Clearance (mm)		Minimum Vertical Clearance ¹ (mm)
	New Sewer Size		
	≤DN 300	>DN 300	
Sewers	600	600	300
Gas Mains	600	600	300
Telecommunication conduits and cables	600	600	300
Electricity conduits and cables	600	1000	300 ²
Drains	600	600	300
Water mains	1000 ³ /600	1000 ³ /600	500 ⁴
Kerbs	150	600 ⁵	150

NOTES:

- Vertical clearances apply when sewers cross one another and other utility services, except in the case of water mains when a vertical separation shall always be maintained, even when the sewer and water main are parallel. *The sewer should always be located below the water main to minimise the possibility of backflow contamination in the event of a water main break.*
- For minimum vertical clearances for electrical services refer to PWC Power Networks requirements.
- When the sewer is at the minimum vertical clearance below the water main (500mm), maintain a minimum horizontal clearance of 1000mm. *This minimum horizontal clearance can be progressively reduced to 600mm as the vertical clearance is increased to 750mm.*
- Sewers should always cross under water mains and stormwater drains.* For cases where there is no alternative and the sewer must crossover a water main, construction shall be in accordance with Standard Drawing WAT-1211 of WSA 03.
- Clearance from kerbs shall be measured from the nearest point of the kerb.

Requirement	Clause												
<p>Delete the second paragraph ("Design flow shall be calculated ...") and insert the following:</p> <p>"Sewers shall be sized and graded to ensure the following:</p> <p style="padding-left: 40px;">(a) Adequate hydraulic capacity at peak wet weather flow (Q_w)</p> <p style="padding-left: 40px;">(b) Self cleansing velocity at most probable peak dry weather flow, Q_m</p> <p>Sewer grades shall be selected such that Q_m is exceeded at least once per day.</p> <p>Sewers shall be designed such that full flow capacity exceeds PWWF.</p> <p>Mannings formula or the Colebrook-White formula shall be used for the computation of pipe capacities. Resistance factors shall be as follows:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Pipe Material</th> <th>Mannings n</th> <th>Colebrook White k (mm)</th> </tr> </thead> <tbody> <tr> <td>Plastic Type Pipes (uPVC, GRP etc)</td> <td>0.012</td> <td>0.3</td> </tr> <tr> <td>Unlined Concrete Pipes, DICL Pipes</td> <td>0.015</td> <td>0.6</td> </tr> <tr> <td>VC Pipes, Plastic Lined Concrete Pipes</td> <td>0.013</td> <td>0.3</td> </tr> </tbody> </table> <p>Pipe grades shall be selected such that self cleansing velocity is achieved at most probable peak dry weather flow (Q_m).</p> <p>To calculate the minimum slope to achieve self-cleansing velocity, use the following formula:</p> $S_{min} = 540 F_m / d^{1.33}$ <p>Where:</p> <p style="padding-left: 40px;">S_{min} = minimum slope to achieve self-cleansing velocity (%)</p> <p style="padding-left: 40px;">d = internal diameter of pipe (mm)</p> <p style="padding-left: 40px;">F_m = materials factor</p> <p>For all pipes where $d > 300\text{mm}$, $F_m = 1.0$.</p> <p>For smooth bore pipes (eg. PVC or GRP pipe), where $d \leq 300\text{mm}$, $F_m = 1.2$.</p> <p>For VC pipe or cement mortar lined pipe, where $d \leq 300\text{mm}$, $F_m = 1.4$."</p> <p>Delete the fourth paragraph ("Sizing of pipes shall provide for ...").</p> <p>Delete the final paragraph.</p>	Pipe Material	Mannings n	Colebrook White k (mm)	Plastic Type Pipes (uPVC, GRP etc)	0.012	0.3	Unlined Concrete Pipes, DICL Pipes	0.015	0.6	VC Pipes, Plastic Lined Concrete Pipes	0.013	0.3	4.5.1
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<p>Delete the existing wording and insert the following:</p> <p>"Design for full pipe flow at PWWF (ie no air space at design flow [PWWF])."</p>	4.5.3												

