Portishead Branch Line (MetroWest Phase 1)

TR040011

Applicant: North Somerset District Council
6.26 Surface Water Drainage Strategy for Portishead and Pill Stations, Haul Roads and Compounds
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, Regulation 5 (2)(a)
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The original submission version of this document can be found in Appendix 17.1 of the ES. The document contained within the ES will not be updated. However, this standalone version of this document may be updated and the latest version will be the final document for the purposes of the Order.

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Document history

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1. Introduction

1.1 The four West of England authorities North Somerset Council (“NSC”), Bristol City Council (“BCC”), Bath and North-East Somerset Council (“B&NES”), and South Gloucestershire Council (“SGC”) are jointly promoting a programme of rail enhancement projects known as MetroWest. The MetroWest programme includes MetroWest Phase 1, MetroWest Phase 2 and smaller projects such as specific new/re-opened stations. MetroWest Phase 1 is being led by NSC on behalf of the four councils as a third party rail project working with Network Rail Infrastructure Limited (“NRIL”). MetroWest Phase 1 involves providing a new train service between Portishead, Pill and Bristol Temple Meads, an upgraded train service for the Bristol to Avonmouth and Severn Beach line, and local stations between Bristol and Bath

1.2 The scope of this drainage strategy is to outline the drainage design works for the MetroWest scheme development sites as detail below:

- Pill station carpark and drop-off area
- Portishead station carparks and associate roads
- Construction compounds:
  - Haul roads (temporary compound)
  - East of Portishead Station (temporary compound)
  - C15 Sheepway (permanent and temporary compounds)
  - C14 The Portbury Hundred (temporary compound)
  - C13 Lodway Farm (temporary compound)
  - C9 Ham Green (permanent and temporary compounds)
  - C4 Clanage Road (permanent and temporary compounds)

1.3 The design approach sets out the rationale behind the development of the surface water drainage strategy.

1.4 The selection and application of SuDS solutions has also been determined with respect to the confines and nature of the proposed development.

2. General Approach

2.1 In developing this drainage design, a number of assumptions have been made to reflect the design development stage at the time of writing. For the construction stage, a conservative approach has been taken. This assumes that any contractor would surface all the construction compounds such that they would be considered impermeable. It is recognised that this may well not be the case with a wide range of options available to contractors which offer more porous surfaces, and that not all the construction areas would be surfaced. Nevertheless, the adoption of this worst-case scenario does mean that generally, the maximum requirements are presented and that actual drainage proposals by contractors are likely to have less in the way of drainage requirements during construction.

3. Design Criteria

3.1 The design criteria used, detailed in table 1 below, are according to North Somerset Council's (NSCs) requirements for a design life of 60 years for the drainage system in the permanent development sites and for a design life of 1-2 years for the temporary development sites.

	Design return period	Exceedance flows return period	Climate change allowance
Permanent development sites	1:30	1:100	40%
Temporary development sites	1:30	1:100	10%

Table 1. Design criteria

3.2 Maximum discharge rates:

- For green-field sites: green-field peak rate or max. of 2.5 l/s
- For pre-developed sites: green-field peak rate or min. of 2.5 l/s if attenuation is possible, otherwise a reduction of 30% for the existing discharge rate.
- For Pill Station and Portishead Station- based on the Concept Drainage, attached on Appendix G.

3.3 Table 2 shows the parameters considered for the greenfield discharge rate calculations. The whole scheme falls within hydrological region no. 8.

Site	SAAR (Standard Average Annual Rainfall) (mm)	SPR (Standard Percentage Runoff)
Portishead Station	889	0.15
Pill Station	882	0.4
Haul Roads	827	0.37
Compound east of Portishead Station	894	0.15
C-15 Sheepway Compound	827	0.37
C-14 Portbury Hundred Compound	841	0.37
C-9 Ham Green Compound	839	0.47
C-13 Lodway Farm Compound	841	0.37
C-4 Clanage Road Compound	836	0.15

Table 2. Parameters for greenfield discharge rate

4. Exceedance flows

4.1 Exceedance flows would normally be expected to inundate the drainage system and therefore the design approach was to convey and store exceedance volumes above ground until there is sufficient capacity within the drainage system to accept inflows again (i.e. after the storm event has passed).

4.2 The management of exceedance flows is an integral part of the overall site design and as such, will be allowed for in the drainage design.

4.3 Exceedance routes up to the 1 in 100-year rainfall event, with an allowance for climate change have been included at the drainage strategy and demonstrate that any exceedance flow will be managed within the site extents.

5. Design Approach

5.1 In accordance with the National Planning Policy Framework and the relevant planning practice guidance[1], surface water runoff will be managed as close to where it falls as possible to mimic natural drainage. North Somerset Sustainable Drainage Developer Guide[2] (NSSDDG) also states that treating the runoff at source is important and their preferred option is to treat and convey the runoff on the surface.

5.2 NSSDDG indicates where infiltration SuDS can be potentially used within the authority's area. The guidance recommends that where soils may be slow draining, have a shallow water table, are located on floodplain deposits, or have some combination of these characteristics, infiltration is not recommended. In this case the preferred storage forms are: ponds, porous pavement layer with impermeable membrane or wetlands. Based on the NSSDDG maps, the proposed development areas in Portishead Station and Haul road have significant constraints for infiltration SuDS since they're located within flood zones 2 or 3.

5.3 Consequently, infiltration is not recommended in the proposed development areas. Instead, a combination of traditional drainage and SuDS including bioretention areas, permeable pavement, detention basins, filter drain and swales, are promoted to ensure pollutants in surface water flows are minimised and exceedance flow paths are managed.

5.4 The drainage provisions promoted to support the development sites (Portishead Station, Pill Station, haul roads and the compounds) are detailed in Section 5, and on the associated drawings presented in Appendix B, C, D, and E.

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[1] Planning Practice Guidance: [https://www.gov.uk/government/collections/planning-practice-guidance]
[2] North Somerset Sustainable Drainage Developer Guide: [http://www.n-somerset.gov.uk/wp-content/uploads/2015/12/sustainable-drainage-developer-guide.pdf]

5.5 Surface water drainage calculations have been undertaken using MicroDrainage WinDES software. The calculations establish the type and sizing of drainage assets promoted to manage the surface water runoff. These calculations are presented within Appendices B, C, D and E for each development area respectively.

6. Development sites

6.1 Portishead Station

6.1.1 The proposed drainage for the carparks and highways work at Portishead Station have been analysed on a catchment basis. Four catchments have been identified as shown on drawing 467470.BQ.04.20-DS-Portishead of Appendix B.

6.2 Catchment A.1

6.2.1 Catchment A.1 lies to the northwest of the proposed development including the proposed car park and footpaths. The area is currently part of the former railway line and scrub area.

6.2.2 Specifically, the development area will discharge to the watercourse to the north west of the site. This watercourse is a main river, Portbury Ditch, under the EA jurisdiction. The EA has verbally advised that the discharge rate into the ditch shall be set by NSC flood authority. North Somerset Levels IDB has confirmed that all the impermeable areas including the parking should be discharged at greenfield rates and volumes or 2.5l/s as the minimum practicable (refer to Appendix A).

6.2.3 As described in section 4 of this document, infiltration is not considered to be a viable option for this area and thus it is proposed to collect the runoff water through permeable pavement (concrete block paviours) in the southern parking bays (aisles to remain asphalt), with a 300 mm deep clean stone reservoir layer which extends beneath the adjacent footpath.

6.2.4 The runoff will be attenuated within the 300mm depth of clean stone reservoir layer which will also provide treatment as the water flows through the stone and the geotextile membrane. The water will then be conveyed in a linear swale with check dams spaced every 54m (that include an orifice at the invert level of the swale) which will provide storage and attenuation. The connection between the reservoir layer and the swale will be made by a 100mm pipe. The discharge to Portbury Ditch is designed to be limited to 2.5l/s by flow control at the chamber downstream the swale outlet.

6.2.5 For further details, refer to DRG. 467470.BQ.04.20-DS-Portishead in Appendix B.

6.2.6 The suggested dimensions of the swale can be found in Table 3:3 below.

Swale	Approx. length (m)	Depth (m)	Base width (m)	Side Slope (1:x)	Top width (m)	Greenfield runoff (l/s) for 1in30 yr	Admissible peak flow (l/s) for 1in30 yr
1	275	0.450	1	4	4.6	0.6	2.5

Table 3: Dimensions of the proposed swale at Catchment A.1

6.2.7 The analysis of water levels, in vicinity of the proposed Portbury Ditch outfall, for 25 year and 50 year climate change (assumed to be 20%) scenarios are 4.85m and 7.05m respectively. For a 1 in 30 year event this has been interpolated as 5.29m (refer to Appendix A). A capacity check with Microdrainage software has been undertaken and confirms that both the swale and the permeable pavement are suitable for this tide lock level of 5.29m for a 1 in 30 year including an allowance of 40% climate change.

Exceedance flows

6.2.8 Exceedance flow, based on 1:100 return period plus 40% allowance for climate change, is designed to be managed within the footprint of the carpark, to allow the water level to rise from the drainage system up to 16mm above surface at the lowest points of the carpark. The total flooded volume for the 100yr return period is 177m^3. The southern swale top embankment should be raised by 100mm above the footpath level to contain exceedance volumes within the carpark.

Further work

6.2.9 The existing ditch should be surveyed (connectivity and levels) to investigate connection for discharging.

6.2.10 The Environment Agency should be contacted to agree discharge point.

6.3 Catchment A.2

6.3.1 Catchment A.2 lies to the north of the proposed Portishead railway station and includes the diversion of an existing road and roundabout. The diverted road and new roundabout will tie into Harbour Road to the west and Phoenix Road to the east of the existing roundabout.

6.3.2 There is an existing surface water drainage network in this catchment area, which is identified on Wessex Water services plan as a highway drain. The existing highway runoff discharges via 225mm pipe into ‘The Cut’ watercourse on the north-east of the area (shown on the Appendix B drawings as the proposed discharge point). This approach is based on the Concept Drainage Report attached in Appendix G.

6.3.3 For determining the discharge flow rate from this catchment, an assessment has been carried out to calculate the existing discharge rate for the pre-development site (impermeable catchment of 3,130 m^2). A MicroDrainage model was created for this purpose to simulate the existing drainage system, based on the assumption that the existing drainage system was designed for no-surcharge during 1:1 year rain event with no climate change allowance (See Calculations at

Appendix B). The model results showing existing peak flow of 65 l/s for 1:30 return period. As recommended in the North Somerset Sustainable Drainage Developer Guide, a reduction of 30% has been applied to restrict the proposed drainage discharge to 45.5 l/s.

6.3.4 It is proposed that the road area will fall into three bio-retention areas, where the runoff water will settle and infiltrate into porous layer which will outfall to proposed drainage pipe. This system will include an overflow set to 150 mm below road level. For the areas where draining into the bio-retention areas is not viable, trapped-gullies are proposed to collect the run-off discharging into the proposed sewer. For attenuation, off-line storage of 9 m^3 and 22.5 m^3 are proposed to be located beneath the bio-retention areas. The proposed drainage pipeline of 225mm diameter will convey the runoff from the bio-retention areas along Phoenix Way to discharge into the existing watercourse, as shown in Drawing 467470.BQ.04.20-DS-Portishead on Appendix B.

6.3.5 For limiting the outfall flow rate, an orifice flow control is proposed before the discharge point.

6.3.6 The proposed runoff will be treated by a combination of filtration through the bio-retention areas (vegetation, soil and filter material), or in other locations by trapped-gullies and a subsequent bypass oil separator before discharge.

Exceedance flows

6.3.7 The proposed drainage system will surcharge during 1:100 years rain event without flooding to the highway.

Further work

6.3.8 During detailed design, survey should be included to assess the capacity of the existing drainage highway network, to include the existing discharge structure.

6.3.9 As depth of the drainage system might be limited due to tide-lock level of 5.29m, alternatives of slot-drain or beany blocks should be considered during detailed design to replace the drain sewer at the upstream of the system.

6.4 Catchment A.3

6.4.1 Catchment A.3 lies to the south of the proposed railway station and includes a new road and footways that tie into Quays Avenue. The impermeable area for this catchment is 2,918m^2.

6.4.2 There are no available Wessex Water sewer records of an existing surface water drainage network on Quays Avenue, other than gullies. Therefore, it is assumed that a highway pipe network is present. The existing impermeable area for this catchment is 2,166m^2.

6.4.3 For determining the discharge flow rate from this catchment, an assessment has been carried out to calculate the existing discharge rate for the pre-development.

A MicroDrainage model was created for this purpose to simulate the existing drainage system, based on the assumption that the existing drainage system was designed for no-surcharge during 1:1 year rain event with no climate change allowance (See Calculations at Appendix B). The model results showing existing peak flow of 52 l/s for 1:30 return period. As recommended in the North Somerset Sustainable Drainage Developer Guide, a reduction of 30% has been applied to restrict the proposed drainage discharge to 35 l/s.

6.4.4 An option is that the highway runoff would be captured by a dry swale on the west side of the highway as shown in Drawing 467470.BQ.04.20-DS-Portishead. The carriageway would be profiled to drain to the west side of the catchment into the proposed swale with filter drain.

6.4.5 An alternative would be to capture the highway run-off to the east and into the open space to the south of the station building.

6.4.6 Site constraints would mean this catchment would be drained through a mix of filter drain and swale. On the west side for example, between the proposed bus stop and the catchment boundary, the upper part of the catchment will need to be drained by a filter drain as there is not enough room to accommodate a swale. On the east side the area available for a swale is constrained by the footpath at the junction at Galingale Way needing a pipe connection into the existing highway drainage.

6.4.7 The filter drains would be generally 1.5m deep by 1.5m wide and incorporates a 225mm perforated pipe to convey the runoff. Where sufficient space is available, a dry swale would be proposed. The swale slopes would be set to 1 in 4 as recommended in the SuDS Manual to prevent erosion channelling from lateral inflows, thus giving a swale of generally 0.35m deep. The width and depth would vary depending in the space available. The swale would be the fall of the proposed highway with a longitudinal gradient ranging from 1 in 50 at the top to 1 in 80 at the end.

6.4.8 The swale would be a lined under-drained swale, which will allow the infiltration of the runoff into the filter trench beneath the base during the more frequently occurring storms to provide treatment of the most contaminated runoff. The swales sides and infiltration trench would be lined with an impermeable membrane to ensure that flows are treated before discharge and not infiltrated directly to the ground.

6.4.9 Check dams are promoted along the swale to restrict peak flows and enhance infiltration to the filter trenches. The check dams would be spaced every 20m and set at 0.15m below the top level of the swale to keep a reasonable freeboard.

6.4.10 The swale would discharge into the existing drainage network on Quays Road. A flow control system will be included in the most downstream chamber to restrict flows at 35l/s as calculated before.

Exceedance flows

6.4.11 Exceedance flow, based on 1:100 return period plus 40% allowance for climate change, is designed to be managed within the footprint of the dry swale and the adjacent footpath without affecting the proposed highway. The hydraulic model showed that the total flooded volume is $14m^3$. The flooded volume will exceed the system from the downstream end and will be temporally stored on the surface of the system and the adjacent footpath until the drainage system has enough capacity to deal with those flows.

Further work

6.4.12 Existing manholes and drainage system to be surveyed (CCTV, connectivity and levels) to investigate connection for discharging.

6.4.13 Assess the capacity of the existing highway drainage network.

6.5 Catchment A.4

6.5.1 This catchment is located at the north east of the development area and includes the station car parking and hardstanding by the Portishead station. The site's impermeable area is 3,689 m^2.

6.5.2 Runoff will be collected via linear drainage channels, which will feed into a shallow (300mm deep) geocelullar crate system located beneath the parking bays. The runoff will be treated in several steps as it passes through the drainage network as set out below;

1. Runoff passes into the Permachannel unit which traps silt and coarse particles.
2. Runoff leaves the Permachannel by a diffuser unit which provide a further filtration of oils.
3. Runoff then reaches the first geocellular crate which is fitted with a 'Biomat'. The Biomat geotextile traps oils and other hydrocarbon based floatable contaminants and biodegrades these.
4. Runoff will then leave the Permavoid geocellular crates by an orifice plate flow control before discharging into a watercourse.

6.5.3 The run-off discharge from the car-park will be restricted to max flow rate of 2.5 l/s as there is enough room available to attenuate flows at greenfield runoff peaks or a minimum practicable of 2.5l/s.

6.5.4 Proposed discharge point is to the proposed highways drainage system for Catchment A.2, which outfalls into 'The Cut' watercourse to the north east of the compound as shown in drawing no. 467470.BQ.04.20-DS-Portishead in Appendix B.

6.5.5 For modelling purposes, the car-park has been divided into three sub-catchments – therefore, three sets of calculations are attached in Appendix B.

Exceedance flows

6.5.6 Exceedance flow, based on 1:100 return period plus 40% allowance for climate change, is designed to be managed within the footprint of the carpark, to allow the water level to raise from the Geo-cellular storage and up to 3-11 mm above surface at the lowest points of the carpark. This volume of water is designed to be held by the pavement kerbs. During an exceedance event, the discharge flow rate can reach a peak of 4 l/s for a duration of 500 minutes.

Further work

6.5.7 During detailed design, the existing drainage system should be surveyed (CCTV, connectivity and levels) to assess the capacity and consider discharging to it.

6.6 Pill Station Carpark

6.6.1 Pill station carpark is located between the railway line, Monmouth Close and Avon Road. The catchment area of the carpark is 1,488 m^2.

6.6.2 Surface water runoff from the car park up to the 30 year return period plus a 40% allowance for climate change will be collected through permeable pavement (concrete block paviours) in the parking bays (aisles to remain asphalt), with a clean stone reservoir beneath (this does not extend beyond the parking bays). The runoff will be attenuated within 330mm depth of clean stone (reservoir layer) which will also provide treatment as the water flows through the stone and the geotextile membrane. The reservoir layer will outfall through an orifice flow control limited to 5 l/s (based on the Concept Drainage Design Report Rev 01 from January 2017 refer to Appendix G).

6.6.3 The proposed discharge from the reservoir layer will connect into the existing highway drainage system on Avon Road.

6.6.4 The drop-off area located at Station Road is proposed to be drained in a similar approach with permeable pavement and reservoir layer beneath the three disabled parking spaces. Discharge will be into the existing highway drainage on Station Road.

Exceedance flows

6.6.5 Exceedance flows, based on 1:100 year return period plus 40% allowance for climate change, are designed to be managed within the footprint of the carpark. During an exceedance event, water level will surcharge the subbase pavement layer but it will emerge on the carpark surface. The discharge will reach a peak of 5.2 l/s for a duration of 100 minutes.

Further work

6.6.6 Existing manholes and drainage system in Avon Road and Station Road to be surveyed (CCTV, connectivity and levels).

6.7 Haul roads

6.7.1 Surface water runoff from haul roads up to the 30 year return period plus a 10% allowance for climate change will be captured by ditches, with no exceedance flows occurring up to 100 year return period. In case of blockage, exceedance will be temporarily stored on the surface of the haul roads until sufficient capacity is available within the drainage network.

6.7.2 The temporary haul roads will lie alongside the railway for 1,290m between Portishead and Portbury Hundred construction compound. The haul roads will be approximately 8m wide and the running surface is assumed to be constructed of a Clause 803 (SHW) Type 1 sub-base. Although this granular material is not totally impermeable, the catchment areas of the haul roads have been assumed to be 100% impermeable for the calculations.

6.7.3 Check dams will be promoted along the proposed ditches to capture sediment and minimise contaminated runoff being discharged to downstream watercourses. The accumulated silt will need to be removed and disposed of periodically. The spacing of check dams will depend on the longitudinal slope of the ditches which is still uncertain due to the absence of proposed ground model. The calculations to size the ditches have assumed a relatively flat gradient of 1 in 400 for all the ditches draining the haul roads. The design will need to be checked to confirm that it is adequate when the proposed ground levels are available.

6.7.4 It is recommended to undertake a survey of the conditions and capacity in the receiving watercourses prior to works commencing onsite and on completion in order to confirm there is no larger silt deposits due to the works.

6.7.5 Discharge from the ditches need to be attenuated at greenfield runoff rates or 2.5l/s as the minimum practicable. Vortex flow controls (VFCs) or other types of flow control will be used to achieve the discharge requirements. As runoff peaks are going to be attenuated at greenfield rates, the removal of contaminants through settling and adsorption will be enhanced.

6.7.6 The haul roads will cross existing drainage ditches that will need to be culverted during the duration of the works and subsequently reinstated on completion. A hydraulic assessment should be carried out to estimate the culvert diameter with the minimum requirement being 750mm diameter.

6.7.7 The suggested dimensions of the ditches can be found in Table 4: and the alignment and discharge points are presented in Drawing 467470.BQ.04.20-DS-Haulroads in Appendix D.

Ditch	Approx. length (m)	Depth (m)	Base width (m)	Side Slope (1:x)	Top width (m)	Greenfield runoff (l/s) for 1 in 30 yr	Permissible peak flow (l/s) for 1 in 30 yr
D1	376	0.8	0.8	1	2.4	2.2	2.5
D2	297	0.8	0.7	1	2.3	2	2.5
D3	187	0.7	0.5	1	1.9	1.2	2.5
D4	343	0.9	0.5	1	2.3	2	2.5
D5	87	0.6	0.5	1	1.7	0.7	2.5
D6	297	0.8	0.7	1	2.3	2	2.5

Table 4: Dimensions of the proposed ditches for Haul roads

6.7.8 During detail design, if there is not enough room to accommodate the proposed ditches alongside the haul roads, shallower and narrower ditches could be promoted, with attenuation taking place in detention basins before the discharge to the receiving watercourses, subject to sufficient space being available at the discharge points to accommodate the basins. Runoff from the haul roads will be conveyed by the ditches and piped to the detention basins. The discharge from the basins would be restricted by flow controls. The suggested dimensions of the ditches and detention basins can be found in Table 5 and Table 6 below.

	Approx. length (m)	Depth (m)	Base width (m)	Side Slope (1:x)	Top width (m)	Pipe outlet (mm)
D1 and D2	673	0.4	0.5	1	1.3	300
D3, D4, D5 and D6	617	0.4	0.5	1	1.3	Twin 300

Table 5 : Dimensions of the alternative proposed haul roads ditches

Basin	Approx. base area (m^2)	Approx. base area (m^2)	Volume available (m^3)	Depth (m)	Side Slope (1:x)	Greenfield runoff (l/s) for 1 in 30 yr
D1 and D2	201	452	326.5	1	4	4.3
D3, D4, D5 and D6	361	680	512.2	1	4	5

Table 6 : Dimensions of the proposed detention basins for alternative haul roads ditches

6.7.9 There is an option to connect the runoff from the Haul roads to the adjacent track drainage, subject to Network Rail consent, rather than constructing a new drainage system. At this scenario, the proposed ditches (No.1 – 6) will not be required. In addition it is like that the surfaced width of the haul road would be reduced.

6.8 Temporary Construction Compounds

6.8.1 Introduction

6.8.1.1 This section includes the drainage strategy for the construction compounds. The compounds listed below are not included in the scope of this report:

- Compound to the north of Portishead station (refer to sheet 1 of Appendix H). For this area, it is assumed the car park would be implemented and used as a compound with its drainage design as described above (refer to Drawing 467470.BQ.04.20-DS-Portishead of Appendix B).
- M5 compound (refer to sheet 6 of Appendix H). This area is already a hardstanding area.
- Compound located between Lodway Farm compound and Pill station car park (the garages by Avon Bridge, refer to sheet 7 of Appendix H). This area is an existing highway.
- Small compound located to the south-east of Pill station car park, next to Station Road (refer to sheet 8 of Appendix H). Only the design of the drainage of the car park will be undertaken (refer to Drawing 467470.BQ.04.20-DS-Portishead of Appendix B).
- Small compound located to the west of Watch House Road (refer to sheet 8 of Appendix H). This area was already developed.
- Compound to the west of Winterstoke Road (refer to sheet 19 of Appendix H). This area is an existing car park.

6.8.2 Compound located to the east of Portishead Station

6.8.2.1 The compound to the east of Portishead Station is a temporary site for the construction of Trinity footbridge that will cross over the railway. The compound has an approximate proposed footprint of 0.106 ha. The surface material for the hardstanding of the temporary compound is assumed to be type 1 aggregate.

6.8.2.2 It is assumed that the terrain will fall from south-west to north-east. Surface water runoff from this compound up the 30 year return period plus an allowance for climate change of 10% (since this compound is temporary) will be captured by a filter drain installed along in the southern edge of the compound and then then discharge into the Cut at the greenfield runoff rate of 2.5l/s (minimum practicable).

6.8.2.3 The suggested dimensions of the filter drains can be found in Table 7 and the alignment and discharge points are presented in Drawing 467470.BQ.04.20-DS-East_of_Portishead in Appendix E.

Approx. length (m)	Depth (m)	Width (m)	Pipe diameter (mm)	No. of pipes at the bottom of the trench
150	1.4	0.45	150	1

Table 7: Filter drains for compound to the east of Portishead Station

6.8.2.4 The calculations to size the filter drain assumed a gradient of 1 in 200. The design will need to be checked to confirm that it is adequate when the proposed ground levels are available.

6.8.2.5 For pollution control purposes, the filter drain provides water treatment and sediment removal as runoff percolates through the granular material. Additionally, filter drains will be lined with a geotextile for further water treatment and to avoid infiltration of runoff into the ground. It is recommended that at the beginning of the run of the filter drain, a chamber with a grated gully is installed to allow for maintenance. It is recommended to install a bypass separator in case oil handling is proposed within this compound.

Exceedance flows

6.8.2.6 The construction of a bank surrounding the compound is proposed to control the exceedance flows. The proposed filter drain present flooding for the 1 in 100 year return period event (see Table 8):

Drainage Elements	Exceedance flood volume (m^3)	
	30 year return period; 10% allowance for climate change	100 year return period; 10% allowance for climate change
Filter drain	0	7.6

Table 8: Exceedance flood volume

Exceedance routes are proposed to be located along the northern edge of the compound towards a green area located to the north-east of the compound. This area has a surface of 1512m^2.

6.8.3 C15 Sheepway Compound

6.8.3.1 Sheepway compound is located at the junction between the railway line and Sheepway Road. The site will include 0.042ha temporary compound and 0.065ha permanent compounds. The design of the compound includes green areas and hardstanding for parking and welfare facilities.

6.8.3.2 This compound will include a small amount of parking, welfare facilities and materials storage.

6.8.3.3 Only existing topographic data was available at present. The drainage system has been designed to drain from south to north and it should be checked when the proposed ground model is available.

6.8.3.4 Surface water runoff from the permanent area of the compound up to the 30-year return period plus 40% allowance for climate change will be captured by a french drain and discharge either to the Network Rail drainage system to the south or to an existing ditch to the west of the site as shown in Drawing 467470.BQ.04.20-DS-C15 in Appendix E. The discharge will occur at greenfield runoff rates or 2.5l/s as the minimum practicable.

6.8.3.5 The suggested dimensions of the French drain can be found in Table 9 and the alignment and discharge point are presented in Drawing 467470.BQ.04.20-DS-C15 in Appendix E.

Approx. length (m)	Depth (m)	Width (m)	Pipe diameter (mm)	No. of pipes at the bottom of the trench
113	1	0.7	150	1

Table 9: Dimensions of the French drain for the permanent area for Sheepway Compound

6.8.3.6 Surface water runoff from the temporary area of the compound for the 30 year return period plus 10% allowance for climate change will be captured by filter drain and then conveyed by pipes to discharge into existing ditches at the greenfield runoff rate.

6.8.3.7 The suggested dimensions of the filter drain can be found in Table 10.

Approx. length (m)	Depth (m)	Width (m)	Pipe diameter (mm)	No. of pipes at the bottom of the trench
139	1	0.3	150	1

Table 10: Filter drains for the temporary area for Sheepway Compound

6.8.3.8 The calculations to size the filter drains assumed a gradient of 1 in 400. The design will need to be checked to confirm that it is adequate when the proposed ground levels are available.

6.8.3.9 The proposed footpath shall be drained to the adjacent field. The area at the east side of the compound is recommended to be discharged to the track drainage.

Exceedance flows

6.8.3.10 For the permanent area, the French drain will flood for the 1 in 100 return period event but there is no flooding for the 1 in 30 return period. There is no flooding for the temporary area in either the 1 in 30 return period event or for the 1 in 100 return period event (see Table 11).

Drainage elements	Return Period (yr)	Climate Change (%)	Exceedance flood volume (m^3)
French Drain	30	40	0
French Drain	100	40	4.2
Filter drain	30	10	0
Filter drain	100	10	0

Table 11: Exceedance flood volume for the temporary and permanent areas

6.8.3.11 Exceedance routes are proposed to be located at the northern side of the compound as shown in drawing 467470.BQ.04.20-DS-C15 in Appendix E.

