Plumbing and Drainage

Designing sanitary plumbing systems

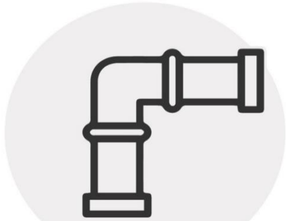
Presenters:
Sam Wood, Shay Harrop and Bruce Klein

Part 2 of 3 | Plumbing and drainage design | Webinar series

What we'll cover

Webinar 1

Plumbing & Drainage Foundations



Webinar 2

Foul Water Fundamentals

- RFI data
- Pipe sizing and gradient
- Ventilation
- Junctions
- Gullies
- Cover
- Structure
- Maintenance

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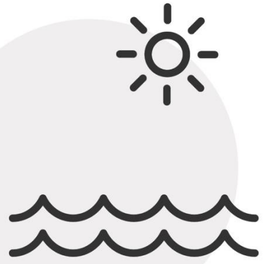
Webinar 3

Safe & Sustainable Water Supply



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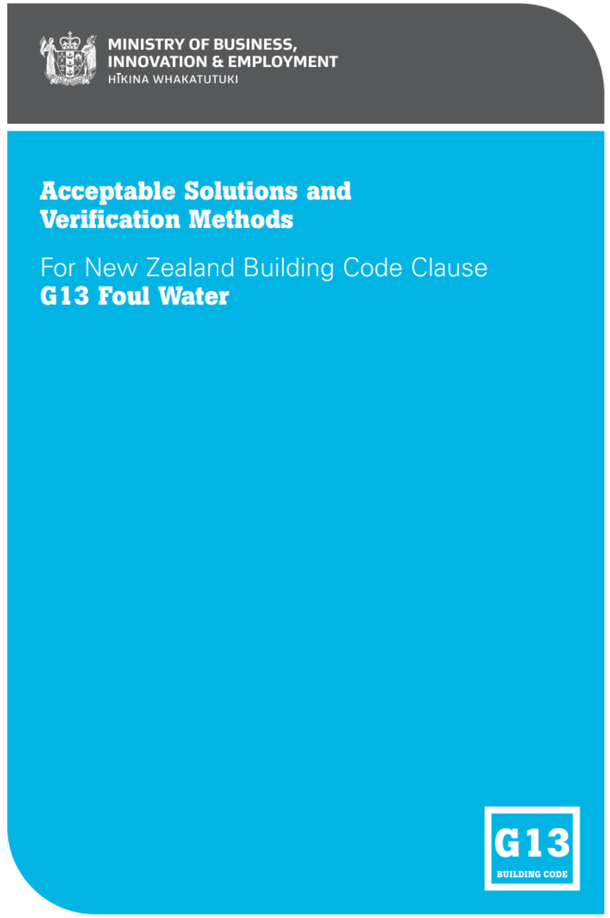
Good design improves life

Acceptable Solutions

- G12/AS1 – above-ground sanitary plumbing, 3 floors or fewer
- G13/AS2 – below-ground foul water drains no greater than 150 mm
- G13/AS3 – AS/NZS 3500.2 subject to modifications



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Quick quiz

From the 18 councils surveyed, what was the most common request for information on building plans?

Venting drains

What we'll cover

Webinar 2

Foul Water Fundamentals

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- **RFI data**
- Pipe sizing and gradient
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- Junctions
- Gullies
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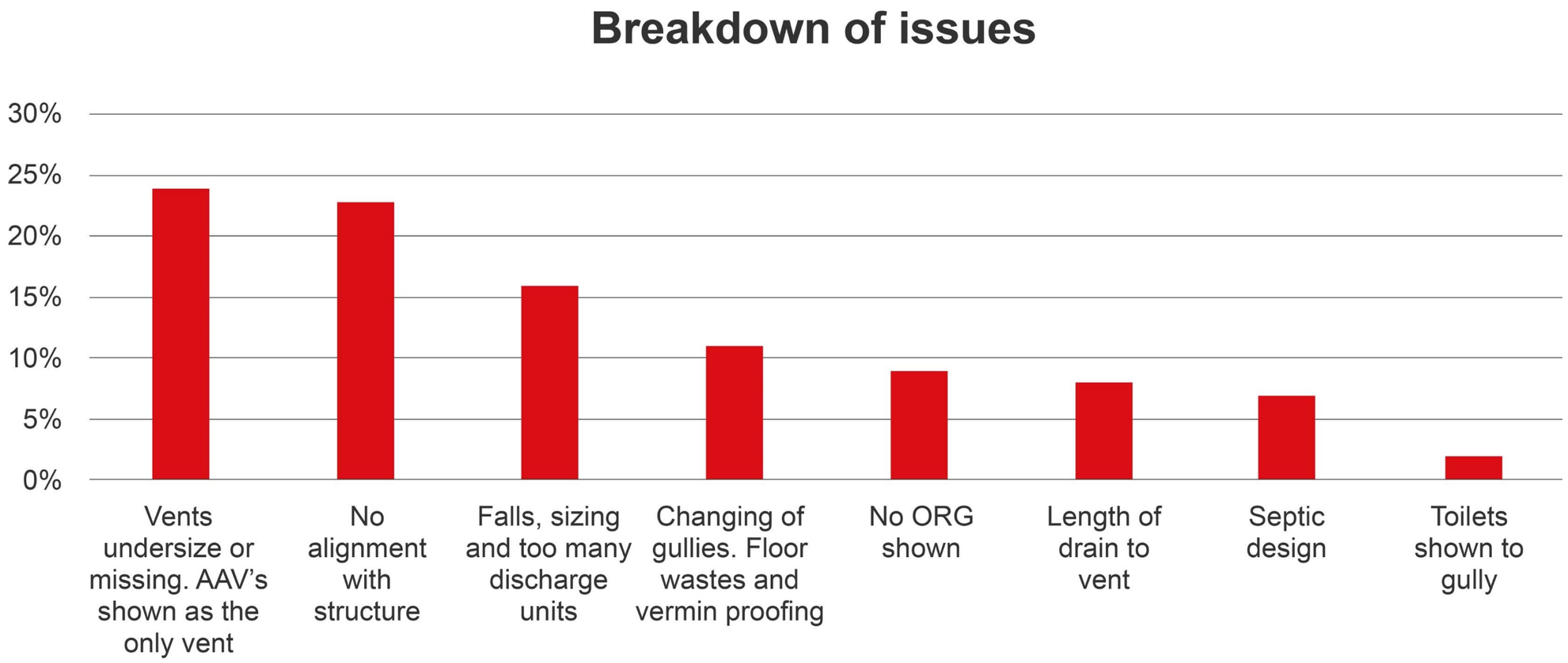
Common RFI's based on BCA data

Request for Information data



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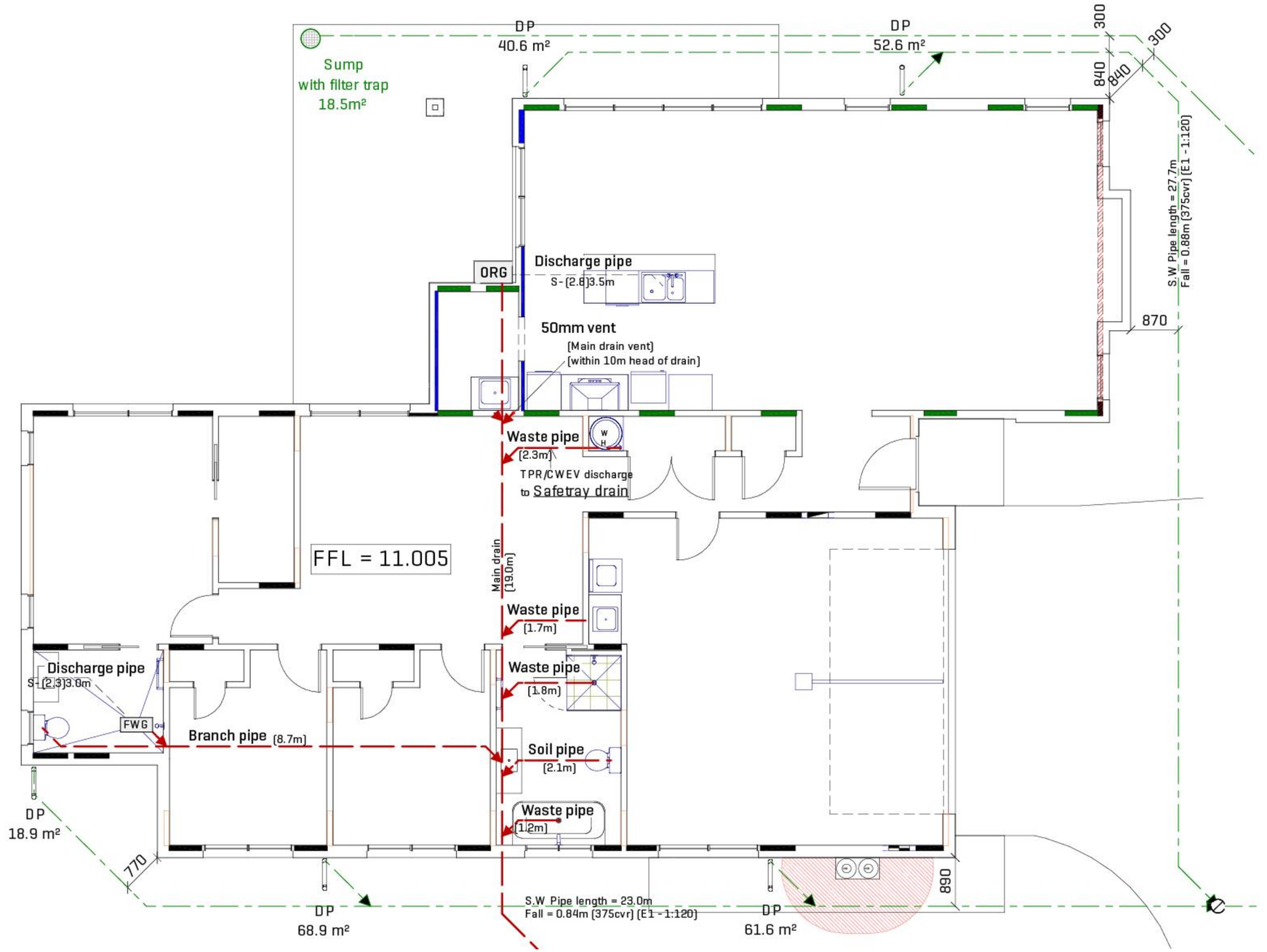
Definitions



Quick quiz

What is the minimum size pipe that can used for a branch drain?

65 mm

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Foul Water Fundamentals

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- RFI data
- **Pipe sizing and gradient**
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What do the different Acceptable Solutions require?

Pipe sizing and gradient

Table 2. Discharge units and fixture discharge pipe sizes.

Fixture type	Discharge units	Minimum discharge pipe size (mm)
Basin	1	32
Bath (with or without overhead shower)	4	40
Bathroom group (WC pan, bath and shower, bidet and basin all in one room)	6	For combined discharge pipe sizes for groups of fixtures, see Table 3
Bidet	1	32
Cleaner's sink	1	40
Clothes washing machine (domestic)	5	40
Dishwasher (domestic)	3	40
Drinking fountain	1	25
Kitchen sink (commercial)	3	50
Kitchen sink (domestic, single or double with waste disposal unit)	3	40
Laundry (single or double tub with washing machine)	5	40
Shower	2	40
Urinal (1 or 2 stall type)	1 per 600 mm	50
Urinal (3 or more stalls)	1 per 600 mm	80
Urinal (bowl type)	1	32
WC pan	4	80

Adapted from G13/AS1 Table 2.

Table 6. Fixture unit ratings.

Sanitary fixture or appliance	Minimum size of trap outlet and discharge pipe (DN)	Fixture unit rating
Basin	32	1
Bidet	32	1
Drinking fountain	25	1
Cleaning sink	40	1
Urinal (wall-hung)	32	1
Urinal (stall type or each 600 mm length)	80–100	1 (per 600 mm section)
Shower (single)	40	2
Shower (multiple per head)	40	2 (per head)
Sinks (single or double + disposal unit)	40	3
Dishwasher (domestic)	40	3
Bath (with or without overhead shower)	40	4
Shub (combined shower and bath tub)	40	4
WC pan (cistern flush)	80–100	4
Clothes washing machine (domestic)	40	5
Laundry tub/trough (single or double)	40–50	5
WC pan (flushing valve)	80–100	6
Bathroom fixtures in one compartment including hand basin, bath, shower, WC	80–100	6
Floor waste gully (without fixture connections)	50–80	0
Floor waste gully (with fixture connections)	See Figure 69	Sum of all fixture units connected

Notes:

- For any fixture with a discharge in excess of 500 litres, refer to AS/NZS 3500.2:2021 Table 6.3B.
- For specialist and healthcare fixture unit ratings, refer to AS/NZS 3500.2:2021 Table 6.3A.

Adapted from AS/NZS 3500.2:2021 Table 6.3A.

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Pipe sizing and gradient – G13/AS1

Table 3. Discharge unit (DU) loading for stacks and graded discharge pipes.

Diameter (mm)	Maximum discharge from any one floor	Maximum loading at base of vertical stack	Maximum DUs for a gradient of:				
			1:20	1:30	1:40	1:50	1:60
32	1	1	1				
40	2	6	6	5	4	not permitted	
50	5	15	15	10	8		
65	6	18	51	29	21		
80	13	40	65	39	27	20	16
100	65	195	376	248	182	142	115

Adapted from G13/AS1 Table 4.

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Pipe sizing and gradient – G13/AS2

Table 30. Minimum drain size and gradients related to the discharge units carried.

Drain diameter (mm)	Minimum gradient									
	1:20	1:40	1:60	1:80	1:100	1:120	1:140	1:160	1:180	1:200
	Total discharge units carried by pipe (obtained from Table 3)									
80	215	100	61	44	34					
100	515	255	205	149	122	104				
150	2,920	1,790	1,310	1,040	855	760	677	611	558	515

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Pipe sizing and gradient – G13/AS3

AS/NZS 3500.2 – graded discharge pipes

Table 7. Maximum allowable discharge units related to pipe size and gradient in graded discharge pipes.

Minimum gradient of pipe		Discharge pipe diameter (DN)				
%	Ratio	40	50	65	80	100
5.0	1:20	6	15	51	65	376
3.35	1:30	5	10	29	39	248
2.5	1:40	4	8	21	27	182
2.0	1:50	Combinations of gradients and pipe sizes not permitted			20	142
1.65	1:60				16	115

Notes:

- For larger pipe sizes and lower gradients, refer to AS/NZS 3500.2:2021 Table 8.2.2(A).
- It is recommended that a discharge pipe from a WC with a 4.5 litre flushing cistern has a minimum gradient of 2.5% not 1.65%.