Requirement	Clause																				
<p>After the first paragraph, insert the following:</p> <p>“The minimum size for property connections shall be 150mm.</p> <p>Property connection sewers servicing loads greater than 80EP shall be connected to sewer at a maintenance hole.”</p> <p>Delete Table 4.3 and insert the following:</p> <p style="text-align: center;">TABLE 4.3(NT) MINIMUM PIPE SIZES FOR RETICULATION AND PROPERTY CONNECTION SEWERS</p> <table border="1" data-bbox="1626 680 2588 982"> <thead> <tr> <th data-bbox="1626 680 2421 737">Sewer</th> <th data-bbox="2421 680 2588 737">Minimum Size (DN)</th> </tr> </thead> <tbody> <tr> <td data-bbox="1626 737 2421 890"> <ul style="list-style-type: none"> • Property connection sewer servicing one or more residential lots • Property connection sewer servicing one commercial lot • Property connection sewer servicing one industrial lot • Reticulation sewers servicing residential lots • Reticulation sewers servicing commercial lots </td> <td data-bbox="2421 737 2588 890" style="text-align: center;">150</td> </tr> <tr> <td data-bbox="1626 890 2421 982"> <ul style="list-style-type: none"> • Reticulation sewers servicing industrial lots • Property connection sewer servicing a site where large flows may be expected </td> <td data-bbox="2421 890 2588 982" style="text-align: center;">225</td> </tr> </tbody> </table>	Sewer	Minimum Size (DN)	<ul style="list-style-type: none"> • Property connection sewer servicing one or more residential lots • Property connection sewer servicing one commercial lot • Property connection sewer servicing one industrial lot • Reticulation sewers servicing residential lots • Reticulation sewers servicing commercial lots 	150	<ul style="list-style-type: none"> • Reticulation sewers servicing industrial lots • Property connection sewer servicing a site where large flows may be expected 	225	4.5.4														
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<p>Delete Clause 4.5.5</p> <p>Delete Table 4.4.</p>	4.5.5																				
<p>Replace existing Table 4.6 with the following:</p> <p style="text-align: center;">TABLE 4.6(NT) ABSOLUTE MINIMUM GRADES</p> <table border="1" data-bbox="1762 1192 2469 1541"> <thead> <tr> <th data-bbox="1762 1192 2119 1255">Pipe Size</th> <th data-bbox="2119 1192 2469 1255">Absolute Minimum Grade (%)</th> </tr> </thead> <tbody> <tr><td data-bbox="1762 1255 2119 1287">150</td><td data-bbox="2119 1255 2469 1287">0.84</td></tr> <tr><td data-bbox="1762 1287 2119 1318">225</td><td data-bbox="2119 1287 2469 1318">0.48</td></tr> <tr><td data-bbox="1762 1318 2119 1350">300</td><td data-bbox="2119 1318 2469 1350">0.32</td></tr> <tr><td data-bbox="1762 1350 2119 1381">375</td><td data-bbox="2119 1350 2469 1381">0.22</td></tr> <tr><td data-bbox="1762 1381 2119 1413">400</td><td data-bbox="2119 1381 2469 1413">0.20</td></tr> <tr><td data-bbox="1762 1413 2119 1444">450</td><td data-bbox="2119 1413 2469 1444">0.16</td></tr> <tr><td data-bbox="1762 1444 2119 1476">525</td><td data-bbox="2119 1444 2469 1476">0.13</td></tr> <tr><td data-bbox="1762 1476 2119 1507">600</td><td data-bbox="2119 1476 2469 1507">0.11</td></tr> <tr><td data-bbox="1762 1507 2119 1541">750</td><td data-bbox="2119 1507 2469 1541">0.10</td></tr> </tbody> </table> <p>Note: The minimum grade is to be determined by the Designer. The absolute minimum grades specified in Table 4.6 apply when the determined minimum grade is less than those specified in the table.</p>	Pipe Size	Absolute Minimum Grade (%)	150	0.84	225	0.48	300	0.32	375	0.22	400	0.20	450	0.16	525	0.13	600	0.11	750	0.10	4.5.7.1
Pipe Size	Absolute Minimum Grade (%)																				
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Requirement	Clause																																																																																																																																	
<p>Replace existing Table 4.7 with the following:</p> <p style="text-align: center;">TABLE 4.7 MINIMUM GRADES FOR PROPERTY CONNECTION SEWERS AND PERMANENT ENDS</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="text-align: center;">Situation</th> <th style="text-align: center;">Minimum Grade (%)</th> </tr> </thead> <tbody> <tr> <td>DN150 property connection sewers</td> <td style="text-align: center;">1.0</td> </tr> <tr> <td>DN225 property connection sewers</td> <td style="text-align: center;">0.7</td> </tr> <tr> <td>Permanent upstream ends of DN150, 225 and 300 sewers with load <20 EP</td> <td style="text-align: center;">1.0</td> </tr> </tbody> </table>	Situation	Minimum Grade (%)	DN150 property connection sewers	1.0	DN225 property connection sewers	0.7	Permanent upstream ends of DN150, 225 and 300 sewers with load <20 EP	1.0	<p>4.5.7.1 (cont)</p>																																																																																																																									
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<p>Refer to Table 4.7(NT) above.</p>	<p>4.5.7.3</p>																																																																																																																																	
<p>Where physically and economically practicable, all sewers > DN300 should be designed with grades which meet slime control requirements. Similarly, all reticulation sewers receiving flows from pump stations should be designed with grades which meet slime control requirements. Use the table below (Table 11 extracted from Sydney Water Sewer Design Manual – January 1995 - [DN200, DN250, DN500, DN1050 and >DN1200 not included]).</p> <p>Note that $Q_m = Q_{dmp}$</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th rowspan="2" style="text-align: center;">Nominal Pipe Size (DN)</th> <th colspan="9" style="text-align: center;">Slope(%) for Q_m/Q_w</th> </tr> <tr> <th style="text-align: center;">0.05</th> <th style="text-align: center;">0.075</th> <th style="text-align: center;">0.10</th> <th style="text-align: center;">0.125</th> <th style="text-align: center;">0.15</th> <th style="text-align: center;">0.20</th> <th style="text-align: center;">0.25</th> <th style="text-align: center;">0.30</th> <th style="text-align: center;">0.35</th> </tr> </thead> <tbody> <tr><td>150</td><td>2.44</td><td>2.04</td><td>1.80</td><td>1.63</td><td>1.51</td><td>1.33</td><td>1.21</td><td>1.12</td><td>1.06</td></tr> <tr><td>225</td><td>1.62</td><td>1.36</td><td>1.19</td><td>1.08</td><td>1.00</td><td>0.89</td><td>0.81</td><td>0.75</td><td>0.70</td></tr> <tr><td>300</td><td>1.22</td><td>1.02</td><td>0.90</td><td>0.81</td><td>0.75</td><td>0.66</td><td>0.60</td><td>0.56</td><td>0.53</td></tr> <tr><td>375</td><td>1.03</td><td>0.86</td><td>0.75</td><td>0.68</td><td>0.63</td><td>0.56</td><td>0.51</td><td>0.47</td><td>0.44</td></tr> <tr><td>400</td><td>0.91</td><td>0.76</td><td>0.67</td><td>0.60</td><td>0.56</td><td>0.49</td><td>0.45</td><td>0.42</td><td>0.39</td></tr> <tr><td>450</td><td>0.82</td><td>0.68</td><td>0.60</td><td>0.54</td><td>0.50</td><td>0.44</td><td>0.40</td><td>0.38</td><td>0.35</td></tr> <tr><td>525</td><td>0.70</td><td>0.58</td><td>0.51</td><td>0.47</td><td>0.43</td><td>0.38</td><td>0.35</td><td>0.32</td><td>0.30</td></tr> <tr><td>600</td><td>0.61</td><td>0.51</td><td>0.45</td><td>0.41</td><td>0.38</td><td>0.30</td><td>0.30</td><td>0.28</td><td>0.26</td></tr> <tr><td>750</td><td>0.48</td><td>0.40</td><td>0.36</td><td>0.32</td><td>0.30</td><td>0.24</td><td>0.24</td><td>0.22</td><td>0.21</td></tr> <tr><td>900</td><td>0.41</td><td>0.34</td><td>0.30</td><td>0.28</td><td>0.25</td><td>0.20</td><td>0.20</td><td>0.19</td><td>0.18</td></tr> <tr><td>1200</td><td>0.31</td><td>0.26</td><td>0.23</td><td>0.20</td><td>0.17</td><td>0.15</td><td>0.15</td><td>0.14</td><td>0.13</td></tr> </tbody> </table>	Nominal Pipe Size (DN)	Slope(%) for Q_m/Q_w									0.05	0.075	0.10	0.125	0.15	0.20	0.25	0.30	0.35	150	2.44	2.04	1.80	1.63	1.51	1.33	1.21	1.12	1.06	225	1.62	1.36	1.19	1.08	1.00	0.89	0.81	0.75	0.70	300	1.22	1.02	0.90	0.81	0.75	0.66	0.60	0.56	0.53	375	1.03	0.86	0.75	0.68	0.63	0.56	0.51	0.47	0.44	400	0.91	0.76	0.67	0.60	0.56	0.49	0.45	0.42	0.39	450	0.82	0.68	0.60	0.54	0.50	0.44	0.40	0.38	0.35	525	0.70	0.58	0.51	0.47	0.43	0.38	0.35	0.32	0.30	600	0.61	0.51	0.45	0.41	0.38	0.30	0.30	0.28	0.26	750	0.48	0.40	0.36	0.32	0.30	0.24	0.24	0.22	0.21	900	0.41	0.34	0.30	0.28	0.25	0.20	0.20	0.19	0.18	1200	0.31	0.26	0.23	0.20	0.17	0.15	0.15	0.14	0.13	<p>4.5.8</p>
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<p>After the final paragraph?, insert the following:</p> <p>The sewerage system shall include a house connection serving each lot in the development. The system shall provide for any ultimate development which could reasonably be expected to gravitate into the system and any external contributions to be allowed for.</p> <p>PWC may request that sewer sizes be larger than required to cater for future adjacent development or additional inflows to the system. In such cases the designer shall liaise with PWC on requirements.</p>	<p>4.6.1</p>																																																																																																																																	