6.8.3.12 During detailed design, there might be opportunities to propose flooded volumes to be managed within the compound site, once the layout of the compound has been designed.

Further recommendations

6.8.3.13 Historic borehole logs undertaken in the vicinity of the compound available in the BGS viewer were used to investigate the ground water flood risk. The highest ground water level encountered in the area was at 4.5m BGL. If during the construction ground water is found close to the surface (ie: 2m BGL), the drainage system will need to be revised to suit the ground water conditions.

6.8.3.14 Further consultation with the EA will be undertaken during the detailed design phase to check if compensatory flood storage is required.

6.8.4 C14 Portbury Hundred Compound

6.8.4.1 Portbury Hundred compound is located south of Sheepway, between the railway line and the A369 Portbury Hundred highway and to the west of the crossing of Station Road and the A369. It has a proposed footprint of 11.4 ha and the surface is assumed to be constructed of Type 1 aggregate. Although this granular material is not totally impermeable, for the scope of this report it has been assumed that it is completely impermeable for the calculations.

6.8.4.2 This construction compound could include a large amount of parking spaces for staff vehicles, storage of materials, offices and welfare facilities. The materials stored could be sleepers, drainage, troughing, energy recovery units for vegetation removal, spoil, ballast and track formation. Plant vehicles will circulate in the area, including dumpers, excavators, dozers and lorries.

6.8.4.3 No topographical data was available at present. Therefore, since the existing ditches SG1 and D4 are flowing from north to south, it was assumed the terrain is falling from north to south in this area.

6.8.4.4 With the aim of not posing any flood risk to the new railway and to the access track located in the southern edge of the compound, the proposed fall of the ground will be towards the south-west and south-east, having a watershed along the axis of the access track up to the northern edge. In case of flooding, only the lower-western and lower-eastern corners of the compound would be affected, keeping the access track and the majority of the compound free of flooding.

6.8.4.5 The compound will be then divided into four sub-catchments: A and B and C and D (see drawing 467470.BQ.04.20-DS-C14 in Appendix E for reference).

6.8.4.6 Sub-catchments A and B would fall towards south-west, making the ditch in sub-catchment A and the pipe in sub-catchment B tend towards the south. C would fall towards the south-east, making the pipe in this area lean towards the south. D would fall towards the south, making the ditch in sub-catchment D falling towards the south-west, in order to convey the runoff towards the basin located in the southeast corner of sub-catchment C.

6.8.4.7 In the scenario set out below, surface water runoff from this compound up the 30-year return period plus an allowance for climate change of 10% (since this compound is temporary) could be captured by filter drains installed in each sub-catchment and then conveyed by ditches or pipes to two attenuation basins, which will then discharge into two existing ditches at the greenfield runoff rate. Obviously a contractor may wish to adopt a different approach.

6.8.4.8 The suggested dimensions of the filter drains can be found in Table 12: and the alignment and discharge points are presented in Drawing 467470.BQ.04.20-DS-C14 in Appendix E.

Approx. length (m)	Depth (m)	Width (m)	Pipe diameter (mm)	No. of pipes at the bottom of the trench
100	1.4	0.45	150	1

Table 12: Filter drains for Portbury Hundred Construction Compound

6.8.4.9 The calculations to size the filter drains assumed a gradient of 1 in 200. The design will need to be checked to confirm that it is adequate when the proposed compound ground levels are available.

6.8.4.10 For pollution control purposes, filter drains provide water treatment and sediment removal as runoff percolates through the granular material. Additionally, filter drains can be lined with a geotextile for further water treatment and to avoid infiltration of runoff into the ground. It is recommended that at the beginning of the run of each filter drain, a chamber with a grated gully is installed to allow for maintenance.

6.8.4.11 In the case of fuel and oil handling occurring, a separate drainage system will be installed including oil separator to treat flows. All fuel and oil storage tanks would be installed within a bunded area with 110% storage volume of the tank available, should the tank be ruptured or a spill occur.

6.8.4.12 The results from the hydraulic modelling show that a filter drain with such dimensions is able to drain a contributing area of 0.27 ha. Considering this the number of filter drains necessary to drain each catchment are shown in Table 13:

Sub-catchment	No. of filter drains
A	13
B	13
C	10
D	8

Table 13: No. of filter drains needed in each sub-catchment.

6.8.4.13 In sub-catchments A and D, runoff conveyed by filter drains would be collected by two ditches flowing along the western and southern edges of the compound respectively. It is proposed that these ditches are grass-lined and that they include an impermeable lining. The proposed indicative dimensions for these ditches are the following:

Ditch	Approx. length (m)	Depth (m)	Base width (m)	Side Slope (1:x)	Top width (m)
Catchment A	386	1	1	3	7
Catchment D	230.5	1	1	3	7

Table 14: Dimensions of the proposed ditches for Portbury Hundred construction compound.

6.8.4.14 The calculations to size the ditches assumed a gradient of 1 in 500. The design will need to be checked to confirm that it is adequate when the proposed ground levels are available.

6.8.4.15 It is proposed to include check dams to be installed just upstream of each filter drains connection. This will provide attenuation of peak flows and pollution control, allowing for sediment settling. Also, it must be noted that the grass lining in the ditches provides water treatment as well.

6.8.4.16 In sub-catchments B and C, runoff conveyed by filter drains would need to be collected by two pipes flowing along the western and eastern edges of these catchments respectively. The proposed dimensions for these pipes are shown in Table 15:

Pipes	Approx. length of total run (m)	Longitudinal slope (1:x)	Pipe diameter (mm)
Catchment B	222	100	525

Pipes	Approx. length of total run (m)	Longitudinal slope (1:x)	Pipe diameter (mm)
Catchment D	144	100	525

Table 15: Dimension of the proposed pipes for Portbury Hundred construction compound.

6.8.4.17 The calculations to size these pipes assumed a gradient of 1 in 100. The design will need to be checked to confirm that it is adequate when the proposed ground levels for the compound area are available. Due to the large diameter of these pipes, they may have limited cover. If this is the case during detailed design, it is recommended to install protection to these pipes or prevent heavy loads being placed on them. Chambers will need to be included every 100m maximum for maintenance purposes.

6.8.4.18 Two attenuation basins would be constructed in this compound in this scenario: Basin 1 could be located in the south-western corner and Basin 2 could be located in the southern edge of the compound, close to the right boundary of sub-catchment C (see drawing 467470.BQ.04.20-DS-C14 in Appendix E for reference). Basin 1 is proposed to discharge into the existing ditch SG1, located to the west of the construction compound, while Basin 2 is proposed to discharge into existing ditch D4, which crosses the compound in its central part. Therefore, the portion of ditch D4 within Portbury Hundred Compound is proposed to be culverted. Discharge into the existing D4 culvert is subject to IDB consent (see Appendix A). The indicative dimensions for the basins are displayed in Table 16:

Basins	Depth (m)	Top area (m^2)	Base area (m^2)	Total volume available (m^3)	Greenfield runoff (l/s) for 1 in 30 yr
Basin 1	1.5	2850	1968	3493	45.5
Basin 2	1.5	2000	1271	2433	31.6

Table 16: Dimensions of the proposed attenuation basins for Portbury Hundred compound.

6.8.4.19 Regarding pollution control, the detention basin would provide water treatment within a forebay that allows for sediment settling. The sedimentation forebay will be at least 10% of the total basin area as recommended in the SuDS Manual. In addition, it is recommended to install gabion baskets within the basins to provide additional sediment catching. If the compound is to be used to store ballast, it is recommended the installation of bypass separators at the outlets of both basins.

Variable impermeability scenarios

6.8.4.20 The dimensions of the proposed attenuation basins (Table 17) are indicative for the 1 in 30-year return period flood event and assuming that the site is 100% impermeable.

6.8.4.21 The maximum volume of the basins has also been calculated considering the 1 in 5 and the 1 in 10-year return period flooding for the two basins with 100% permeability.

6.8.4.22 Additionally, in order to test differing impermeability scenarios, the maximum volume of the basins has been calculated considering 75% and 50% impermeability for the two basins for the 1 in 30-year return period. Results are presented in Table 17 below.

Basins	Return Period (yr)	Permeability (%)	Maximum Volume (m^3)
Basin 1	**30**	**100**	**2,623**
Basin 1	5	100	1,746
Basin 1	10	100	2,043
Basin 1	30	75	1,902
Basin 1	30	50	1,218
Basin 2	**30**	**100**	**1,816**
Basin 2	5	100	1,203
Basin 2	10	100	1,410
Basin 2	30	75	1,313
Basin 2	30	50	836

Table 17: Basin's volumes for different return periods and permeabilities

Exceedance flows

6.8.4.23 The construction of a bank surrounding the compound is proposed to control the exceedance flows.

6.8.4.24 The filter drains and the ditch for sub-catchment D are the only elements of the drainage system that flood during the 1 in 100 return period event (see Table 18:).

Drainage Elements	Exceedance flood volume (m^3)	
	30 year return period; 10% allowance for climate change	100 year return period; 10% allowance for climate change
Filter drain	0	7
Ditch for catchment D	0	2.3
Total flooded volume	0	308

Table 18: Exceedance flood volume

6.8.4.25 It has to be noted that the exceedance flooded volume shown in Table 18: for filter drains corresponds to one filter drain. Considering all the filter drains to be installed in this compound would give a total exceedance flooded volume of 308 m^3.

6.8.4.26 Exceedance routes are proposed to be located in the south-western corner of sub-catchment A towards the green area located to the west of Portbury 6.8.4.27 Hundred compound and in the southern edge of sub-catchment D towards a green area located between the compound and the A369 (see drawing 467470.BQ.04.20-DS-C14 in Appendix E for reference).

6.8.4.27 During detailed design, there might be opportunities to propose flooded volumes to be managed within the compound site, once the layout of the compound has been designed.

Further recommendations

6.8.4.28 Historic boreholes logs undertaken in the vicinity of the compound available in the BGS viewer were used to investigate the groundwater flood risk. The highest level at which groundwater was encountered in the area was at 1.7 m bgl, which is the reason why all drainage is proposed to have a depth of 1.5 m or less. It must be noted that one of the boreholes available in the BGS viewer, undertaken to the south-east of the site, water was encountered at 2.13 m bgl after what it rose up to 0.91 m bgl. The SUDS Manual recommends investigating groundwater levels to ensure the base of the proposed drainage system is at least 1 m above the maximum anticipated groundwater level. Prior to construction it is therefore recommended that piezometers are installed to monitor groundwater levels over a 6 month period taking in April and May which are typically expected to be the peak for groundwater levels in the UK. If groundwater is encountered less than 1 m below the invert level of the proposed drainage system, the drainage design should take this into account and be amended accordingly.

6.8.4.29 Topographical survey is required in order to finalise the drainage system design, as described above, for the Portbury Hundred construction compound. If the existing ditches are found to be at a higher level than the proposed attenuation basins, the drainage proposals will need adjusting if feasible, or alternatively a pumping system may be required.

6.8.4.30 Further consultation with the EA will be undertaken during the detail design phase to check if compensatory flood storage will be required.

6.8.5 C13 Lodway Farm Compound

6.8.5.1 Lodway Farm compound is located adjacent to the M5, to the south of the railway line immediately North of Pill. It has a proposed footprint of 8.2 ha and the surface is assumed be constructed of Type 1 aggregate. Although this granular material is not totally impermeable, for the scope of this report it has been assumed that it is completely impermeable for the calculations. Within the compound there are archaeological and reptile areas and these areas have been excluded from the drainage system of the compound. The total contributing area of this compound after the exclusion of these areas is 6.36ha.

6.8.5.2 This construction compound will include a medium amount of parking spaces for staff vehicles, storage of materials, offices and welfare facilities. The materials stored will be sleepers, drainage, troughing, energy recovery units for vegetation removal, spoil, ballast and track formation. Plant vehicles will circulate in the area, including dumpers, excavators, dozers and lorries, and a short section of temporary track may be constructed to allow trains onto the area for ballast removal and delivery.

6.8.5.3 Surface water runoff from this compound up the 30 year return period plus an allowance for climate change of 10% (since this compound is temporary) will be captured by filter drains in this scenario, and then conveyed by a runoff collector along the northern edge of the compound to an attenuation basin. This would will then discharge into an existing culvert to the north, subject to confirmation by Network Rail, at the greenfield runoff rate. The existing ground falls towards the railway and therefore the proposed location of the drainage collector is inevitable. The drainage collector would need to be of a sort which allows vehicles to pass over it onto the track works.

6.8.5.4 The suggested dimensions of the filter drains can be found in Table 19 and the alignment and discharge points are presented in Drawing 467470.BQ.04.20-DS-C13 in Appendix E.

Approx. length (m)	Depth (m)	Width (m)	Pipe diameter (mm)	No. of pipes at the bottom of the trench
Varies	1.4	0.45	150	1

Table 19: Filter drains for Lodway Farm Construction Compound

6.8.5.5 The calculations to size the filter drains assumed a gradient of 1 in 200. The design will need to be checked to confirm that it is adequate when the proposed ground levels are available.

6.8.5.6 For pollution control purposes, filter drains provide water treatment and sediment removal as runoff percolates through the granular material. Additionally, filter drains will be lined with a geotextile for further water treatment and to avoid infiltration of runoff into the ground. It is recommended that at the beginning of the run of each filter drain, a chamber with a grated gully is installed to allow for maintenance.

6.8.5.7 In the case of fuel and oil handling occurring, a separate drainage system will be installed including oil separator to treat flows. All fuel and oil storage tanks will be installed within a bunded area with 110% storage volume of the tank available, should the tank be ruptured or a spill occur.

6.8.5.8 One attenuation basin would need be constructed in this compound drainage scenario, located in the north-western corner of the compound (see drawing 467470.BQ.04.20-DS-C13 in Appendix E for reference). The basin is proposed to discharge into the existing culvert at the northern part of the compound. The exact location of the existing culvert is to be confirmed by Network Rail. The proposed dimensions for the basin are displayed in Table 20:

Basins	Depth (m)	Top area (m^2)	Base area (m^2)	Total volume available (m^3)	Greenfield runoff (l/s) for 1 in 30 yr
Basin	1.5	2,601	1,728	3,224	43.2

Table 20: Dimensions of the proposed attenuation basin for Lodway Farm compound.

6.8.5.9 Regarding pollution control, basins provide water treatment allowing for sediment settling. In addition, it is recommended to install gabion baskets within the basin to provide additional sediment catching. Since the compound will be used to store ballast, it is recommended the installation of bypass separators at the outlet of the basin. In addition, the basin should be constructed with a forebay at the inlet, and a micropool at the outlet to aid sediment control.

Further work

6.8.5.10 Historical borehole logs undertaken in the vicinity of the compound available in the BGS viewer were used to investigate the groundwater flood risk. The highest level at which groundwater was encountered in the area was at 1.7 m bgl, which is the reason why all drainage is proposed to have a depth of 1.5 m or less. The SUDS Manual recommends investigating groundwater levels to ensure the base of the proposed drainage system is at least 1 m above the maximum anticipated groundwater level. Prior to construction it is therefore recommended that piezometers are installed to monitor groundwater levels over a 6 months period taking in April and May which are typically expected to be the peak for groundwater levels in the UK. If groundwater is encountered less than 1 m below the invert level of the proposed drainage system, the drainage design should take this into account and be amended accordingly.

6.8.5.11 Topographical survey is required in order to finalise the drainage system design for the Lodway Farm compound.

6.8.5.12 Further consultation with the EA will be undertaken during the detail design phase to check if compensatory flood storage will be required.

6.8.6 C9 Ham Green Access point and compound

6.8.6.1 Ham Green Access point and compound is located to the north of the eastern portal of Pill Tunnel. Ham Green Lake is located just to the east of the access point compound. This compound has a proposed footprint of 0.491 ha, from which 0.286 ha are the temporary compound and 0.204 ha will be the permanent construction. The permanent construction comprises a Network Rail pedestrian and vehicular access road, as well as some space for parking and landscaped areas. Low loaders to drop off RRVs will be using the entrance area to the access point. Network Rail is proposing a permeable solution for the temporary compound.

6.8.6.2 Surface water runoff from the permanent areas of the compound up to the 30 year return period plus an allowance for climate change of 40% will be captured by a linear ditch (0.172ha) that will be connected to a filter drain at the eastern edge of the turn area. Discharge from filter drains will be attenuated in a Geo-cellular storage or similar, with 34.2m^3 required storage volume. It is recommended the discharge from the Geo-cellular storage to be connected to the existing Network Rail silt trap before outfall to Ham Green Lake. The system will discharge into the silt trap at greenfield runoff rates or 2.5l/s as the minimum practicable.

6.8.6.3 Network Rail has been informed of the discharge flow rate and volumes arriving to the silt trap (see Appendix A) from the access point. Since the capacity of the silt trap is unknown it has been agreed that the drainage will be treated prior to discharging to the silt trap. Therefore, a bypass oil separator is recommended before the connection with the existing outfall to provide water treatment. During detailed design, survey of the silt trap is required to identify its capacity.

6.8.6.4 The suggested dimensions of the ditch for the permanent areas is shown in Table 21: and the alignment and discharge points are presented in Drawing 467470.BQ.04.20-DS-C9 in Appendix E.

Approx. length (m)	Depth (m)	Top width (m)	Base width (m)	Side slope (1inX)
190	0.8	2.1	0.5	1

Table 21: Dimensions of the proposed ditch for the permanent areas Ham Green Compound

6.8.6.5 In terms of pollution control, several measures are proposed to prevent any sediment from reaching Ham Green Lake. Check dams will be installed along the proposed ditch to capture sediment. The accumulated silt will need to be removed periodically. The spacing of check dams will depend on their height and the longitudinal slope of the ditch which is still uncertain due to the absence of a detailed proposed ground model.

6.8.6.6 A silt pollution control (i.e. straw bale barrier) has been proposed to be placed during construction at the eastern edge of the site (as shown in 467470.BQ.04.20-DS-C9) to protect the Ham Green Lake from runoff and to provide temporary pollution control.

Exceedance flows

6.8.6.7 Exceedance routes from the Geo-cellular storage location towards the green areas are located to the east of the compound, between the compound fence and the Ham Green Lake (see drawing 467470.BQ.04.20-DS-C9 in Appendix E for reference).

6.8.6.8 Since the proposed drainage system is discharging into the lake, exceedance events could cause the Ham Green Lake to spill. Then, exceedance flows were checked for 100 yr return period. For the permanent areas, the pipeline running from the Geo-cellular storage towards the existing silt trap from Network Rail presents flooding for the 1 in 100 year return period:

Drainage Elements	30 year return period; 40% allowance for climate change	100 year return period; 40% allowance for climate change
Outlet Pipeline	0	1.9m^3

Table 22: Exceedance flood volumes

Further recommendations

6.8.6.9 Historical boreholes logs undertaken in the vicinity of the compound available in the BGS viewer were used to investigate the ground water flood risk. The highest ground water level encountered in the area was at 22m BGL. If during construction ground water is found close to the surface, the drainage system will need to be revised to suit the ground water conditions.

6.8.6.10 Survey of the existing silt trap in the Railway Network drainage system outfall into the Ham Green Lake to be undertaken to check if it can accommodate the runoff from the compound.

6.8.6.11 Further consultation with the EA will be undertaken in the detail design phase to check if compensatory flood storage will be necessary.

6.8.7 C4 Clanage Road Compound

6.8.7.1 C4 Clanage Road compound is located to the west of Bristol, between the A369 and the railway line. This compound has a proposed footprint of 0.6137 ha, from which 0.312 ha are the permanent construction and 0.3017ha are the temporary compound. The surface material for the hardstanding of the temporary compound will be type 1 aggregate.

6.8.7.2 This site will be the main compound for construction activities through the Avon Gorge, including track works, earthworks, underbridge strengthening, signalling and telecoms. The site will be used as a medium-sized parking area, for materials storage, offices and welfare facilities. RRAP will be installed to allow RRVs access into the gorge, for which the construction of a ramp will be required to facilitate this.

6.8.7.3 The site is in flood zone 3 and is prone to waterlogging. It is understood that this will mean that the compound may be occasionally flooded and it is accepted that it not be possible to use for periods of time. In addition, it is proposed that materials and equipment will only be stored there for immediate maintenance activities.

6.8.7.4 No topographical data is available at present. Therefore, for the purpose of the drainage design of the temporary areas, it is proposed that the ground falls south-east, to allow for a low point in the south-eastern corner of the temporary extents.

6.8.7.5 Surface water runoff from the temporary areas of the compound up to the 30 year return period plus an allowance for climate change of 10% would be captured by a runoff collector and then discharge unattenuated via a pump supplied by Network Rail to the River Avon, subject to Environment Agency's consent (refer to Appendix A). The runoff collector is proposed to run along the southern edge of the temporary compound, ending in the south-eastern corner.

6.8.7.6 In terms of pollution control, a bypass separator is recommended before the discharge to the River Avon to provide water treatment.

7. Contributing areas & Runoff assessment

7.1 As any additional runoff up to the 30yr return period is to be managed in a sustainable way through the implementation of SuDS, there should be no increase to flood risk posed from surface water, including during exceedance events up to the 100yr return period. Pre- and post-development areas are presented in Table 23: to Table 26: below.

Portishead Station						
	Pre - development			Post - development		
Catchment Area	Permeable area (m^2)	Impermeable area (m^2)	Total (m^2)	Permeable area (m^2)	Impermeable area (m^2)	Total (m^2)
C.1	7,513	0	7,513	1,410	6,103	7,513
C.2	1,702	3,130	4,832	752	4,080	4,832
C.3	2,322	2,166	4,488	1,570	2,918	4,488
C.4	1,822	1,867	3,689	100	3,589	3,689

Table 23: Pre- and post-development areas in Portishead Station

Pill Station						
	Pre - development			Post - development		
Catchment Area	Permeable area (m^2)	Impermeable area (m^2)	Total (m^2)	Permeable area (m^2)	Impermeable area (m^2)	Total (m^2)
	8,455	0	8,455	2,352	6,103	8,455

Table 24: Pre- and post-development areas in Pill Station

Haul roads						
	Pre - development			Post - development		

Area	Permeable area (m^2)	Impermeable area (m^2)	Total (m^2)	Permeable area (m^2)	Impermeable area (m^2)	Total (m^2)
1	3,286	0	3,286	0	3,286	3,286
2	2,963	0	2,963	0	2,963	2,963
3	1,759	0	1,759	0	1,759	1,759
4	2,966	0	2,966	0	2,966	2,966
5	1,020	0	1,020	0	1,020	1,020
6	2,970	0	2,970	0	2,970	2,970

Table 25: Pre- and post-development areas for Haul Roads

Table 26: Pre- and post-development areas for compounds

*Both permanent and temporary impermeable areas have been considered.

8. Modelling

8.1 The hydraulic modelling results show that runoff up to a 1 in 30-year return period (which has 3.33% chance of occurring in any given year) will be contained in the proposed drainage features without flooding. A list of the assets for the development site, with corresponding references to the drawings and calculations, are shown in Table 27. It should be noted that calculations and drawings are presented in Appendices B, C, D and E for each development area respectively.

Development Area	Drawing Reference	Calculation Reference – 1 in 30-year results
Portishead Station Cat A.1 (Appendix B)	467470.BQ.04.20-DS-Portishead	467470.BQ.04.20-DS-PortisheadCat.A.1Calculations
Portishead Station Cat A.2 (Appendix B)		467470.BQ.04.20-DS-PortisheadCat.A.2Calculations
Portishead Station Cat A.3 (Appendix B)		467470.BQ.04.20-DS-PortisheadCat.A.3Calculations
Portishead Station Cat A.4 (Appendix B)		467470.BQ.04.20-DS-PortisheadCat.A.4Calculations
Pill station carpark (Appendix C)	467470.BQ.04.20-DS-Pill	467470.BQ.04.20-DS-PillCalculations
Haul roads (Appendix D)	467470.BQ.04.20-DS-Haulroads	467470.BQ.04.20-DS-HaulroadsCalculations
Compound east of Portishead Station [work is in progress] (Appendix E)		467470.BQ.04.20-DS-EastPortisheadCalculations
C15 Sheepway compound (Appendix E)	467470.BQ.04.20-DS-C15	467470.BQ.04.20-DS-C15Calculations
C14 Portbury Hundred compound (Appendix E)	467470.BQ.04.20-DS-C14	467470.BQ.04.20-DS-C14Calculations
Turning area for construction vehicles east to C14 (Appendix E)	467470.BQ.04.20-DS-C14turningarea	467470.BQ.04.20-DS-C14turningareaCalculations
C13 Lodway Farm (Appendix E)	467470.BQ.04.20-DS-C13	467470.BQ.04.20-DS-C13Calculations
C9 Ham Green compound (Appendix E)	467470.BQ.04.20-DS-C9	467470.BQ.04.20-DS-C9Calculations
C4 Clanage Road (Appendix E)	467470.BQ.04.20-DS-C4	-

Table 27: Calculations and associated drawing number for the proposed drainage options of the development areas

9. Pollution Control & Water Quality

9.1 Due to the diverse nature of the developments covered in this drainage strategy, each site has been assessed independently.

9.2 SuDS have been promoted where possible as recommended on the National Planning Policy Framework and the North Somerset Sustainable Drainage Developer Guide as one of the most appropriate methods to provide the adequate water treatment before the discharge to the environment.

9.3 The Simple Index Approach, in line with Section 26.7.1 of the CIRIA C753 SuDS Manual 2015, has been undertaken for the developments classified as medium pollution hazard and mitigation measures have been consulted to the environmental regulator for the higher risk sites to ensure effective pollution control. The process and results are presented in appendix F.

9.4 Pollution hazards were identified and measures proposed in accordance to relevant legislation and best practices. Measures proposed for each site have been outlined in their correspondent sections of this report. This includes dry swales, bioretention areas, filter drains, ditches with check dams, detention basins and Class 1 bypass separator that has been sized to fully treat the more frequent flows.

9.5 Refer to Appendix F for details about pollution control and water quality.

10. General Recommendations and Missing Information

- Existing drainage system to be surveyed (CCTV, connectivity and levels)
- Topographical survey is recommended to be undertaken.
- Due to lack of gradient in the existing ditches, pumping might be required.
- Existing watercourses to which discharge is proposed should be surveyed to assess conditions and capacity.
- Outfalls should be monitored on a regular basis and only clear and uncontaminated water should be discharged from site. Outfalls will be equipped with shut-off valves to stop water flow in case any contamination event occurs.

APPENDICES

APPENDIX A

North Somerset Levels Internal Drainage Board (IDB) Drainage Advice and Pollution Mitigation Measures, Analysis of Portbury Ditch Water Levels

North Somerset Levels Internal Drainage Board Pre-application Response No. 2

Response to emails 20/3/2018

Email dated 13 April 2018 from Dario de Frutos Subtil

Compounds:

There are two main compounds to discharge to IDB watercourses: sheepway compound and the portubury 100 compound. The design of the compounds is still on progress and the only available information we have at the moment is that both construction compounds will be used for storage of materials (sleepers, troughing, spoil, ballast and track formation), welfare facilities and parking. Heavy vehicles will be using the compounds such as dumpers, excavators, dozers and lorries.

NSLIDB response:

The Board expects that all compounds and in particular any culverting to be removed post construction and as a minimum returned to their pre-development condition. If included in a remedial landscape scheme the watercourses should not be planted with anything other than a standard grass seed mix to prevent erosion. Any other vegetation should be left to colonise naturally.

Note that the Board requires that any open watercourses within the compounds should be fully culverted for the duration of the works, min 750mm dia (subject to final approval on receipt of detailed proposals) and all to be removed on completion to prevent construction runoff from entering the watercourse.

Measures to minimise and control the risk of contaminated runoff from the compounds should be implemented as part of site set-up. The main risks in term of water pollution hazard and how they will be mitigated below:

Sediments:

Filter drains will be proposed as the conveyance system for most part of the compounds. The flows from the filter drains will be then directed to ditches located around the perimeter of the compounds that will also allow sedimentation. Additionally, catchpits with sumps will be also promoted to capture the silt.

NSLIDB Comment:

That seems a reasonable approach, the outfall should be monitored on a regular basis and only clear and uncontaminated water should be discharged from site. This should be the driving factor for the design of the onsite features and additional measure introduced if required throughout the construction period.

Detention basins will be proposed as the most downstream before the discharge (at the greenfield runoff peak) to the watercourses to provide water storage but also a secondary water treatment (sedimentation and pollution removal).

Storage materials areas should be under cover to prevent wash down.

NSLIDB Comment:

Agree that basins at final outfall points are essential. All basins and discharge points should have means of shutting off outlets in case of spillage etc. Discharge rate liable to be academic – outfalls will almost certainly be submerged owing to lack of gradients in local ditch network and getting the water away will be the challenge. It may be found necessary to pump in order to maintain satisfactory ground conditions within the compounds. We comment elsewhere on the suitability of the offsite ditches to convey the compound drainage.