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Pipe sizing and gradient – G13/AS3

AS/NZS 3500.2 – drainage

Table 34. Minimum drain size and gradients related to the fixture units they carry.

Gradient		Size of drain (DN)				
		65	80	100	125	150
Ratio	%	Fixture unit loadings				
1:20	5.00	60	215	515	1,450	2,920
1:30	3.35	36	140	345	1,040	2,200
1:40	2.50	25	100	255	815	1,790
1:50	2.00		76	205	665	1,510
1:60	1.65		61	165	560	1,310
1:70	1.45		(50)	(140)	485	1,160
1:80	1.25		(42)	(120)	425	1,040
1:90	1.10	These combinations not permitted			(380)	935
1:100	1.00				(340)	855

Note: Figures in brackets are the maximum fixture units under reduced gradient rules.

Adapted from AS/NZS 3500.2:2021 Table 3.3.1.

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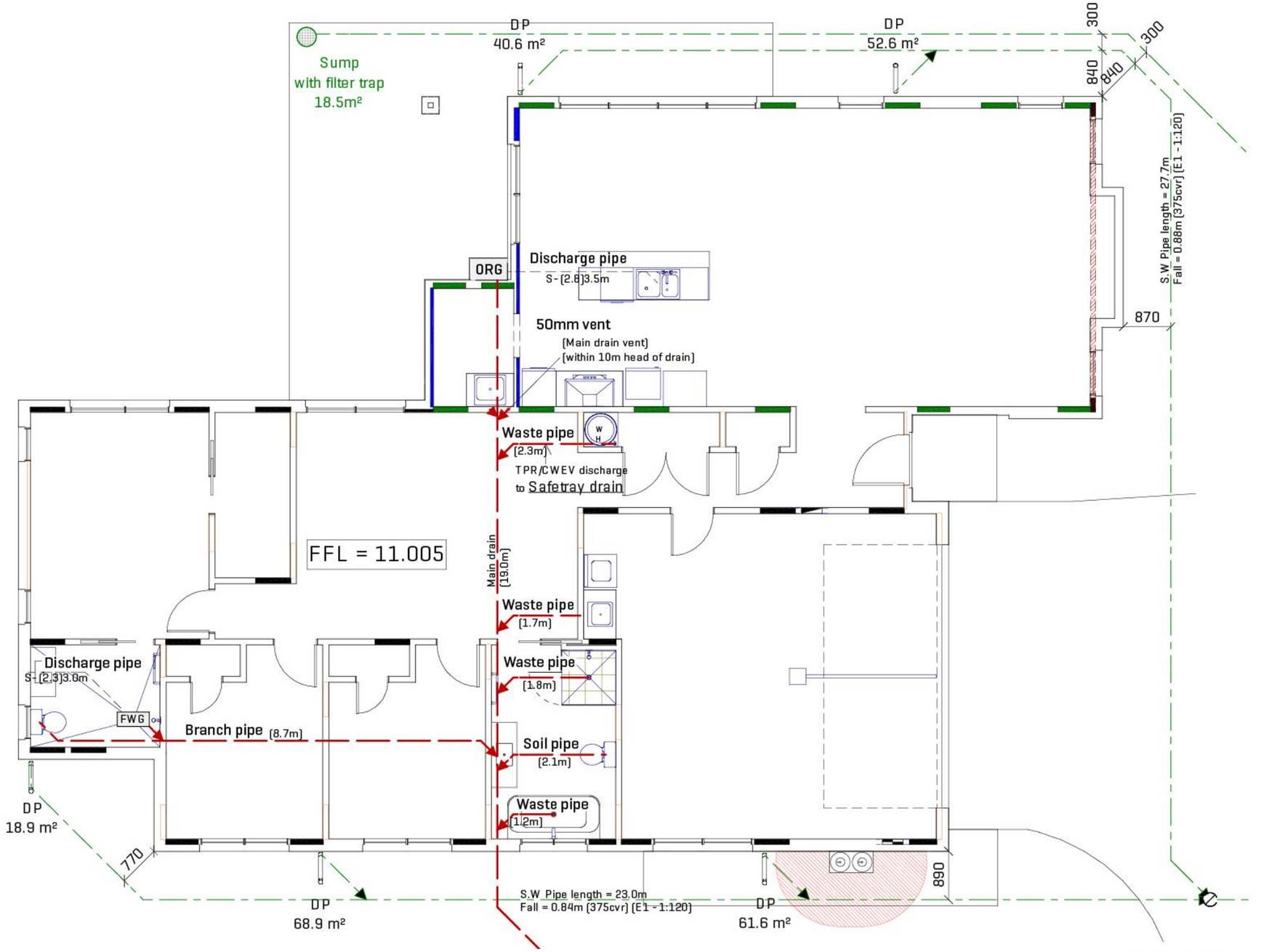
Pipe sizing and gradient - example



Quick quiz

According to G13/AS1, what is the minimum required size for at least one terminal vent in the system?

80mm for G13/AS1 allowing for reduced falls if AS 3500 50mm but falls increase

What we'll cover

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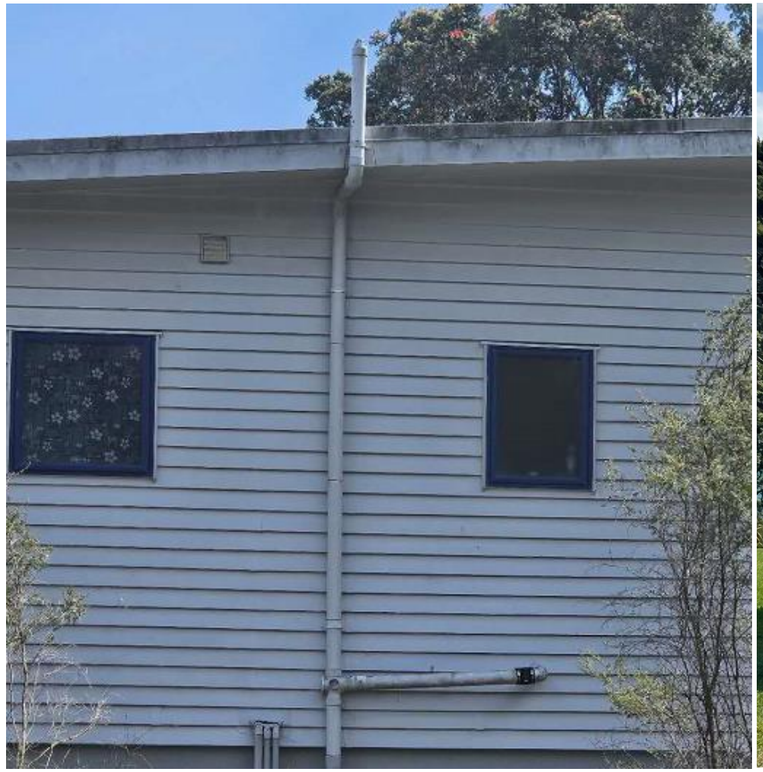
Foul Water Fundamentals

YOU ARE HERE NOW

- RFI data
- Pipe sizing and gradient
- **Ventilation**
- Junctions
- Gullies
- Cover
- Structure
- Maintenance

What do you need to consider?
What do the different stack systems require?
Where do you put them?

Venting



G13 venting – fully vented

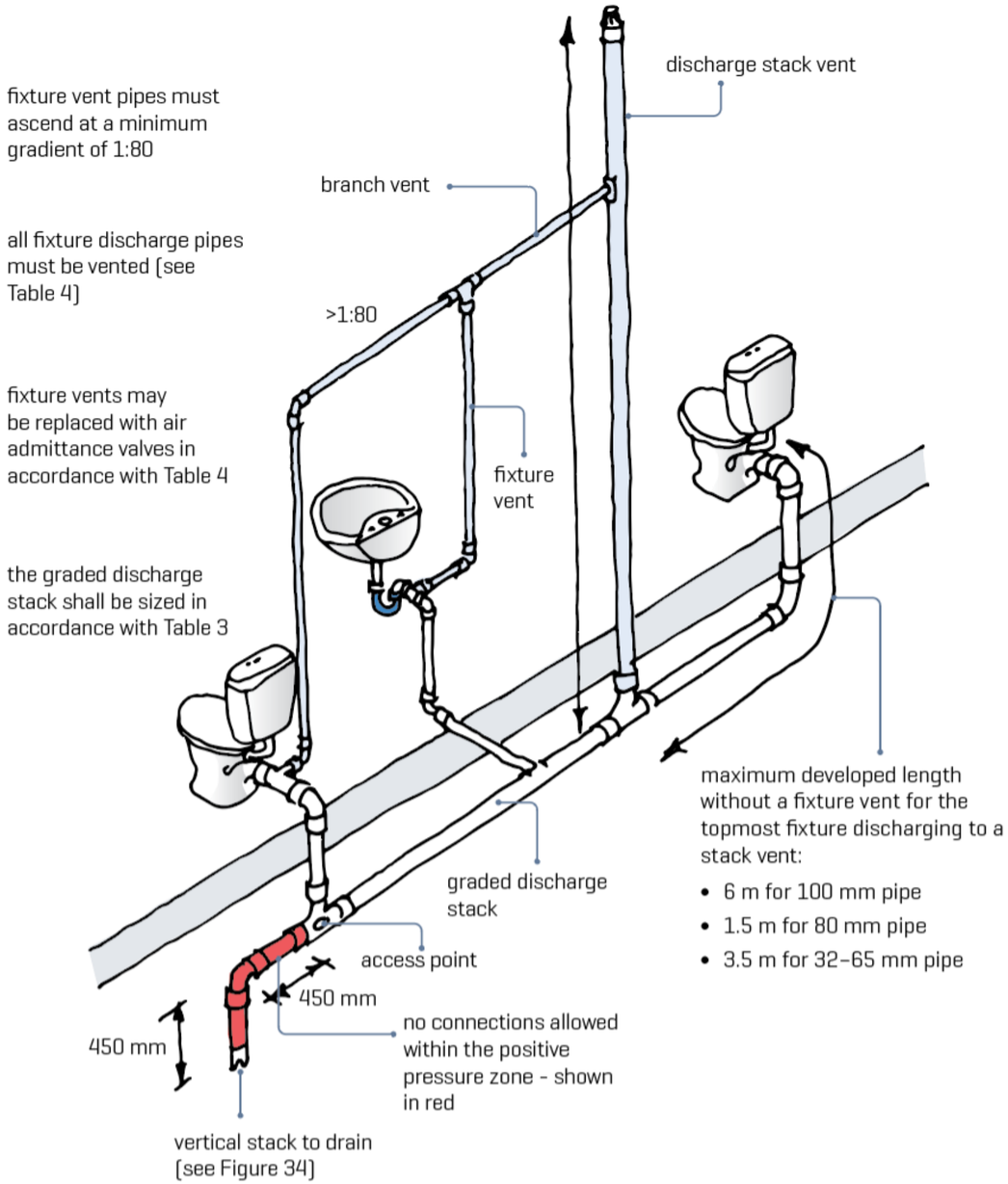
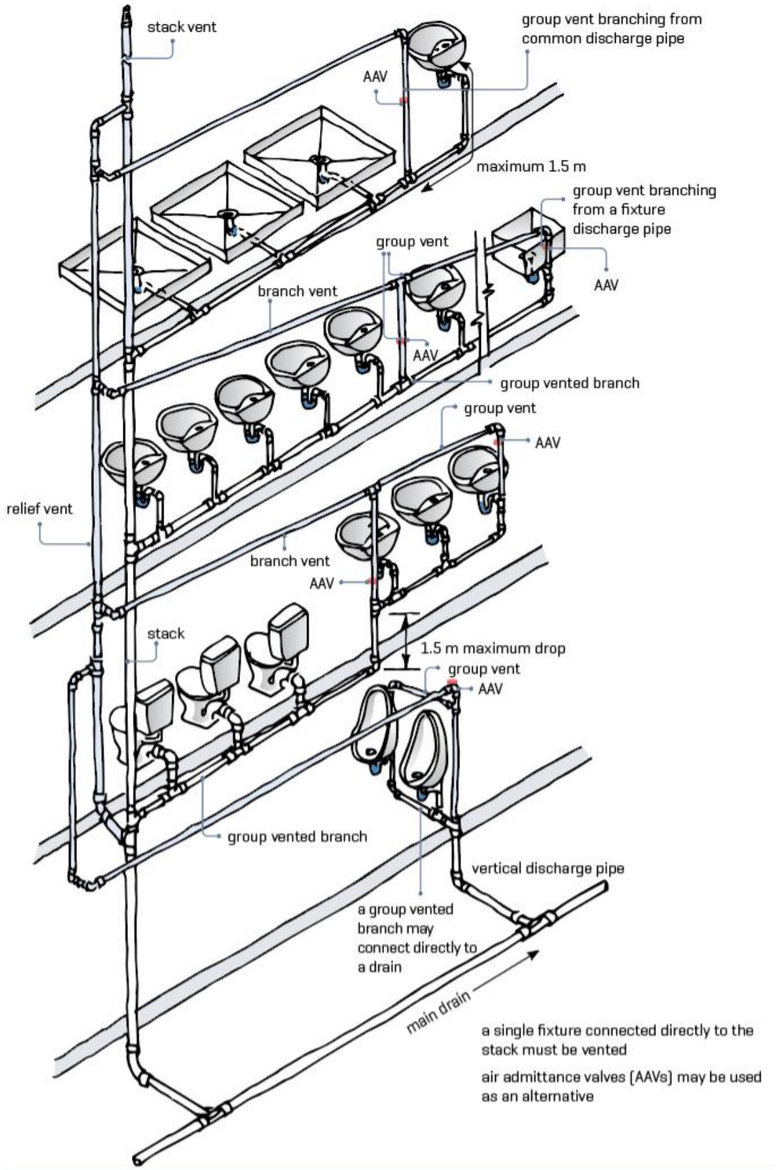


Figure 20. Basic rules for a graded discharge stack.

AS/NZS 3500.2 – fully vented modified



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected

the Y connections for branch connections must discharge to pipes in the vertical plane

15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 127. Basic principles for a fully vented modified system – the principles apply to all types of fixtures.