Requirement	Clause
<p>Sewerage Systems shall be designed to conform with the following criteria:</p> <ul style="list-style-type: none"> • Minimum cover • Lot control and fixture control • Flow capacity (i.e. the sewer shall be sized and graded to accommodate the maximum flow) • Minimum gradient of sewers (i.e. self cleansing grades where greater than required for capacity) • Provision for existing flows and future extensions • Will allow safe operation and maintenance • Reduce carbon footprint by eliminating pump stations" 	4.6.1 (cont)
<p>After the first paragraph, insert the following:</p> <p>"Sewers shall have a minimum cover measured from the top of the pipe to finished surface as follows:</p> <ul style="list-style-type: none"> • House drains refer AS/NZS3500.1 • Sewers in road reserves 750 mm • Other sewers 600 mm • Sewers installed by thrust boring 1500mm <p>Due allowance shall be made for abnormal loadings, adverse ground conditions according to AS/NZS 2566.1 – Buried Flexible Pipelines. Designers shall provide certification for these conditions.</p> <p>Where minimum cover cannot be achieved the designer shall, with the approval of PWC, consider the use of a stronger grade of sewer, and/or application of mechanical protection in the form of a concrete slab (minimum thickness 100 mm structurally designed). PWC approval shall be sought in any instance where a design incorporates cover less than the minimum requirement.</p> <p>In situations in which a sewer traverses an Open Unlined Drain (OUD) the designer shall provide concrete slab protection against scouring and reduction of cover. In addition, cement stabilised backfill or a backfill material approved by PWC shall be used."</p> <p>Delete the second paragraph ("Sewers shall have minimum covers ...").</p> <p>Delete the fifth paragraph ("<i>In order to reduce installation costs ...</i>").</p> <p>Delete Table 4.8.</p>	4.6.3
<p>After the final paragraph, add:</p> <p>"Minimum grades permitted for calculation of lot control shall be in accordance with AS/NZS 3500.</p> <p>The type and method of connection shall be as shown on following PWC standard drawings: W2-1-01, W2-1-02, W2-1-03, W2-1-04, W2-1-08 and W2-1-10."</p>	4.6.4.1

Requirement	Clause
Delete the existing clause and insert: "For residential lots with more than six units, the area to be serviced shall be taken as the whole area of the lot. For residential lots with six or less units and to be serviced from the front of the lot, the area to be serviced shall be taken as the whole area of the lot excluding the 1.5 m from the rear boundary and 1.5m from the side boundaries. For residential lots with six or less units and to be serviced from the rear of the lot, the area to be serviced shall be taken as the whole area of the lot excluding 6.0 m inside the front boundary."	4.6.4.2
Before the first paragraph, insert the following: "The area to be controlled shall be taken as the whole of the lot for commercial and industrial lots." Delete the first paragraph. Delete the last paragraph.	4.6.4.3
Before the first paragraph, insert the following: "In extreme cases where lot control requirements necessitate the sewer to be excessively deep, PWC may consider a reduced area of lot control subject to adequate justification by the Designer. Where lot control requirements are relaxed, the extent of servicing must be noted and graphically represented on the as constructed drawing, survey plan and as part of the Administration Interests."	4.6.4.4
Delete the second last paragraph (" <i>Alternatively, a pressure ...</i> ") Delete Clause 4.6.4.5.	4.6.4.5
PWC does not require basements to be serviced by gravity drainage. Delete the existing wording and insert the following:	4.6.5.1
"The soffit requirement shall be measured from the ORG (overflow relief gully) level to the top of the pipe at the sewer service connection point (refer PWC standard drawings W2-1-01, W2-1-02, W2-1-03, W2-1-08 and W2-1-10 as applicable)." In the second paragraph, delete "150mm" and insert "200mm".	4.6.6.1
In the last paragraph, delete the words "or by using a vertical bend prior to the MH (refer to Clause 4.6.7)." Delete Table 4.9.	4.6.6.2
In the first paragraph, delete the words "nominated in Table 4.9" and insert "shown at Table 2 on PWC standard drawing W2-2-01D and as defined by associated notes". Delete reference to standard drawings SEW-1303 and SEW-1306.	4.6.6.4
Refer PWC standard drawing W2-2-03. Delete (b)	4.6.6.5

Requirement	Clause
Delete Clause 4.6.7.	4.6.7
Vertical curves are not permitted. Delete Clause 4.6.8.	4.6.8
Compound curves are not permitted. After the first paragraph, insert the following: "Protection against corrosion is required for MH's on mains \geq DN 375. Protection is required at receiving maintenance holes (including rising main discharge points). Protection against corrosion may be required for sewers and MH's in areas servicing industrial / trade waste discharges." Steel pipelines shall not be used in gravity sewers without specific approval from PWC.	4.7.2
Delete reference to SEW-1105.	4.8.1
After the last paragraph, insert the following: "The property connection shall be located as per PWC Standard Drawings W2-1-01, W2-1-02, W2-1-03, W2-1-04, W2-1-08 and W2-1-10 to give the most economical layout of house drains without adversely affecting the depth of the sewer. The preferred location is on the downstream side of the lot, 1.5 m from the boundary. A minimum DN150 house sewer connection shall be provided to each lot. The location, level and type of each house connection shall be shown on the Design Drawings and the As Constructed Drawings with associated Field Returns. A boundary trap will be required where the receiving sewer \geq DN 375 or where the receiving sewer is immediately downstream of a MH receiving the discharge of a rising main. Loads \geq 80EP shall discharge to a maintenance hole." Delete reference to standard drawings SEW-1409, SEW-1410 and SEW-1411.	5.1
Refer also PWC standard drawing W2-2-06.	5.2
After the last paragraph, insert the following: "Loads \geq 80EP shall discharge to a maintenance hole." Buried interface connection method is not permitted by PWC.	5.3.1
Refer PWC standard drawings W2-1-01, W2-1-02, W2-1-03, W2-1-08 and W2-1-10. Delete Clause 5.3.3	5.3.3
Delete the existing wording and insert the following: "Each lot shall be serviced by a single lot connection unless shown to the satisfaction of PWC that it is not technically feasible to achieve a single connection point."	5.5.2