Fuel and oil:

For the areas of fuel and oil handling, oil separators will be provided to remove hydrocarbons from high-risk areas of runoff. In addition, penstock chambers will be proposed downstream of the oil separators and at other locations of the network to enable shut down of the surface water drainage network in case of a spill occurs. *NSLIDB Agreed*

Water from wash down areas:

Wash down areas should be isolated and appropriate water treatment to be provided as required. *NSLIDB Agreed*

Haul roads

The main pollution hazard for the haul roads is likely to be silt.

The runoff generated is currently proposed to be conveyed in ditches with checkdams to capture the sediment. The accumulated sediment will need to be digged and disposed periodically. As runoff peaks are going to be attenuated at greenfield peak, the removal of contaminants through settling, adsorption will be enhanced.

NSIDB response:

As mentioned above any discharge from the site should be clear and uncontaminated. A survey of silt levels in receiving watercourses should be undertaken prior to works commencing onsite. Any silt that does end up in adjacent watercourses should be disposed of post construction by the main contractor.

Email from Dave Bellamy dated 10 April 2018

I made a note during the meeting in February that the discharge into the Portbury Ditch Main river from the Portishead car park could be unattenuated. Is that still correct?

NSLIDB response:

Only discharge from the actual platform and station building can be discharged unattenuated, all other areas including parking, should be discharged at greenfield rates and volumes.

Email from Gloria Rigual Muñoz dated 12 April 2018

I'm writing to you regarding the ditch D4 that crosses the proposed location for Portbury Hundred Construction Compound. I wanted to ask you if this ditch could be culverted to allow for the construction of the compound above it.

Also, referring to Dave's email early this week, if you could come back to us as soon as possible with your preferred discharge points and the greenfield runoff rates, that would be really helpful for us. For now, we're assuming a minimum discharge rate of 5 l/s since controlling flow at lower discharge can be technically unfeasible.

NSLIDB response:

As discussed above the Board would require any open watercourses within compounds should be culverted to prevent contamination by construction run-off. Therefore we wouldn't have any issues with the culverting of ditch D4.

The Board believes that with modern vortex flow controls flows can be restricted to 2.5 l/s without an unnecessary risk of blockages.

Email from Dave Bellamy dated 5 April 2018

We are currently looking at the Drainage Strategy for the reinstatement of the railway between Bristol and Portishead. At the meeting I attended on 8th April it was stated that haul road and construction compound drainage could discharge to the local rhyne network at greenfield run-off rate. For a lot of these areas, we are calculating very low rates (0.6-0.9l/s) and I am wondering if there is a practical minimum rate that we can use in our design to reduce storage requirements?

Also, could you please let me know typical maximum and minimum water levels for the area between the M5 and Portishead?

NSLIDB response:

As discussed above flow control structures should be set to a minimum of 2.5 l/s.

With regard to discharge points our marked up plans associated with our official consultation response may help. They will be sent under separate cover.

All of the watercourses, outside of those maintained by the IDB, in the area are in need of maintenance to bring them into a suitable condition to discharge into. This should include works to ensure a drainage route to an IDB maintained watercourse or main river. Localised pumping maybe required to ensure a suitable contractors compound if land raising is not undertaken.

The Board do not have any records of water levels in the area.

The requirement for any compensatory flood storage will be an EA requirement and consultation should be had with them in this regard.

NSLIDB Draft Meeting Notes 8th February 2018

Comments:

It is important to refer to the marked up drawings which we supplied and which were displayed at the meeting. They clarify many of the points made in the minutes.

Note 1. Should read - The IDB currently have about a 4m width for clearing the cut which is barely adequate and involves the machine slightly overhanging the railway fence

Note 5 – Sheepway Low Loader Access

Back in 2007 the Board had a great deal of difficulty sorting out the low loader / machine access arrangement off Sheepway and in the end a practical trial was carried out with our low loader before the alignments for the fencing and gates etc were finalised. The final arrangement has turned out to be satisfactory but the Board never did receive as built drawings. The only drawings the Board have on file are for a number of (unsatisfactory) previous draft proposals. Please send us a copy of the basic survey on which your current proposal drawing is based and we will mark this up as requested.

Note 6 – Culvert Headwalls

Attached is a suggested sketch arrangement SK 1 which might allow open watercourse clearance without a need to work inside the railway fence, whilst still permitting access to the headwalls without leaving railway property. Comments invited.

Note 9 – Temporary Culvert Sizes

All temporary culverts to be a minimum of 750mm (subject to final approval on receipt of detailed proposals)

Note 12 - Port of Bristol owns land and ditch north of railway and need to be involved in this point.

Also attached is out high level tracking plan. When detailed fencing and compound drawings have been produced we will be able to mark up our tracking requirements.

Phillips, Becky/BRS

From: Vasilyev, Kostya/UKS
Sent: 18 January 2017 13:36
To: Lillie, Penny/UKS
Cc: Cooper, Robert/UKS; Bird, Robert/UKS
Subject: RE: Portishead -tide locked level
Attachments: Scanned from a Xerox Multifunction Printer.pdf

Penny

Thank you for your enquiry.

Following the location of points on the scan sent to me and Robert Bird on 16/01/2017 13:13 by Robert Cooper, I can say that the water levels for the 25 year and 50 year events (climate change scenario) are as follows:

The **left point** as per the scan referenced above (please also find it attached) (near the drain , the location is to the south of Harbour Road):

50 year event: 7.05m
25 year event: 4.85m

The levels are the same for both pre-development and post development situation for each of the return periods listed above.

It looks like the water stays within the ditch or is not overtopping the planned ground levels (in post development situation).

There is no water level information in the model for the **right point** (to the north of Phoenix Road).

In order to provide some estimate for this point we looked at the downstream end of this drain (at its confluence with the Portbury? Drain, the location is to the east of Newfoundland Way, see the red star on the map below). These levels will provide a very conservative approximation of levels at the right point on the scan provided. Taking this information from the downstream end of this drain allows us to estimate levels further upstream of this drain as this drain is not represented in a model.

The downstream side of the brook that flows by the r**ight point**:

50 year event:
7.06m (post development situation)
7.05m (pre-development situation)
25 year event:
5.24m (both pre and post development situation)

It looks like the water stays within the ditch or is not overtopping the planned ground levels (in post development situation).

Hope it helps.

Please let us know if there are more questions.

Many thanks.

Kind regards

Kostya

Konstantin Vasilyev
BSc MSc C.WEM CSci CEnv MCIWEM
Water Engineer
Customer Support Manager – Flood Modeller Suite
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D +44 (0) 1793 81 6438

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From: Lillie, Penny/UKS
Sent: 17 January 2017 10:48
To: Bird, Robert/UKS <Robert.Bird@ch2m.com>
Cc: Vasilyev, Kostya/UKS <Kostya.Vasilyev@ch2m.com>; Cooper, Robert/UKS <Robert.Cooper@ch2m.com>
Subject: RE: Portishead -tide locked level

Hi Robert B
Do you know when we will get information for our work. I need to update Client.
thanks

Penny Lillie
Project Engineer

Direct +44 (0)1793 816671
Mobile +44 (0)7547 190959

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www.ch2m.com

From: Cooper, Robert/UKS
Sent: 17 January 2017 09:00
To: Bird, Robert/UKS <Robert.Bird@ch2m.com>; Lillie, Penny/UKS <Penny.Lillie@ch2m.com>
Cc: Vasilyev, Kostya/UKS <Kostya.Vasilyev@ch2m.com>
Subject: RE: Portishead -tide locked level

Robert,

The hydrographs would also be useful to input into Micro Drainage.

Regards

Robert Cooper
Senior Engineer
D +44 01793816260

CH2M
Burderop Park
Swindon
Wilts SN4 0QD
www.ch2m.com | LinkedIn | Twitter | Facebook

From: Cooper, Robert/UKS
Sent: 16 January 2017 13:13
To: Bird, Robert/UKS <Robert.Bird@ch2m.com>; Lillie, Penny/UKS <Penny.Lillie@ch2m.com>
Cc: Vasilyev, Kostya/UKS <Kostya.Vasilyev@ch2m.com>
Subject: RE: Portishead -tide locked level

Robert,

Please refer to attached mark-up showing outfall location.

I trust this is clear.

Regards

Robert Cooper
Senior Engineer
D +44 01793816260

CH2M
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www.ch2m.com | LinkedIn | Twitter | Facebook

From: Bird, Robert/UKS
Sent: 13 January 2017 17:59
To: Lillie, Penny/UKS <Penny.Lillie@ch2m.com>
Cc: Cooper, Robert/UKS <Robert.Cooper@ch2m.com>; Vasilyev, Kostya/UKS <Kostya.Vasilyev@ch2m.com>
Subject: RE: Portishead -tide locked level

Penny

Please can you send a sketch showing outfall location(s) - or describe with words if easier..... I will then consult Kostya to review coastal model results.

We have coastal flood model results for the 25 year and 50 year events but not the 30 year event – so we may have to work with the 50-year event?

regards

Robert

From: Lillie, Penny/UKS
Sent: 12 January 2017 10:45
To: Bird, Robert/UKS <Robert.Bird@ch2m.com>
Cc: Cooper, Robert/UKS <Robert.Cooper@ch2m.com>
Subject: Portishead -tide locked level

Happy New Year Robert

Following our meeting in Dec, we have now received guidance from the local council (NSC) for drainage design.

They have said we need to demonstrate the drainage system maintains a 1 in 30 year capacity with climate change capacity under tide locked conditions.

Just wondering if you could provide guidance on the tide locked level? From my notes at our Dec meeting a level of 7.9m for 200 return was mentioned?

regards

Penny Lillie
Project Engineer

Direct +44 (0)1793 816671
Mobile +44 (0)7547 190959

Linfoot, Andrew/BRS

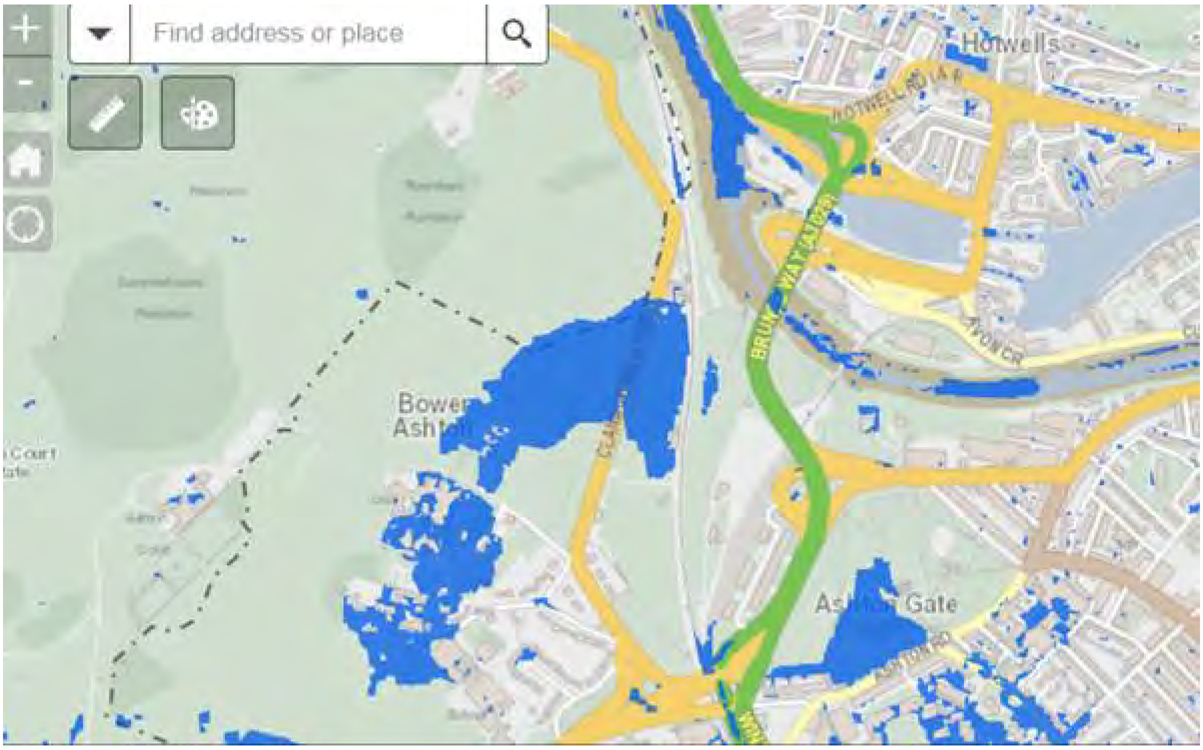
From: Patrick Goodey <patrick.goodey@bristol.gov.uk>
Sent: 27 June 2018 16:37
To: Abigail Hall; 'Agriodima, Margarita/EXT'
Subject: [EXTERNAL] RE: Metrowest inquiry - runoff rate from a temporary compound to the Avon

Hi both,

If this site is draining directly into the River Avon then an unrestricted discharge is fine - this is likely to need approval from the EA via the environmental permit. You also need to make a reasonable consideration of tide locking.

The proposal to pump is not preferred – are you able to drain the site via gravity?

Also note that some areas around Clanage Road is a known are of high risk from surface water flooding so your drainage strategy/FRA must address this. The below screenshot of http://maps.bristol.gov.uk/bfrm/ shows the risk area. We have many recent records of flooding here that verify the mapped risk.



I hope that helps, let me know if you have any more questions

Thanks
Patrick

Patrick Goodey
Flood Risk Manager
Tel: 0117 922 3206
Mob: 07557 203 443

Bristol City Council has developed its Local Flood Risk Management Strategy. The final report can be viewed via www.bristol.gov.uk/floodstrategy

From: Abigail Hall
Sent: 27 June 2018 15:26
To: 'Agriodima, Margarita/EXT'
Cc: Patrick Goodey
Subject: RE: Metrowest inquiry - runoff rate from a temporary compound to the Avon

Hi Patrick,

I'm not sure what to respond to this one, they have been asking for a response today. I think they are preparing an FRA for the works.

My initial thoughts were to let it go unrestricted into the Avon, but our discharge zones map indicates that it will be in the Ashton Gate area and discharge rates should be limited.

Thanks,
Abi

From: Agriodima, Margarita/EXT [mailto:Margarita.Agriodima@jacobs.com]
Sent: 25 June 2018 11:55
To: Abigail Hall
Cc: Bellamy, Dave/EXT; Reshef, Imri/EXT
Subject: Metrowest inquiry - runoff rate from a temporary compound to the Avon

Hello,

We are preparing the drainage strategy for the temporary construction compounds for Metrowest project. Could you please confirm us if the discharge rate to the Avon should be restricted to the greenfield runoff rate for the temporary site? The design life of the temporary site is 1-2 years.

This concerns a temporary compound (Clanage Road) where there is no presence of any existing drainage system and we are proposing to temporarily pump the runoff from the compound.

Kind Regards,

Margarita Agriodima, MEng GMICE
Jacobs
Graduate Water Engineer | Environment Maritime Resilience
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+ 44(0)7534676287 mobile
margarita.agriodima@jacobs.com

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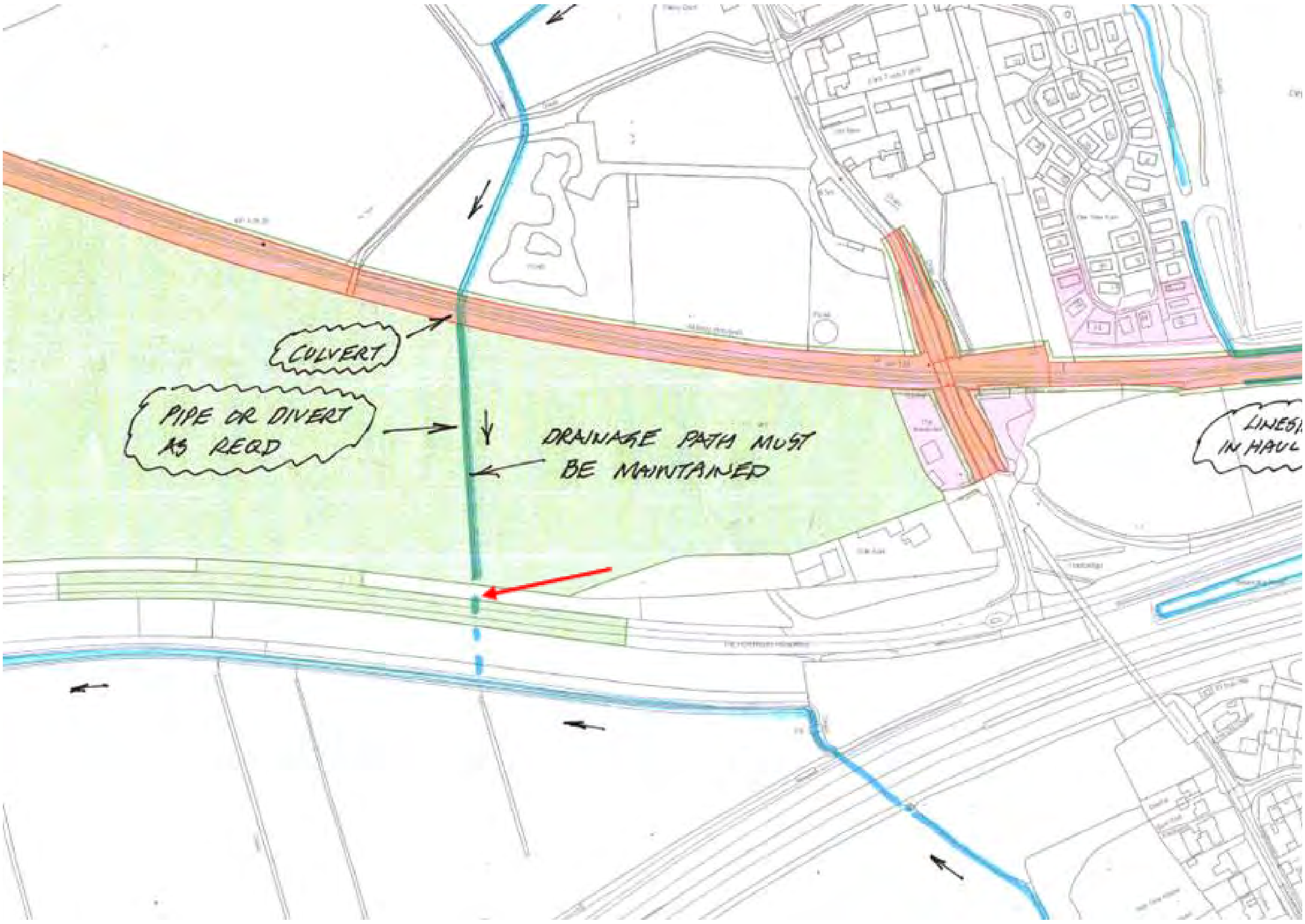
Sowton, Exeter EX27LB
United Kingdom
www.jacobs.com

Linfoot, Andrew/BRS

From:	Reshef, Imri/EXT
Sent:	25 June 2018 12:37
To:	developmentcontrol@nslidb.org.uk; alsopengineer@gmail.com
Cc:	Fabisiak, Magda/BRS; Agriodima, Margarita/EXT; Bellamy, Dave/EXT; Linfoot, Andrew/BRS
Subject:	FW: [EXTERNAL] Re: MetroWest - query about ditch D4
Attachments:	NSLIDB Metrowest pre-application response 2.pdf; NSLIDB response to Metrowest Stage 2 Consultation.pdf; SK 1 culvert headwall sketch.pdf; NSLIDB Metro West mark up Dec 2017.zip; Keeching Route for The Cut & The Moat.pdf

Simon/Dan,
Following the correspondence from April, can you please confirm that it is possible to discharge the runoff water from Portbury Hundred compound to the existing D4 culvert crossing A369 (discharge rate will be in greenfield runoff rates as detailed in the Drainage Strategy Report). Please see the plan below with red arrow showing the proposed connection.



Kind regards,

Imri Reshef | Jacobs | Assistant Water Engineer | Environment Maritime Resilience | +44.1392.340.974 DD | +44 1392.444.252 office |
Imri.Reshef@jacobs.com | www.jacobs.com

From: Simon Bunn [mailto:developmentcontrol@nslidb.org.uk]
Sent: 20 April 2018 16:29
To: Rigual Munoz, Gloria/EXT <Gloria.RigualMunoz@jacobs.com>; Bellamy, Dave/EXT <Dave.Bellamy@jacobs.com>; De Frutos Subtil, Dario/EXT <Dario.deFrutosSubtil@ch2m.com>
Cc: Giles Oliver <theengineer@nslidb.org.uk>; Linfoot, Andrew/BRS <Andrew.Linfoot@jacobs.com>; Fabisiak, Magda/BRS <Magda.Fabisiak@jacobs.com>; Dan Alsop Chartered Engineer <alsopengineer@gmail.com>; Jennifer Devereux <Jennifer.Devereux@n-somerset.gov.uk>
Subject: RE: [EXTERNAL] Re: MetroWest - query about ditch D4

Gloria/Dave/Dario,

Please find attached our response (no 2) to various queries that I have pulled together into one document.

If you have any further questions, please do not hesitate to ask.

Kind regards,

Simon

Simon Bunn
Development Control Officer

North Somerset Levels IDB
The Cider House
The Grange Business Park
Hewish
Weston-super-Mare
N. Somerset
BS24 6RR

Tel: 01934 833388

Email: developmentcontrol@nslidb.org.uk

From: Rigual Munoz, Gloria/EXT [mailto:Gloria.RigualMunoz@jacobs.com]
Sent: 18 April 2018 11:57
To: Dan Alsop Chartered Engineer <alsopengineer@gmail.com>
Cc: Simon Bunn <developmentcontrol@nslidb.org.uk>; Giles Oliver <theengineer@nslidb.org.uk>; Bellamy, Dave/EXT <Dave.Bellamy@jacobs.com>; Linfoot, Andrew/BRS <Andrew.Linfoot@jacobs.com>; Fabisiak, Magda/BRS <Magda.Fabisiak@jacobs.com>
Subject: RE: [EXTERNAL] Re: MetroWest - query about ditch D4

Hi Dan,

Your queries have been passed to the Bristol team, in charge of gathering that information.

Thank you.

Kind regards,
Gloria

From: Dan Alsop Chartered Engineer [mailto:alsopengineer@gmail.com]
Sent: 17 April 2018 16:57
To: Rigual Munoz, Gloria/EXT <Gloria.RigualMunoz@ch2m.com>
Cc: Simon BUNN <developmentcontrol@nslidb.org.uk>; Giles OLIVER <theengineer@nslidb.org.uk>
Subject: [EXTERNAL] Re: MetroWest - query about ditch D4

Dear Gloria,
We are trying to sort out responses to the multiple queries your team has recently sent us. As they are mostly interdependent I will be routing all my answers via Simon Bunn.
One trouble is that we are still waiting for the info we were promised at the meeting held on 8th Feb, viz, details of the proposed fencing, especially around Portishead Station adjacent to the IDB watercourse, a basic survey of the existing Sheepway access point as we cannot tell from the drawings supplied whether what is proposed will be adequate, and a list of key contacts with who does what. If you could chivvy those along we will be able to get back to you sooner.
Sorry I can't be more helpful at the moment.
Regards,
Dan Alsop

From: Rigual Munoz, Gloria/EXT
Sent: Thursday, April 12, 2018 4:18 PM
To: alsopengineer@gmail.com
Cc: Bellamy, Dave/EXT ; De Frutos Subtil, Dario/EXT ; Agriodima, Margarita/EXT ; Reshef, Imri/EXT ; theengineer@nslidb.org.uk ; developmentcontrol@nslidb.org.uk
Subject: MetroWest - query about ditch D4

Hi Dan,

I'm writing to you regarding the ditch D4 that crosses the proposed location for Portbury Hundred Construction Compound. I wanted to ask you if this ditch could be culverted to allow for the construction of the compound above it.

Also, referring to Dave's email early this week, if you could come back to us as soon as possible with your preferred discharge points and the greenfield runoff rates, that would be really helpful for us. For now, we're assuming a minimum discharge rate of 5 l/s since controlling flow at lower discharge can be technically unfeasible.

Thank you.

Kind regards,

Gloria Rigual Muñoz | Jacobs | Graduate Water Engineer | Environment Maritime Resilience | +44.1392.340.971 DD | +44.1392.444.252 office |
gloria.rigualmunoz@jacobs.com | www.jacobs.com

From: Agriodima, Margarita/EXT
To: "Jake.Faucitt@networkrail.co.uk"
Cc: Bellamy, Dave/EXT; Linfoot, Andrew/BRS
Subject: RE: Metrowest - Discharge volume from Ham Green Compound
Date: 29 June 2018 10:19:00
Attachments: Hydrograph for Ham Green Compound.pdf

Hi Jake,

I am contacting you regarding the drainage strategy of Metrowest since I would like to inform you about the discharge volume to the silt trap from the Network Railway drainage system for the C9-Ham Green Compound.

The total volume will discharge after approximately 19 hours at 2.5l/s discharge rate to the silt trap. Please see the attached hydrograph.

Please let me know if you require any more information.

Kind Regards,

Margarita Agriodima, MEng GMICE
Jacobs
Graduate Water Engineer | Environment Maritime Resilience
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+ 44(0)7534676287 mobile
margarita.agriodima@jacobs.com

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APPENDIX B

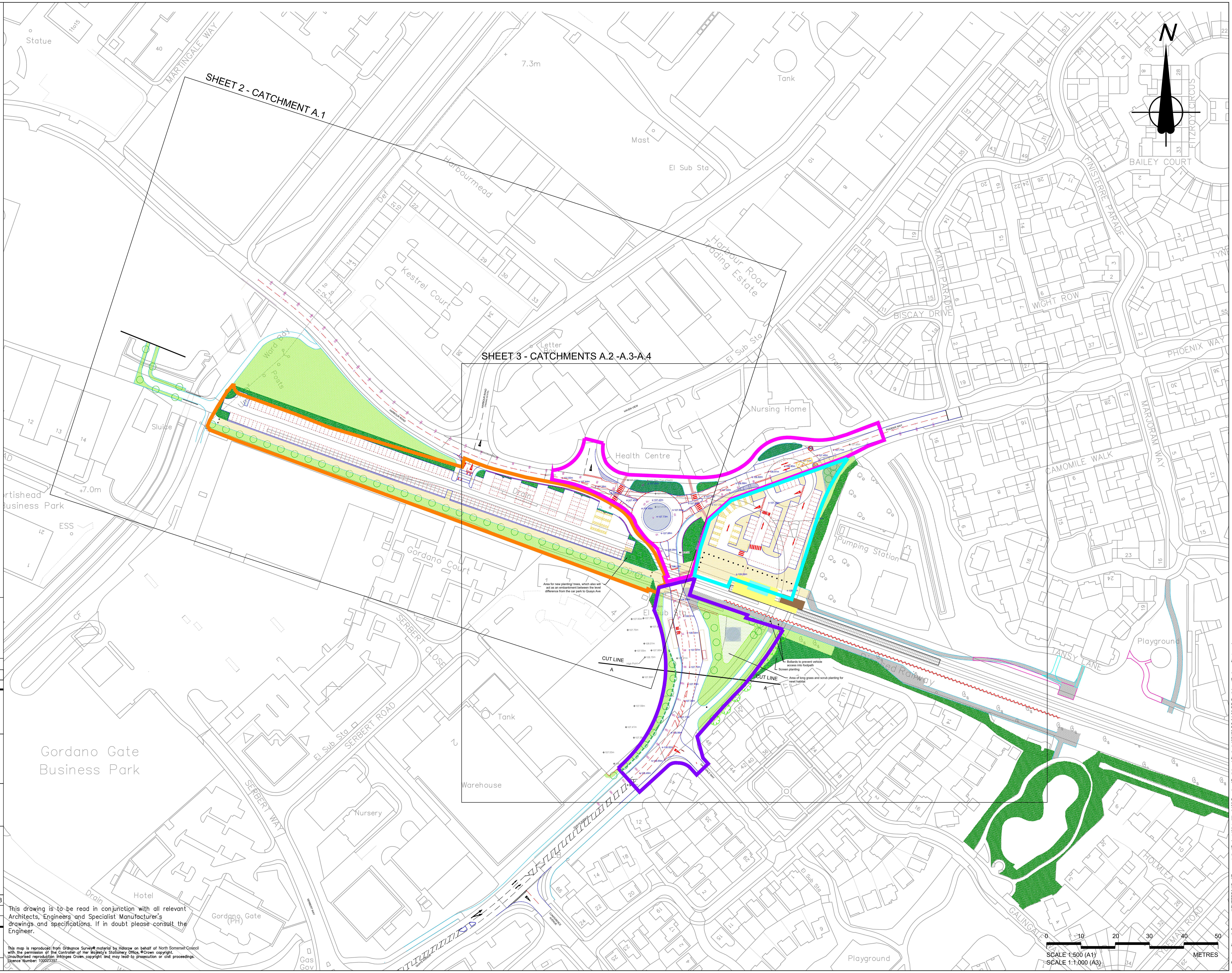
Portishead Station Drainage Strategy Drawings and Calculations

NOTES

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout based on available OS or topographical survey.