AS/NZS 3500.2 – single stack

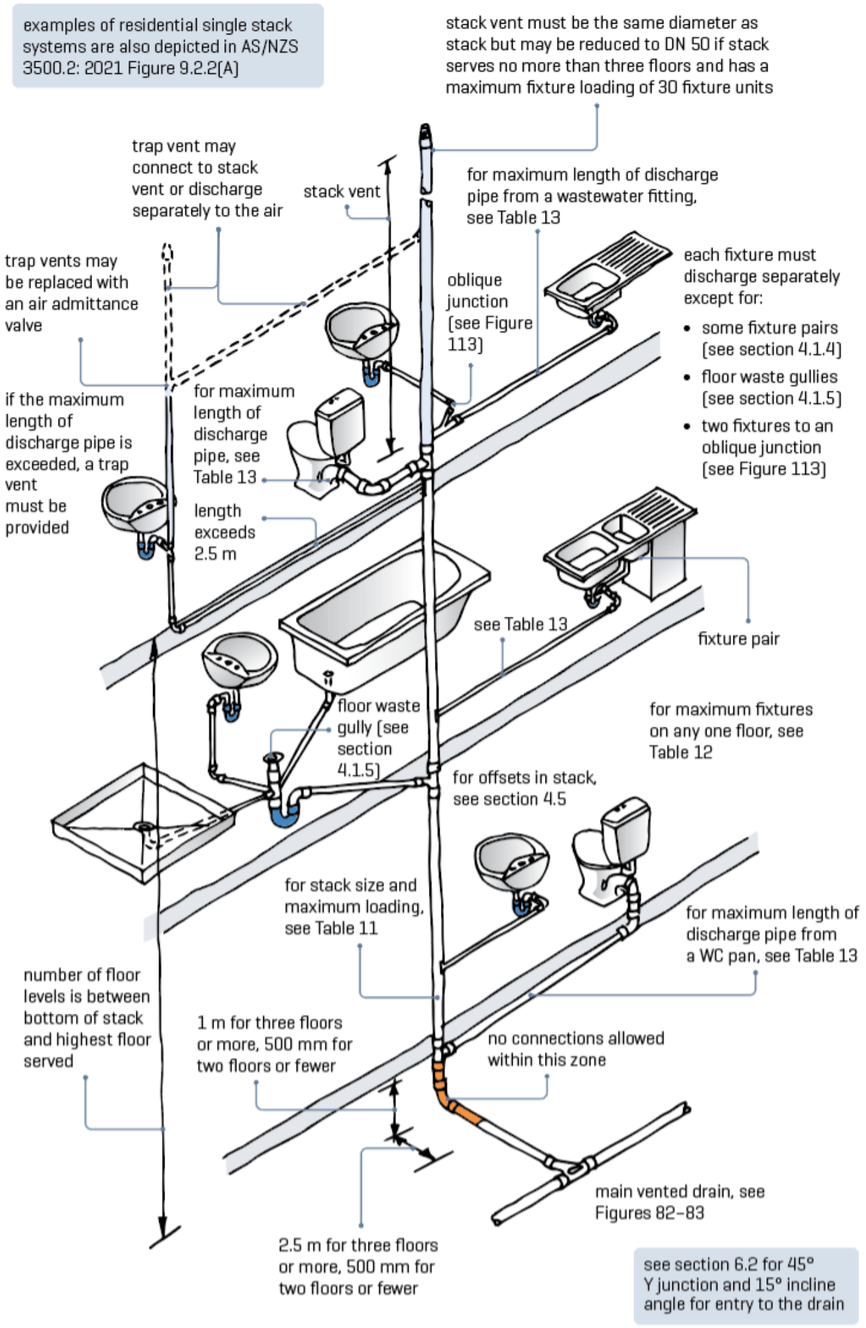
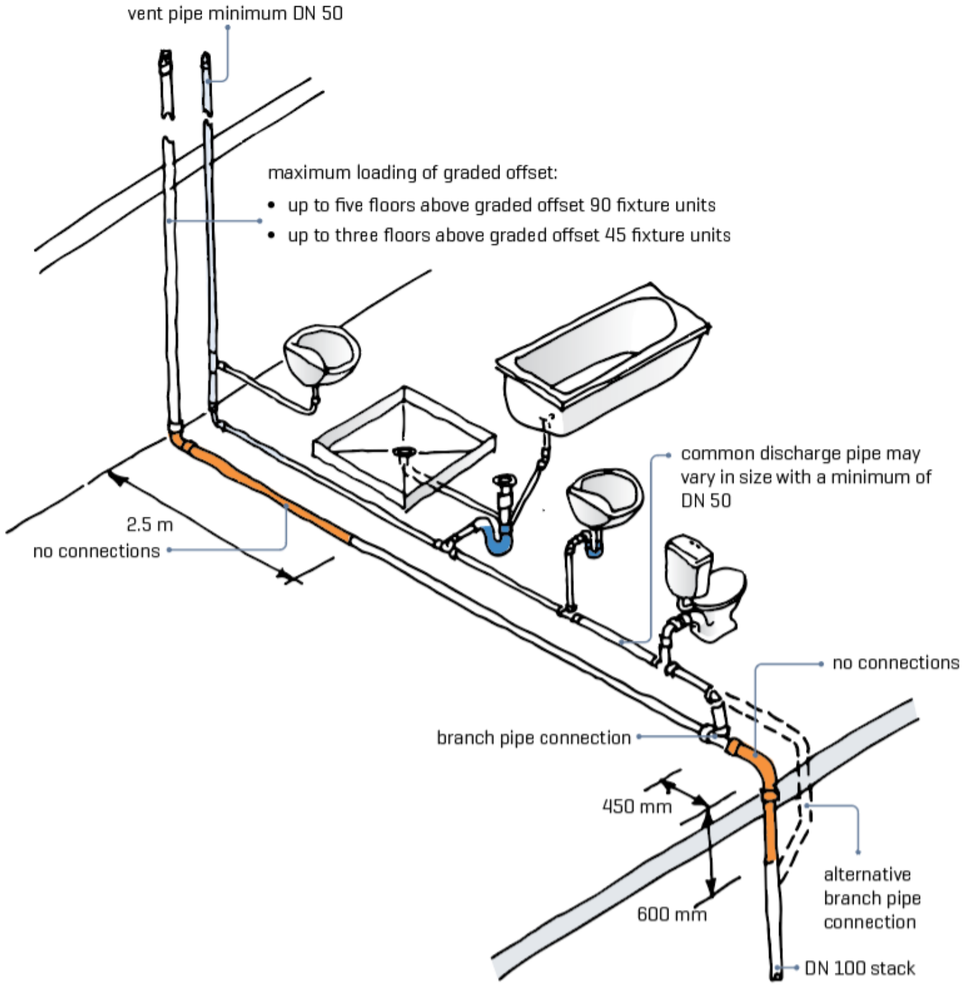


Figure 104. Basic principles for single stack system in a residential building.

AS/NZS 3500.2 – single stack



the branch discharge pipe shall be at least 10 mm higher than the soffit discharge pipe to which it is connected
the Y connections for branch connections must discharge to pipes in the vertical plane
15° incline is required for 100 mm branch discharge pipes connected to 100 mm discharge pipes in the horizontal plane

Figure 123. Connection of multiple fixtures into or below a graded offset of a DN 100 single stack.

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AS/NZS 3500.2 – single stack modified

examples of residential single stack modified systems are also depicted in AS/NZS 3500.2: 2021 Figure 9.2.3(A)

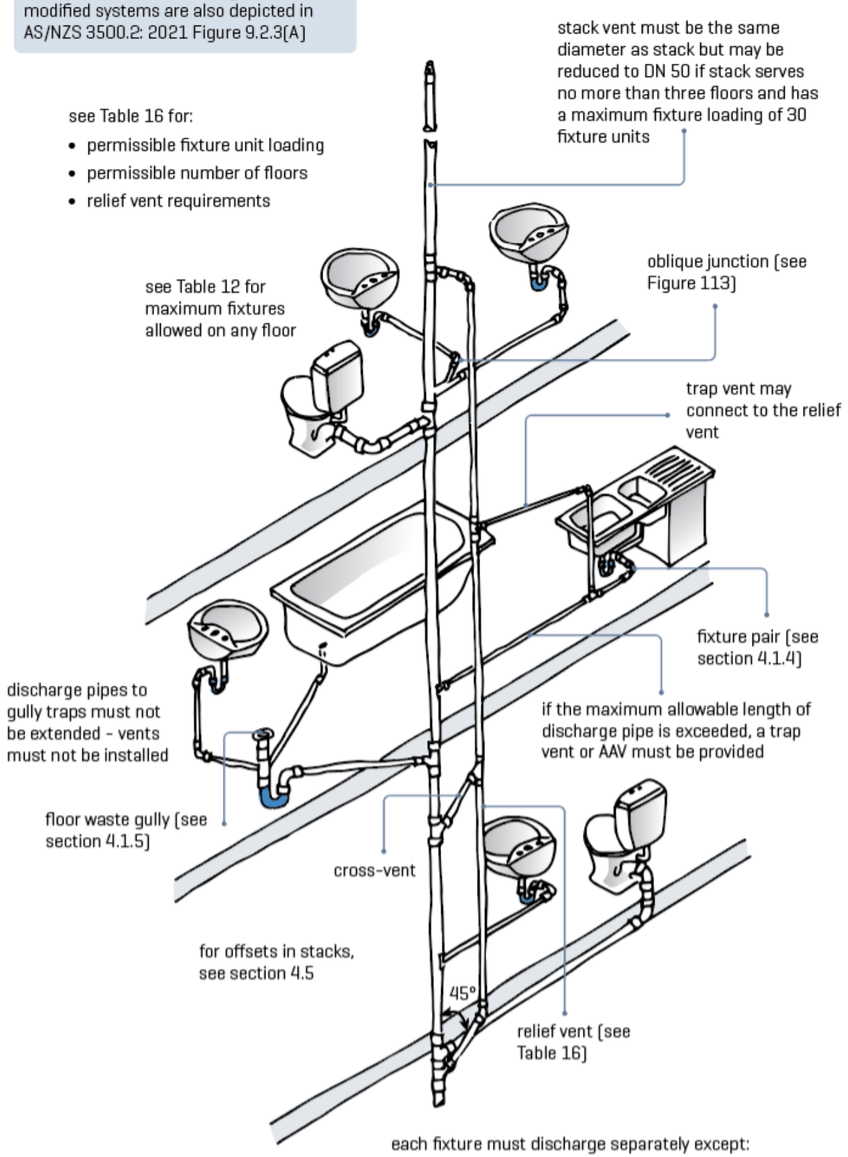

Figure 106. Basic principles for single stack modified system in a residential building.

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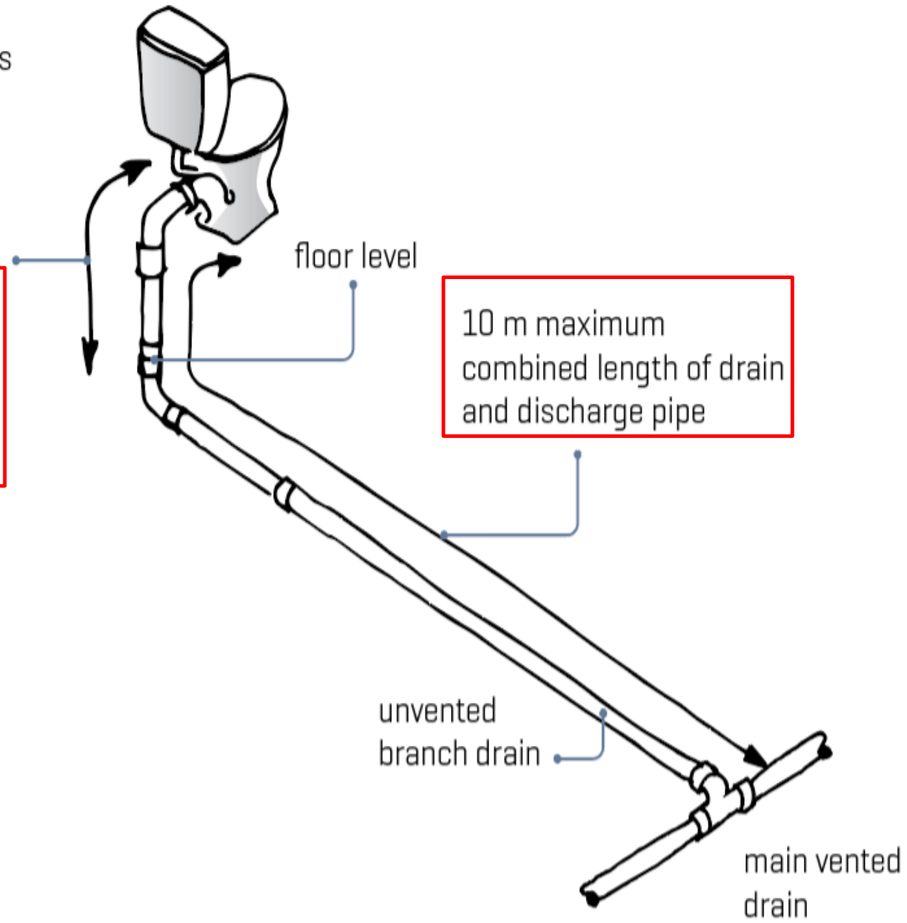
Venting branches/ discharge

vertical drop in discharge pipes – when the discharge pipe is smaller than the unvented branch drain, the maximum length of the vertical drop is:

- 2 m for WC with DN 80 discharge
- 1.5 m for basins and bidets
- 2.5 m for all other fixtures

when the discharge pipe and drain are the same diameter, the maximum unvented drain length of 10 m applies



see section 6.2 for 45° Y junction and 15° incline angle for entry to the drain

Figure 100. Maximum length of unvented branch drain and fixture discharge pipe.

G13/AS1 – vent sizing

Table 4. Vent pipe sizes.

Fixture vent pipes	Diameter of fixture discharge pipe (mm)	Minimum diameter of fixture vent size (mm)
	32	32
	40	32
	50	40
	65	40
	80	40
	100	40
Branch vents, branch drain vents, relief vents and discharge stack vents	Maximum discharge units carried by pipe	Minimum diameter of vent (mm)
	up to 15	40
	16–65	50
	66–376	65
	more than 376	80
Main drain vents	Minimum diameter of open vent pipe is 80 mm	

Adapted from G13/AS1 Table 6.

AS/NZS 3500.2 – vent sizing

Table 36. Size of drain vents

Fixture discharge units carried by drain (see Table 6)	Vent rating required	Pipe size (DN)
10 or fewer	0.5	40
11 to 30	1	50
31 to 175	2	65
176 to 400	3	80
More than 400	6	100

Adapted from AS/NZS 3500.2:2021 Table 3.9.3.1.