Requirement	Clause
Delete reference to SEW-1104 and SEW-1105. Refer PWC standard drawing W2-1-04. Delete (a). Delete (c). Delete the last paragraph ("When sewers are constructed ...").	5.6.1
Add: (g) to avoid electrical and gas services with sufficient clearance for trenching to expose customer sanitary drains and property connection for repair. Refer PWC standard drawing W2-1-04.	5.6.2
Delete reference to SEW-1108. Delete the existing wording. Refer PWC standard drawings W2-1-08 and W2-1-10.	5.7
Delete (a). Delete reference to SEW-1104. Refer PWC standard drawing W2-1-04.	5.8
Delete reference to standard drawings SEW-1300, SEW-1301, SEW-1302, SEW-1303, SEW-1304, SEW-1305, SEW-1306, SEW-1307, SEW-1308 and SEW-1315. For MH's, refer to PWC standard drawings W2-2-01A, W2-2-01D, W2-2-03, W2-2-04 and W2-2-06. For MS's, refer to PWC standard drawings W2-1-09, W2-2-207 and W2-2-08. For TMS's, refer to PWC standard drawing W2-1-06.	6.1
Delete the first paragraph including (a) to (i). Before the second paragraph, insert the following: "Maintenance holes shall be located as follows: <ul style="list-style-type: none"> • at changes in grade; • at changes in direction; • at changes in pipe diameter; • at connection points with other sewers; • at the connection point for pressure mains; and • at the maximum spacing given in Table S6 	6.2

Requirement	Clause																																																			
TABLE S6 MAXIMUM MAINTENANCE HOLE SPACING <table border="1" style="margin: 10px auto;"> <thead> <tr> <th style="text-align: center;">Sewer Size</th> <th style="text-align: center;">Maximum Spacing</th> </tr> </thead> <tbody> <tr> <td>DN150 - DN300 without immediate MS</td> <td>100m</td> </tr> <tr> <td>DN150 - DN300 with immediate MS</td> <td>200m</td> </tr> <tr> <td>DN375 - DN450</td> <td>120m</td> </tr> <tr> <td>> DN450</td> <td>150m</td> </tr> </tbody> </table>	Sewer Size	Maximum Spacing	DN150 - DN300 without immediate MS	100m	DN150 - DN300 with immediate MS	200m	DN375 - DN450	120m	> DN450	150m	6.2 (cont)																																									
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<p>Before the first paragraph, insert the following:</p> <p>“PWC require that maintenance shafts are not used in a configuration where two maintenance shafts are located without a maintenance hole separating them.”</p> <p>Delete the first paragraph.</p> <p>Delete Table 6.1 and insert the following:</p> <p style="text-align: center;">TABLE 6.1(NT) ACCEPTABLE MH, MS AND TMS OPTIONS FOR RETICULATION SEWERS</p> <table border="1" style="margin: 10px auto;"> <thead> <tr> <th rowspan="2" style="text-align: center;">APPLICATION</th> <th colspan="3" style="text-align: center;">ACCEPTABLE OPTIONS</th> </tr> <tr> <th style="text-align: center;">MH</th> <th style="text-align: center;">MS</th> <th style="text-align: center;">TMS</th> </tr> </thead> <tbody> <tr> <td>Intersection: ≤ 2 inlets at the same level</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Intersection: ≤ 3 inlets at any level</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">NO</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Change of grade at the same level</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">NO</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Change of grade at different levels</td> <td style="text-align: center;">YES Internal or external drops</td> <td style="text-align: center;">NO</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Change in sewer size</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">NO</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Change in sewer horizontal direction</td> <td style="text-align: center;">YES Within permissible deflection limits</td> <td style="text-align: center;">YES Prefabricated units only. Maximum 90° deflection</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Change of pipe material</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">NO</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Permanent end of reticulation sewer</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">YES</td> </tr> <tr> <td>Sewer rising main discharge point</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">NO</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Junction of reticulation sewer and property connection sewer – same size sewers</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">YES Maximum of 2 property connections into riser shaft</td> <td style="text-align: center;">NO</td> </tr> <tr> <td>Junction of reticulation sewer and property connection sewer – different size sewers</td> <td style="text-align: center;">YES</td> <td style="text-align: center;">YES Maximum of 2 property connections into riser shaft</td> <td style="text-align: center;">NO</td> </tr> </tbody> </table>	APPLICATION	ACCEPTABLE OPTIONS			MH	MS	TMS	Intersection: ≤ 2 inlets at the same level	YES	YES	NO	Intersection: ≤ 3 inlets at any level	YES	NO	NO	Change of grade at the same level	YES	NO	NO	Change of grade at different levels	YES Internal or external drops	NO	NO	Change in sewer size	YES	NO	NO	Change in sewer horizontal direction	YES Within permissible deflection limits	YES Prefabricated units only. Maximum 90° deflection	NO	Change of pipe material	YES	NO	NO	Permanent end of reticulation sewer	YES	YES	YES	Sewer rising main discharge point	YES	NO	NO	Junction of reticulation sewer and property connection sewer – same size sewers	YES	YES Maximum of 2 property connections into riser shaft	NO	Junction of reticulation sewer and property connection sewer – different size sewers	YES	YES Maximum of 2 property connections into riser shaft	NO	6.3.1
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Requirement	Clause
<p>Delete the existing clause.</p> <p>Delete Figure 6.1.</p> <p>Delete Figure 6.2.</p> <p>Insert the following:</p> <p>"For reticulation sewers and subject to the provisions of Clause 6.3.1, the maximum distance between any two consecutive maintenance structures shall 100m for mains \leq DN300 and 120m for DN375 or DN450 mains.</p> <p>At the permanent end of line sewers, the distance from the end of line maintenance structure to the nearest downstream MH shall not exceed 100m."</p>	6.3.2
<p>Refer also Clause 4.3.6 above.</p> <p>Before the first paragraph, insert: "No more than one maintenance structure shall be located on any residential lot."</p> <p>Insert "(d) below high tide level"</p> <p>In (ii), delete "high tide" and insert "storm surge".</p> <p>Delete the last paragraph and insert the following:</p> <p>"Sewers need not terminate at an MH, MS or TMS if the sewer is to be extended in the near future, provided that the length of the resulting dead end sewer is less than 10m and that no properties are connected to the resulting dead end sewer. PWC approval shall be sought where a MH, MS or TMS is not proposed."</p>	6.4
<p>At (a), delete reference to "Standard Drawing SEW-1306" and insert "PWC Standard Drawing W2-2-03".</p> <p>At (b), after "TMS adjacent to an existing MH." add "with the new sewer connected to the riser of the TMS (applicable only where new sewer is DN150 or DN225)."</p>	6.5
<p>Delete reference to SEW-1300, SEW-1301, SEW-1302, SEW-1303, SEW-1304, SEW-1305, SEW-1306, SEW-1307, SEW-1308 and SEW_1313.</p> <p>Delete existing clause and insert:</p> <p>"Standard MH construction shall be:</p> <ul style="list-style-type: none"> • precast concrete MH segments with precast concrete cover slab and poured-in-situ base slab and poured-in-situ sewer channels <p>MH construction details are shown on PWC Standard Drawings W2-2-01A, W2-2-1B and W2-1-2.</p> <p>DN1050 MH's are not permitted for new construction."</p>	6.6.2