KEY

- Catchment Area 1 (CAT A.1)
- Catchment Area 2 (CAT A.2)
- Catchment Area 3 (CAT A.3)
- Catchment Area 4 (CAT A.4)



This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

DRAFT

Rev	By	Chkd	Apprvd	Date	Description
A	IR	-	-	23/05/2018	First Issue

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

PORTISHEAD STATION
DRAINAGE STRATEGY
CATCHMENTS KEY PLAN
Sheet 1 of 3

Drawn by: IR Date: 23/05/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-DS-PORTISHEAD

Revision A

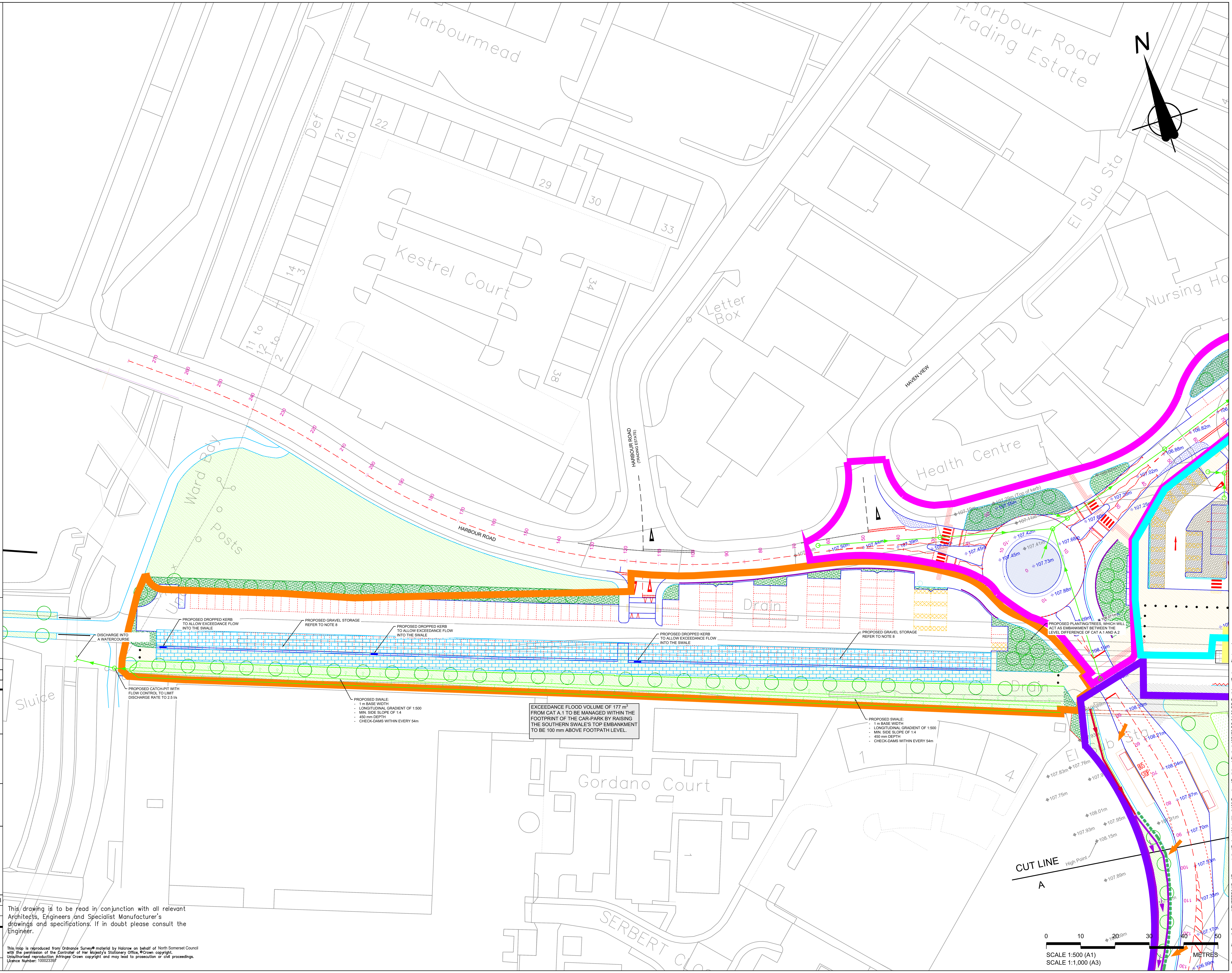
Drawing Scale: AS SHOWN

NOTES

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout based on available OS or topographical survey.
6. Outfalls should be monitored on a regular basis and equipped with shut-off valves.
7. Tide-lock level of 5.29mAOD has been considered during the drainage design.
8. Proposed drainage strategy for Cat A.1 based on collecting the runoff water through permeable pavement (concrete blocks) on the parking bays. The runoff will be attenuated within 300 mm height of clean stone reservoir beneath the parking bays and the footpath. From the gravel reservoir the water will be discharged into a swale. The proposed swale includes check-dams to control the flow rate and use the gravel storage for attenuation.

KEY

- Catchment Area 1 (CAT A.1)
- Catchment Area 2 (CAT A.2)
- Catchment Area 3 (CAT A.3)
- Catchment Area 4 (CAT A.4)
- Proposed drainage pipeline
- Proposed MH/Catchpit
- Proposed Gravel Storage
- Proposed Linear Drainage Channel
- Proposed Filter Drain
- Proposed Swale with Filter Drain
- Exceedance Route



This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

DRAFT

Rev	By	Chkd	Apprvd	Date	Description
A	IR	-	-	23/05/2018	First Issue

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www.ch2m.com

Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PORTISHEAD STATION
DRAINAGE STRATEGY
CAT A.1
Sheet 2 of 3

Drawn by: IR — Date: 23/05/2018
Checked by: - — Date: -
Approved by: - — Date: -

Drawing No. 467470.BQ.04.20-DS-PORTISHEAD — Revision A

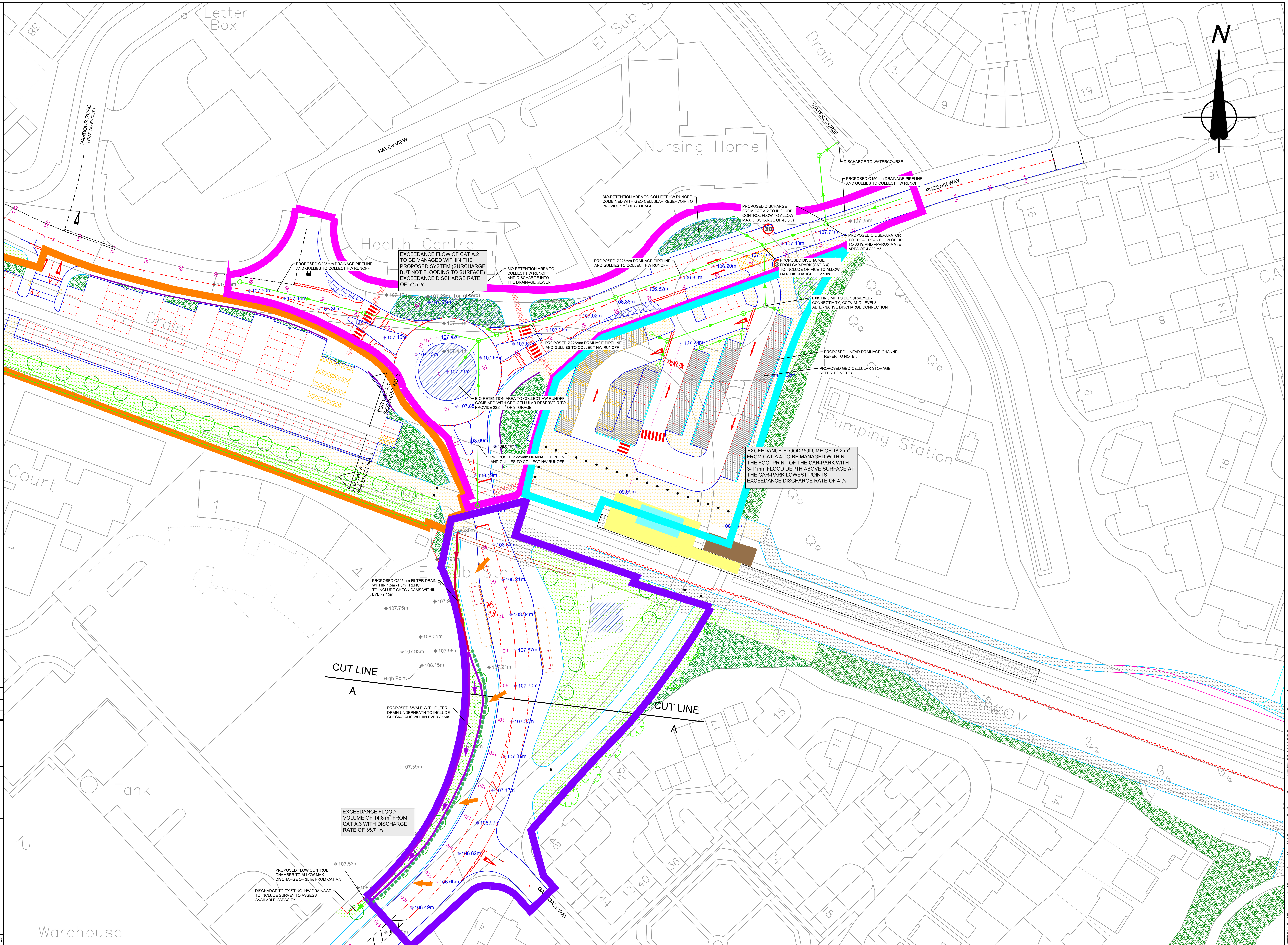
Drawing Scale: AS SHOWN

NOTES

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout based on available OS or topographical survey.
6. Outfalls should be monitored on a regular basis and equipped with shut-off valves.
7. Tide-lock level of 5.29mAOD has been considered during the drainage design.
8. Proposed drainage strategy for the car-park (Cat A.4) is based on linear drainage channel to collect the runoff. The runoff will be treated through filter media and Bio-mat crates and will be attenuate within 300mm height of Geo-cellulare crates which will be located beneath the parking bays.

KEY

- Catchment Area 1 (CAT A.1)
- Catchment Area 2 (CAT A.2)
- Catchment Area 3 (CAT A.3)
- Catchment Area 4 (CAT A.4)
- Proposed drainage pipeline
- Proposed MH/Catchpit
- Proposed Geo-cellular Storage
- Proposed Linear Drainage Channel
- Proposed Filter Drain
- Proposed Swale with Filter Drain
- Exceedance Route



This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

SCALE 1:500 (A1)
SCALE 1:1,000 (A3)
0 10 20 30 40 50 METRES

DRAFT

Rev	By	Chkd	Apprvd	Date	Description
A	IR	-	-	23/05/2018	First Issue

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Project: PORTISHEAD BRANCH LINE (METROWEST PHASE 1)

Drawing: PORTISHEAD STATION DRAINAGE STRATEGY
CAT A.2-A.3-A.4
Sheet 3 of 3

Drawn by: IR Date: 23/05/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No.: 467470.BQ.04.20-DS-PORTISHEAD
Revision: A

Drawing Scale: AS SHOWN

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	30	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Inverts

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	2.000	0.004	500.0	0.156	5.00	0.0	0.600		o	100	Pipe/Conduit	🔒
S1.001	54.000	0.108	500.0	0.000	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	🔒
S2.000	2.000	0.004	500.0	0.176	5.00	0.0	0.600		o	100	Pipe/Conduit	🔒
S1.002	54.000	0.108	500.0	0.000	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	🔒
S3.000	2.000	0.004	500.0	0.157	5.00	0.0	0.600		o	100	Pipe/Conduit	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.10	6.604	0.156	0.0	0.0	0.0	0.34	2.7«	21.1
S1.001	50.00	8.66	6.600	0.156	0.0	0.0	0.0	0.25	60.6	21.1
S2.000	50.00	5.10	6.496	0.176	0.0	0.0	0.0	0.34	2.7«	23.8
S1.002	50.00	12.23	6.492	0.332	0.0	0.0	0.0	0.25	60.6	45.0
S3.000	50.00	5.10	6.388	0.157	0.0	0.0	0.0	0.34	2.7«	21.3

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.003	54.000	0.108	500.0	0.000	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	
S4.000	2.000	0.004	500.0	0.110	5.00	0.0	0.600		o	100	Pipe/Conduit	
S1.004	54.000	0.108	500.0	0.000	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	
S5.000	2.000	0.004	500.0	0.106	5.00	0.0	0.600		o	100	Pipe/Conduit	
S1.005	54.000	0.108	500.0	0.000	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	
S1.006	5.000	0.025	200.0	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.003	50.00	15.79	6.384	0.489	0.0	0.0	0.0	0.25	60.6«	66.2
S4.000	50.00	5.10	6.280	0.110	0.0	0.0	0.0	0.34	2.7«	14.9
S1.004	50.00	19.36	6.276	0.599	0.0	0.0	0.0	0.25	60.6«	81.1
S5.000	50.00	5.10	6.172	0.106	0.0	0.0	0.0	0.34	2.7«	14.4
S1.005	50.00	22.92	6.168	0.705	0.0	0.0	0.0	0.25	60.6«	95.5
S1.006	50.00	23.02	6.060	0.705	0.0	0.0	0.0	0.92	36.6«	95.5

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 5
Number of Online Controls 6 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30, 100
Climate Change (%) 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SPP1	360 Winter	30	+40%	30/15 Summer	100/60 Winter		
S1.001	SSW1	240 Summer	30	+40%	30/240 Summer	30/120 Summer		
S2.000	SPP2	480 Winter	30	+40%	30/15 Summer	100/60 Winter		
S1.002	SSW2	480 Winter	30	+40%	100/180 Winter	100/180 Winter		
S3.000	SPP3	960 Winter	30	+40%	30/15 Summer	100/120 Winter		
S1.003	SSW3	960 Winter	30	+40%	100/240 Winter	100/240 Winter		
S4.000	SPP4	1440 Winter	30	+40%	30/15 Summer	100/720 Winter		
S1.004	SSW4	1440 Winter	30	+40%	100/720 Winter	100/720 Winter		
S5.000	SPP5	2160 Winter	30	+40%	30/15 Summer	100/960 Winter		
S1.005	SSW5	2160 Winter	30	+40%	100/960 Winter	100/960 Winter		
S1.006	SOutlet	2160 Winter	30	+40%	30/120 Summer	100/720 Winter		

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SPP1	6.970	0.266	0.000	0.86		3.4	FLOOD RISK	18
S1.001	SSW1	7.050	0.000	0.000	0.01		4.3	FLOOD	20
S2.000	SPP2	6.888	0.292	0.000	1.15		4.5	FLOOD RISK	21
S1.002	SSW2	6.884	-0.058	0.000	0.01		3.6	FLOOD RISK	15
S3.000	SPP3	6.798	0.310	0.000	0.67		2.6	FLOOD RISK	19
S1.003	SSW3	6.796	-0.038	0.000	0.01		3.5	FLOOD RISK	17
S4.000	SPP4	6.691	0.311	0.000	0.29		1.2	FLOOD RISK	10
S1.004	SSW4	6.690	-0.036	0.000	0.01		3.0	FLOOD RISK	8
S5.000	SPP5	6.593	0.321	0.000	0.24		1.0	FLOOD RISK	9
S1.005	SSW5	6.592	-0.026	0.000	0.01		2.9	FLOOD RISK	9
S1.006	SOutlet	6.495	0.210	0.000	0.09		2.5	FLOOD RISK	10

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 5
Number of Online Controls 6 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30, 100
Climate Change (%) 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SPP1	180 Winter	100	+40%	30/15 Summer	100/60 Winter		
S1.001	SSW1	360 Winter	100	+40%	30/240 Summer	30/120 Summer		
S2.000	SPP2	720 Winter	100	+40%	30/15 Summer	100/60 Winter		
S1.002	SSW2	600 Winter	100	+40%	100/180 Winter	100/180 Winter		
S3.000	SPP3	1440 Winter	100	+40%	30/15 Summer	100/120 Winter		
S1.003	SSW3	1440 Winter	100	+40%	100/240 Winter	100/240 Winter		
S4.000	SPP4	2160 Winter	100	+40%	30/15 Summer	100/720 Winter		
S1.004	SSW4	2160 Winter	100	+40%	100/720 Winter	100/720 Winter		
S5.000	SPP5	2880 Winter	100	+40%	30/15 Summer	100/960 Winter		
S1.005	SSW5	2880 Winter	100	+40%	100/960 Winter	100/960 Winter		
S1.006	SOutlet	2880 Winter	100	+40%	30/120 Summer	100/720 Winter		

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SPP1	7.064	0.360	13.782	1.59		6.3	FLOOD	18
S1.001	SSW1	7.051	0.001	1.114	0.01		5.5	FLOOD	20
S2.000	SPP2	6.960	0.364	17.982	1.90		7.5	FLOOD	21
S1.002	SSW2	6.957	0.015	14.853	0.01		3.9	FLOOD	15
S3.000	SPP3	6.856	0.368	22.329	0.98		3.8	FLOOD	19
S1.003	SSW3	6.855	0.021	20.948	0.01		3.5	FLOOD	17
S4.000	SPP4	6.741	0.361	14.781	0.46		1.8	FLOOD	10
S1.004	SSW4	6.740	0.014	14.433	0.01		3.2	FLOOD	8
S5.000	SPP5	6.631	0.359	12.853	0.35		1.4	FLOOD	9
S1.005	SSW5	6.631	0.013	12.818	0.01		3.3	FLOOD	9
S1.006	SOutlet	6.527	0.242	17.030	0.10		2.6	FLOOD	10

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	7.500	6.100	1.250	Open Manhole	1200
S1.001	o	225	S2	7.000	5.572	1.203	Open Manhole	1200
S1.002	o	225	S3	7.710	5.305	2.180	Open Manhole	1200
S1.003	o	225	S4	8.230	5.038	2.967	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	45.000	99.3	S2	7.000	5.647	1.203	Open Manhole	1200
S1.001	45.000	168.5	S3	7.710	5.305	2.180	Open Manhole	1200
S1.002	45.000	168.5	S4	8.230	5.038	2.967	Open Manhole	1200
S1.003	45.000	164.8	S	8.900	4.765	3.910	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.078	0.078	0.078
1.001	-	-	100	0.078	0.078	0.078
1.002	-	-	100	0.079	0.079	0.079
1.003	-	-	100	0.078	0.078	0.078
				Total	Total	Total
				0.313	0.313	0.313

Summary Wizard of 15 minute 1 year Summer I+0% for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 5, 30
Climate Change (%)	0, 0, 0, 0

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	64	6.197	-0.053	0.000	0.69		11.9	OK
S1.001	S2	64	5.688	-0.109	0.000	0.51		19.4	OK
S1.002	S3	64	5.446	-0.084	0.000	0.69		26.3	OK
S1.003	S4	64	5.201	-0.062	0.000	0.84		32.4	OK

Summary Wizard of 15 minute 2 year Summer I+0% for Storm

Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 0
Number of Offline Controls 0
Number of Storage Structures 0
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 20.000
Ratio R 0.350
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep Fine
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 2, 5, 30
Climate Change (%) 0, 0, 0, 0

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	52	6.217	-0.033	0.000	0.89		15.4	OK
S1.001	S2	52	5.709	-0.088	0.000	0.66		25.0	OK
S1.002	S3	52	5.476	-0.054	0.000	0.88		33.7	OK
S1.003	S4	52	5.280	0.017	0.000	1.04		39.9	SURCHARGED

Summary Wizard of 15 minute 5 year Summer I+0% for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 5, 30
Climate Change (%)	0, 0, 0, 0

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	88	6.324	0.074	0.000	1.04		18.1	SURCHARGED
S1.001	S2	88	5.745	-0.052	0.000	0.81		30.9	OK
S1.002	S3	88	5.617	0.087	0.000	0.96		36.7	SURCHARGED
S1.003	S4	88	5.372	0.109	0.000	1.19		45.9	SURCHARGED

Summary Wizard of 15 minute 30 year Summer I+0% for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 5, 30
Climate Change (%)	0, 0, 0, 0

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S1	76	6.838	0.588	0.000	1.19		20.6	SURCHARGED
S1.001	S2	76	6.510	0.713	0.000	0.88		33.4	SURCHARGED
S1.002	S3	76	6.293	0.763	0.000	1.29		49.3	SURCHARGED
S1.003	S4	76	5.823	0.560	0.000	1.69		65.0	SURCHARGED

Existing Network Details for Storm

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	30.000	0.200	150.0	0.064	3.00	0.0	0.600	o	225	Pipe/Conduit
1.001	33.269	0.227	146.6	0.074	3.00	0.0	0.600	o	225	Pipe/Conduit
2.000	40.000#	0.400	100.0	0.085	3.00	0.0	0.600	o	225	Pipe/Conduit
1.002	1.000#	0.010	100.0	0.000	3.00	0.0	0.600	o	225	Pipe/Conduit
1.003	72.000#	0.460	156.5	0.166	3.00	0.0	0.600	o	225	Pipe/Conduit
1.004	45.000#	0.300	150.0	0.109	3.00	0.0	0.600	o	225	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	6.050	0.064	0.0	1.07	42.4
1.001	5.850	0.138	0.0	1.08	42.9
2.000	6.200	0.085	0.0	1.31	52.0
1.002	5.620	0.223	0.0	1.31	52.0
1.003	5.610	0.389	0.0	1.04	41.5
1.004	5.150	0.498	0.0	1.07	42.4

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.064	0.064	0.064
1.001	-	-	100	0.074	0.074	0.074
2.000	-	-	100	0.085	0.085	0.085
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.166	0.166	0.166
1.004	-	-	100	0.109	0.109	0.109
				Total	Total	Total
				0.498	0.498	0.498

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.350		

Storage Structures for Storm

Tank or Pond Manhole: 6, DS/PN: 1.002

Invert Level (m) 5.620

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	150.0	0.150	150.0

Tank or Pond Manhole: 8, DS/PN: 1.004

Invert Level (m) 5.150

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	60.0	0.150	60.0

30 year Return Period Summary of Critical Results by Maximum Outflow (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	40.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 5, 10, 30, 100
Climate Change (%)	0, 0, 0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	30	+0%	10/15 Summer				6.552
1.001	2	15 Summer	30	+0%	5/15 Summer				6.434
2.000	5	15 Summer	30	+0%	100/15 Summer				6.378
1.002	6	60 Winter	30	+0%	5/30 Winter				6.048
1.003	7	15 Summer	30	+0%	5/15 Summer				5.973
1.004	8	60 Winter	30	+0%	1/15 Summer				5.732

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.277	0.000	0.74		29.1	SURCHARGED	
1.001	2	0.359	0.000	1.53		61.5	SURCHARGED	
2.000	5	-0.047	0.000	0.93		46.0	OK	
1.002	6	0.203	0.000	1.00		30.0	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Outflow (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.003	7	0.138	0.000	1.02		41.2	SURCHARGED	
1.004	8	0.357	0.000	1.19		48.1	SURCHARGED	

Existing Network Details for Storm

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
1.000	30.000	0.200	150.0	0.064	3.00	0.0	0.600	o	225	Pipe/Conduit
1.001	33.269	0.227	146.6	0.074	3.00	0.0	0.600	o	225	Pipe/Conduit
2.000	40.000#	0.400	100.0	0.085	3.00	0.0	0.600	o	225	Pipe/Conduit
1.002	1.000#	0.010	100.0	0.000	3.00	0.0	0.600	o	225	Pipe/Conduit
1.003	72.000#	0.460	156.5	0.166	3.00	0.0	0.600	o	225	Pipe/Conduit
1.004	45.000#	0.300	150.0	0.109	3.00	0.0	0.600	o	225	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	6.050	0.064	0.0	1.07	42.4
1.001	5.850	0.138	0.0	1.08	42.9
2.000	6.200	0.085	0.0	1.31	52.0
1.002	5.620	0.223	0.0	1.31	52.0
1.003	5.610	0.389	0.0	1.04	41.5
1.004	5.150	0.498	0.0	1.07	42.4

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.064	0.064	0.064
1.001	-	-	100	0.074	0.074	0.074
2.000	-	-	100	0.085	0.085	0.085
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.166	0.166	0.166
1.004	-	-	100	0.109	0.109	0.109
				Total	Total	Total
				0.498	0.498	0.498

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	40.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.350		

Storage Structures for Storm

Tank or Pond Manhole: 6, DS/PN: 1.002

Invert Level (m) 5.620

Depth (m)	**Area (m^2)**	**Depth (m)**	**Area (m^2)**
0.000	150.0	0.150	150.0

Tank or Pond Manhole: 8, DS/PN: 1.004

Invert Level (m) 5.150

Depth (m)	**Area (m^2)**	**Depth (m)**	**Area (m^2)**
0.000	60.0	0.150	60.0

Summary of Critical Results by Maximum Outflow (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 40.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 1, 2, 5, 10, 30, 100
Climate Change (%) 0, 0, 0, 0, 0, 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Summer	100	+0%	10/15 Summer				6.978
1.001	2	15 Summer	100	+0%	5/15 Summer				6.802
2.000	5	15 Summer	100	+0%	100/15 Summer				6.618
1.002	6	60 Winter	100	+0%	5/30 Winter				6.239
1.003	7	15 Summer	100	+0%	5/15 Summer				6.130
1.004	8	60 Winter	100	+0%	1/15 Summer				5.858

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.703	0.000	0.92		36.3	SURCHARGED	
1.001	2	0.727	0.000	1.90		76.6	SURCHARGED	
2.000	5	0.193	0.000	1.19		58.8	SURCHARGED	
1.002	6	0.394	0.000	1.14		34.0	SURCHARGED	
1.003	7	0.295	0.000	1.11		44.6	SURCHARGED	

Summary of Critical Results by Maximum Outflow (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.004	8	0.483	0.000	1.30		52.5	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	15.402	0.100	154.0	0.034	5.00	0.0	0.600		o	150	Pipe/Conduit	
S1.001	18.201	0.300	60.7	0.048	0.00	0.0	0.600		o	150	Pipe/Conduit	
S1.002	20.065	0.400	50.2	0.047	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	
S1.003	20.093	0.300	67.0	0.035	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	
S1.004	20.020	0.550	36.4	0.073	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	
S1.005	20.753	0.250	83.0	0.035	0.00	0.0		0.040	4 \=/	1000	1:4 Swale	
S1.006	15.035	0.090	167.1	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.32	6.800	0.034	0.0	0.0	0.0	0.81	14.3	4.6
S1.001	50.00	5.55	6.650	0.082	0.0	0.0	0.0	1.29	22.9	11.2
S1.002	50.00	5.97	7.550	0.129	0.0	0.0	0.0	0.80	191.3	17.5
S1.003	50.00	6.46	7.150	0.164	0.0	0.0	0.0	0.69	165.5	22.2
S1.004	50.00	6.81	6.850	0.237	0.0	0.0	0.0	0.94	224.5	32.1
S1.005	50.00	7.37	6.300	0.273	0.0	0.0	0.0	0.62	148.7	36.9
S1.006	50.00	7.62	4.850	0.273	0.0	0.0	0.0	1.01	40.1	36.9

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30
Climate Change (%) 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	SFD1	120 Winter	30	+40%	30/15 Summer				8.120
S1.001	SFD2	120 Winter	30	+40%	30/15 Summer				8.102
S1.002	SSW1	15 Winter	30	+40%					7.821
S1.003	SSW2	15 Winter	30	+40%					7.434
S1.004	SSW3	15 Winter	30	+40%					7.157
S1.005	SSW4	30 Summer	30	+40%					6.616
S1.006	SOutlet	30 Winter	30	+40%	30/15 Summer				6.389

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SFD1	1.170	0.000	0.30		3.9	FLOOD RISK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.001	SFD2	1.302	0.000	0.44		9.4	FLOOD RISK	
S1.002	SSW1	-0.079	0.000	0.02		22.7	FLOOD RISK	
S1.003	SSW2	-0.066	0.000	0.04		32.7	FLOOD RISK	
S1.004	SSW3	-0.043	0.000	0.05		58.3	FLOOD RISK	
S1.005	SSW4	-0.034	0.000	0.08		66.6	FLOOD RISK	
S1.006	SOutlet	1.314	0.000	1.01		35.7	FLOOD RISK	

Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 6 Number of Storage Structures 6 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.350
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 30, 100
Climate Change (%) 40, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	SFD1	600 Winter	30	+40%	30/15 Summer			
S1.001	SFD2	600 Winter	30	+40%	30/15 Summer			
S1.002	SSW1	600 Winter	30	+40%				
S1.003	SSW2	600 Winter	30	+40%				
S1.004	SSW3	600 Winter	30	+40%				
S1.005	SSW4	600 Winter	30	+40%				
S1.006	SOutlet	60 Winter	100	+40%	30/15 Summer	100/15 Summer		

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	SFD1	8.092	1.142	0.000	0.12		1.6	FLOOD RISK	
S1.001	SFD2	8.085	1.285	0.000	0.18		3.9	FLOOD RISK	
S1.002	SSW1	7.792	-0.108	0.000	0.01		6.2	FLOOD RISK	
S1.003	SSW2	7.396	-0.104	0.000	0.01		7.8	FLOOD RISK	

Summary of Critical Results by Maximum Flood Volume (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.004	SSW3	7.104	-0.096	0.000	0.01		11.3	FLOOD RISK	
S1.005	SSW4	6.557	-0.093	0.000	0.02		13.0	FLOOD RISK	
S1.006	SOutlet	6.414	1.339	14.008	1.01		35.7	FLOOD	8

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 625 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.587	0.137	0.0	0.5	0.5	16.3	O K
30 min Summer	6.617	0.167	0.0	0.5	0.5	21.7	O K
60 min Summer	6.647	0.197	0.0	0.6	0.6	27.2	O K
120 min Summer	6.676	0.226	0.0	0.6	0.6	32.5	O K
180 min Summer	6.690	0.240	0.0	0.6	0.6	35.1	O K
240 min Summer	6.698	0.248	0.0	0.6	0.6	36.6	O K
360 min Summer	6.707	0.257	0.0	0.6	0.6	38.0	Flood Risk
480 min Summer	6.709	0.259	0.0	0.6	0.6	38.4	Flood Risk
600 min Summer	6.710	0.260	0.0	0.6	0.6	38.6	Flood Risk
720 min Summer	6.709	0.259	0.0	0.6	0.6	38.6	Flood Risk
960 min Summer	6.708	0.258	0.0	0.6	0.6	38.2	Flood Risk
1440 min Summer	6.701	0.251	0.0	0.6	0.6	36.9	Flood Risk
2160 min Summer	6.687	0.237	0.0	0.6	0.6	34.4	O K
2880 min Summer	6.673	0.223	0.0	0.6	0.6	32.0	O K
4320 min Summer	6.649	0.199	0.0	0.6	0.6	27.6	O K
5760 min Summer	6.629	0.179	0.0	0.5	0.5	23.8	O K
7200 min Summer	6.612	0.162	0.0	0.5	0.5	20.7	O K
8640 min Summer	6.597	0.147	0.0	0.5	0.5	18.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	16.8	26
30 min Summer	67.708	0.0	22.5	41
60 min Summer	43.136	0.0	28.7	70
120 min Summer	26.651	0.0	35.6	128
180 min Summer	19.868	0.0	39.8	186
240 min Summer	16.054	0.0	42.9	244
360 min Summer	11.891	0.0	47.7	362
480 min Summer	9.596	0.0	51.4	446
600 min Summer	8.121	0.0	54.4	502
720 min Summer	7.083	0.0	56.9	564
960 min Summer	5.703	0.0	61.1	694
1440 min Summer	4.198	0.0	67.4	970
2160 min Summer	3.085	0.0	74.3	1384
2880 min Summer	2.477	0.0	79.5	1792
4320 min Summer	1.816	0.0	87.3	2596
5760 min Summer	1.456	0.0	93.2	3352
7200 min Summer	1.227	0.0	98.0	4112
8640 min Summer	1.067	0.0	102.2	4848

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	6.585	0.135	0.0	0.5	0.5	15.8	O K
15 min Winter	6.599	0.149	0.0	0.5	0.5	18.4	O K
30 min Winter	6.632	0.182	0.0	0.5	0.5	24.4	O K
60 min Winter	6.666	0.216	0.0	0.6	0.6	30.6	O K
120 min Winter	6.699	0.249	0.0	0.6	0.6	36.7	O K
180 min Winter	6.716	0.266	0.0	0.7	0.7	39.8	Flood Risk
240 min Winter	6.726	0.276	0.0	0.7	0.7	41.6	Flood Risk
360 min Winter	6.737	0.287	0.0	0.7	0.7	43.6	Flood Risk
480 min Winter	6.741	0.291	0.0	0.7	0.7	44.3	Flood Risk
600 min Winter	6.741	0.291	0.0	0.7	0.7	44.4	Flood Risk
720 min Winter	6.740	0.290	0.0	0.7	0.7	44.2	Flood Risk
960 min Winter	6.738	0.288	0.0	0.7	0.7	43.7	Flood Risk
1440 min Winter	6.727	0.277	0.0	0.7	0.7	41.8	Flood Risk
2160 min Winter	6.707	0.257	0.0	0.6	0.6	38.0	Flood Risk
2880 min Winter	6.686	0.236	0.0	0.6	0.6	34.3	O K
4320 min Winter	6.650	0.200	0.0	0.6	0.6	27.8	O K
5760 min Winter	6.622	0.172	0.0	0.5	0.5	22.6	O K
7200 min Winter	6.599	0.149	0.0	0.5	0.5	18.4	O K
8640 min Winter	6.581	0.131	0.0	0.4	0.4	15.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.948	0.0	105.8	5552
15 min Winter	101.754	0.0	18.8	26
30 min Winter	67.708	0.0	25.2	40
60 min Winter	43.136	0.0	32.2	68
120 min Winter	26.651	0.0	39.9	126
180 min Winter	19.868	0.0	44.7	182
240 min Winter	16.054	0.0	48.1	240
360 min Winter	11.891	0.0	53.5	352
480 min Winter	9.596	0.0	57.6	462
600 min Winter	8.121	0.0	60.9	564
720 min Winter	7.083	0.0	63.8	590
960 min Winter	5.703	0.0	68.5	740
1440 min Winter	4.198	0.0	75.3	1046
2160 min Winter	3.085	0.0	83.3	1496
2880 min Winter	2.477	0.0	89.1	1932
4320 min Winter	1.816	0.0	97.9	2736
5760 min Winter	1.456	0.0	104.5	3520
7200 min Winter	1.227	0.0	110.0	4264
8640 min Winter	1.067	0.0	114.6	5016

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	6.566	0.116	0.0	0.4	0.4	12.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.948	0.0	118.7	5752

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.090

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.030	4	8	0.030	8	12	0.030

Model Details

Storage is Online Cover Level (m) 7.000

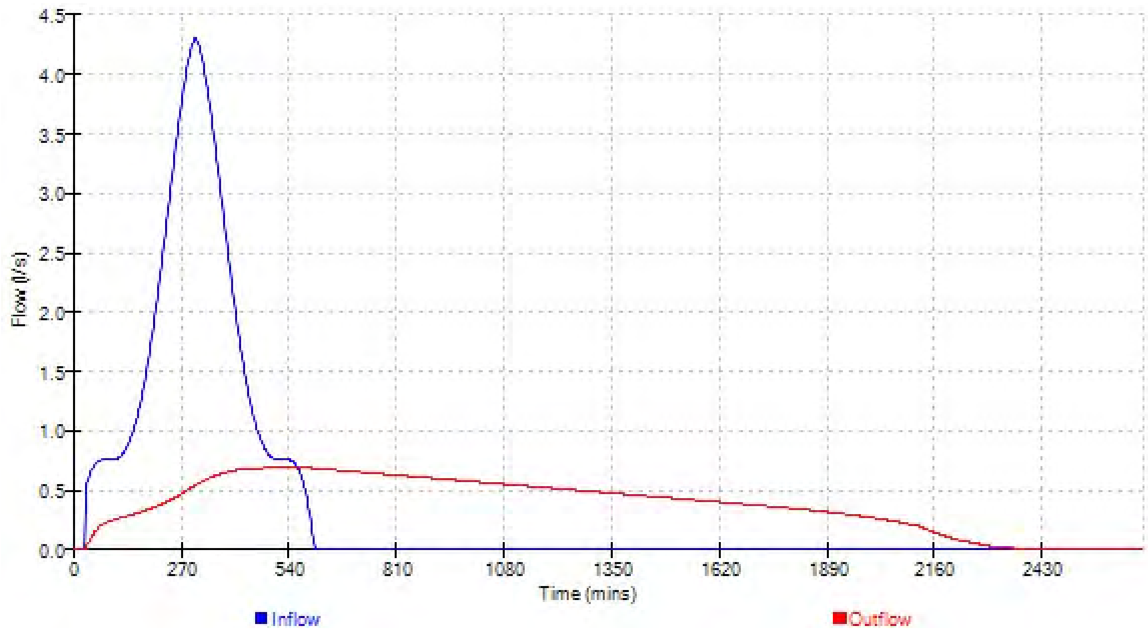
Porous Car Park Structure

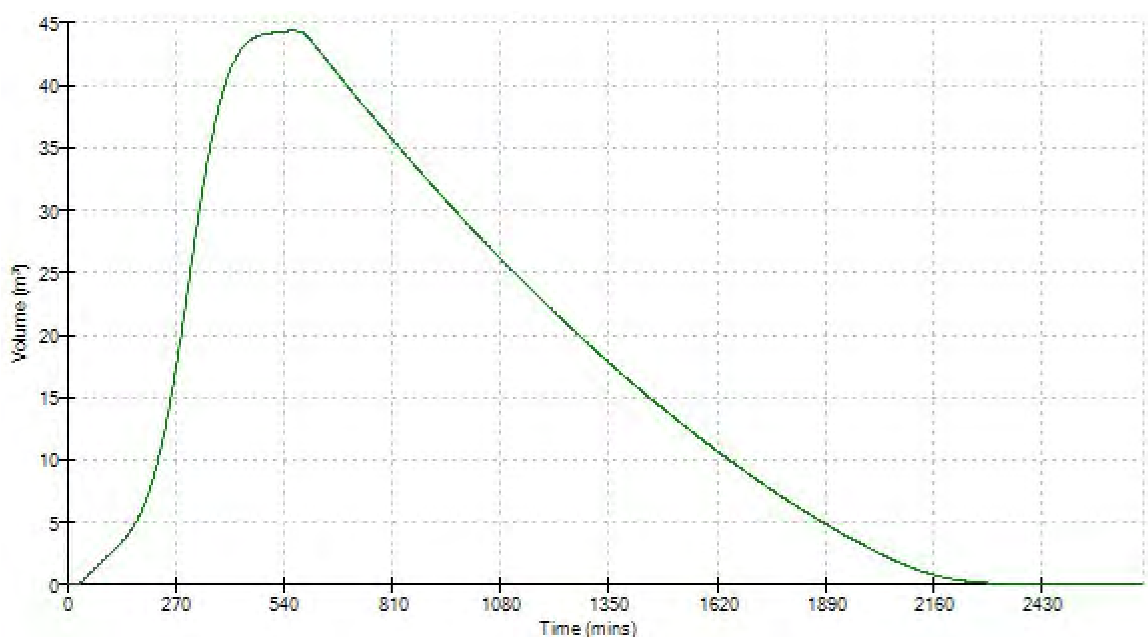
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	48.0
Max Percolation (l/s)	53.3	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	2
Porosity	0.95	Evaporation (mm/day)	1
Invert Level (m)	6.450	Cap Volume Depth (m)	0.300

Orifice Outflow Control

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 6.450

Event: 600 min Winter





Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 636 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.615	0.165	0.0	0.5	0.5	21.3	O K
30 min Summer	6.655	0.205	0.0	0.6	0.6	28.6	O K
60 min Summer	6.696	0.246	0.0	0.6	0.6	36.1	O K
120 min Summer	6.736	0.286	0.0	0.7	0.7	43.3	Flood Risk
180 min Summer	6.755	0.305	0.0	0.7	0.7	46.8	Flood Risk
240 min Summer	6.767	0.317	0.0	0.7	0.7	48.8	Flood Risk
360 min Summer	6.782	0.332	0.0	0.7	0.7	50.9	Flood Risk
480 min Summer	6.787	0.337	0.0	0.7	0.7	51.5	Flood Risk
600 min Summer	6.788	0.338	0.0	0.7	0.7	51.5	Flood Risk
720 min Summer	6.787	0.337	0.0	0.7	0.7	51.4	Flood Risk
960 min Summer	6.783	0.333	0.0	0.7	0.7	51.0	Flood Risk
1440 min Summer	6.770	0.320	0.0	0.7	0.7	49.3	Flood Risk
2160 min Summer	6.751	0.301	0.0	0.7	0.7	46.1	Flood Risk
2880 min Summer	6.733	0.283	0.0	0.7	0.7	42.9	Flood Risk
4320 min Summer	6.702	0.252	0.0	0.6	0.6	37.2	Flood Risk
5760 min Summer	6.676	0.226	0.0	0.6	0.6	32.4	O K
7200 min Summer	6.654	0.204	0.0	0.6	0.6	28.4	O K
8640 min Summer	6.635	0.185	0.0	0.5	0.5	25.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	21.9	26
30 min Summer	88.566	0.0	29.5	41
60 min Summer	56.713	0.0	37.9	70
120 min Summer	35.004	0.0	46.9	128
180 min Summer	25.973	0.0	52.2	186
240 min Summer	20.877	0.0	56.0	246
360 min Summer	15.365	0.0	61.8	362
480 min Summer	12.341	0.0	66.2	480
600 min Summer	10.402	0.0	69.8	530
720 min Summer	9.042	0.0	72.8	594
960 min Summer	7.241	0.0	77.7	720
1440 min Summer	5.284	0.0	83.3	988
2160 min Summer	3.848	0.0	92.8	1408
2880 min Summer	3.068	0.0	98.6	1820
4320 min Summer	2.226	0.0	107.2	2604
5760 min Summer	1.771	0.0	113.6	3400
7200 min Summer	1.483	0.0	118.8	4176
8640 min Summer	1.284	0.0	123.3	4920

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	6.620	0.170	0.0	0.5	0.5	22.2	O K
15 min Winter	6.630	0.180	0.0	0.5	0.5	24.0	O K
30 min Winter	6.674	0.224	0.0	0.6	0.6	32.2	O K
60 min Winter	6.721	0.271	0.0	0.7	0.7	40.7	Flood Risk
120 min Winter	6.768	0.318	0.0	0.7	0.7	48.9	Flood Risk
180 min Winter	6.803	0.353	0.0	0.8	0.8	53.0	Flood Risk
240 min Winter	7.000	0.550	0.0	1.0	1.0	55.2	FLOOD
360 min Winter	7.002	0.552	0.0	1.0	1.0	57.2	FLOOD
480 min Winter	7.003	0.553	0.0	1.0	1.0	57.8	FLOOD
600 min Winter	7.003	0.553	0.0	1.0	1.0	57.7	FLOOD
720 min Winter	7.003	0.553	0.0	1.0	1.0	57.7	FLOOD
960 min Winter	7.002	0.552	0.0	1.0	1.0	57.2	FLOOD
1440 min Winter	7.000	0.550	0.0	1.0	1.0	55.2	FLOOD
2160 min Winter	6.786	0.336	0.0	0.7	0.7	51.4	Flood Risk
2880 min Winter	6.754	0.304	0.0	0.7	0.7	46.7	Flood Risk
4320 min Winter	6.709	0.259	0.0	0.6	0.6	38.4	Flood Risk
5760 min Winter	6.672	0.222	0.0	0.6	0.6	31.8	O K
7200 min Winter	6.643	0.193	0.0	0.6	0.6	26.4	O K
8640 min Winter	6.619	0.169	0.0	0.5	0.5	22.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.137	0.0	127.2	5648
15 min Winter	131.851	0.0	24.5	26
30 min Winter	88.566	0.0	33.0	40
60 min Winter	56.713	0.0	42.5	68
120 min Winter	35.004	0.0	52.5	126
180 min Winter	25.973	0.0	58.5	184
240 min Winter	20.877	0.4	62.7	240
360 min Winter	15.365	2.4	69.3	352
480 min Winter	12.341	3.1	74.2	458
600 min Winter	10.402	3.0	78.2	546
720 min Winter	9.042	3.0	81.5	572
960 min Winter	7.241	2.4	87.0	724
1440 min Winter	5.284	0.5	91.2	1026
2160 min Winter	3.848	0.0	104.0	1516
2880 min Winter	3.068	0.0	110.6	1960
4320 min Winter	2.226	0.0	120.2	2776
5760 min Winter	1.771	0.0	127.3	3584
7200 min Winter	1.483	0.0	133.2	4336
8640 min Winter	1.284	0.0	138.3	5104

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	6.599	0.149	0.0	0.5	0.5	18.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.137	0.0	142.7	5848

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.090

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.030	4	8	0.030	8	12	0.030

Model Details

Storage is Online Cover Level (m) 7.000

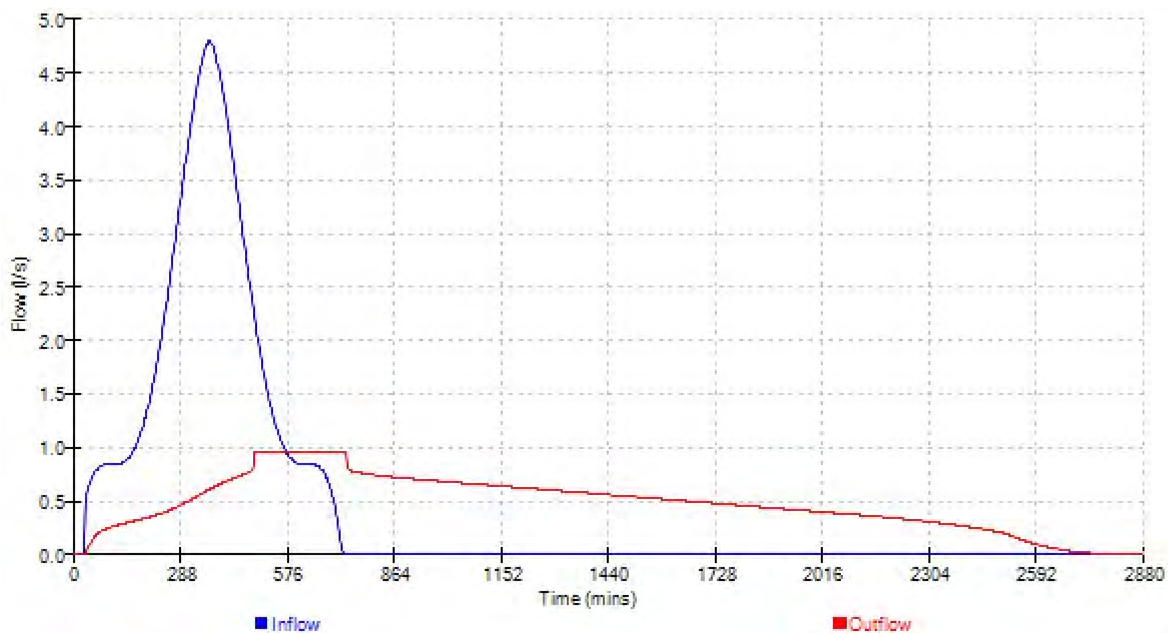
Porous Car Park Structure

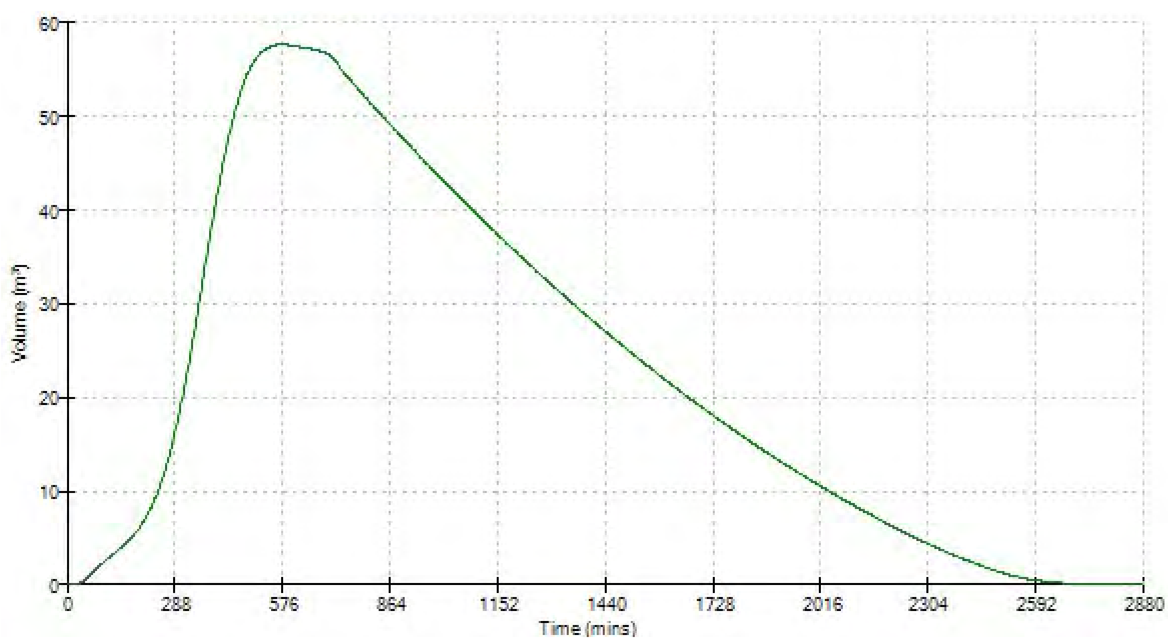
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	48.0
Max Percolation (l/s)	53.3	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	2
Porosity	0.95	Evaporation (mm/day)	1
Invert Level (m)	6.450	Cap Volume Depth (m)	0.300

Orifice Outflow Control

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 6.450

Event: 720 min Winter





Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 804 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.571	0.121	0.0	0.4	0.4	19.5	O K
30 min Summer	6.602	0.152	0.0	0.5	0.5	26.1	O K
60 min Summer	6.636	0.186	0.0	0.5	0.5	33.1	O K
120 min Summer	6.669	0.219	0.0	0.6	0.6	40.0	O K
180 min Summer	6.686	0.236	0.0	0.6	0.6	43.6	O K
240 min Summer	6.697	0.247	0.0	0.6	0.6	45.9	O K
360 min Summer	6.710	0.260	0.0	0.6	0.6	48.5	Flood Risk
480 min Summer	6.716	0.266	0.0	0.7	0.7	49.7	Flood Risk
600 min Summer	6.718	0.268	0.0	0.7	0.7	50.2	Flood Risk
720 min Summer	6.719	0.269	0.0	0.7	0.7	50.5	Flood Risk
960 min Summer	6.720	0.270	0.0	0.7	0.7	50.6	Flood Risk
1440 min Summer	6.717	0.267	0.0	0.7	0.7	50.1	Flood Risk
2160 min Summer	6.707	0.257	0.0	0.6	0.6	48.1	Flood Risk
2880 min Summer	6.696	0.246	0.0	0.6	0.6	45.7	O K
4320 min Summer	6.673	0.223	0.0	0.6	0.6	40.9	O K
5760 min Summer	6.653	0.203	0.0	0.6	0.6	36.7	O K
7200 min Summer	6.636	0.186	0.0	0.5	0.5	33.1	O K
8640 min Summer	6.621	0.171	0.0	0.5	0.5	30.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	19.8	26
30 min Summer	67.708	0.0	26.3	41
60 min Summer	43.136	0.0	34.5	70
120 min Summer	26.651	0.0	42.9	128
180 min Summer	19.868	0.0	48.0	188
240 min Summer	16.054	0.0	51.8	246
360 min Summer	11.891	0.0	57.7	364
480 min Summer	9.596	0.0	62.1	480
600 min Summer	8.121	0.0	65.7	564
720 min Summer	7.083	0.0	68.6	616
960 min Summer	5.703	0.0	72.8	740
1440 min Summer	4.198	0.0	76.0	1004
2160 min Summer	3.085	0.0	90.2	1416
2880 min Summer	2.477	0.0	96.6	1824
4320 min Summer	1.816	0.0	106.1	2640
5760 min Summer	1.456	0.0	113.3	3416
7200 min Summer	1.227	0.0	119.3	4184
8640 min Summer	1.067	0.0	124.4	4936

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	6.608	0.158	0.0	0.5	0.5	27.3	O K
15 min Winter	6.583	0.133	0.0	0.5	0.5	22.0	O K
30 min Winter	6.618	0.168	0.0	0.5	0.5	29.4	O K
60 min Winter	6.656	0.206	0.0	0.6	0.6	37.3	O K
120 min Winter	6.694	0.244	0.0	0.6	0.6	45.2	O K
180 min Winter	6.714	0.264	0.0	0.7	0.7	49.4	Flood Risk
240 min Winter	6.726	0.276	0.0	0.7	0.7	52.0	Flood Risk
360 min Winter	6.742	0.292	0.0	0.7	0.7	55.3	Flood Risk
480 min Winter	6.750	0.300	0.0	0.7	0.7	56.9	Flood Risk
600 min Winter	6.754	0.304	0.0	0.7	0.7	57.7	Flood Risk
720 min Winter	6.755	0.305	0.0	0.7	0.7	57.9	Flood Risk
960 min Winter	6.754	0.304	0.0	0.7	0.7	57.8	Flood Risk
1440 min Winter	6.749	0.299	0.0	0.7	0.7	56.8	Flood Risk
2160 min Winter	6.734	0.284	0.0	0.7	0.7	53.7	Flood Risk
2880 min Winter	6.717	0.267	0.0	0.7	0.7	50.0	Flood Risk
4320 min Winter	6.683	0.233	0.0	0.6	0.6	42.9	O K
5760 min Winter	6.654	0.204	0.0	0.6	0.6	36.9	O K
7200 min Winter	6.630	0.180	0.0	0.5	0.5	31.9	O K
8640 min Winter	6.610	0.160	0.0	0.5	0.5	27.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.948	0.0	128.8	5664
15 min Winter	101.754	0.0	22.3	26
30 min Winter	67.708	0.0	29.2	40
60 min Winter	43.136	0.0	38.7	68
120 min Winter	26.651	0.0	48.1	126
180 min Winter	19.868	0.0	53.9	184
240 min Winter	16.054	0.0	58.2	242
360 min Winter	11.891	0.0	64.7	356
480 min Winter	9.596	0.0	69.6	468
600 min Winter	8.121	0.0	73.4	576
720 min Winter	7.083	0.0	76.3	680
960 min Winter	5.703	0.0	79.9	772
1440 min Winter	4.198	0.0	82.7	1078
2160 min Winter	3.085	0.0	101.2	1536
2880 min Winter	2.477	0.0	108.3	1972
4320 min Winter	1.816	0.0	119.0	2816
5760 min Winter	1.456	0.0	127.2	3632
7200 min Winter	1.227	0.0	133.8	4400
8640 min Winter	1.067	0.0	139.6	5192

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	6.593	0.143	0.0	0.5	0.5	24.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.948	0.0	144.6	5952