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Location of vents

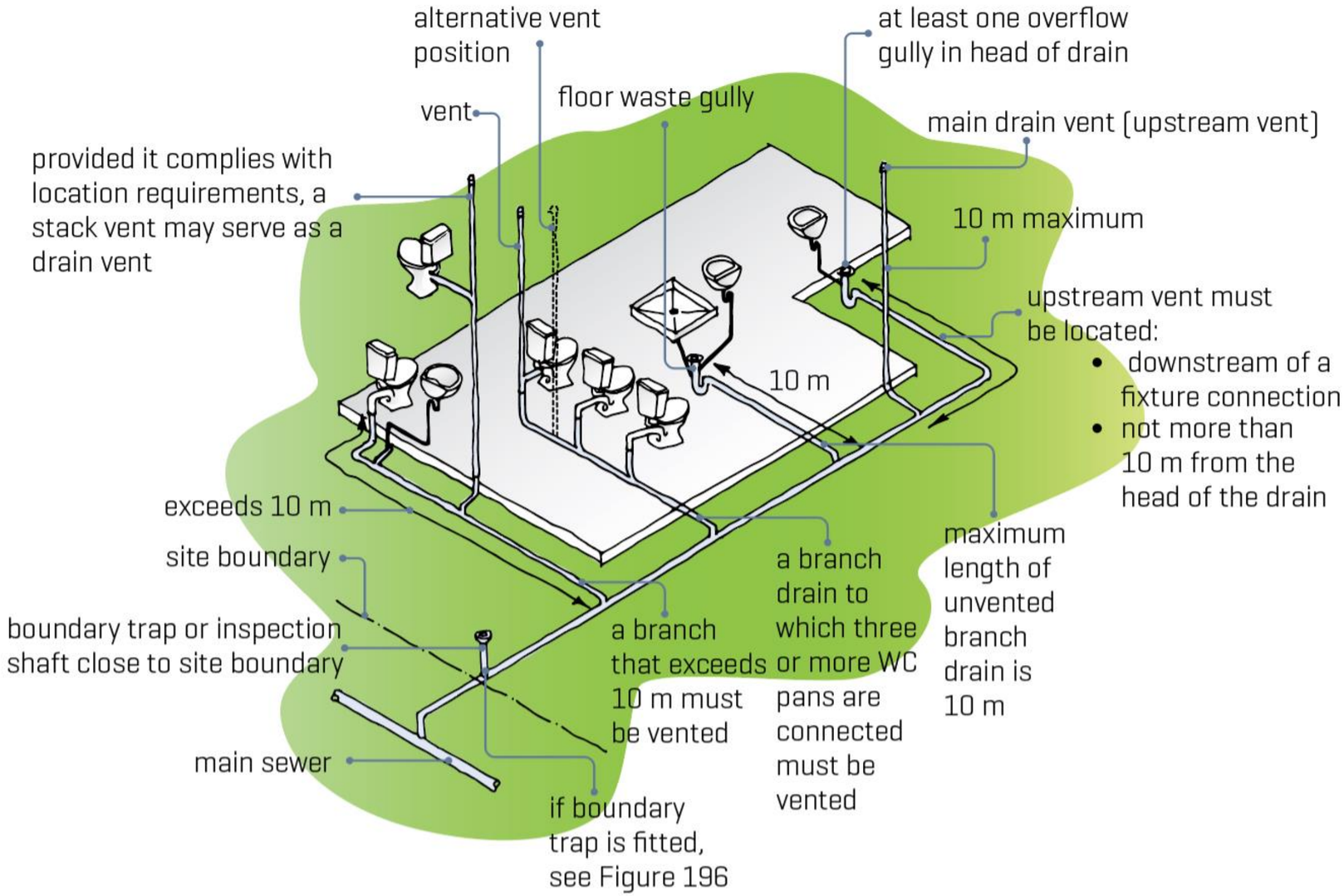

Figure 186. Drain vents.

Termination of vent

- 600 mm above an opening that is within 3 m
- 600 mm above eaves within 600 mm of the vent
- 150 mm above roof
- 3 m away from trafficable deck
- 2 m above or 600 mm below a chimney within 3 m
- 5 m from an air intake

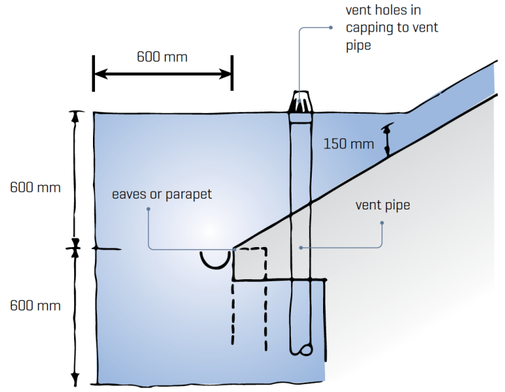

Figure 54. Termination point of vent 600 mm above an eave or parapet and 150 mm above a roof.

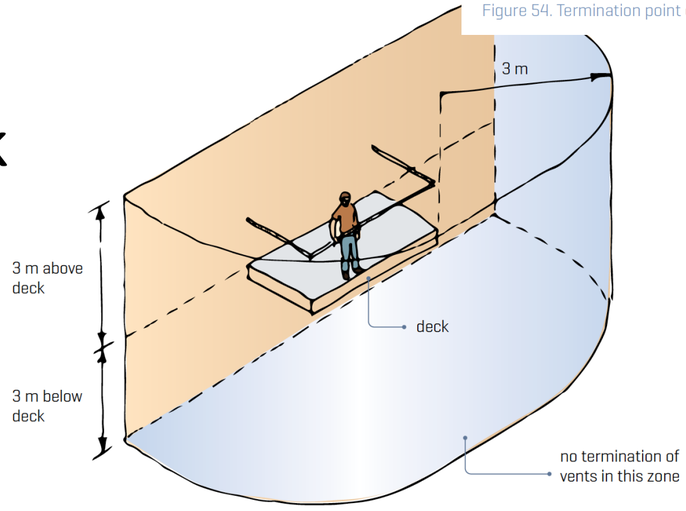

Figure 56. Termination point of vent 3 m above and 3 m horizontally from a deck.

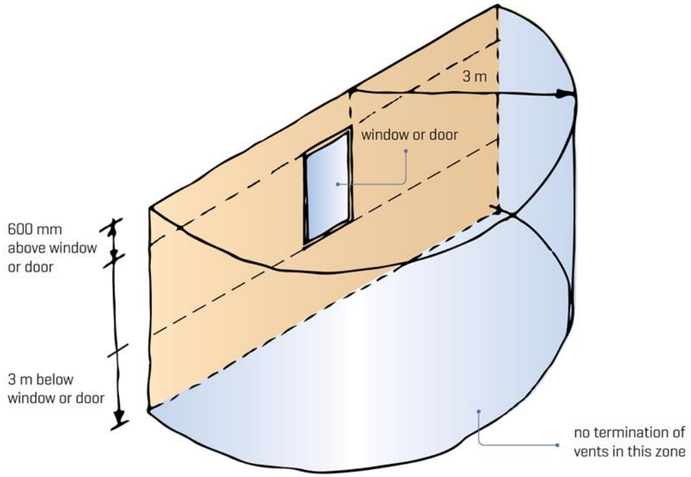

Figure 55. Termination point of vent 600 mm above and 3 m horizontally from a window, door or roof light.

Termination of vent

- 600 mm above an opening that is within 3 m
- 600 mm above eaves within 600 mm of the vent
- 150 mm above roof
- 3 m away from trafficable deck
- 2 m above or 600 mm below a chimney within 3 m
- 5 m from an air intake

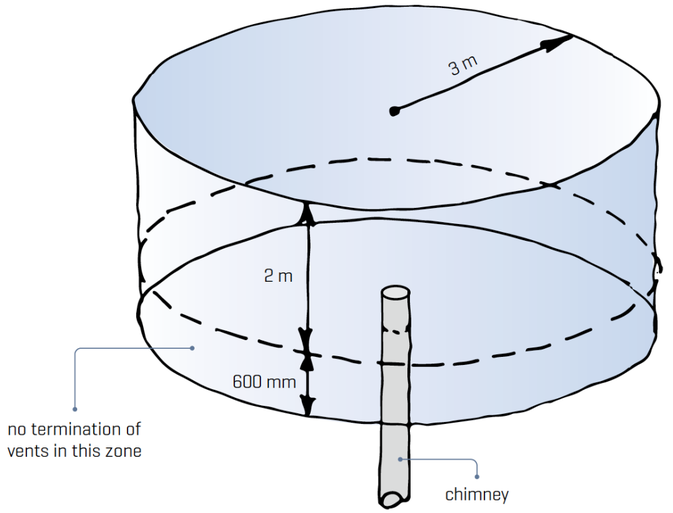

Figure 58. Termination point of vent 2 m above, 600 mm below and 3 m horizontally from a chimney.

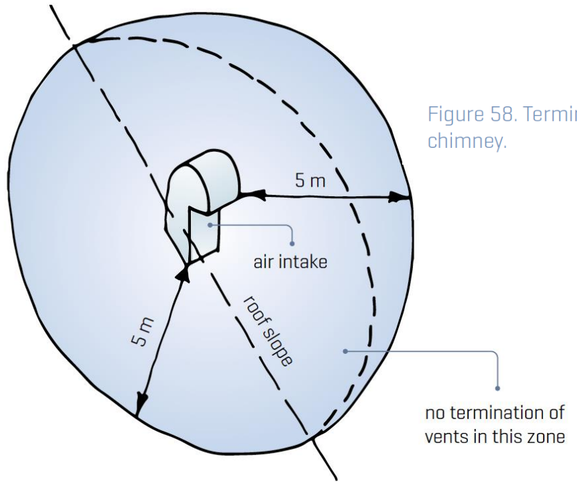

Figure 57. Termination point of vent 5 m from an air intake in any direction.

G13 Venting – AAV fixture vents

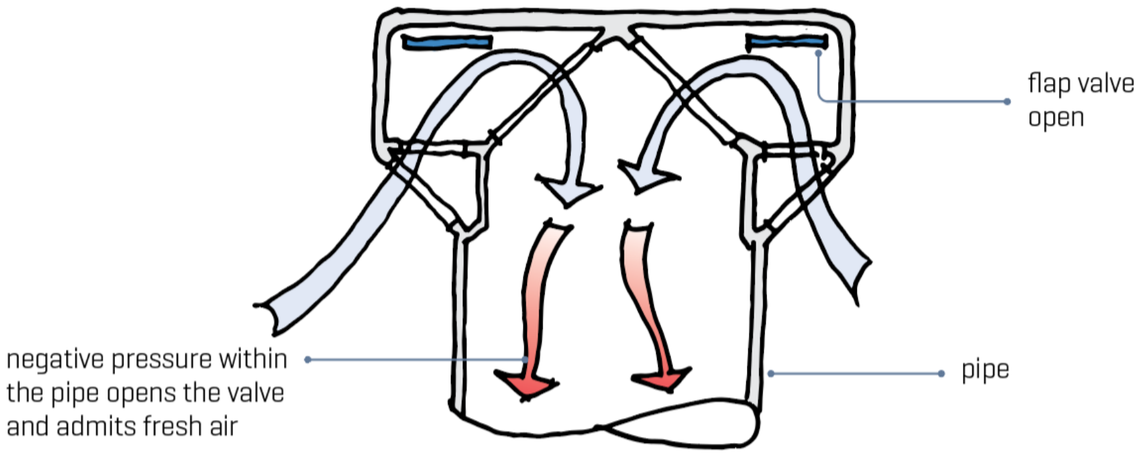

Figure 41. Air admittance valve – open.

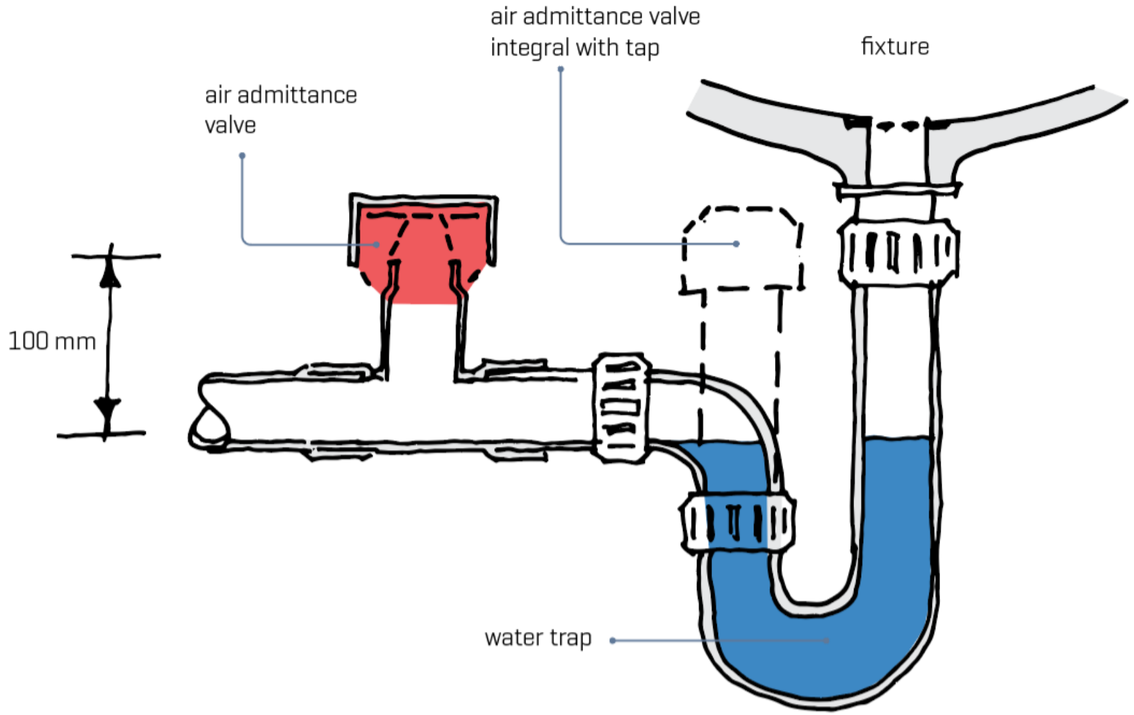

Figure 42. Air admittance valve to discharge pipe.

Quick quiz

In most cases, what is the minimum incline in degrees required for a 100mm equal graded junction?

15 degrees

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What we'll cover

Webinar 2

Foul Water Fundamentals

- RFI data
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- Ventilation
- **Junctions**
- Gullies
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How junctions affect a design?