Requirement	Clause
<p>Delete the first paragraph and insert the following:</p> <p>"Property connection sewers servicing loads ≥ 80EP shall be connected to sewer at a maintenance hole.</p> <p>Property connections servicing loads < 80 EP may be directly connected into a maintenance hole subject to written PWC approval."</p> <p>In the second paragraph, delete "customer sanitary drains" and substitute "property connection sewers".</p> <p>At (b), delete "or external".</p>	6.6.4
<p>Delete the first paragraph and insert the following:</p> <p>"For MH's on sewers \leqDN 300, the minimum internal diameter of MH's shall be 1100mm.</p> <p>For MH's on DN375 sewers, the minimum internal diameter of MH's shall be 1200mm.</p> <p>Refer also Note 13 on PWC Standard Drawing W2-2-01D"</p>	6.6.5
<p>After final paragraph, add:</p> <p>"No more than two internal drops shall be installed in any MH."</p>	6.6.6
<p>Delete reference to SEW-1307.</p> <p>Delete the existing wording and insert the following:</p> <p>"Ladders or step irons are to only be fitted where specifically requested by PWC.</p> <p>Refer to W2-2-04 where ladders are required for MH's up to 6.0m depth to invert. For deeper MH's and where required by PWC, ladders and landings shall specified in accordance with standard drawings SEW-1311 and SEW-1312."</p>	6.6.8
<p>Delete reference to Standard Drawing SEW-1301.</p> <p>Delete reference to Standard Drawing SEW-1308.</p> <p>Delete the first paragraph.</p> <p>In the second paragraph, delete "metal access covers" and substitute "metal covers for concrete in-fill".</p> <p>Refer to Note 1 on PWC Standard Drawing W2-2-01D for guidance on selection of MH covers.</p> <p>After the final paragraph, add the following:</p> <p>"In road reserves and other paved or commonly trafficked areas, manhole covers shall be flush with the finished surface.</p> <p>In areas outside road reserves, manhole covers shall be 150mm above the finished surface.</p>	6.6.9

Requirement	Clause
In areas outside road reserves which are subject to inundation caused by flood water, the finished surface around manhole shall be built up such that the final cover level will exceed the projected 1 in 2 year return period surface water flood level by at least 50 mm. Where this would require construction of maintenance holes more than 0.5 m above the general ground level, construction of maintenance holes below flood level may be permitted where specifically approved by PWC and in accordance with any conditions imposed by PWC."	6.6.9 (cont)
Delete reference to Standard Drawing SEW-1308. Delete reference to SEW-1315.	6.6.10 6.7.1
In the first paragraph, delete "DN 300".	
In the second paragraph, delete the words "and may be used with or without variable bends".	
After the final paragraph, insert the following: "The use of variable bends is not permitted.	
Maintenance Shafts may be incorporated in the sewerage network design in accordance with PWC Standard Drawings W2-1-09, W2-2-07 and W2-2-08.	
Maintenance shafts are only permitted in DN150 and DN225 sewers with no property connections permitted directly into the base of the maintenance shaft.	
A terminal maintenance shaft can be used at the upstream end of the first length provided the length of the resulting top of line sewer is not more than 100m. Terminal maintenance shafts are to be designed in accordance with W2-1-06.	
Property connections are not permitted into terminal maintenance shafts.	
In road reserves and other paved or commonly trafficked areas, maintenance shaft covers shall be heavy duty and flush with the finished surface.	
In areas outside road reserves, maintenance shaft covers shall be 100mm above the finished surface."	
Delete (a)	6.7.2
Delete reference to SEW-1315.	
In the third paragraph, delete reference to Clause 4.6.4.4 and Clause 4.6.4.5.	
At (i), delete "authorised by the Water Agency" and substitute "of 4.5m in Darwin and Alice Springs, otherwise not exceeding 3.0m".	
In the second last paragraph, insert "50mm" in lieu of "300mm". Delete the second paragraph "Where a property connection...".	6.7.3

Requirement	Clause
At (i), insert "300mm" in lieu of "375mm".	7.2.1
Delete reference to SEW-1409.	
Refer PWC Standard Drawing W2-2-06 for in-line and MH gas trap details.	
Delete this clause.	7.2.2
PWC prefers to use gas-check MH's (refer Clause 7.3.1).	
Delete the second paragraph.	7.3.1
Delete the existing wording and insert the following:	7.3.2
"Gas-trap (gas check) MH's shall be provided on reticulation sewers connected to branch and/or trunk sewers DN300 or larger.	
Gas-trap (gas-check) MH's shall be located in road reserves to allow service by an education truck.	
Sewer connections to trunk sewers or to any main downstream of a MH receiving flow from a rising main discharge or an ESTEP system discharge, shall be constructed with a gas trap MH.	
Sewer rising mains shall discharge into a separate gas trap maintenance hole with a transition sewer allowing for minimum turbulence of joining flows. The transition sewer shall connect to the downstream sewer at the soffit level of that sewer via a formed channel through the bench.	
Gas Trap Maintenance Holes and shall be designed in accordance with PWC Standard Drawing W2-2-06.	
Gas trap maintenance holes shall be used in preference to in-line gas traps.	
In-line gas traps, and boundary traps may only be used with PWC approval."	
Before the first paragraph, insert the following:	7.5.1
"Ventilation is required in the Southern Region.	
In the Northern region ventilation may be required dependant on application and location."	
Delete the first paragraph and insert the following:	7.6.2
"Sewers shall be a minimum of DN 225. The sewer shall be made one size larger than determined by following the requirements of Sections 3 and 4. The adopted grade shall be a minimum of 0.5% plus the value shown in Table 4.6(NT)."	
After the final paragraph, insert the following:	
"For sewers <DN 750 installed in a borehole under a major road, a CIPP (cured in place pipe) lining shall be installed in the sewer before the sewer is commissioned. The CIPP lining shall be seamless and light coloured for CCTV inspection.	