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.110

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.037	4	8	0.037	8	12	0.037

Model Details

Storage is Online Cover Level (m) 7.000

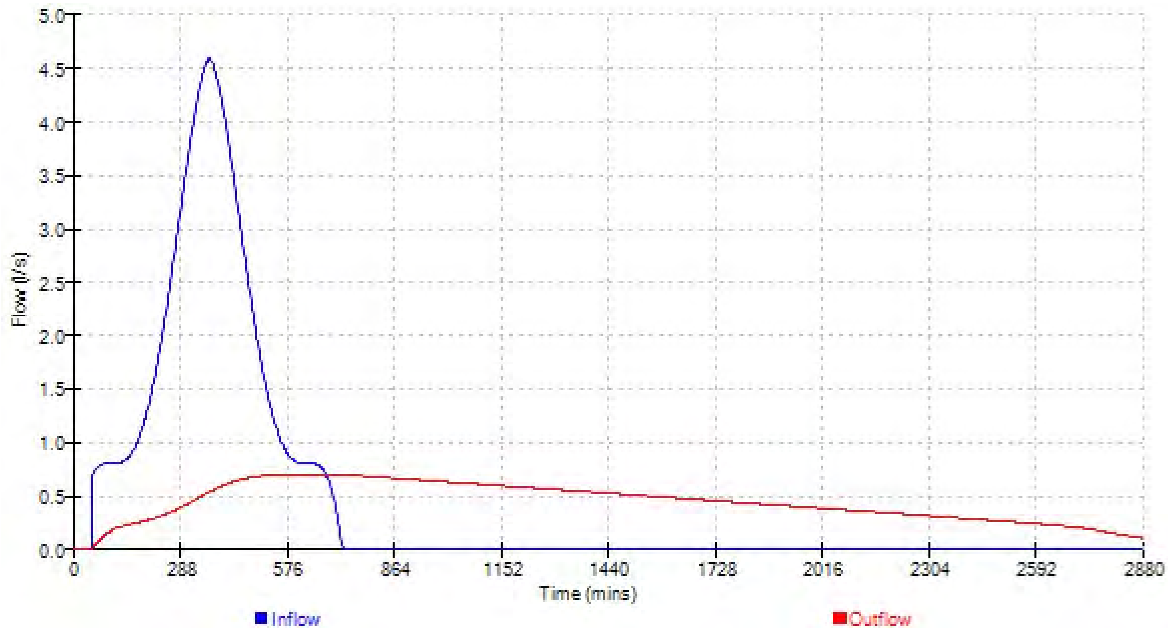
Porous Car Park Structure

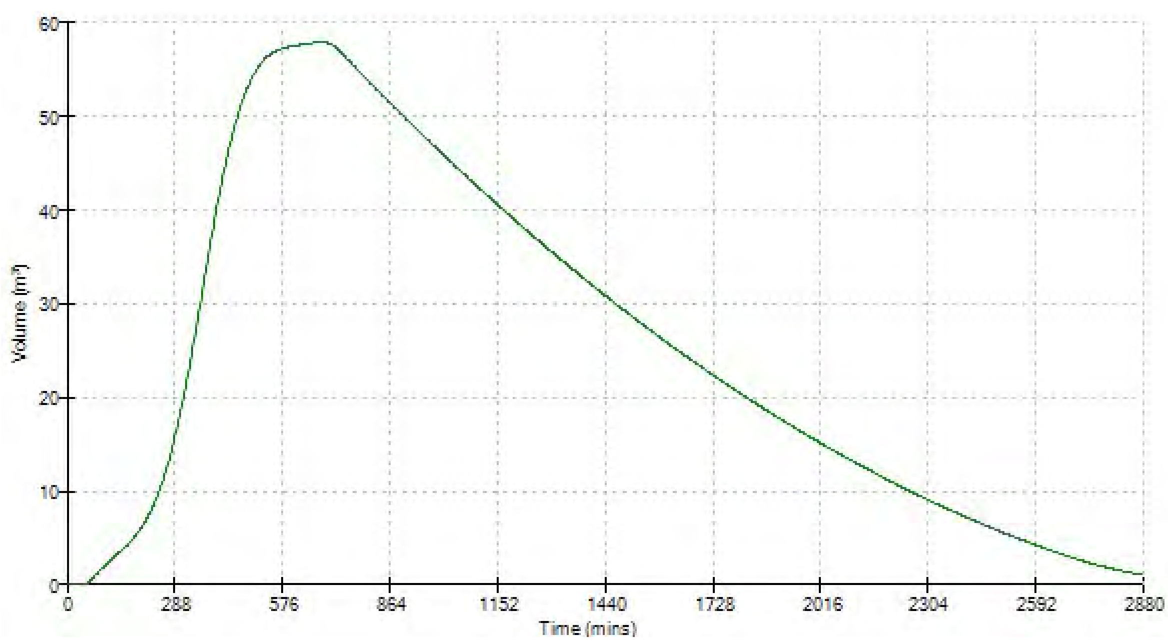
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	8.0
Membrane Percolation (mm/hr)	1000	Length (m)	27.5
Max Percolation (l/s)	61.1	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.95	Evaporation (mm/day)	1
Invert Level (m)	6.450	Cap Volume Depth (m)	0.300

Orifice Outflow Control

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 6.450

Event: 720 min Winter





Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 636 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.615	0.165	0.0	0.5	0.5	21.3	O K
30 min Summer	6.655	0.205	0.0	0.6	0.6	28.6	O K
60 min Summer	6.696	0.246	0.0	0.6	0.6	36.1	O K
120 min Summer	6.736	0.286	0.0	0.7	0.7	43.3	Flood Risk
180 min Summer	6.755	0.305	0.0	0.7	0.7	46.8	Flood Risk
240 min Summer	6.767	0.317	0.0	0.7	0.7	48.8	Flood Risk
360 min Summer	6.782	0.332	0.0	0.7	0.7	50.9	Flood Risk
480 min Summer	6.787	0.337	0.0	0.7	0.7	51.5	Flood Risk
600 min Summer	6.788	0.338	0.0	0.7	0.7	51.5	Flood Risk
720 min Summer	6.787	0.337	0.0	0.7	0.7	51.4	Flood Risk
960 min Summer	6.783	0.333	0.0	0.7	0.7	51.0	Flood Risk
1440 min Summer	6.770	0.320	0.0	0.7	0.7	49.3	Flood Risk
2160 min Summer	6.751	0.301	0.0	0.7	0.7	46.1	Flood Risk
2880 min Summer	6.733	0.283	0.0	0.7	0.7	42.9	Flood Risk
4320 min Summer	6.702	0.252	0.0	0.6	0.6	37.2	Flood Risk
5760 min Summer	6.676	0.226	0.0	0.6	0.6	32.4	O K
7200 min Summer	6.654	0.204	0.0	0.6	0.6	28.4	O K
8640 min Summer	6.635	0.185	0.0	0.5	0.5	25.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	21.9	26
30 min Summer	88.566	0.0	29.5	41
60 min Summer	56.713	0.0	37.9	70
120 min Summer	35.004	0.0	46.9	128
180 min Summer	25.973	0.0	52.2	186
240 min Summer	20.877	0.0	56.0	246
360 min Summer	15.365	0.0	61.8	362
480 min Summer	12.341	0.0	66.2	480
600 min Summer	10.402	0.0	69.8	530
720 min Summer	9.042	0.0	72.8	594
960 min Summer	7.241	0.0	77.7	720
1440 min Summer	5.284	0.0	83.3	988
2160 min Summer	3.848	0.0	92.8	1408
2880 min Summer	3.068	0.0	98.6	1820
4320 min Summer	2.226	0.0	107.2	2604
5760 min Summer	1.771	0.0	113.6	3400
7200 min Summer	1.483	0.0	118.8	4176
8640 min Summer	1.284	0.0	123.3	4920

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	6.620	0.170	0.0	0.5	0.5	22.2	O K
15 min Winter	6.630	0.180	0.0	0.5	0.5	24.0	O K
30 min Winter	6.674	0.224	0.0	0.6	0.6	32.2	O K
60 min Winter	6.721	0.271	0.0	0.7	0.7	40.7	Flood Risk
120 min Winter	6.768	0.318	0.0	0.7	0.7	48.9	Flood Risk
180 min Winter	6.803	0.353	0.0	0.8	0.8	53.0	Flood Risk
240 min Winter	7.000	0.550	0.0	1.0	1.0	55.2	FLOOD
360 min Winter	7.002	0.552	0.0	1.0	1.0	57.2	FLOOD
480 min Winter	7.003	0.553	0.0	1.0	1.0	57.8	FLOOD
600 min Winter	7.003	0.553	0.0	1.0	1.0	57.7	FLOOD
720 min Winter	7.003	0.553	0.0	1.0	1.0	57.7	FLOOD
960 min Winter	7.002	0.552	0.0	1.0	1.0	57.2	FLOOD
1440 min Winter	7.000	0.550	0.0	1.0	1.0	55.2	FLOOD
2160 min Winter	6.786	0.336	0.0	0.7	0.7	51.4	Flood Risk
2880 min Winter	6.754	0.304	0.0	0.7	0.7	46.7	Flood Risk
4320 min Winter	6.709	0.259	0.0	0.6	0.6	38.4	Flood Risk
5760 min Winter	6.672	0.222	0.0	0.6	0.6	31.8	O K
7200 min Winter	6.643	0.193	0.0	0.6	0.6	26.4	O K
8640 min Winter	6.619	0.169	0.0	0.5	0.5	22.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.137	0.0	127.2	5648
15 min Winter	131.851	0.0	24.5	26
30 min Winter	88.566	0.0	33.0	40
60 min Winter	56.713	0.0	42.5	68
120 min Winter	35.004	0.0	52.5	126
180 min Winter	25.973	0.0	58.5	184
240 min Winter	20.877	0.4	62.7	240
360 min Winter	15.365	2.4	69.3	352
480 min Winter	12.341	3.1	74.2	458
600 min Winter	10.402	3.0	78.2	546
720 min Winter	9.042	3.0	81.5	572
960 min Winter	7.241	2.4	87.0	724
1440 min Winter	5.284	0.5	91.2	1026
2160 min Winter	3.848	0.0	104.0	1516
2880 min Winter	3.068	0.0	110.6	1960
4320 min Winter	2.226	0.0	120.2	2776
5760 min Winter	1.771	0.0	127.3	3584
7200 min Winter	1.483	0.0	133.2	4336
8640 min Winter	1.284	0.0	138.3	5104

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	6.599	0.149	0.0	0.5	0.5	18.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.137	0.0	142.7	5848

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.090

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.030	4	8	0.030	8	12	0.030

Model Details

Storage is Online Cover Level (m) 7.000

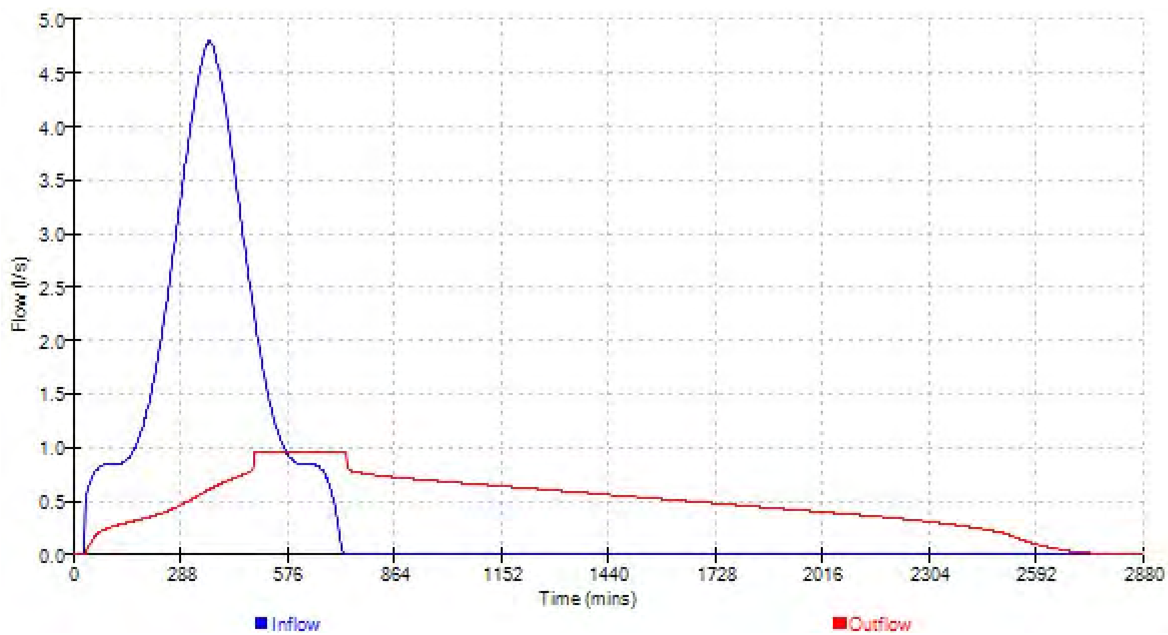
Porous Car Park Structure

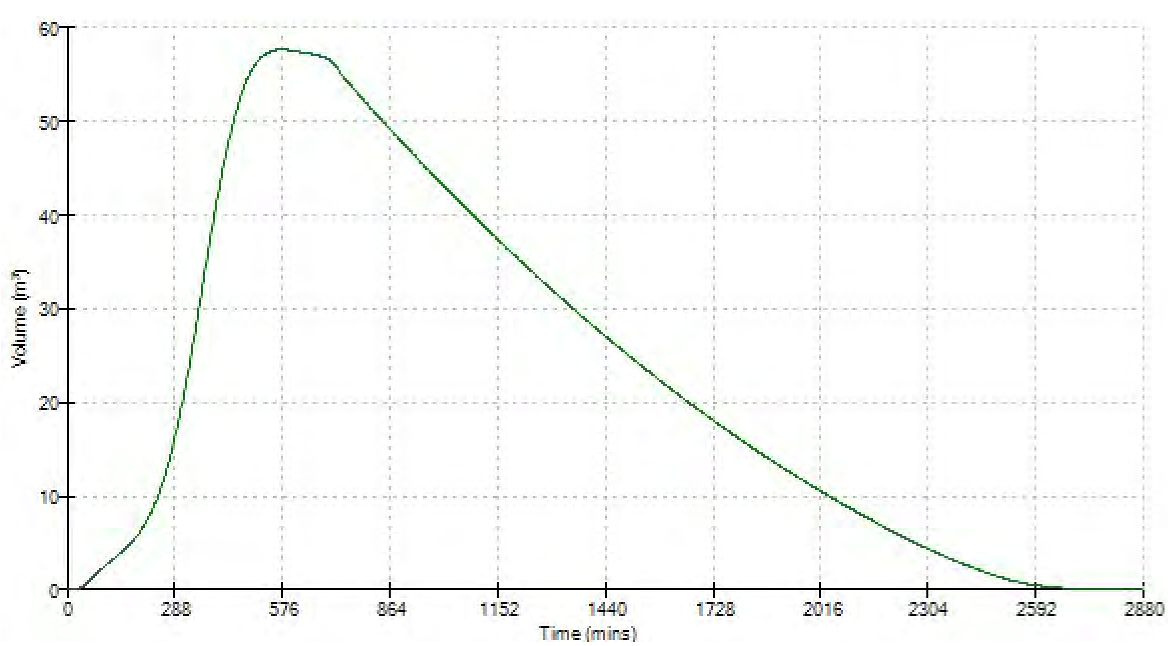
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	48.0
Max Percolation (l/s)	53.3	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	2
Porosity	0.95	Evaporation (mm/day)	1
Invert Level (m)	6.450	Cap Volume Depth (m)	0.300

Orifice Outflow Control

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 6.450

Event: 720 min Winter





Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 714 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.621	0.171	0.0	0.7	0.7	27.9	O K
30 min Summer	6.649	0.199	0.0	0.8	0.8	37.1	O K
60 min Summer	6.678	0.228	0.0	0.9	0.9	46.6	O K
120 min Summer	6.706	0.256	0.0	0.9	0.9	55.9	Flood Risk
180 min Summer	6.721	0.271	0.0	1.0	1.0	60.7	Flood Risk
240 min Summer	6.729	0.279	0.0	1.0	1.0	63.4	Flood Risk
360 min Summer	6.738	0.288	0.0	1.0	1.0	66.4	Flood Risk
480 min Summer	6.741	0.291	0.0	1.0	1.0	67.5	Flood Risk
600 min Summer	6.742	0.292	0.0	1.0	1.0	67.7	Flood Risk
720 min Summer	6.742	0.292	0.0	1.0	1.0	67.7	Flood Risk
960 min Summer	6.741	0.291	0.0	1.0	1.0	67.3	Flood Risk
1440 min Summer	6.735	0.285	0.0	1.0	1.0	65.3	Flood Risk
2160 min Summer	6.723	0.273	0.0	1.0	1.0	61.3	Flood Risk
2880 min Summer	6.710	0.260	0.0	0.9	0.9	57.2	Flood Risk
4320 min Summer	6.688	0.238	0.0	0.9	0.9	49.7	O K
5760 min Summer	6.668	0.218	0.0	0.8	0.8	43.2	O K
7200 min Summer	6.651	0.201	0.0	0.8	0.8	37.6	O K
8640 min Summer	6.636	0.186	0.0	0.8	0.8	32.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	28.7	26
30 min Summer	67.708	0.0	38.4	41
60 min Summer	43.136	0.0	49.1	70
120 min Summer	26.651	0.0	60.8	128
180 min Summer	19.868	0.0	68.1	186
240 min Summer	16.054	0.0	73.4	246
360 min Summer	11.891	0.0	81.6	362
480 min Summer	9.596	0.0	87.9	480
600 min Summer	8.121	0.0	93.0	532
720 min Summer	7.083	0.0	97.3	594
960 min Summer	5.703	0.0	104.5	720
1440 min Summer	4.198	0.0	115.0	990
2160 min Summer	3.085	0.0	127.0	1408
2880 min Summer	2.477	0.0	135.9	1820
4320 min Summer	1.816	0.0	149.3	2604
5760 min Summer	1.456	0.0	159.3	3400
7200 min Summer	1.227	0.0	167.6	4176
8640 min Summer	1.067	0.0	174.7	4856

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	6.624	0.174	0.0	0.7	0.7	28.7	O K
15 min Winter	6.632	0.182	0.0	0.8	0.8	31.4	O K
30 min Winter	6.663	0.213	0.0	0.8	0.8	41.8	O K
60 min Winter	6.696	0.246	0.0	0.9	0.9	52.6	O K
120 min Winter	6.728	0.278	0.0	1.0	1.0	63.2	Flood Risk
180 min Winter	6.745	0.295	0.0	1.0	1.0	68.8	Flood Risk
240 min Winter	6.756	0.306	0.0	1.0	1.0	72.1	Flood Risk
360 min Winter	6.768	0.318	0.0	1.0	1.0	76.0	Flood Risk
480 min Winter	6.774	0.324	0.0	1.0	1.0	77.7	Flood Risk
600 min Winter	6.776	0.326	0.0	1.0	1.0	78.2	Flood Risk
720 min Winter	6.775	0.325	0.0	1.0	1.0	78.0	Flood Risk
960 min Winter	6.772	0.322	0.0	1.0	1.0	77.3	Flood Risk
1440 min Winter	6.763	0.313	0.0	1.0	1.0	74.5	Flood Risk
2160 min Winter	6.745	0.295	0.0	1.0	1.0	68.6	Flood Risk
2880 min Winter	6.726	0.276	0.0	1.0	1.0	62.4	Flood Risk
4320 min Winter	6.692	0.242	0.0	0.9	0.9	51.1	O K
5760 min Winter	6.663	0.213	0.0	0.8	0.8	41.8	O K
7200 min Winter	6.640	0.190	0.0	0.8	0.8	34.1	O K
8640 min Winter	6.621	0.171	0.0	0.7	0.7	27.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.948	0.0	180.9	5640
15 min Winter	101.754	0.0	32.2	26
30 min Winter	67.708	0.0	43.1	40
60 min Winter	43.136	0.0	55.1	68
120 min Winter	26.651	0.0	68.2	126
180 min Winter	19.868	0.0	76.4	184
240 min Winter	16.054	0.0	82.3	240
360 min Winter	11.891	0.0	91.5	354
480 min Winter	9.596	0.0	98.5	466
600 min Winter	8.121	0.0	104.2	572
720 min Winter	7.083	0.0	109.1	672
960 min Winter	5.703	0.0	117.1	760
1440 min Winter	4.198	0.0	126.3	1070
2160 min Winter	3.085	0.0	142.4	1520
2880 min Winter	2.477	0.0	152.4	1964
4320 min Winter	1.816	0.0	167.4	2808
5760 min Winter	1.456	0.0	178.7	3584
7200 min Winter	1.227	0.0	188.0	4336
8640 min Winter	1.067	0.0	196.0	5104

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m^3)	Status
10080 min Winter	6.604	0.154	0.0	0.7	0.7	22.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
10080 min Winter	0.948	0.0	203.0	5840

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.154

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.051	4	8	0.051	8	12	0.051

Model Details

Storage is Online Cover Level (m) 7.000

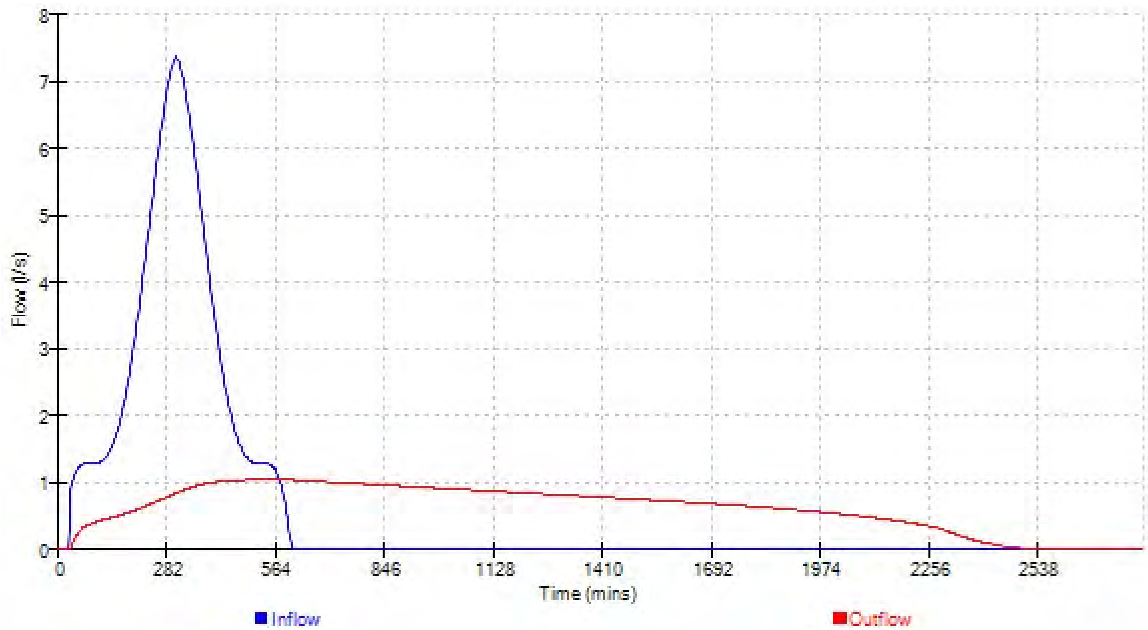
Porous Car Park Structure

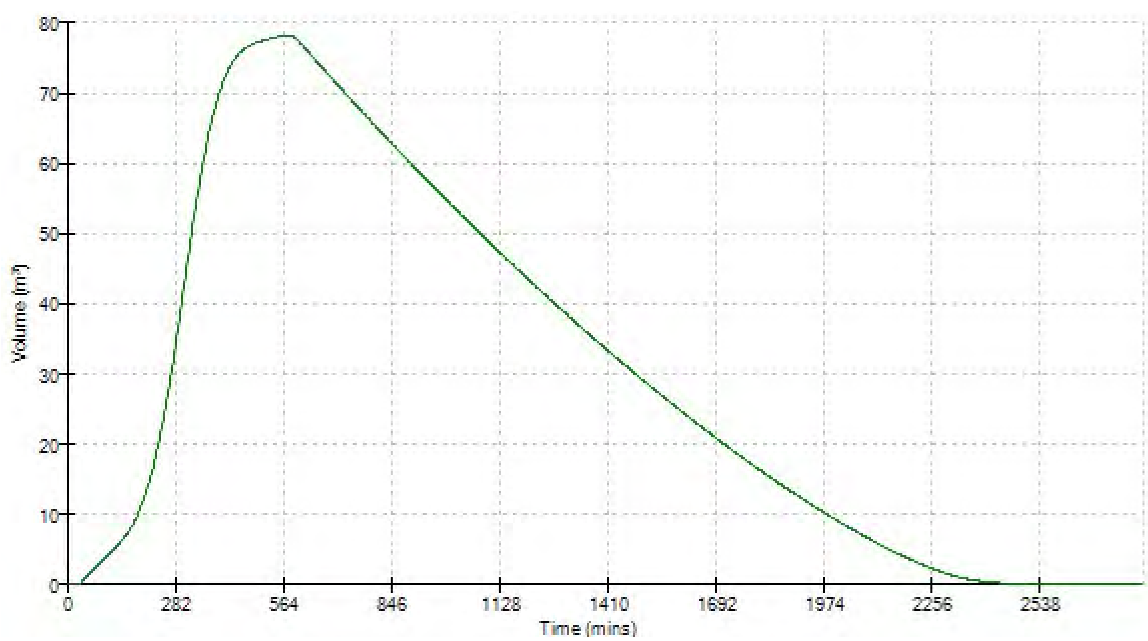
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	86.8
Max Percolation (l/s)	96.4	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	2
Porosity	0.95	Evaporation (mm/day)	1
Invert Level (m)	6.450	Cap Volume Depth (m)	0.300

Orifice Outflow Control

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 6.450

Event: 600 min Winter





Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 763 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.648	0.198	0.0	0.8	0.8	36.5	O K
30 min Summer	6.685	0.235	0.0	0.9	0.9	49.0	O K
60 min Summer	6.725	0.275	0.0	1.0	1.0	62.1	Flood Risk
120 min Summer	6.764	0.314	0.0	1.0	1.0	74.7	Flood Risk
180 min Summer	6.786	0.336	0.0	1.1	1.1	80.9	Flood Risk
240 min Summer	6.800	0.350	0.0	1.1	1.1	84.5	Flood Risk
360 min Summer	6.819	0.369	0.0	1.1	1.1	88.7	Flood Risk
480 min Summer	6.828	0.378	0.0	1.1	1.1	90.3	Flood Risk
600 min Summer	6.829	0.379	0.0	1.1	1.1	90.6	Flood Risk
720 min Summer	6.829	0.379	0.0	1.1	1.1	90.4	Flood Risk
960 min Summer	6.825	0.375	0.0	1.1	1.1	89.8	Flood Risk
1440 min Summer	6.812	0.362	0.0	1.1	1.1	87.2	Flood Risk
2160 min Summer	6.791	0.341	0.0	1.1	1.1	82.2	Flood Risk
2880 min Summer	6.772	0.322	0.0	1.0	1.0	77.0	Flood Risk
4320 min Summer	6.741	0.291	0.0	1.0	1.0	67.5	Flood Risk
5760 min Summer	6.716	0.266	0.0	0.9	0.9	59.2	Flood Risk
7200 min Summer	6.695	0.245	0.0	0.9	0.9	52.2	O K
8640 min Summer	6.677	0.227	0.0	0.9	0.9	46.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	37.4	26
30 min Summer	88.566	0.0	50.4	41
60 min Summer	56.713	0.0	64.8	70
120 min Summer	35.004	0.0	80.1	128
180 min Summer	25.973	0.0	89.3	188
240 min Summer	20.877	0.0	95.7	246
360 min Summer	15.365	0.0	105.7	364
480 min Summer	12.341	0.0	113.2	482
600 min Summer	10.402	0.0	119.3	580
720 min Summer	9.042	0.0	124.4	628
960 min Summer	7.241	0.0	132.3	752
1440 min Summer	5.284	0.0	136.9	1016
2160 min Summer	3.848	0.0	158.8	1432
2880 min Summer	3.068	0.0	168.7	1848
4320 min Summer	2.226	0.0	183.4	2644
5760 min Summer	1.771	0.0	194.2	3456
7200 min Summer	1.483	0.0	203.2	4192
8640 min Summer	1.284	0.0	210.8	4936

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	6.660	0.210	0.0	0.8	0.8	40.8	O K
15 min Winter	6.661	0.211	0.0	0.8	0.8	41.1	O K
30 min Winter	6.704	0.254	0.0	0.9	0.9	55.1	Flood Risk
60 min Winter	6.749	0.299	0.0	1.0	1.0	69.8	Flood Risk
120 min Winter	6.799	0.349	0.0	1.1	1.1	84.2	Flood Risk
180 min Winter	6.835	0.385	0.0	1.1	1.1	91.5	Flood Risk
240 min Winter	6.865	0.415	0.0	1.2	1.2	95.8	Flood Risk
360 min Winter	7.001	0.551	0.0	1.4	1.4	100.5	FLOOD
480 min Winter	7.003	0.553	0.0	1.4	1.4	102.3	FLOOD
600 min Winter	7.004	0.554	0.0	1.4	1.4	102.8	FLOOD
720 min Winter	7.003	0.553	0.0	1.4	1.4	102.4	FLOOD
960 min Winter	7.003	0.553	0.0	1.4	1.4	101.7	FLOOD
1440 min Winter	6.952	0.502	0.0	1.3	1.3	99.2	Flood Risk
2160 min Winter	6.841	0.391	0.0	1.2	1.2	92.6	Flood Risk
2880 min Winter	6.803	0.353	0.0	1.1	1.1	85.2	Flood Risk
4320 min Winter	6.753	0.303	0.0	1.0	1.0	71.2	Flood Risk
5760 min Winter	6.717	0.267	0.0	0.9	0.9	59.4	Flood Risk
7200 min Winter	6.687	0.237	0.0	0.9	0.9	49.6	O K
8640 min Winter	6.663	0.213	0.0	0.8	0.8	41.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.137	0.0	217.5	5664
15 min Winter	131.851	0.0	41.9	26
30 min Winter	88.566	0.0	56.0	40
60 min Winter	56.713	0.0	72.7	70
120 min Winter	35.004	0.0	89.8	126
180 min Winter	25.973	0.0	100.1	184
240 min Winter	20.877	0.0	107.3	242
360 min Winter	15.365	1.6	118.5	354
480 min Winter	12.341	3.4	126.9	466
600 min Winter	10.402	3.8	133.7	572
720 min Winter	9.042	3.5	139.2	666
960 min Winter	7.241	2.8	145.8	752
1440 min Winter	5.284	0.0	148.1	1066
2160 min Winter	3.848	0.0	178.0	1540
2880 min Winter	3.068	0.0	189.1	1992
4320 min Winter	2.226	0.0	205.6	2856
5760 min Winter	1.771	0.0	217.8	3648
7200 min Winter	1.483	0.0	227.8	4464
8640 min Winter	1.284	0.0	236.5	5192