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Junctions

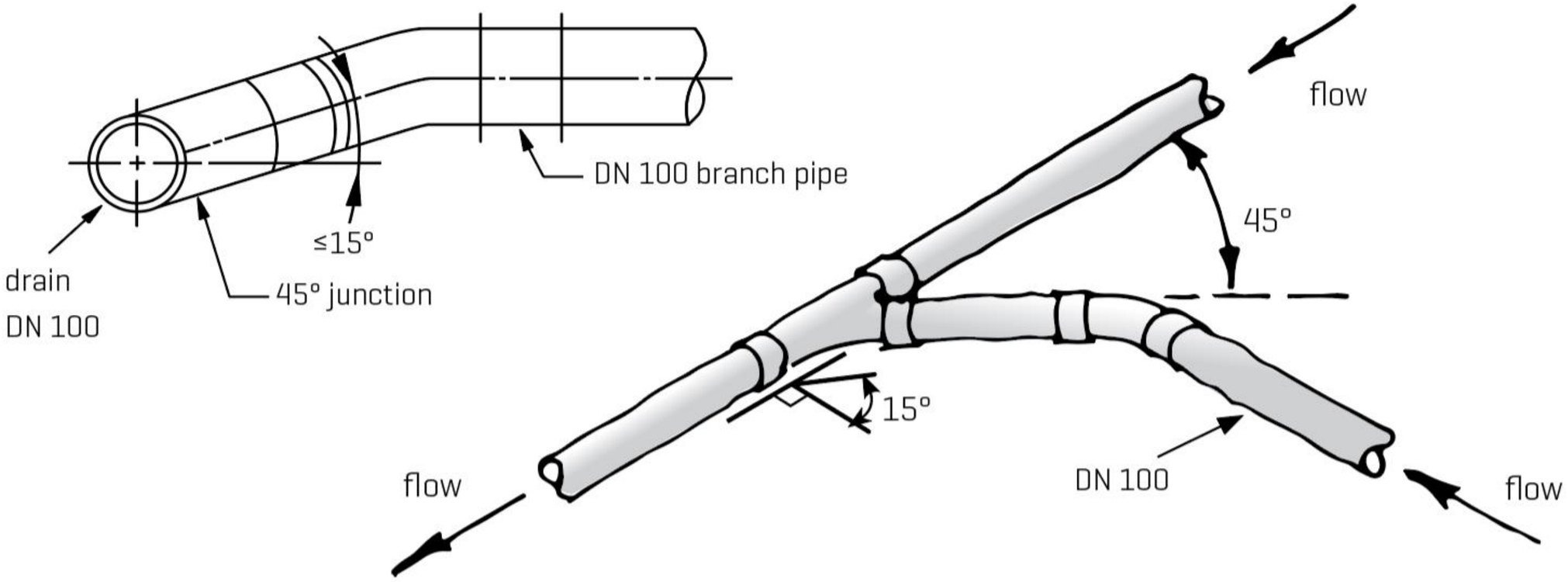


Figure 74. 100 mm branch pipe to 100 mm pipe on grade.

Junctions on grade

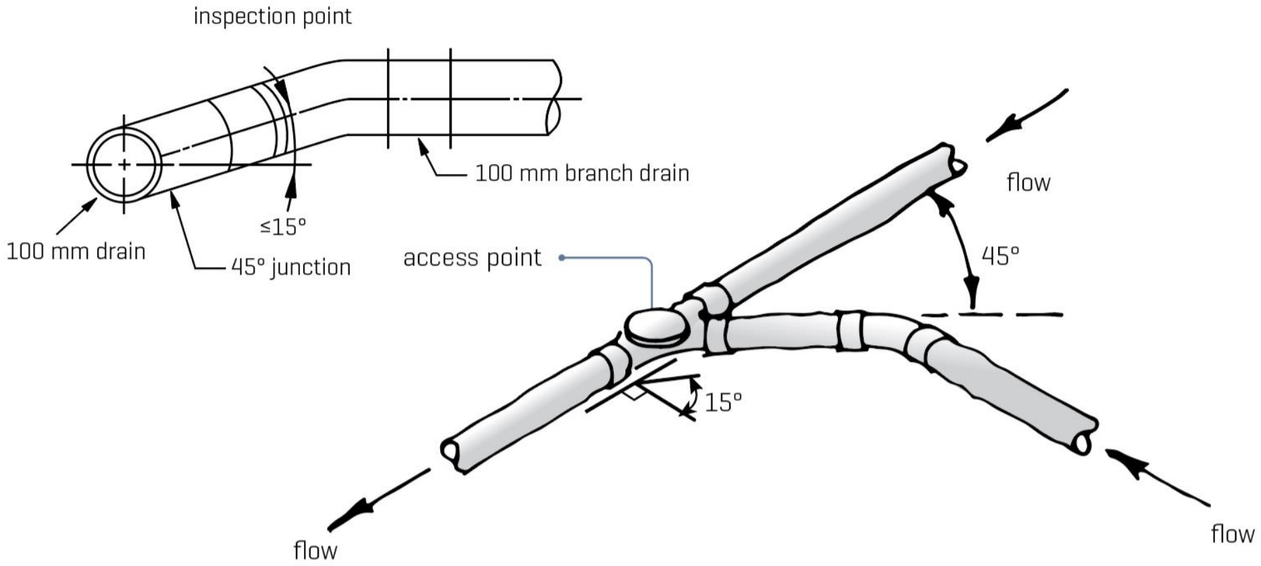


Figure 183. Connection between 100 mm horizontal pipes.

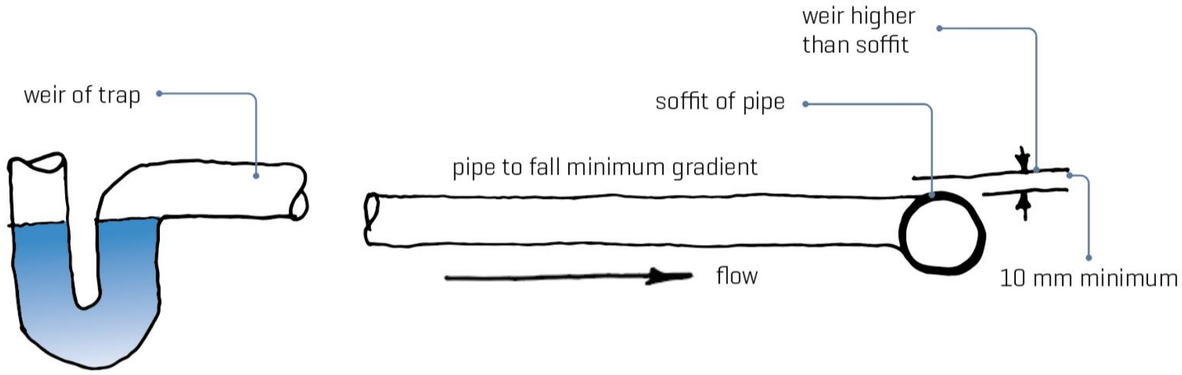


Figure 73. The weir of the trap must be higher than the soffit of the pipe to which it is connected.

Junctions on grade

Exclusion zones

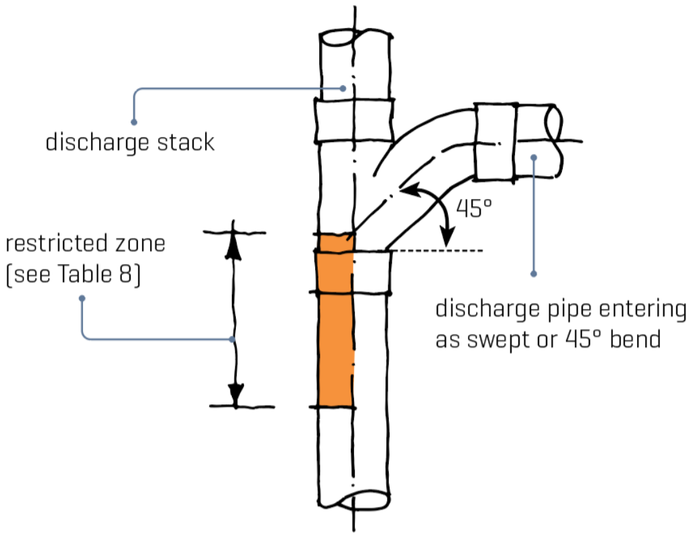


Figure 78. Restricted zone for connections – discharge pipe entering as swept or 45° bend.

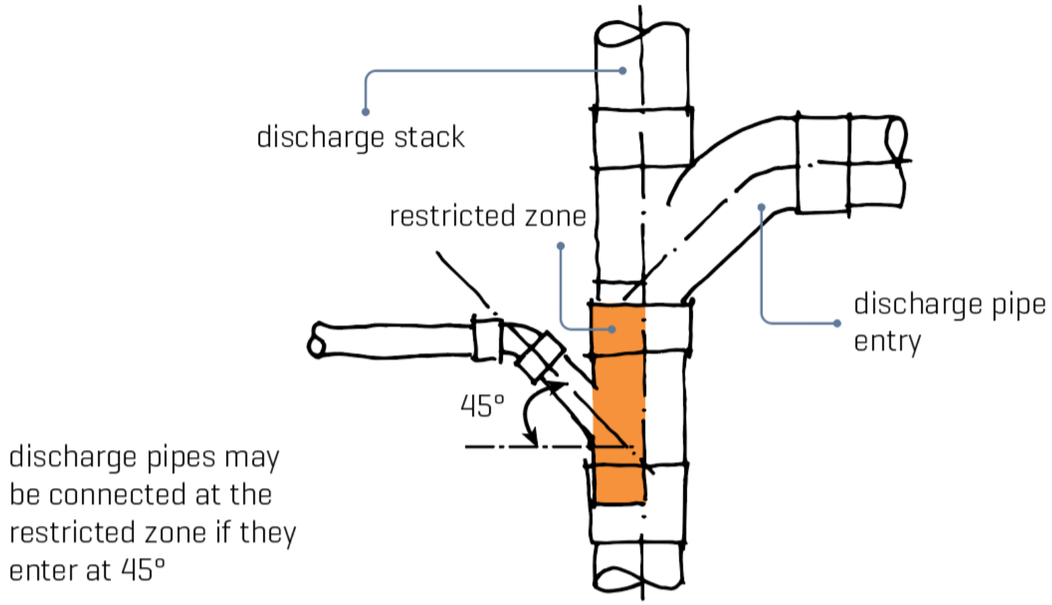


Figure 79. Type of connection allowed in restricted zone – 45° entry.

Exclusion zones

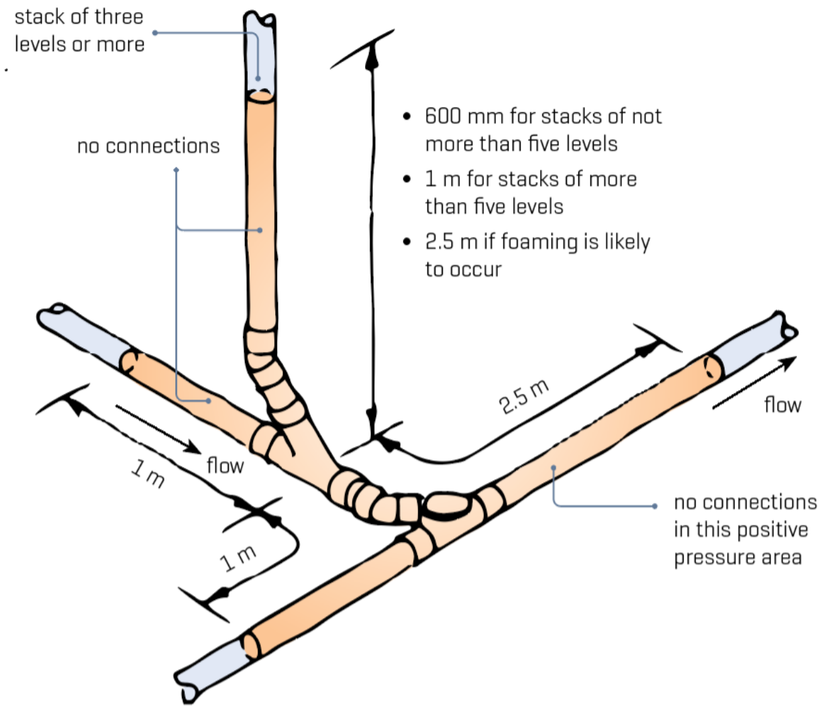
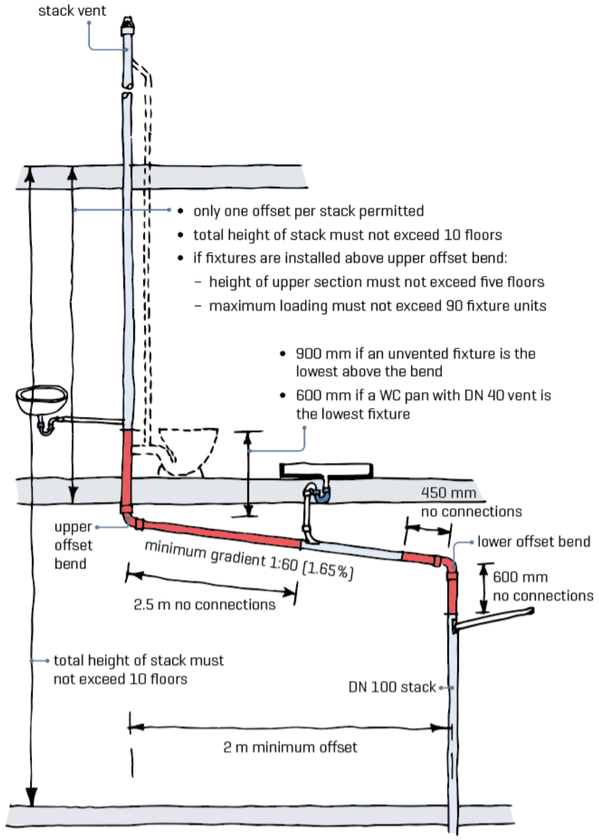


Figure 83. Restrictions on connections in pressure areas at the base of a stack of three levels or more.



the Y connections for branch connections must discharge to pipes in the vertical plane

Figure 118. Offsets in single stack system graded offset (less than 45°) in 100 mm pipe.

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Quick quiz

In G13/AS2, how far below the overflow level of the lowest fixture must the top of an Overflow Relief Gully be positioned?

150mm

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- RFI data
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- **Gullies**
- Cover
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What are the different types of gullies?
Where do they go in a design?

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Gully traps

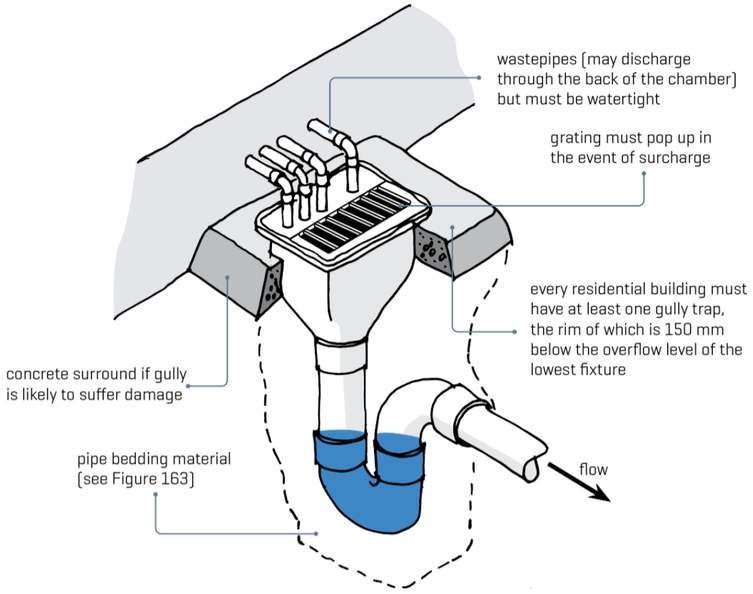


Figure 162. Gully trap.