Requirement	Clause
For sewers \geq DN 750 installed in a borehole under a major road, the sewer shall be constructed using reinforced concrete 'jacking' pipe with a flexible thermoplastic lining that satisfies the requirements of WSA 113."	7.6.2 (cont)
In (a), delete "ADWF" and insert "PDWF".	7.9.1
Delete the first paragraph and insert the following: "Where an ERS is proposed at a site other than a sewerage pumping station, the Designer shall show evidence that an exhaustive investigation has been carried out to determine whether an ERS is required to ensure that occupational health and safety, public health and safety, or the safety of the sewerage system is maintained. Such evidence should include: <ul style="list-style-type: none"> • design computations to demonstrate that uncontrolled spillage would take place in the system without the construction of an ERS; • longitudinal section plans of the sewers and hydraulic grade lines showing the locations of such uncontrolled spillage; • plans showing alternative locations for the ERS; and • all relevant data used and any assumptions made in the design computations, plus any other information the designer/consultant deem relevant." 	7.9.2
Delete Clause 7.10	7.10
Delete the existing wording and insert the following: "Wet weather storage may be considered only where it is not technically feasible to duplicate or upgrade sewers. Where wet weather storage is required within the sewer catchment at a point upstream of and remote from the sewerage pump station, the overflow storage shall: <ul style="list-style-type: none"> • have capacity to store a minimum of one hour of PWWF (as applicable at that location) • not discharge to the environment" 	7.11.1
Delete the second paragraph ("Refer to Table 10.2 and Products and Materials Information and Guidance...").	8.2
Delete the third paragraph (" <i>It is permissible for the Design Drawings and/or ...</i> "). Delete the third paragraph (" <i>Default maximum depths to invert ...</i> ").	8.3
After the final paragraph, insert the following: "Structural computations are required in the following circumstances: <ul style="list-style-type: none"> • A main passing an existing or proposed railway line in accordance with AS/NZS4292.2. • Any main passing under an airplane runway or any land in an airport which may be subject to abnormal loads; • Any main suspended from a structure such a bridge, duct etc.; and • Any main placed on supports crossing a watercourse or open drain A copy of the calculations shall be provided to PWC."	

Requirement	Clause																														
<p>In the first paragraph, insert ">DN 375" in lieu of ">DN 450".</p> <p>At (d), add "including highest annual water table level".</p> <p>Add:</p> <ul style="list-style-type: none"> (i) type and condition of native soil to one metre below proposed sewer invert (j) horizontal and vertical bearing capacity of native soil when water-logged (k) highest annual water table level (l) suitability of native soil for use as backfill 	8.6.1																														
<p>Delete the existing wording and insert the following:</p> <p>"Pipe trench width design requirements and embedment types are set out in the PWC Water Supply and Sewerage Construction Master Specification.</p> <p>Unless geotechnical investigations have been completed and the resultant report supports the use of lower quality bedding, a minimum of Type 2 embedment shall be used for pipe bedding."</p> <table border="1"> <thead> <tr> <th>APPLCIATION</th> <th>MINIMUM PERMISSIBLE EMBEDMENT TYPE</th> <th>COMMENTS</th> </tr> </thead> <tbody> <tr> <td>Under roadways (open cut)</td> <td>4</td> <td>Use cement stabilised sand for trench fill (backfill)</td> </tr> <tr> <td>Under drains</td> <td>4</td> <td>Use 5% cement stabilised gravel for trench fill (backfill)</td> </tr> <tr> <td>Areas with high water table</td> <td>2A / 2B</td> <td>Consider use in conjunction with geotextile</td> </tr> <tr> <td>Areas subject to tidal inundation</td> <td>2A / 2B</td> <td>Consider use in conjunction with geotextile</td> </tr> <tr> <td>Areas where water table is influenced by tides</td> <td>2A / 2B</td> <td>Consider use in conjunction with geotextile</td> </tr> <tr> <td>Poor native soils</td> <td>2A / 2B</td> <td></td> </tr> <tr> <td>High subsoil drainage flows</td> <td>2B</td> <td>Use in conjunction with geotextile</td> </tr> <tr> <td>Grades > 5%</td> <td>1 / 2</td> <td>Use trenchstops or bulkheads in accordance with Clause 8.10</td> </tr> <tr> <td>Normal</td> <td>1</td> <td></td> </tr> </tbody> </table>	APPLCIATION	MINIMUM PERMISSIBLE EMBEDMENT TYPE	COMMENTS	Under roadways (open cut)	4	Use cement stabilised sand for trench fill (backfill)	Under drains	4	Use 5% cement stabilised gravel for trench fill (backfill)	Areas with high water table	2A / 2B	Consider use in conjunction with geotextile	Areas subject to tidal inundation	2A / 2B	Consider use in conjunction with geotextile	Areas where water table is influenced by tides	2A / 2B	Consider use in conjunction with geotextile	Poor native soils	2A / 2B		High subsoil drainage flows	2B	Use in conjunction with geotextile	Grades > 5%	1 / 2	Use trenchstops or bulkheads in accordance with Clause 8.10	Normal	1		8.9
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<p>After the first paragraph, insert the following:</p> <p>"In the Northern Region, consideration shall be given to the installation of concrete bulkheads on each side of road crossings where soil groundwater may drain from one side of the road to the other via the pipe trench."</p> <p>Delete the fifth paragraph ("<i>Bulkheads and trenchstops may not required ...</i>").</p>	8.10																														
Refer also PWC checklists 1, 2 & 3	9.1																														
Refer also PWC checklists 1 & 2.	9.2.3																														