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	6.642	0.192	0.0	0.8	0.8	34.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.137	0.0	244.0	5952

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.154

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.051	4	8	0.051	8	12	0.051

Model Details

Storage is Online Cover Level (m) 7.000

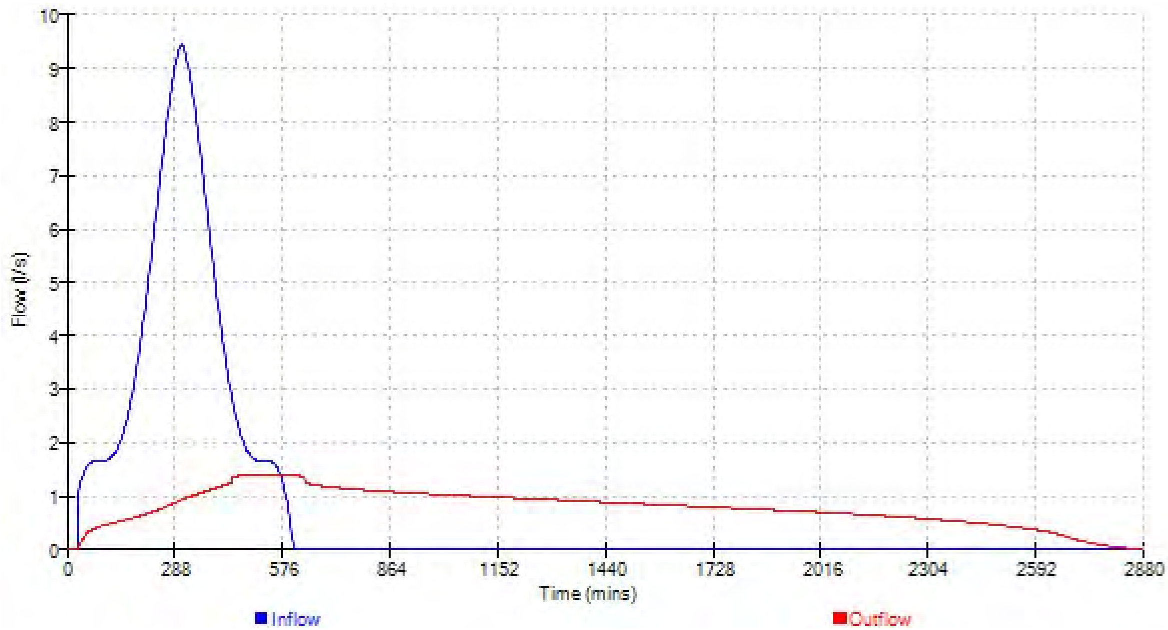
Porous Car Park Structure

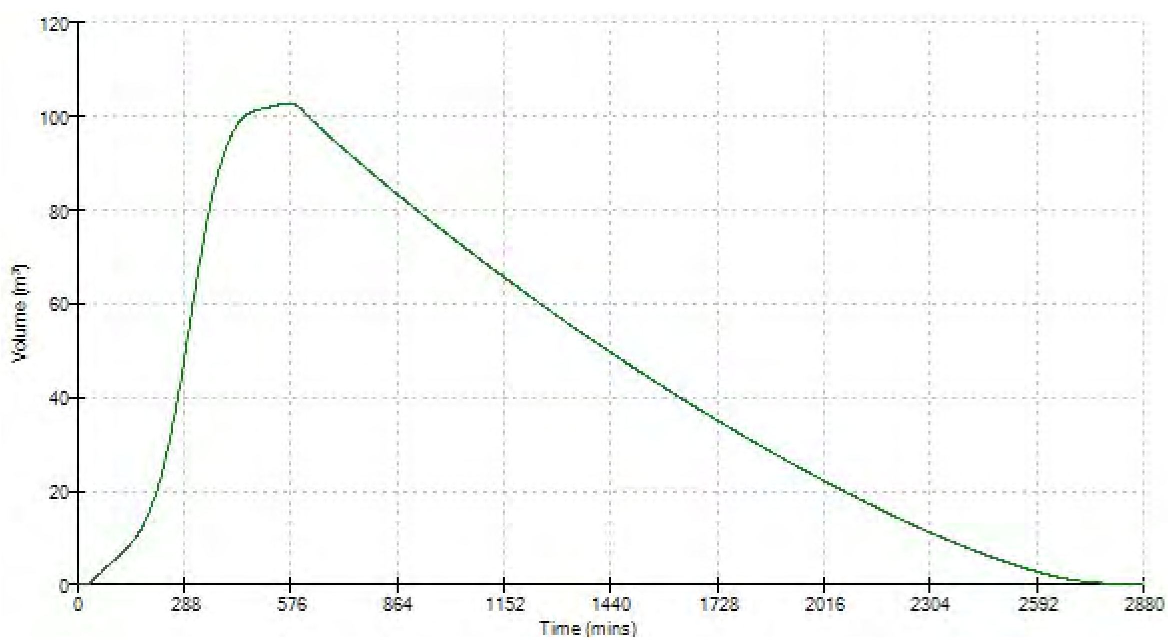
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	86.8
Max Percolation (l/s)	96.4	Slope (1:X)	500.0
Safety Factor	2.0	Depression Storage (mm)	2
Porosity	0.95	Evaporation (mm/day)	1
Invert Level (m)	6.450	Cap Volume Depth (m)	0.300

Orifice Outflow Control

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 6.450

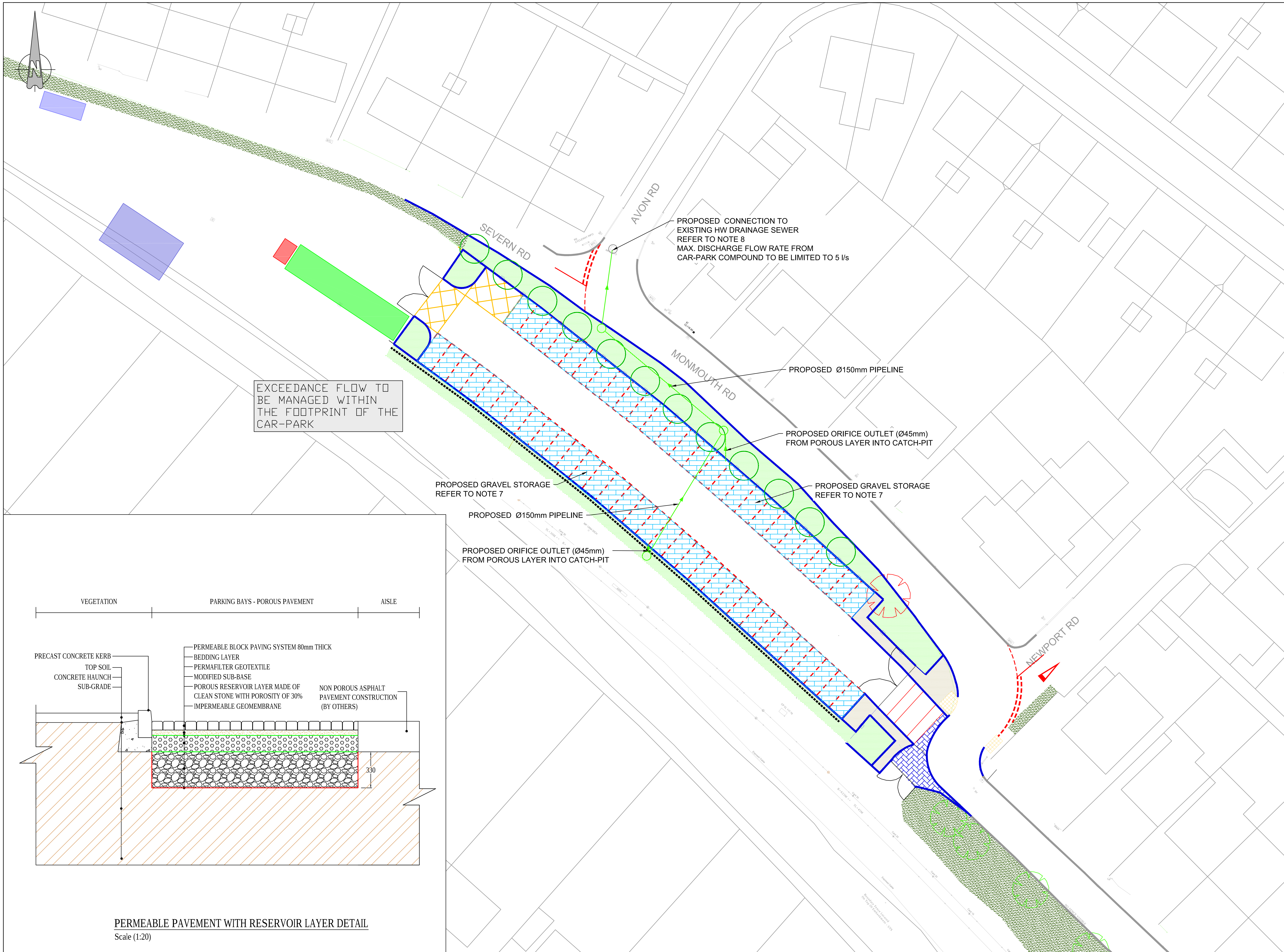
Event: 600 min Winter





APPENDIX C

Pill Station Drainage Strategy Drawings and Calculations



This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

NOTES:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout is based on available OS or topographical surveys.
6. Outfalls should be monitored on a regular basis and equipped with shut-off valves.
7. Proposed car-park drainage system based on collecting the runoff water through permeable pavement (concrete bolcks) on the parking bays. The runoff water will be attenuated within 330mm height of clean stone reservoir layer before discharging into the HW drainage system. See Detail for further information.
8. During detailed design, existing HW drainage system on Avon Road to be surveyed to ensure it has the capacity for receiving the discharge rate of the car-park runoff.

KEY:

- Proposed drainage pipeline
- Proposed MH/Catchpit
- Proposed porous reservoir
- Proposed vegetation
- Existing vegetation retained
- New footpath surface
- Trees to be removed
- Trees to be retained
- Proposed trees
- Vehicle restraint barrier
- Proposed fence
- Existing kerb retained
- Proposed new kerb

DRAFT

Rev	By	Chkd	Apprvd	Date	Description
A	R			23/05/2018	FOR INFORMATION

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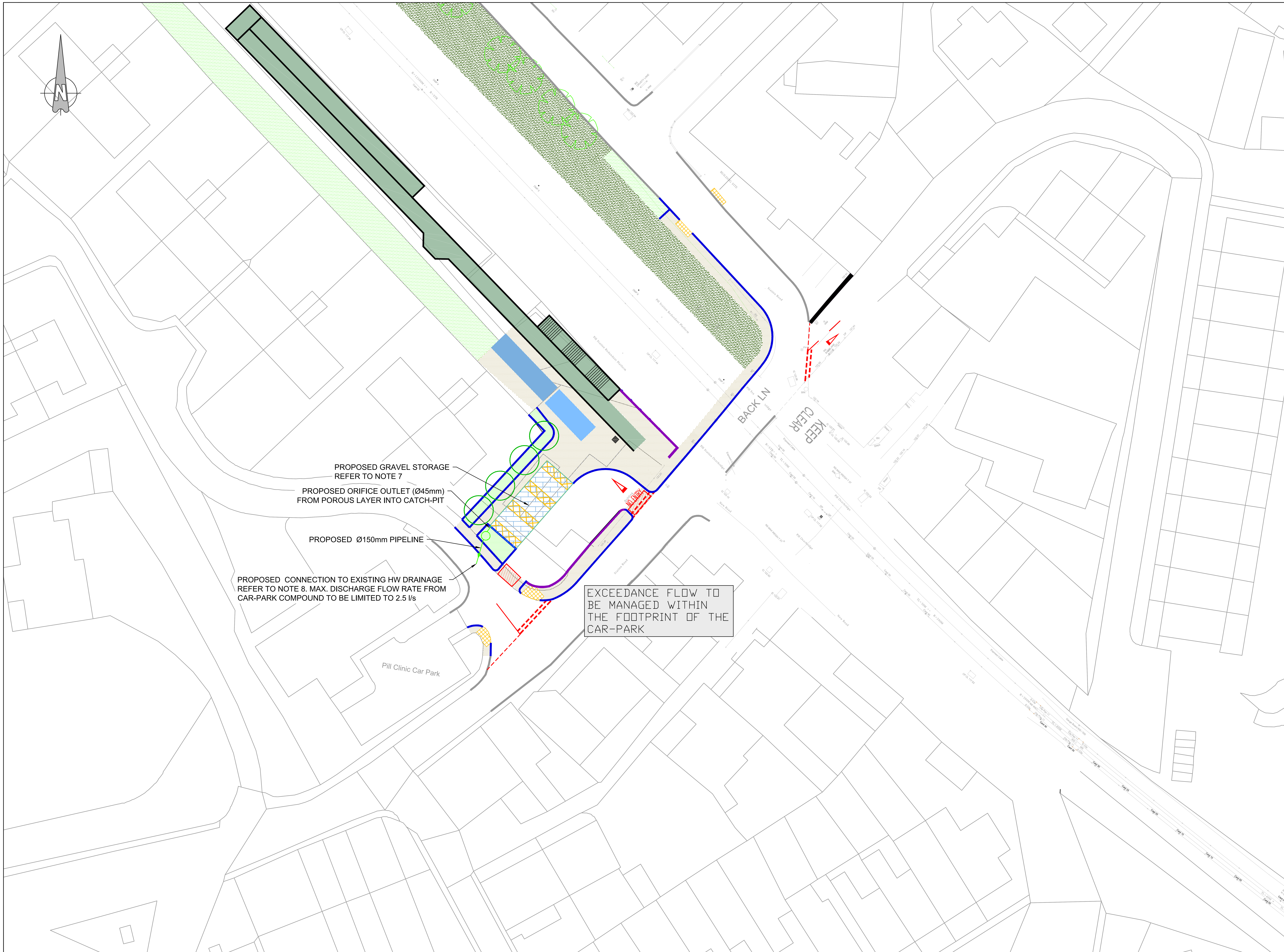
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PILL STATION CAR-PARK
DRAINAGE STRATEGY
Sheet 1 of 2

Drawn by: IR Date: 23/05/2018
Checked by: Date:
Approved by: Date:

Drawing No. 467470.BQ.04.20-DS-Pill
Revision A

Drawing Scale: As shown



This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 5 10 15 20
SCALE 1:250 (A1)
SCALE 1:500 (A3)
METRES

NOTES:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout is based on available OS or topographical surveys.
6. Outfalls should be monitored on a regular basis and equipped with shut-off valves.
7. Proposed car-park drainage system based on collecting the runoff water through permeable pavement (concrete bolcks) on the parking bays. The runoff water will be attenuated within 330mm height of clean stone reservoir layer before discharging into the HW drainage system. See Detail for further information.
8. During detailed design, existing HW drainage system on Avon Road to be surveyed to ensure it has the capacity for receiving the discharge rate of the car-park runoff.

KEY:

- Proposed drainage pipeline
- Proposed MH/Catchpit
- Proposed porous reservoir
- Proposed vegetation
- Existing vegetation retained
- New footpath surface
- Trees to be removed
- Trees to be retained
- Proposed trees
- Vehicle restraint barrier
- Proposed fence
- Existing kerb retained
- Proposed new kerb

DRAFT

Rev	By	Chkd	Apprvd	Date	Description
A	IR			23/05/2018	FOR INFORMATION

travelwest
Bath & North East Somerset, Bristol, North Somerset and South Gloucestershire Councils working together to improve your local transport

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PILL STATION CAR-PARK
DRAINAGE STRATEGY
Sheet 2 of 2

Drawn by: IR Date: 23/05/2018
Checked by: Date:
Approved by: Date:

Drawing No. 467470.BQ.04.20-DS-PILL
Revision A
Drawing Scale: As shown

Drawing file path & name : \\EXTFPP01\Proj\Transportation\Projects\MetroWest\100 Drawings\Pill Station\2018-04-12 copy of 467470.BQ.04.20-207 to 209 Rev H\ 467470.BQ.04.20-DR-PillDrainageStrategy.dwg

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 95 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	17.635	0.215	0.0	1.9	1.9	12.0	O K
30 min Summer	17.675	0.255	0.0	2.0	2.0	15.6	O K
60 min Summer	17.704	0.284	0.0	2.2	2.2	18.2	Flood Risk
120 min Summer	17.716	0.296	0.0	2.2	2.2	19.3	Flood Risk
180 min Summer	17.715	0.295	0.0	2.2	2.2	19.2	Flood Risk
240 min Summer	17.709	0.289	0.0	2.2	2.2	18.7	Flood Risk
360 min Summer	17.695	0.275	0.0	2.1	2.1	17.4	O K
480 min Summer	17.680	0.260	0.0	2.1	2.1	16.1	O K
600 min Summer	17.667	0.247	0.0	2.0	2.0	14.9	O K
720 min Summer	17.654	0.234	0.0	1.9	1.9	13.7	O K
960 min Summer	17.631	0.211	0.0	1.8	1.8	11.7	O K
1440 min Summer	17.596	0.176	0.0	1.7	1.7	8.6	O K
2160 min Summer	17.561	0.141	0.0	1.5	1.5	5.5	O K
2880 min Summer	17.536	0.116	0.0	1.3	1.3	3.7	O K
4320 min Summer	17.504	0.084	0.0	1.0	1.0	1.9	O K
5760 min Summer	17.485	0.065	0.0	0.9	0.9	1.2	O K
7200 min Summer	17.478	0.058	0.0	0.7	0.7	0.9	O K
8640 min Summer	17.472	0.052	0.0	0.6	0.6	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	13.7	23
30 min Summer	67.708	0.0	18.4	36
60 min Summer	43.136	0.0	23.6	62
120 min Summer	26.651	0.0	29.3	96
180 min Summer	19.868	0.0	32.8	130
240 min Summer	16.054	0.0	35.4	164
360 min Summer	11.891	0.0	39.3	234
480 min Summer	9.596	0.0	42.3	300
600 min Summer	8.121	0.0	44.7	366
720 min Summer	7.083	0.0	46.8	432
960 min Summer	5.703	0.0	50.1	558
1440 min Summer	4.198	0.0	55.2	802
2160 min Summer	3.085	0.0	60.5	1156
2880 min Summer	2.477	0.0	64.5	1508
4320 min Summer	1.816	0.0	70.3	2212
5760 min Summer	1.456	0.0	74.5	2936
7200 min Summer	1.227	0.0	77.8	3624
8640 min Summer	1.067	0.0	80.5	4400

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	17.469	0.049	0.0	0.6	0.6	0.7	O K
15 min Winter	17.653	0.233	0.0	1.9	1.9	13.7	O K
30 min Winter	17.698	0.278	0.0	2.1	2.1	17.7	O K
60 min Winter	17.734	0.314	0.0	2.3	2.3	20.9	Flood Risk
120 min Winter	17.748	0.328	0.0	2.3	2.3	22.1	Flood Risk
180 min Winter	17.744	0.324	0.0	2.3	2.3	21.8	Flood Risk
240 min Winter	17.735	0.315	0.0	2.3	2.3	21.0	Flood Risk
360 min Winter	17.713	0.293	0.0	2.2	2.2	19.0	Flood Risk
480 min Winter	17.690	0.270	0.0	2.1	2.1	17.0	O K
600 min Winter	17.670	0.250	0.0	2.0	2.0	15.2	O K
720 min Winter	17.651	0.231	0.0	1.9	1.9	13.5	O K
960 min Winter	17.620	0.200	0.0	1.8	1.8	10.7	O K
1440 min Winter	17.575	0.155	0.0	1.5	1.5	6.7	O K
2160 min Winter	17.532	0.112	0.0	1.3	1.3	3.5	O K
2880 min Winter	17.505	0.085	0.0	1.1	1.1	2.0	O K
4320 min Winter	17.480	0.060	0.0	0.8	0.8	1.0	O K
5760 min Winter	17.472	0.052	0.0	0.6	0.6	0.8	O K
7200 min Winter	17.466	0.046	0.0	0.5	0.5	0.6	O K
8640 min Winter	17.463	0.043	0.0	0.5	0.5	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.948	0.0	82.8	5104
15 min Winter	101.754	0.0	15.4	24
30 min Winter	67.708	0.0	20.7	36
60 min Winter	43.136	0.0	26.5	62
120 min Winter	26.651	0.0	32.9	102
180 min Winter	19.868	0.0	36.8	140
240 min Winter	16.054	0.0	39.7	178
360 min Winter	11.891	0.0	44.1	252
480 min Winter	9.596	0.0	47.5	322
600 min Winter	8.121	0.0	50.2	390
720 min Winter	7.083	0.0	52.5	456
960 min Winter	5.703	0.0	56.3	586
1440 min Winter	4.198	0.0	62.0	828
2160 min Winter	3.085	0.0	68.0	1172
2880 min Winter	2.477	0.0	72.5	1508
4320 min Winter	1.816	0.0	79.1	2208
5760 min Winter	1.456	0.0	83.9	2936
7200 min Winter	1.227	0.0	87.7	3672
8640 min Winter	1.067	0.0	90.9	4352

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	17.460	0.040	0.0	0.4	0.4	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.948	0.0	93.6	5048

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.075

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.025	4	8	0.025	8	12	0.025

Model Details

Storage is Online Cover Level (m) 18.000

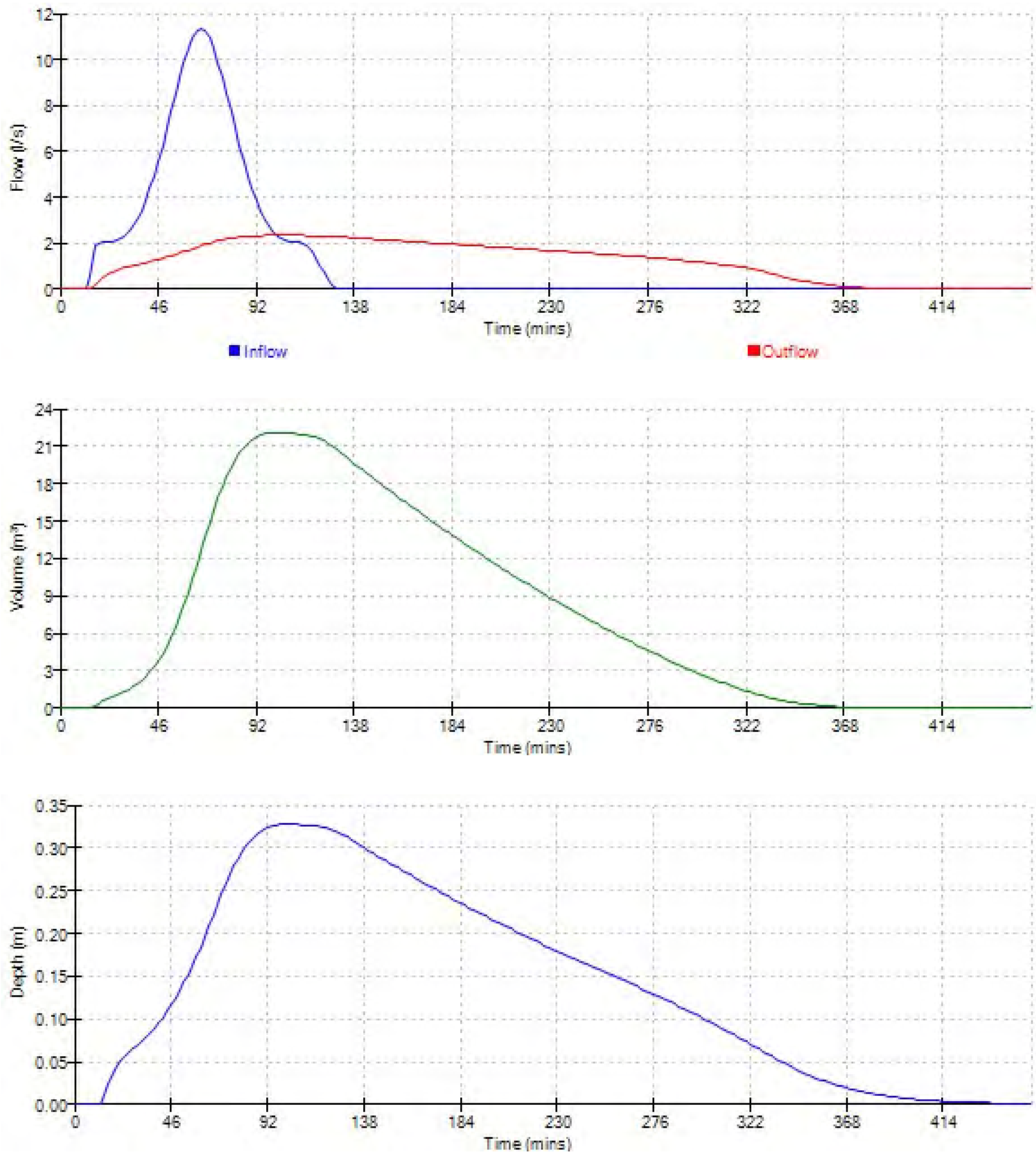
Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.3
Membrane Percolation (mm/hr)	1000	Length (m)	32.0
Max Percolation (l/s)	82.7	Slope (1:X)	200.0
Safety Factor	1.0	Depression Storage (mm)	2
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	17.420	Cap Volume Depth (m)	0.330

Orifice Outflow Control

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 17.420

Event: 120 min Winter



Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 125 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	17.662	0.242	0.0	2.0	2.0	16.0	O K
30 min Summer	17.708	0.288	0.0	2.2	2.2	21.0	Flood Risk
60 min Summer	17.745	0.325	0.0	2.3	2.3	25.1	Flood Risk
120 min Summer	17.763	0.343	0.0	2.4	2.4	27.0	Flood Risk
180 min Summer	17.763	0.343	0.0	2.4	2.4	27.0	Flood Risk
240 min Summer	17.757	0.337	0.0	2.4	2.4	26.4	Flood Risk
360 min Summer	17.744	0.324	0.0	2.3	2.3	25.0	Flood Risk
480 min Summer	17.729	0.309	0.0	2.3	2.3	23.3	Flood Risk
600 min Summer	17.715	0.295	0.0	2.2	2.2	21.8	Flood Risk
720 min Summer	17.702	0.282	0.0	2.2	2.2	20.3	Flood Risk
960 min Summer	17.678	0.258	0.0	2.1	2.1	17.7	O K
1440 min Summer	17.639	0.219	0.0	1.9	1.9	13.4	O K
2160 min Summer	17.598	0.178	0.0	1.7	1.7	9.0	O K
2880 min Summer	17.568	0.148	0.0	1.5	1.5	6.2	O K
4320 min Summer	17.527	0.107	0.0	1.2	1.2	3.3	O K
5760 min Summer	17.502	0.082	0.0	1.0	1.0	1.9	O K
7200 min Summer	17.487	0.067	0.0	0.9	0.9	1.3	O K
8640 min Summer	17.479	0.059	0.0	0.8	0.8	1.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	17.8	24
30 min Summer	88.566	0.0	24.1	37
60 min Summer	56.713	0.0	31.1	64
120 min Summer	35.004	0.0	38.6	104
180 min Summer	25.973	0.0	43.0	136
240 min Summer	20.877	0.0	46.1	170
360 min Summer	15.365	0.0	50.8	240
480 min Summer	12.341	0.0	54.4	308
600 min Summer	10.402	0.0	57.3	376
720 min Summer	9.042	0.0	59.7	442
960 min Summer	7.241	0.0	63.7	570
1440 min Summer	5.284	0.0	69.5	820
2160 min Summer	3.848	0.0	75.5	1176
2880 min Summer	3.068	0.0	79.9	1532
4320 min Summer	2.226	0.0	86.1	2244
5760 min Summer	1.771	0.0	90.5	2944
7200 min Summer	1.483	0.0	93.9	3672
8640 min Summer	1.284	0.0	96.7	4400