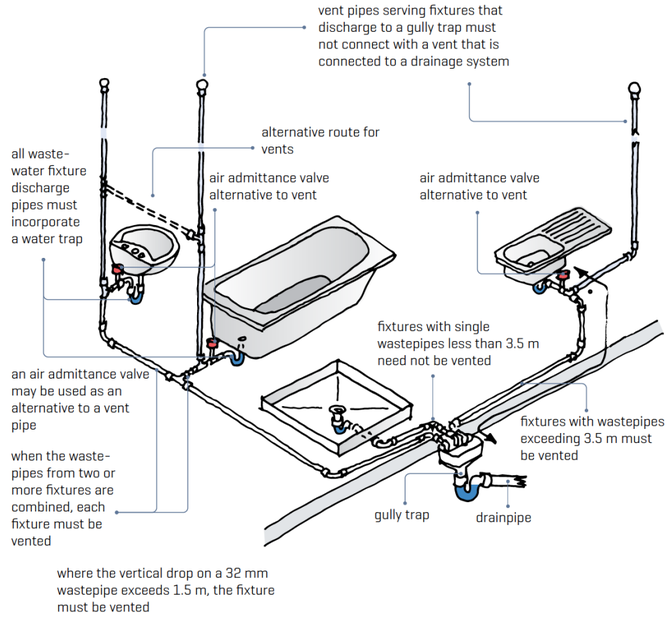
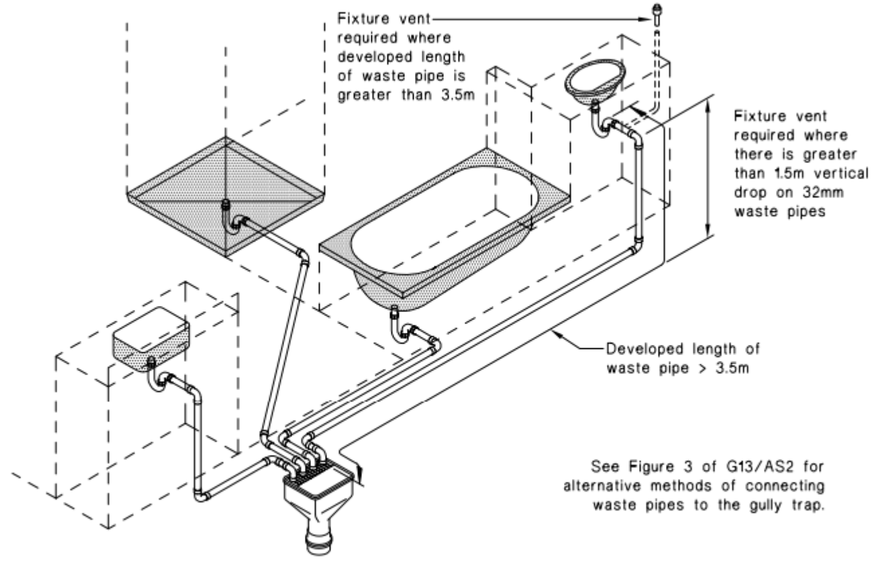


Figure 17. Basic rules for wastepipes discharging to a gully trap.



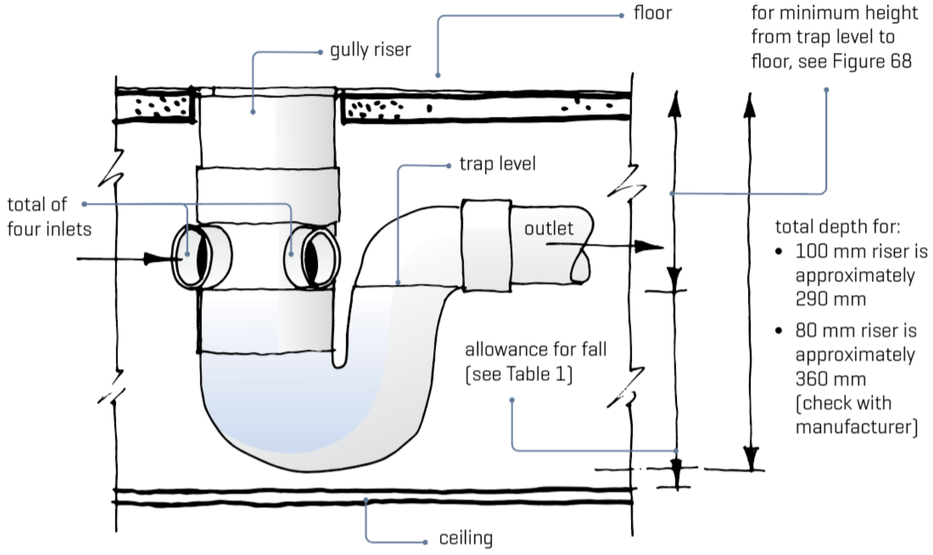


Figure 15. Space required for a floor waste gully.

Gully traps – floor waste gullies

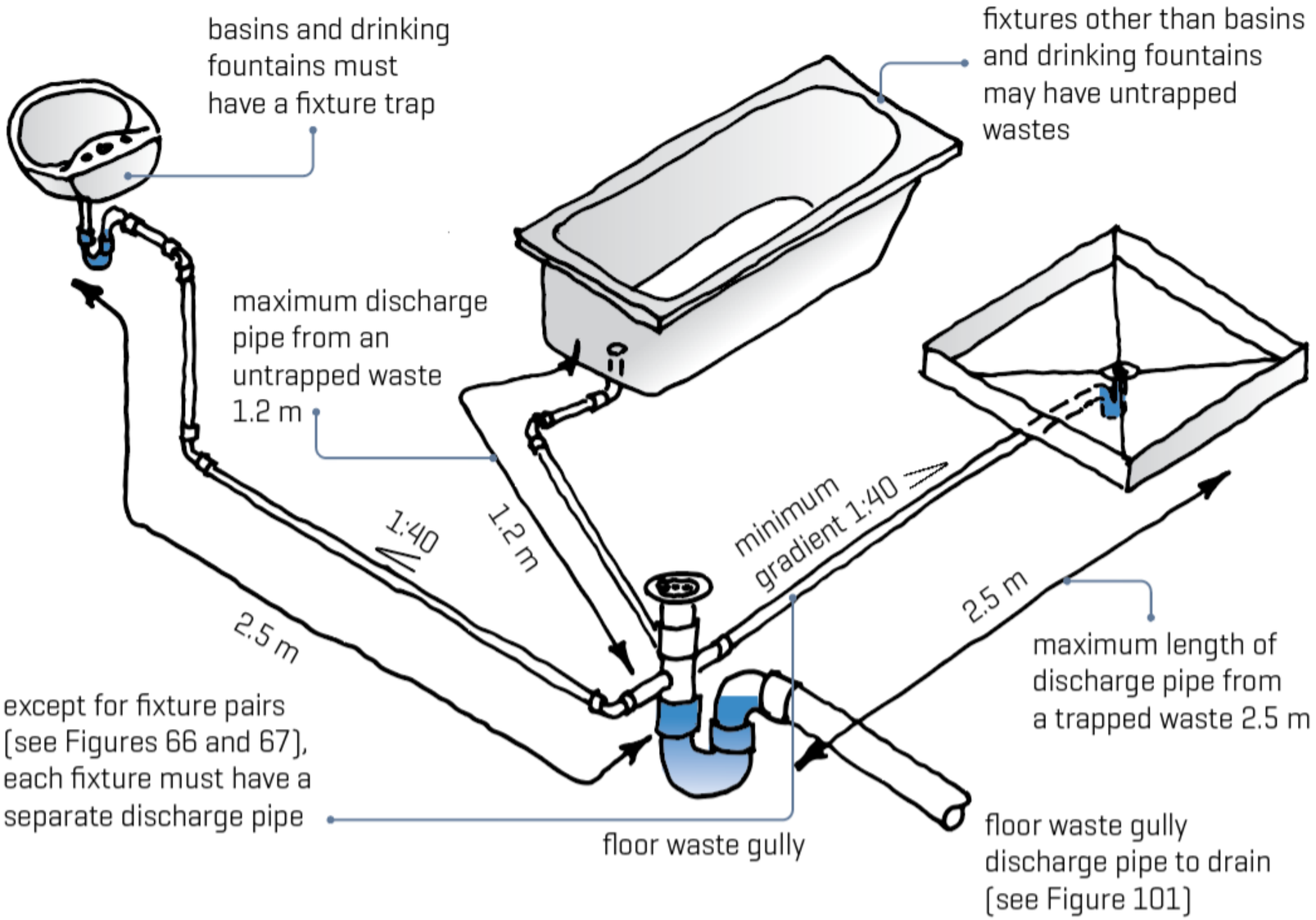


Figure 69. Connections to a floor waste gully.

Gully traps – floor waste gullies

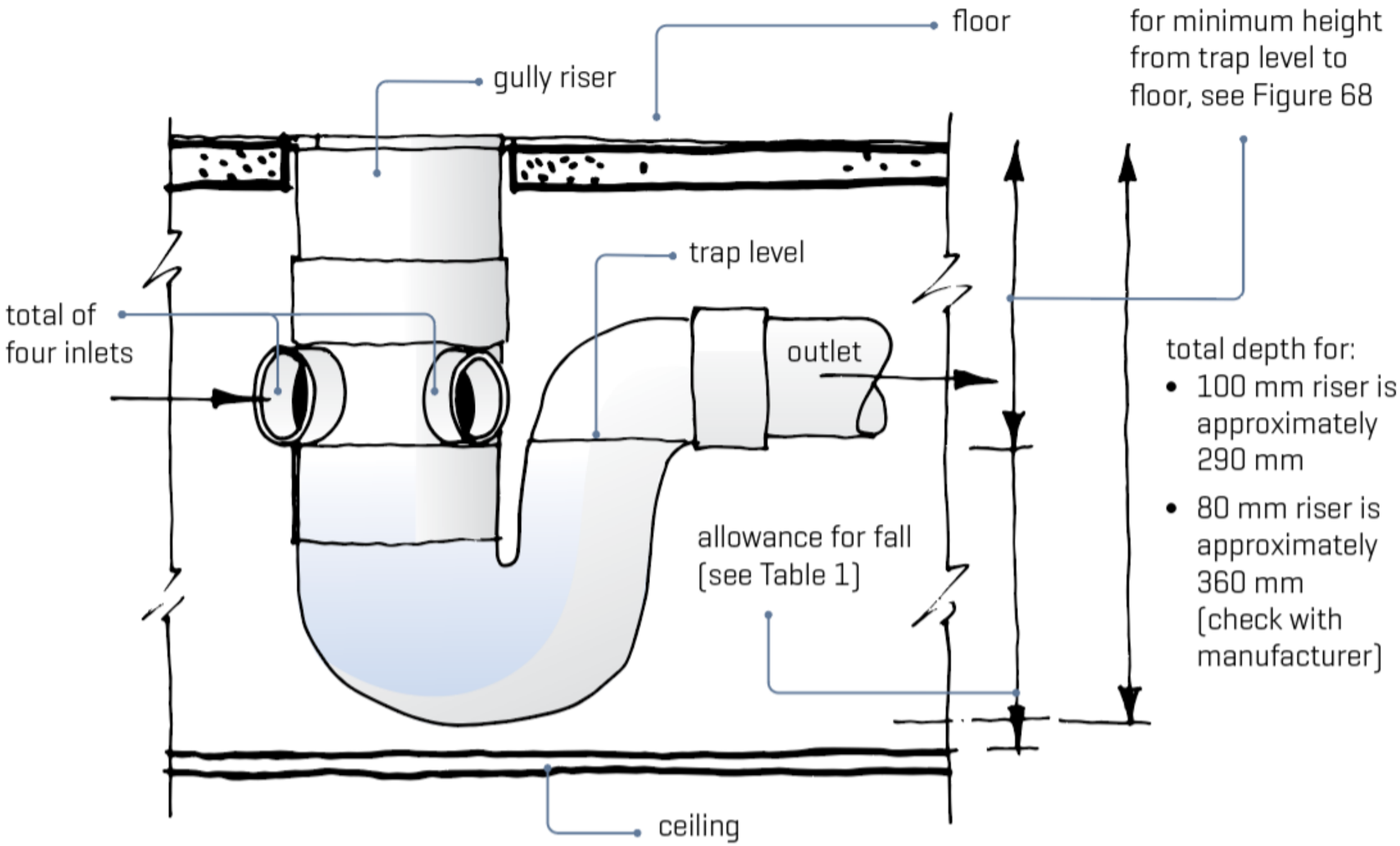


Figure 15. Space required for a floor waste gully.