Requirement	Clause
Add: (o) in tabulated form; size, length, connection type and IL of property connections. The IL is the level at the connection of PWC and private sewers. (p) length from upstream manhole to property connection junction	9.2.5
Add: (j) location of sacred sites (k) AAPA permit numbers	9.2.7
PWC drawing standards are available on the PWC website (www.powerwater.com.au)	9.3
Delete the existing wording and insert the following: "The required scale for Master Services Drawings is 1:500."	9.3.1
Delete the existing wording and insert the following: "All drawings to be provided in CAD format .DGN or .DWG. Where a hard copy of 'as-constructed' information is required it shall be provided on Mylar (film) and to the approved page size. All 'as-constructed' drawings shall be provided at least one week prior to scheduled handover inspection. All 'as-constructed' survey information shall be collected by surveyors. Cadastral surveys to be undertaken by registered surveyor. Certification of all 'as-constructed' information shall be undertaken by the certifying consulting engineer. Manufacturer details of any specific infrastructure shall be included in the 'as-constructed' information. Details of material to include type, class and manufacturer. MGA Coordinates for infrastructure including valves, maintenance holes, maintenance shafts, property connection junctions and property connection points shall be provided. Provide Final Design report to PWC at least one week prior to scheduled handover inspection. Operations and Maintenance manuals for rotating mechanical infrastructure shall be provided to PWC at least one week prior to scheduled handover inspection. This shall include, but not be limited to, pumps, pump controls, valve controls and valve actuators."	9.3.2
Replace with Revised Appendix A. Refer below.	Appendix A
Delete Appendix B	Appendix B

REVISED APPENDIX A – ASSESSMENT OF FUTURE LOADS**A1 GENERAL**

Determination of equivalent population (EP) is required as an element of design flow estimation for undeveloped areas or where an existing system does not have flow gauges.

The method detailed below differentiates between residential "synchronous" discharges and commercial / industrial development discharges. Peak discharges from office blocks and industries generally do not follow the same morning and evening peaks exhibited by residential areas. Commercial and industrial peaks may occur at any time during working hours and seldom synchronise.

Rather than sum the EP of each industrial development, a "dispersion factor" is applied to multiple industrial developments of identical classification to avoid over-estimation of industrial flows. For a building that comprises both residential dwellings and commercial areas (eg. high rise apartment block with ground level commercial areas [eg. restaurant, hairdresser, real estate office, convenience store]).

Where an area or catchment is predominantly industrial or commercial (eg. less than 50% of total EP is attributable to "synchronous" developments), then estimation methods will need to be adjusted. In these circumstances, consult with PWC.

A2 ESTIMATION METHOD

Equivalent Population (EP) should be calculated as the sum of the residential, commercial and industrial loadings of the proposed development:

$$EP = \Sigma (EP_{\text{Residential}} + EP_{\text{Commercial}} + EP_{\text{Industrial}})$$

For residential areas the EP shall be determined based on the following density per residential unit, given in Table S2. The table refers to existing zonings referred to in the Northern Territory Planning Scheme; however the designer must refer to the specific Planning Scheme or the associated Land use Objectives within which the development takes place and equate the specific zonings to those listed in the table.

TABLE S2(A) RESIDENTIAL POPULATION DENSITY BY ZONE

ZONE	ALLOWANCE (EP)
SD - Single Dwelling Residential (including rural dwellings)	3.5 per dwelling unit
MD – Multiple Dwelling Residential	2.2 per dwelling unit
MR – Medium Density Residential	2.0 per dwelling unit
HR – High Density Residential	2.0 per dwelling unit
CV - Caravan Park	2.0 per site

Rural Living/ Residential Lots (not normally connected to sewer)

Land Use	Population Density	Comment
Rural Lot – less than 2 ha	≥ 3.5 EP/gross ha	Default – one dwelling/lot
Rural Lot – 2 ha Lot	4.5 EP/gross ha	Default – two dwellings/lot
Rural Lot – 3 ha Lot	3.5 EP/gross ha	Default – two dwellings/lot
Rural Lot – 5 ha Lot	2.4 EP/gross ha	Default – two dwellings/lot
Rural Lot – 8 ha Lot or more	1.5 EP/gross ha	Default – two dwelling/lot
RL	Refer to PWC	

The following tables S2(B) provide estimates of contributions to EP from residential areas where defined lot layouts are not available. They are based on area and should only be used where more data is not available on the development.

TABLE S2(B) RESIDENTIAL POPULATION DENSITY BY AREA

Residential – Single Occupancy Lots

Classification	Gross Area		Nett Area		Remarks
	Unit	EP per Unit	Unit	EP per Unit	
Single lot 1000m ²	gross hectare	25	net hectare	35	Default lot size is 700m ² . Approx 30% of gross area considered to be used for roads, parks etc.
Single lot 700m ²	gross hectare	35	net hectare	50	
Single lot 500m ²	gross hectare	50	net hectare	71	
Single lot 300m ²	gross hectare	80	net hectare	114	

Residential – Multiple Occupancy Lots

Classification	Gross Area		Nett Area		Remarks
	Unit	EP per Unit	Unit	EP per Unit	
MD (group housing)	gross hectare	45	net hectare	64	Default - 20 dwellings per gross hectare
MR (up to 4 storey)	gross hectare	96	net hectare	136	Default - 48 dwellings per gross hectare
HR (up to 5 storey)	gross hectare	120	net hectare	171	Default - 60 dwellings per gross hectare
HR (up to 8 storey)	gross hectare	190	net hectare	271	Default - 96 dwellings per gross hectare
HR (up to 12 storey)	gross hectare	280	net hectare	400	Default - 144 dwellings per gross hectare
CV (Caravan Park)	gross hectare	80	net hectare	114	Default - 40 sites per gross hectare

Table S3 provides estimates of contributions to EP from commercial developments and special cases such as schools, parks and clubs.

TABLE S3 EQUIVALENT POPULATIONS FOR NON-RESIDENTIAL DEVELOPMENT

Commercial / Special Cases

Land Use	Unit	Base Rate	% Non-Synchronous flow
Business Office/Shopping Centre	EP/gross ha	20	60
Retail, Transport Industrial Area, Office Staff	EP/person	0.2	
	EP/Visitors	0.05	
Commercial/Light Industries, Sports Centre, Church, Airport, Traven, Pub, Club, Child Care Centre, Airport, Public halls and function room ¹	EP/gross ha	35	60
	EP/person	0.3	
	EP/Visitors	0.05	
Hotel, Motel, Institutional Accommodation, Nursing Home, Prison/, Sports Centre, Hostel, Service Stations, Prisons, Take Away Food, Restaurants, Cafes and bars, Military Camp, Boarding School ¹	EP/gross ha	40	100
	EP/person	0.5	
	EP/Visitors	0.05	
School ¹	EP/Student & Staff	0.3	60
	EP/Visitors	0.05	
Health Care Centre, Hospital ²	EP/gross ha	175	60
	EP/Bed	2.5	
	EP/Visitors	0.05	
General Industries (low water dependent)	EP/gross ha	60	60
Future Unknown Industrial Area ³	EP/gross ha	150	60
Playing Fields, Parks, Open Space ⁴	EP/gross ha	20	50
Outdoor Entertainment	EP/gross ha	20	50
	EP/visitor	0.05	

1. Use the maximum number of occupants for which the facilities were designed and/or licensed
2. Use only number of available beds – allowance for staff, visitors and staff accommodation included in EP/available bed rate.
3. Only used when the future types of industry are unknown – otherwise use Table A2 and Table A3
4. Use other Tables to calculate load from club facilities etc.

Where a suitable category does not exist or if it is more appropriate then, with PWC approval, Tables A2 and A3 may be used to estimate EP.

A2.1 Residential Component**A2.1.1 Single Occupancy Lots**

The contribution to EP should be taken as 3.5 per single occupancy lot (ie. a single residence or dwelling - refer also to Clause 3.5.1).

If the number of single residences or dwellings is not known (ie. areas reserved for future residential development without a defined lot layout):

- (a) Assume that 70% of the gross area designated "SD" will contain single dwellings (ie. 30% allowance for parks, roads etc); and
- (b) Estimate the average area, in square metres, of a single occupancy lot

The number of single occupancy lots can then be calculated from:

$$\text{Number of single occupancy lots} = \frac{0.7 * \text{Gross hectares} * 10,000}{\text{Average area in m}^2 \text{ of a single occupancy lot}}$$

The default area for SD lots is 700m². Where indicative lot size is less than 700m², then the smaller area should be used in EP estimation.

A2.1.1 Multiple Occupancy Lots

For multiple occupancy lots, use the applicable EP allowance as listed in Table S2.

A2.2 Commercial & Special Use Components

Contributions from commercial and special use properties such as schools and clubs should be determined from records of similar developments. Table S3 provides default values where such records are not available.

A2.3 Industrial Component**A2.3.1 General**

For industrial developments, for which the types of developments are known and tables in S3 do not cover the type of development then, Tables A2 and A3 may apply with the approval of PWC. If there is inadequate information about the specific types of commercial and industrial development or if Table A2 does not adequately describe the development, Table S2 may be used (ie. 150 EP per gross hectare for 'future industrial areas').

A2.3.2 Use of Tables A2 & A3

Industrial contributions to EP may be determined as follows:

- (a) Locate the relevant industry type (ie. columns 1 to 3 of Table A2) and for each industry type, identify the relevant "EP classification" (ie. numbers 1 to 10 from column 4)
 - (i) Assess the number of independent sewer connections of identical EP classification (eg. "1" for one laundry, "3" for three laundries etc.). This number is "N" in Table A3.
 - (ii) Using the "EP classification number" from table A2 and the number of identical connections, "N", extract the EP per built-up hectare from Table A3.

(b) For each type of development, determine the built-up area (in hectares) from a plan of the proposed site. Note that built-up area refers to the floor area of buildings (eg. lettable area) and not gross hectares.

(c) For each type of development, calculate the EP from:

$$EP = (EP \text{ per built-up hectare}) * (\text{built-up area in hectares})$$

(d) Sum the contribution of each type of development to give the total commercial/industrial contribution to EP.

**TABLE A2 NON-SYNCHRONOUS DISCHARGES
LIST OF INDUSTRIES AND THEIR EP CLASSIFICATIONS**

INDUSTRY			EP Classification	Notes
Meal Preparation	Non-Residential	Restaurant	8	
		Cafeteria	8	
		Canteen	8	
		Caterers	8	
Food Manufacture	Dairy	Milk	2	
		Cheese, butter & yoghurt	4	
		Ice cream	6	
	Fruit & Vegetable	Cannery	5	
		Condiments & sauces	5	
	Meat	Abattoir	5	
		Rendering tallow	6	
		Gelatine and glue	4	
		Poultry	3	1
		Small-goods	5	
	Grain	Flour milling	10	
		Starch	4	1
		Edible oils & fats	3	
		Cereals	7	
		Bakery	10	
		Biscuits & cakes	7	1
	Beverages	Beer	5	1
		Soft drinks & cordials	6	
Others	Yeast	3		
	Confectionary	8		
	Salt	6		
Textiles and Leather	Tannery & Hides		5	1
	Wool	Wool scour	3	1
		Felt & carpet	6	
		Dyeing & spinning	6	1
Cotton & Synthetics	Dyeing & spinning	6	1	
Chemical	Petrochemical	Oil refinery	10	(2)
	Pharmaceutical		7	
	Organic	Liquids	6	
		Resins, polymers & plastics	6	
		Adhesives	6	
		Soaps & detergents	7	
Paint manufacture	8			

**TABLE A2 NON-SYNCHRONOUS DISCHARGES
LIST OF INDUSTRIES AND THEIR EP CLASSIFICATIONS**

INDUSTRY			EP Classification	Notes
Metal Processing	Metal finishing	Electroplating	6	1
		Anodising	6	
		Galvanising	6	
Metal Processing	Battery manufacture	Dry cell	7	
		Wet cell (lead acid)	7	
	Engineering	Machine shops	7	1
		Sheet metal	7	1
		Foundry	7	1
		Rolling	5	1
Extrusion	7	1		
Manufacture – Non-Metallic	Paper		8	
	Plastics		6	
	Wood		8	
	Mining (Earth)	Glass	8	
		Fibre cement	9	
Concrete products	5			
Services	Laboratories	Industrial & research	5	
	Laundries	Industrial	1	
	Others	Film Processing	6	1
Future Processing				4

NOTES:

- Some industries may have discharges much larger than usual. Discharges should be reviewed against available information for the development.
- Building area not applicable. Total property area is used.
- For high-rise CBD hotels and motels, use "High-rise hotels" from Table S3
- Where the type of future industry is unknown, use "Future industrial areas" from Table S3

**TABLE A3 EP OF NON-RESIDENTIAL EP/ha CLASSIFICATIONS
EP PER BUILT-UP HECTARE (BU)**

	N=1	N=2	N=3	N>3
1	15 000	10 000	9 150	8 400
2	10 000	6 700	6 100	5 600
3	8 000	5 360	4 880	4 480
4	6 000	4 020	3 660	3 360
5	4 000	2 680	2 440	2 240
6	2 000	1 340	1 220	1 120
7	1 000	670	610	560
8	500	335	305	280
9	250	168	152	140
10	100	67	61	56

NOTES:

- In this table, N is the number of independent industrial connections to a sewer of industries having the same EP classification. The table incorporates a dispersion factor for multiple connections having equivalent loadings.
- Industrial discharges may vary considerably in volume and rate (eg. from 'dry' trades where domestic sewage only is discharged, to 'wet' industries such as laundries where large volumes are discharged at high peak flows). For the purposing of determining N values, factories should be grouped so that those in each group have no more than a 10 to 1 range in peak dry weather discharges (EP). Flows should be assumed to be non-synchronous.