Gully traps – overflow relief gullies

- 150 mm below the flood level of the lowest fixture
- 75 mm above an unpaved surface
- 25 mm above a paved surface (G13/AS2)
- Prevent ponding and water ingress in a paved area (AS/NZS 3500.2)

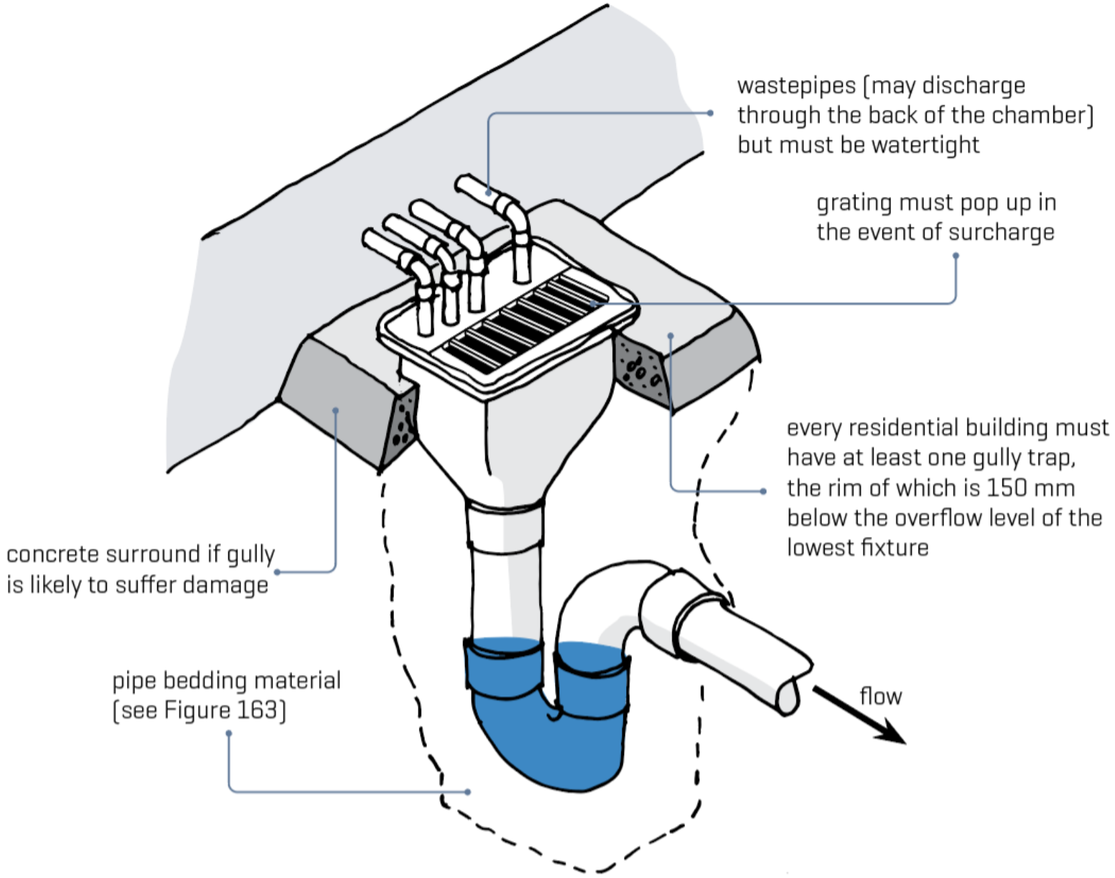
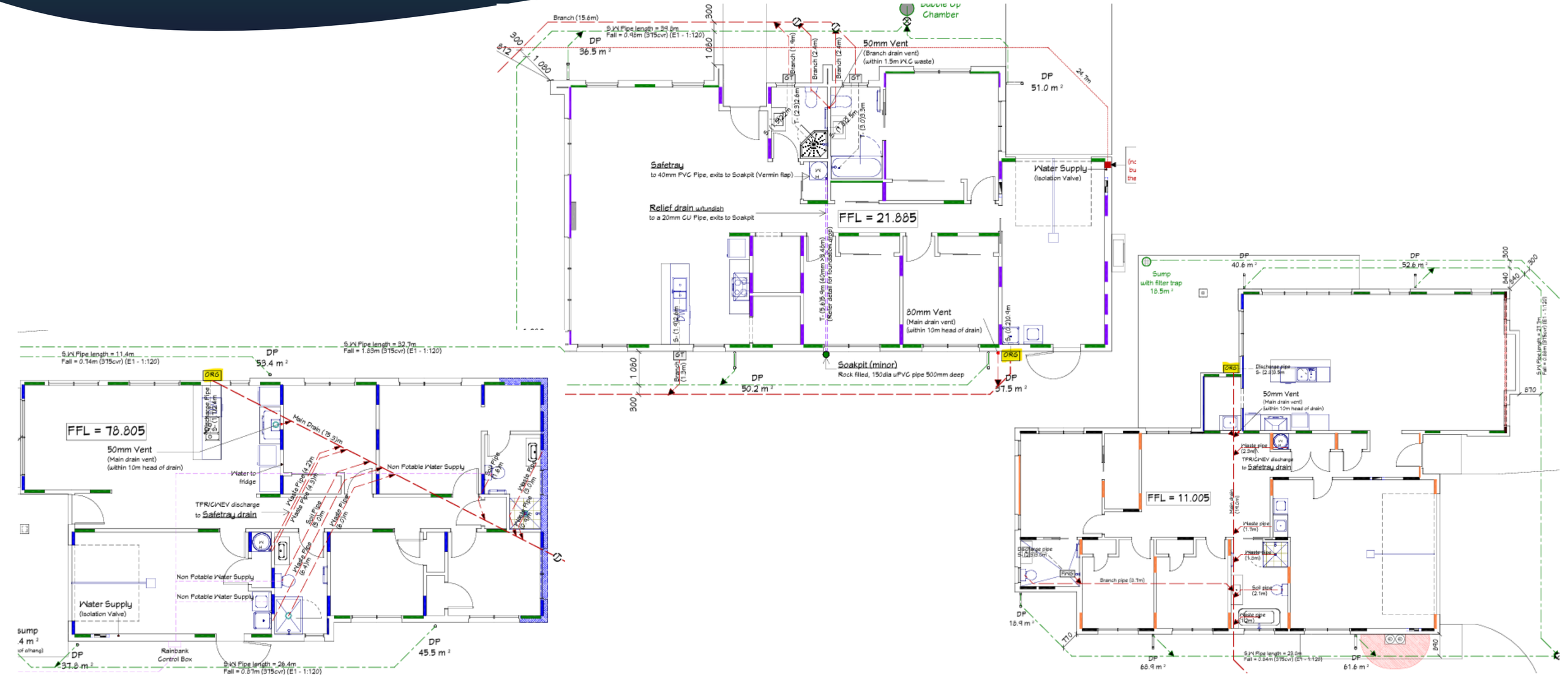


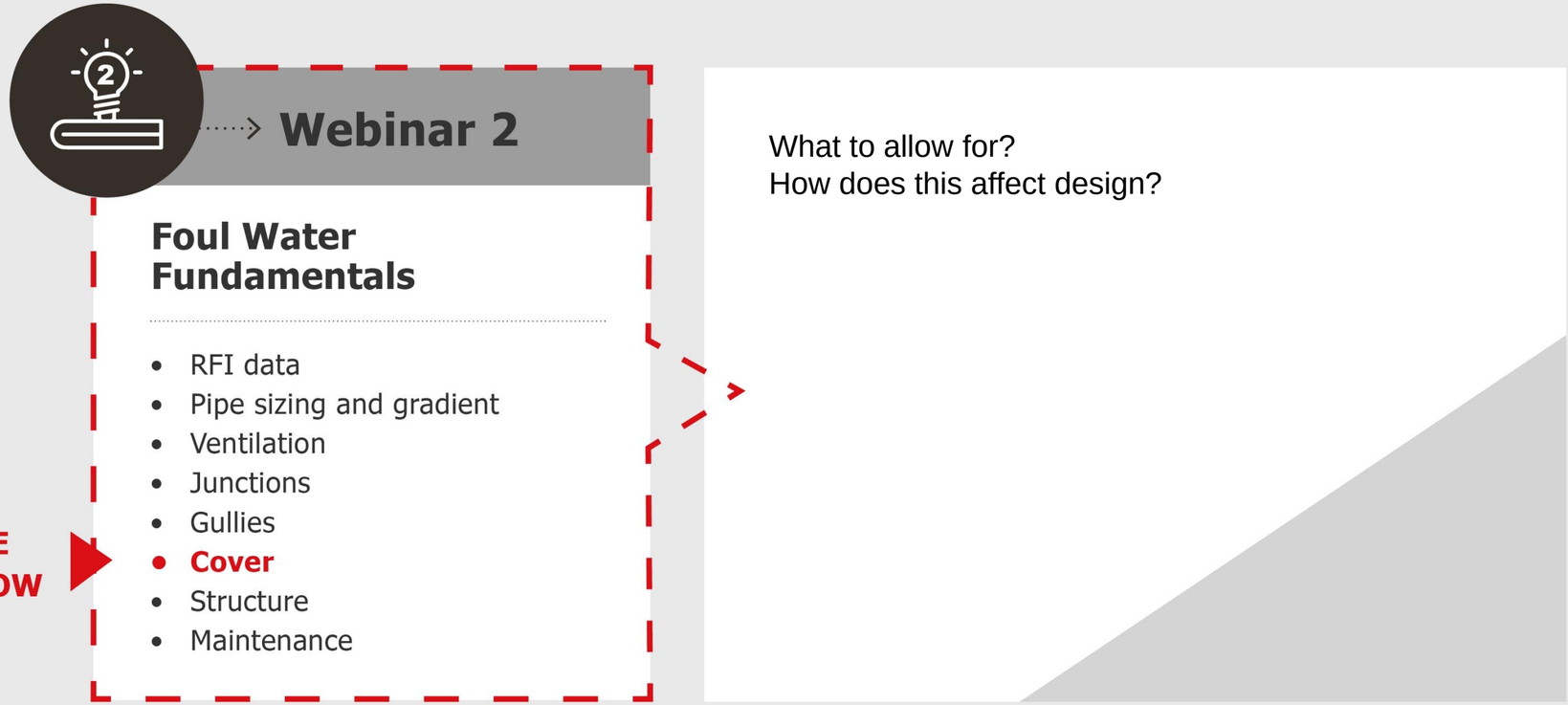
Figure 162. Gully trap.

Overflow relief gully location



Gully traps – disconnector gullies

What we'll cover



Cover

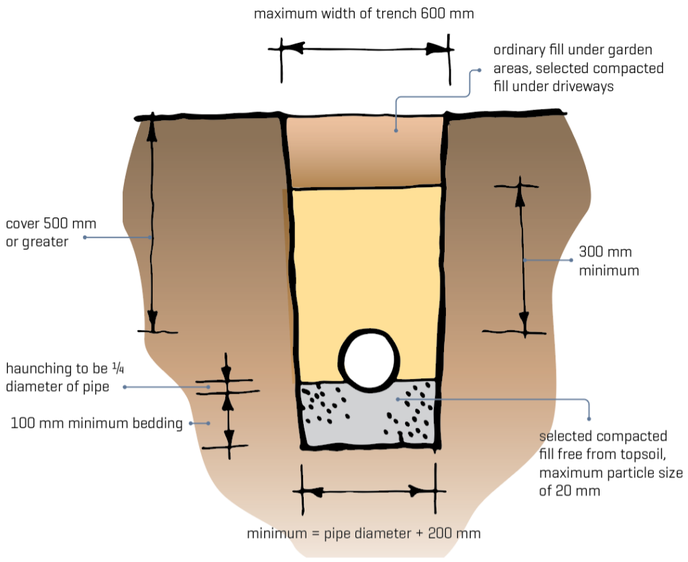


Figure 167. Bedding and backfilling where cover over drain is 500 mm or greater.

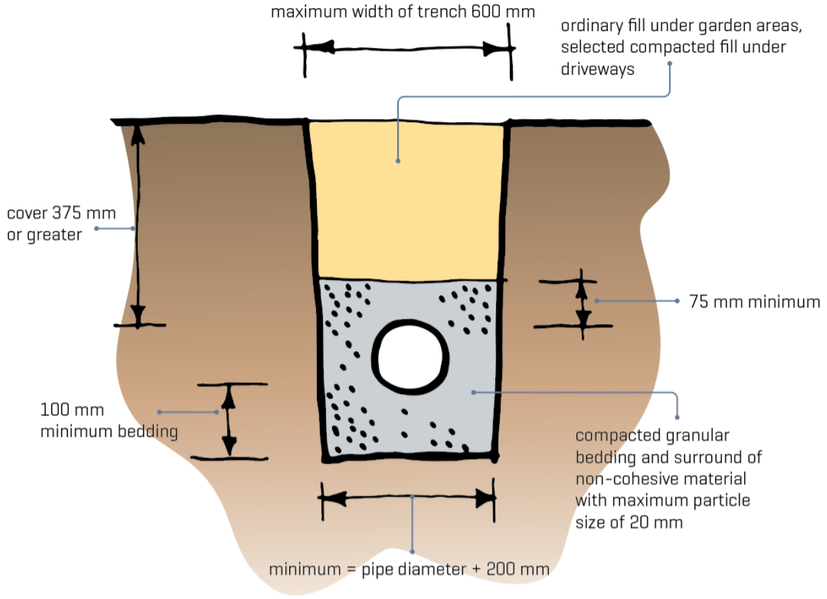
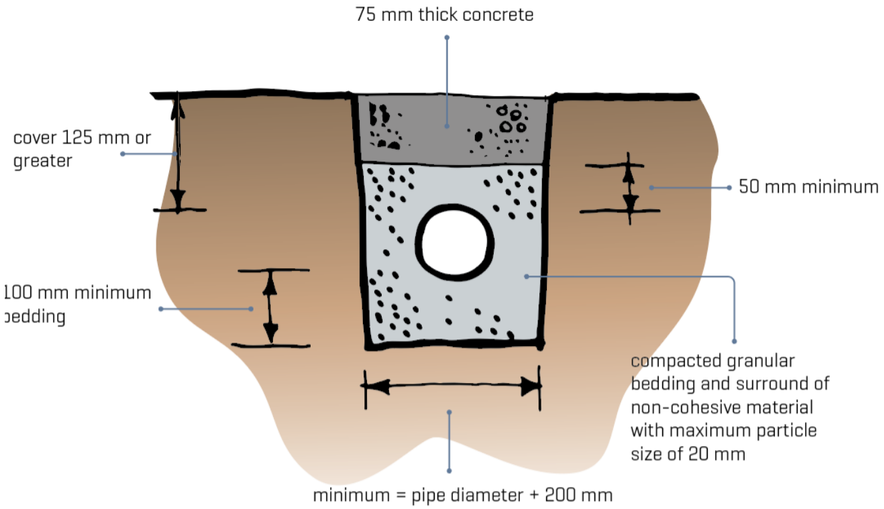


Figure 168. Bedding and backfilling where cover over drain is 375 mm or greater.



gure 169. Bedding and backfilling where cover over drain is 125 mm or greater.

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Cover

G13/AS2 – proximity to foundation

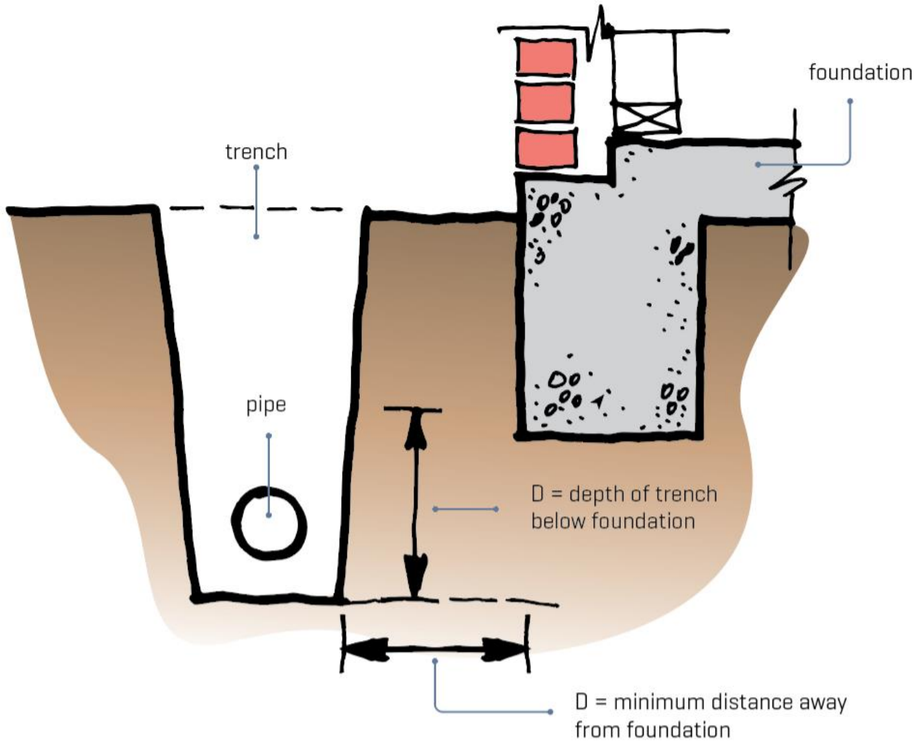

Figure 170. Relationship between trench depth and foundation for trenches remaining open for no longer than 48 hours.

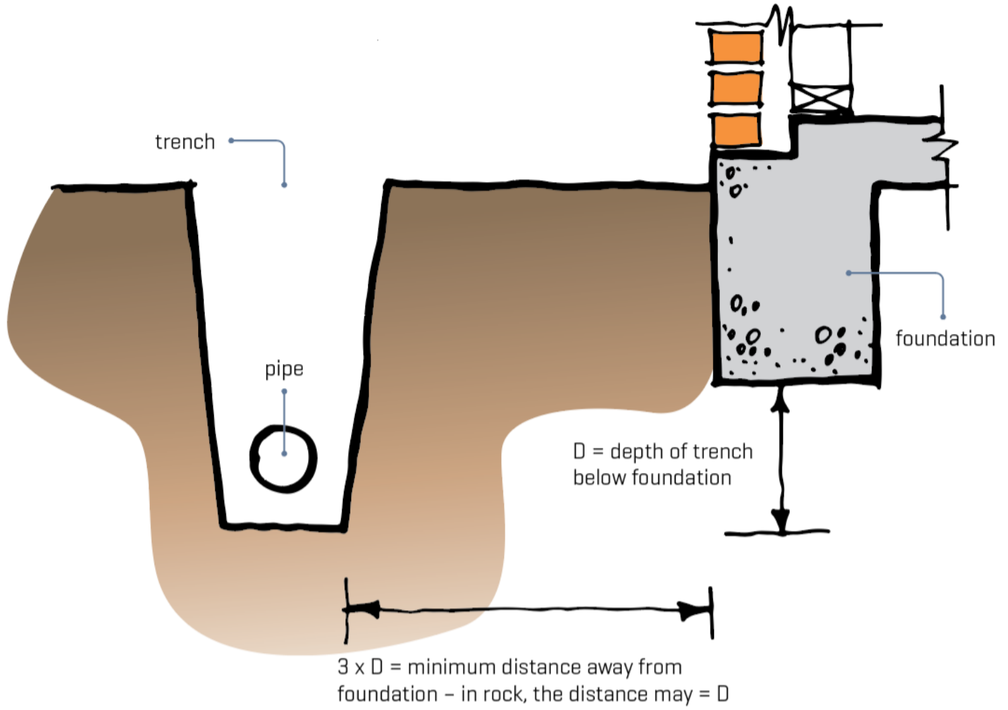

Figure 171. Relationship between trench depth and foundation for trenches remaining open for longer than 48 hours.

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Quick quiz

Can I run a waste through a joist mid span?

No under NZS 3604 you must be within 3 x the depth of the joist to a structural support. Otherwise, you a proprietary or engineered solution

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What we'll cover

Webinar 2

Foul Water Fundamentals

- RFI data
- Pipe sizing and gradient
- Ventilation
- Junctions
- Gullies
- Cover
- **Structure**
- Maintenance

YOU ARE HERE NOW

How does the plumbing design affect the structure?
What are the best practice design considerations?

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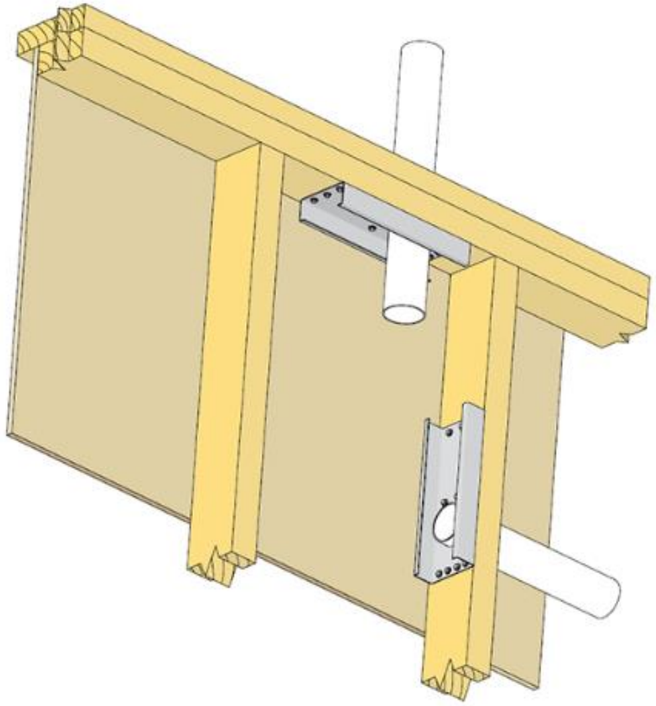
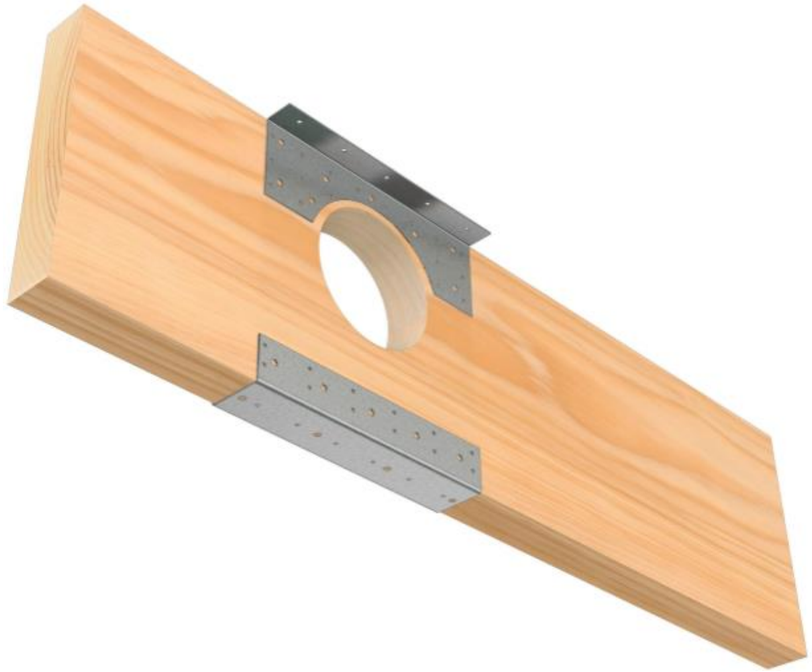
Structure

Structure

Structure





Passive Fire

What we'll cover

Webinar 2

Foul Water Fundamentals

- RFI data
- Pipe sizing and gradient
- Ventilation
- Junctions
- Gullies
- Cover
- Structure
- **Maintenance**

YOU ARE HERE NOW

How do you allow for maintenance in a foul water system?

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Maintenance

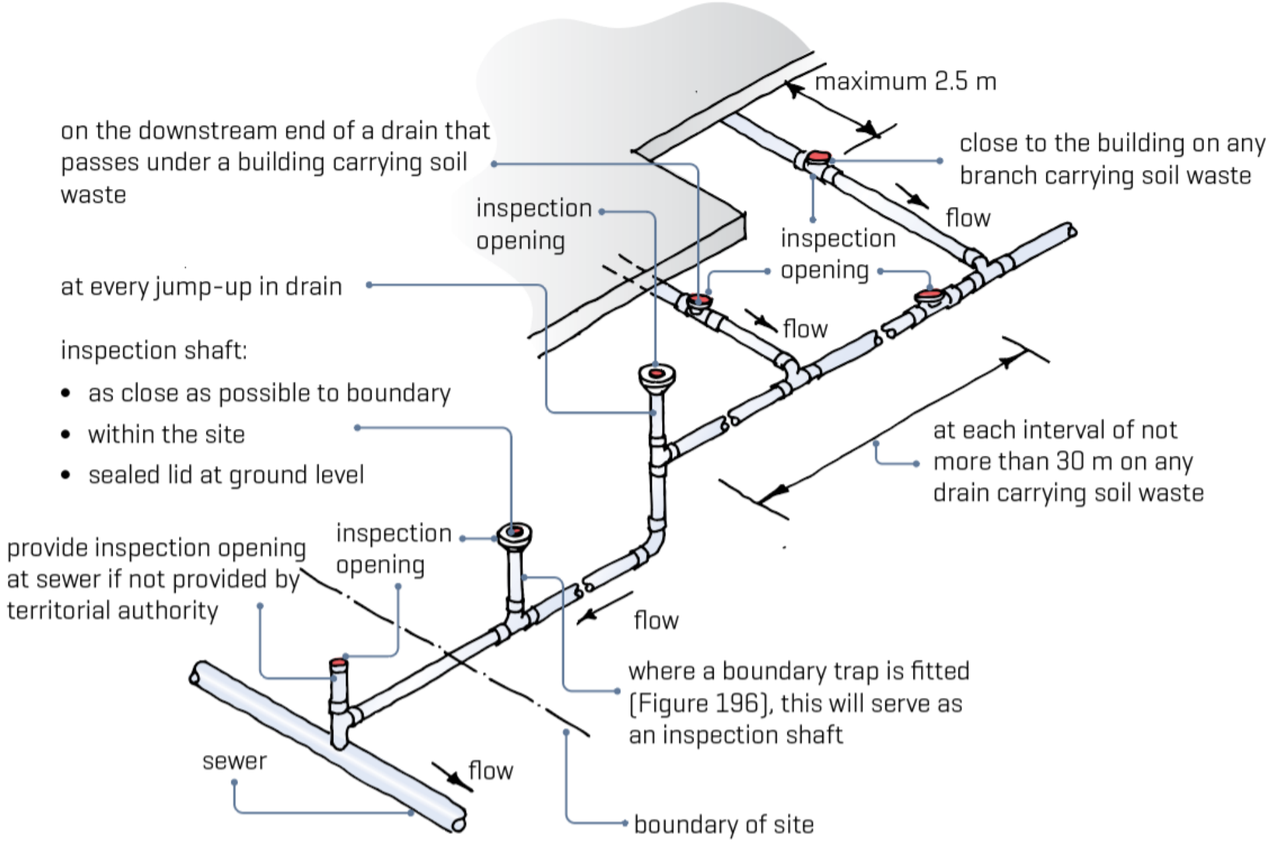
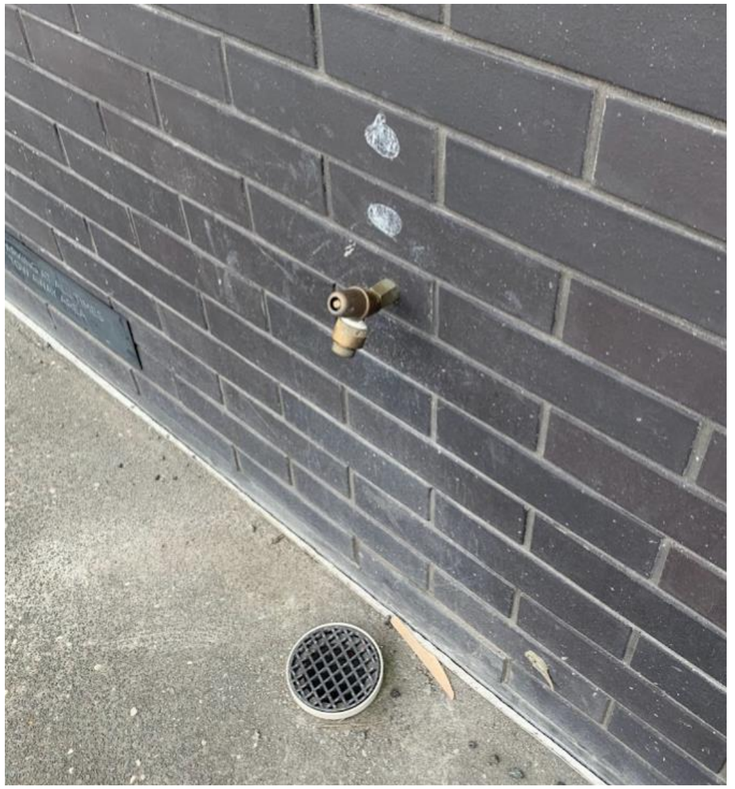


Figure 190. Locations at which inspection openings must be provided – refer to AS/NZS 3500.2:2021 clause 4.7.



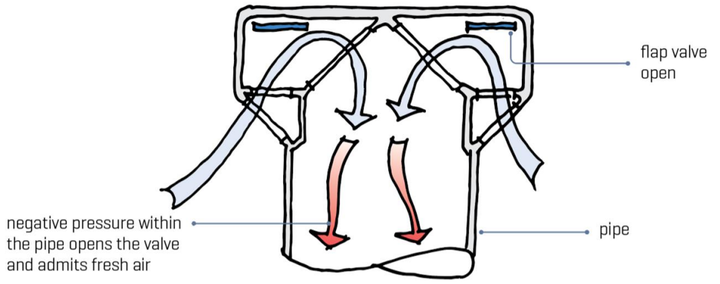


Figure 41. Air admittance valve – open.

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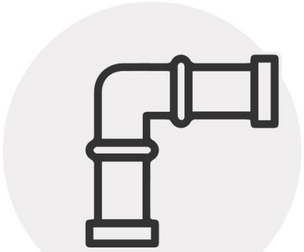
Next webinars

Webinar 1

Plumbing & Drainage Foundations

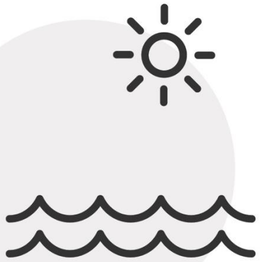


Webinar 2

Foul Water Fundamentals

Webinar 3

Safe & Sustainable Water Supply



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