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	17.475	0.055	0.0	0.7	0.7	0.8	O K
15 min Winter	17.681	0.261	0.0	2.1	2.1	18.1	O K
30 min Winter	17.734	0.314	0.0	2.3	2.3	23.9	Flood Risk
60 min Winter	17.780	0.360	0.0	2.5	2.5	28.7	Flood Risk
120 min Winter	17.807	0.387	0.0	2.6	2.6	31.1	Flood Risk
180 min Winter	17.806	0.386	0.0	2.5	2.5	30.9	Flood Risk
240 min Winter	17.795	0.375	0.0	2.5	2.5	30.1	Flood Risk
360 min Winter	17.771	0.351	0.0	2.4	2.4	27.8	Flood Risk
480 min Winter	17.748	0.328	0.0	2.3	2.3	25.4	Flood Risk
600 min Winter	17.727	0.307	0.0	2.3	2.3	23.1	Flood Risk
720 min Winter	17.707	0.287	0.0	2.2	2.2	20.9	Flood Risk
960 min Winter	17.672	0.252	0.0	2.0	2.0	17.1	O K
1440 min Winter	17.620	0.200	0.0	1.8	1.8	11.4	O K
2160 min Winter	17.568	0.148	0.0	1.5	1.5	6.3	O K
2880 min Winter	17.533	0.113	0.0	1.3	1.3	3.7	O K
4320 min Winter	17.494	0.074	0.0	1.0	1.0	1.6	O K
5760 min Winter	17.479	0.059	0.0	0.8	0.8	1.0	O K
7200 min Winter	17.473	0.053	0.0	0.7	0.7	0.8	O K
8640 min Winter	17.468	0.048	0.0	0.6	0.6	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.137	0.0	99.0	5048
15 min Winter	131.851	0.0	20.0	24
30 min Winter	88.566	0.0	27.1	37
60 min Winter	56.713	0.0	34.9	64
120 min Winter	35.004	0.0	43.3	114
180 min Winter	25.973	0.0	48.2	144
240 min Winter	20.877	0.0	51.7	184
360 min Winter	15.365	0.0	57.1	258
480 min Winter	12.341	0.0	61.1	332
600 min Winter	10.402	0.0	64.3	402
720 min Winter	9.042	0.0	67.1	470
960 min Winter	7.241	0.0	71.5	604
1440 min Winter	5.284	0.0	78.1	854
2160 min Winter	3.848	0.0	84.9	1200
2880 min Winter	3.068	0.0	89.9	1536
4320 min Winter	2.226	0.0	97.0	2212
5760 min Winter	1.771	0.0	102.0	2864
7200 min Winter	1.483	0.0	106.0	3648
8640 min Winter	1.284	0.0	109.3	4320

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	17.464	0.044	0.0	0.5	0.5	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.137	0.0	112.0	4992

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.075

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.025	4	8	0.025	8	12	0.025

Model Details

Storage is Online Cover Level (m) 18.000

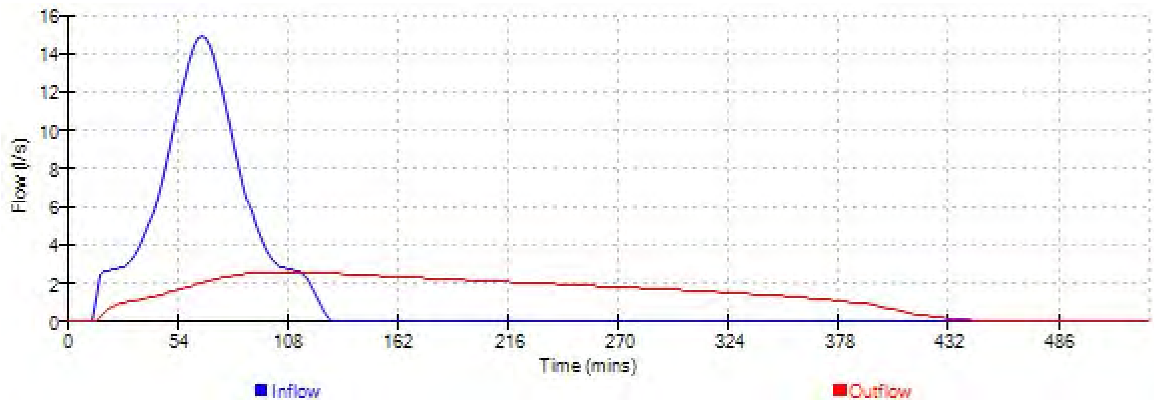
Porous Car Park Structure

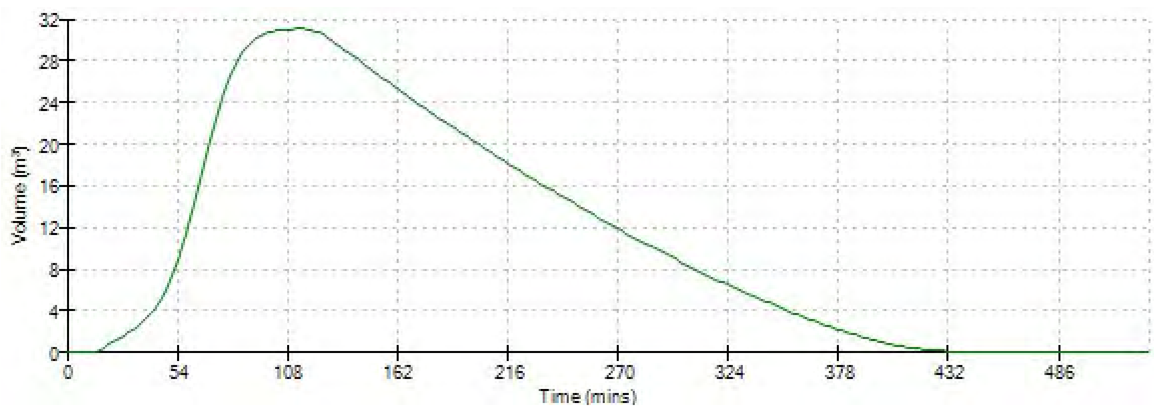
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.5
Membrane Percolation (mm/hr)	1000	Length (m)	38.5
Max Percolation (l/s)	101.6	Slope (1:X)	200.0
Safety Factor	1.0	Depression Storage (mm)	2
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	17.420	Cap Volume Depth (m)	0.330

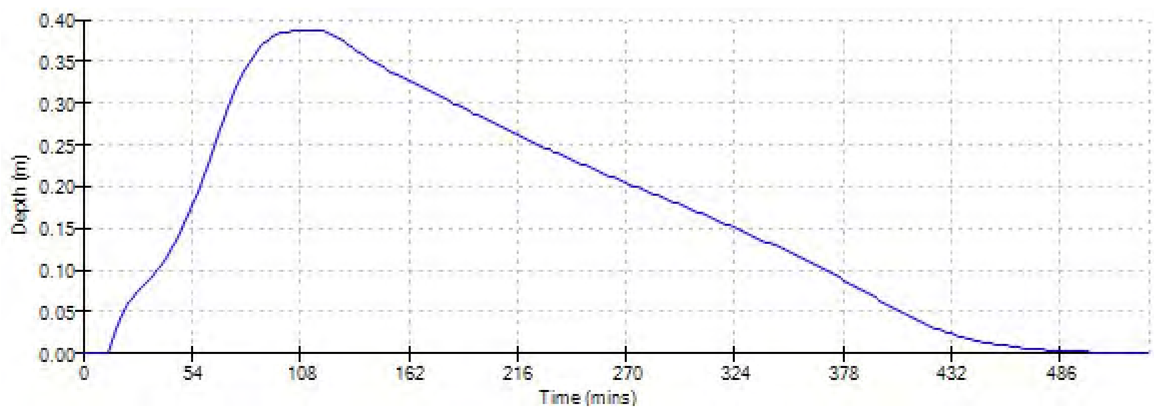
Orifice Outflow Control

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 17.420

Event: 120 min Winter







Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 100 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	17.625	0.205	0.0	1.8	1.8	11.9	O K
30 min Summer	17.658	0.238	0.0	2.0	2.0	15.5	O K
60 min Summer	17.683	0.263	0.0	2.1	2.1	18.3	O K
120 min Summer	17.693	0.273	0.0	2.1	2.1	19.4	O K
180 min Summer	17.693	0.273	0.0	2.1	2.1	19.3	O K
240 min Summer	17.688	0.268	0.0	2.1	2.1	18.8	O K
360 min Summer	17.677	0.257	0.0	2.0	2.0	17.6	O K
480 min Summer	17.665	0.245	0.0	2.0	2.0	16.3	O K
600 min Summer	17.654	0.234	0.0	1.9	1.9	15.1	O K
720 min Summer	17.643	0.223	0.0	1.9	1.9	13.9	O K
960 min Summer	17.624	0.204	0.0	1.8	1.8	11.9	O K
1440 min Summer	17.594	0.174	0.0	1.6	1.6	8.7	O K
2160 min Summer	17.560	0.140	0.0	1.4	1.4	5.6	O K
2880 min Summer	17.535	0.115	0.0	1.3	1.3	3.8	O K
4320 min Summer	17.503	0.083	0.0	1.0	1.0	2.0	O K
5760 min Summer	17.485	0.065	0.0	0.9	0.9	1.2	O K
7200 min Summer	17.478	0.058	0.0	0.7	0.7	0.9	O K
8640 min Summer	17.472	0.052	0.0	0.6	0.6	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	13.6	24
30 min Summer	67.708	0.0	18.3	36
60 min Summer	43.136	0.0	23.5	62
120 min Summer	26.651	0.0	29.2	98
180 min Summer	19.868	0.0	32.7	132
240 min Summer	16.054	0.0	35.2	166
360 min Summer	11.891	0.0	39.1	234
480 min Summer	9.596	0.0	42.1	302
600 min Summer	8.121	0.0	44.5	368
720 min Summer	7.083	0.0	46.5	434
960 min Summer	5.703	0.0	49.9	560
1440 min Summer	4.198	0.0	54.8	802
2160 min Summer	3.085	0.0	60.1	1156
2880 min Summer	2.477	0.0	64.0	1508
4320 min Summer	1.816	0.0	69.5	2212
5760 min Summer	1.456	0.0	73.5	2936
7200 min Summer	1.227	0.0	76.6	3672
8640 min Summer	1.067	0.0	79.1	4312

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	17.468	0.048	0.0	0.6	0.6	0.7	O K
15 min Winter	17.640	0.220	0.0	1.9	1.9	13.6	O K
30 min Winter	17.677	0.257	0.0	2.0	2.0	17.7	O K
60 min Winter	17.707	0.287	0.0	2.2	2.2	21.0	Flood Risk
120 min Winter	17.719	0.299	0.0	2.2	2.2	22.3	Flood Risk
180 min Winter	17.717	0.297	0.0	2.2	2.2	22.1	Flood Risk
240 min Winter	17.710	0.290	0.0	2.2	2.2	21.3	Flood Risk
360 min Winter	17.692	0.272	0.0	2.1	2.1	19.3	O K
480 min Winter	17.674	0.254	0.0	2.0	2.0	17.3	O K
600 min Winter	17.657	0.237	0.0	2.0	2.0	15.5	O K
720 min Winter	17.642	0.222	0.0	1.9	1.9	13.7	O K
960 min Winter	17.615	0.195	0.0	1.8	1.8	10.8	O K
1440 min Winter	17.574	0.154	0.0	1.5	1.5	6.7	O K
2160 min Winter	17.531	0.111	0.0	1.3	1.3	3.5	O K
2880 min Winter	17.504	0.084	0.0	1.1	1.1	2.0	O K
4320 min Winter	17.480	0.060	0.0	0.8	0.8	1.0	O K
5760 min Winter	17.472	0.052	0.0	0.6	0.6	0.8	O K
7200 min Winter	17.466	0.046	0.0	0.5	0.5	0.6	O K
8640 min Winter	17.462	0.042	0.0	0.5	0.5	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.948	0.0	81.2	5008
15 min Winter	101.754	0.0	15.3	24
30 min Winter	67.708	0.0	20.6	36
60 min Winter	43.136	0.0	26.4	62
120 min Winter	26.651	0.0	32.8	104
180 min Winter	19.868	0.0	36.7	140
240 min Winter	16.054	0.0	39.5	180
360 min Winter	11.891	0.0	43.9	254
480 min Winter	9.596	0.0	47.3	324
600 min Winter	8.121	0.0	50.0	392
720 min Winter	7.083	0.0	52.3	460
960 min Winter	5.703	0.0	56.0	588
1440 min Winter	4.198	0.0	61.6	828
2160 min Winter	3.085	0.0	67.6	1172
2880 min Winter	2.477	0.0	72.0	1508
4320 min Winter	1.816	0.0	78.4	2204
5760 min Winter	1.456	0.0	83.0	2912
7200 min Winter	1.227	0.0	86.6	3600
8640 min Winter	1.067	0.0	89.6	4400

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	17.459	0.039	0.0	0.4	0.4	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.948	0.0	92.1	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.075

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.025	4	8	0.025	8	12	0.025

Model Details

Storage is Online Cover Level (m) 18.000

Porous Car Park Structure

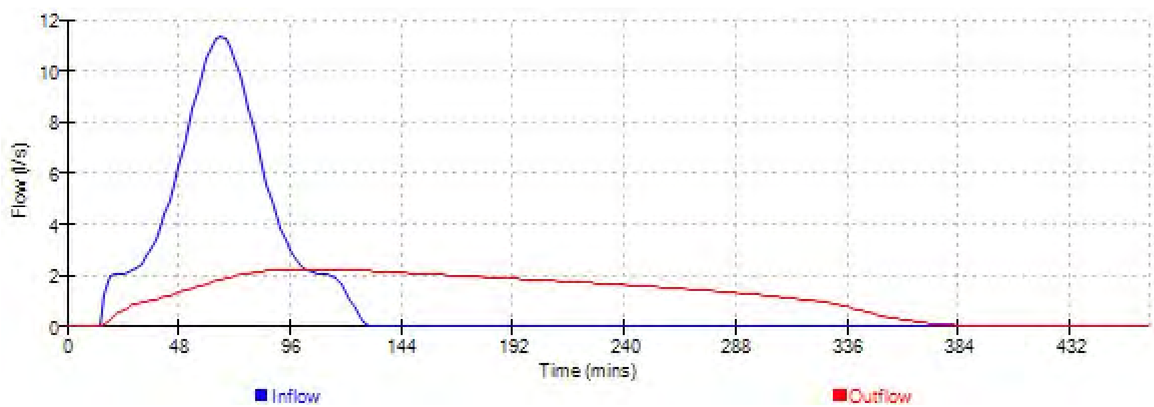
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.5
Membrane Percolation (mm/hr)	1000	Length (m)	38.5
Max Percolation (l/s)	101.6	Slope (1:X)	200.0
Safety Factor	1.0	Depression Storage (mm)	2
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	17.420	Cap Volume Depth (m)	0.330

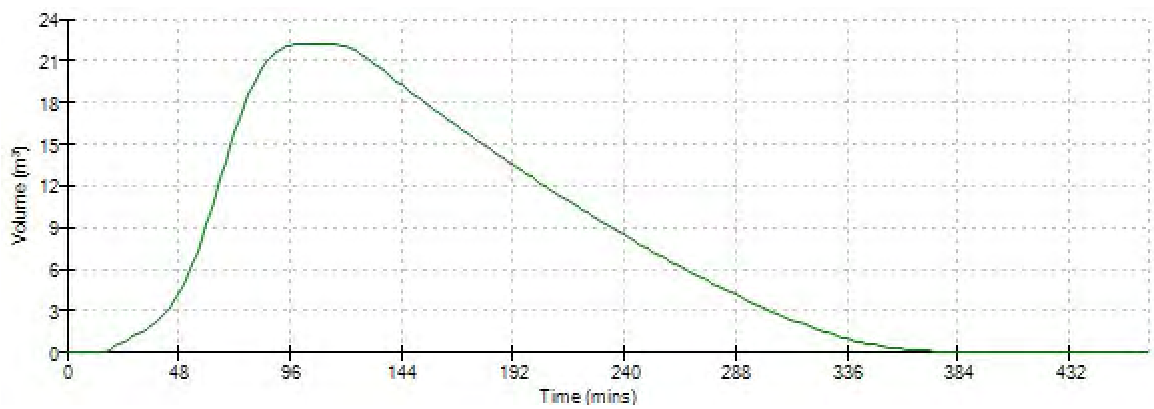
Orifice Outflow Control

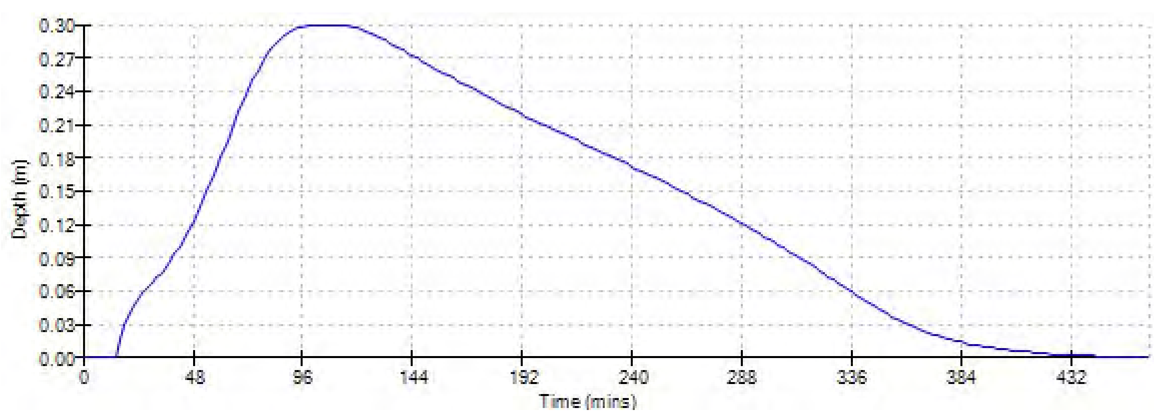
Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 17.420

CH2M		Page 6
Ash House Falcon Road Exeter EX2 7LB		
Date 16/04/2018 14:08 File 2018-04-16-Pill Station ...	Designed by IR065829 Checked by	
XP Solutions	Source Control 2017.1.2	

Event: 120 min Winter







Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 125 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	17.662	0.242	0.0	2.0	2.0	16.0	O K
30 min Summer	17.708	0.288	0.0	2.2	2.2	21.0	Flood Risk
60 min Summer	17.745	0.325	0.0	2.3	2.3	25.1	Flood Risk
120 min Summer	17.763	0.343	0.0	2.4	2.4	27.0	Flood Risk
180 min Summer	17.763	0.343	0.0	2.4	2.4	27.0	Flood Risk
240 min Summer	17.757	0.337	0.0	2.4	2.4	26.4	Flood Risk
360 min Summer	17.744	0.324	0.0	2.3	2.3	25.0	Flood Risk
480 min Summer	17.729	0.309	0.0	2.3	2.3	23.3	Flood Risk
600 min Summer	17.715	0.295	0.0	2.2	2.2	21.8	Flood Risk
720 min Summer	17.702	0.282	0.0	2.2	2.2	20.3	Flood Risk
960 min Summer	17.678	0.258	0.0	2.1	2.1	17.7	O K
1440 min Summer	17.639	0.219	0.0	1.9	1.9	13.4	O K
2160 min Summer	17.598	0.178	0.0	1.7	1.7	9.0	O K
2880 min Summer	17.568	0.148	0.0	1.5	1.5	6.2	O K
4320 min Summer	17.527	0.107	0.0	1.2	1.2	3.3	O K
5760 min Summer	17.502	0.082	0.0	1.0	1.0	1.9	O K
7200 min Summer	17.487	0.067	0.0	0.9	0.9	1.3	O K
8640 min Summer	17.479	0.059	0.0	0.8	0.8	1.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.851	0.0	17.8	24
30 min Summer	88.566	0.0	24.1	37
60 min Summer	56.713	0.0	31.1	64
120 min Summer	35.004	0.0	38.6	104
180 min Summer	25.973	0.0	43.0	136
240 min Summer	20.877	0.0	46.1	170
360 min Summer	15.365	0.0	50.8	240
480 min Summer	12.341	0.0	54.4	308
600 min Summer	10.402	0.0	57.3	376
720 min Summer	9.042	0.0	59.7	442
960 min Summer	7.241	0.0	63.7	570
1440 min Summer	5.284	0.0	69.5	820
2160 min Summer	3.848	0.0	75.5	1176
2880 min Summer	3.068	0.0	79.9	1532
4320 min Summer	2.226	0.0	86.1	2244
5760 min Summer	1.771	0.0	90.5	2944
7200 min Summer	1.483	0.0	93.9	3672
8640 min Summer	1.284	0.0	96.7	4400

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Summer	17.475	0.055	0.0	0.7	0.7	0.8	O K
15 min Winter	17.681	0.261	0.0	2.1	2.1	18.1	O K
30 min Winter	17.734	0.314	0.0	2.3	2.3	23.9	Flood Risk
60 min Winter	17.780	0.360	0.0	2.5	2.5	28.7	Flood Risk
120 min Winter	17.807	0.387	0.0	2.6	2.6	31.1	Flood Risk
180 min Winter	17.806	0.386	0.0	2.5	2.5	30.9	Flood Risk
240 min Winter	17.795	0.375	0.0	2.5	2.5	30.1	Flood Risk
360 min Winter	17.771	0.351	0.0	2.4	2.4	27.8	Flood Risk
480 min Winter	17.748	0.328	0.0	2.3	2.3	25.4	Flood Risk
600 min Winter	17.727	0.307	0.0	2.3	2.3	23.1	Flood Risk
720 min Winter	17.707	0.287	0.0	2.2	2.2	20.9	Flood Risk
960 min Winter	17.672	0.252	0.0	2.0	2.0	17.1	O K
1440 min Winter	17.620	0.200	0.0	1.8	1.8	11.4	O K
2160 min Winter	17.568	0.148	0.0	1.5	1.5	6.3	O K
2880 min Winter	17.533	0.113	0.0	1.3	1.3	3.7	O K
4320 min Winter	17.494	0.074	0.0	1.0	1.0	1.6	O K
5760 min Winter	17.479	0.059	0.0	0.8	0.8	1.0	O K
7200 min Winter	17.473	0.053	0.0	0.7	0.7	0.8	O K
8640 min Winter	17.468	0.048	0.0	0.6	0.6	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.137	0.0	99.0	5048
15 min Winter	131.851	0.0	20.0	24
30 min Winter	88.566	0.0	27.1	37
60 min Winter	56.713	0.0	34.9	64
120 min Winter	35.004	0.0	43.3	114
180 min Winter	25.973	0.0	48.2	144
240 min Winter	20.877	0.0	51.7	184
360 min Winter	15.365	0.0	57.1	258
480 min Winter	12.341	0.0	61.1	332
600 min Winter	10.402	0.0	64.3	402
720 min Winter	9.042	0.0	67.1	470
960 min Winter	7.241	0.0	71.5	604
1440 min Winter	5.284	0.0	78.1	854
2160 min Winter	3.848	0.0	84.9	1200
2880 min Winter	3.068	0.0	89.9	1536
4320 min Winter	2.226	0.0	97.0	2212
5760 min Winter	1.771	0.0	102.0	2864
7200 min Winter	1.483	0.0	106.0	3648
8640 min Winter	1.284	0.0	109.3	4320

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
10080 min Winter	17.464	0.044	0.0	0.5	0.5	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	1.137	0.0	112.0	4992

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.075

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.025	4	8	0.025	8	12	0.025

Model Details

Storage is Online Cover Level (m) 18.000

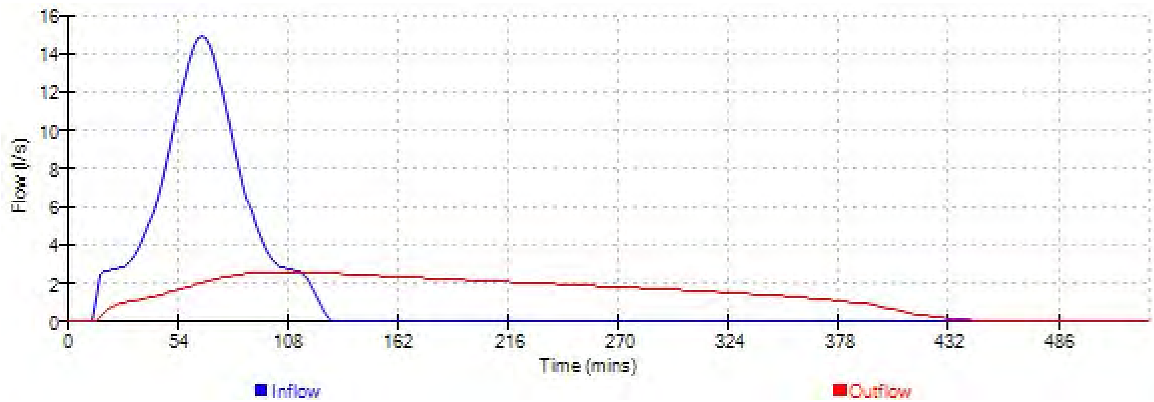
Porous Car Park Structure

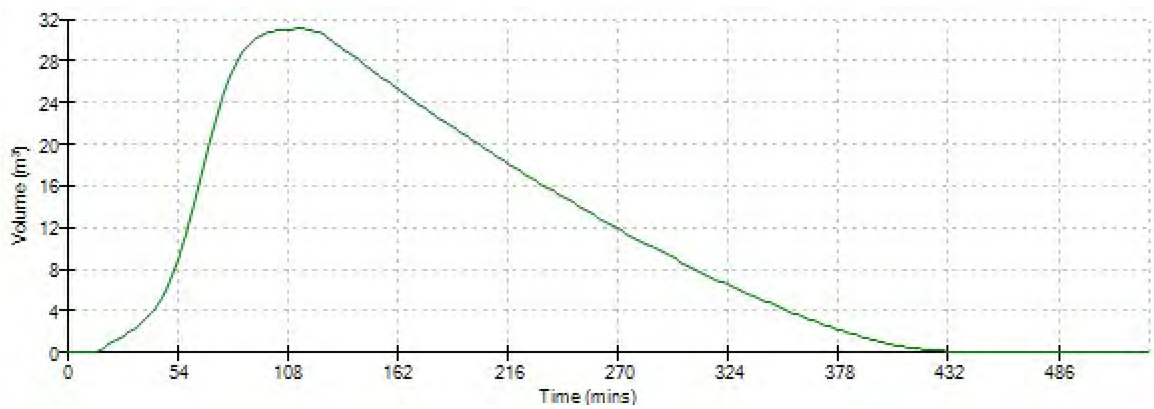
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.5
Membrane Percolation (mm/hr)	1000	Length (m)	38.5
Max Percolation (l/s)	101.6	Slope (1:X)	200.0
Safety Factor	1.0	Depression Storage (mm)	2
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	17.420	Cap Volume Depth (m)	0.330

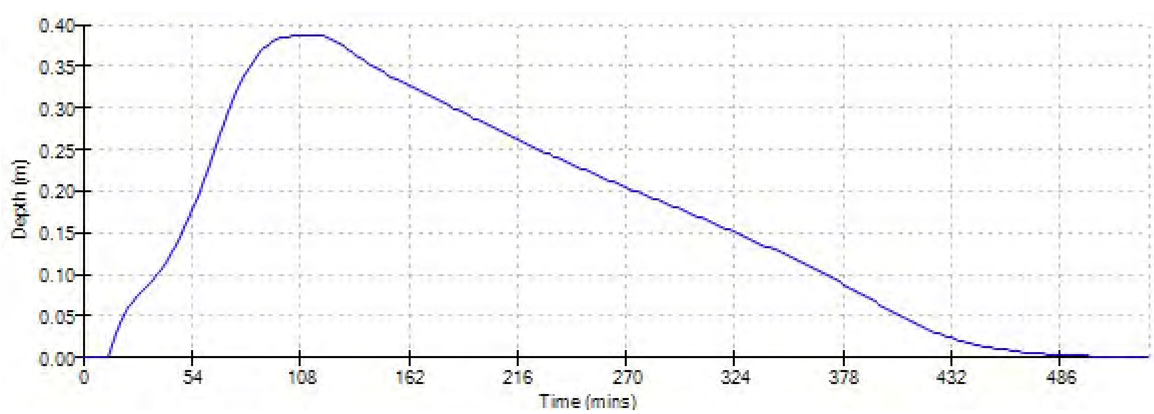
Orifice Outflow Control

Diameter (m) 0.045 Discharge Coefficient 0.600 Invert Level (m) 17.420

Event: 120 min Winter







APPENDIX D

Haul Roads Drainage Strategy Drawings and Calculations

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 489 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.663	0.463	0.0	1.8	1.8	47.5	O K
30 min Summer	9.722	0.522	0.0	1.9	1.9	62.4	Flood Risk
60 min Summer	9.773	0.573	0.0	2.0	2.0	77.5	Flood Risk
120 min Summer	9.815	0.615	0.0	2.1	2.1	91.4	Flood Risk
180 min Summer	9.832	0.632	0.0	2.1	2.1	97.6	Flood Risk
240 min Summer	9.840	0.640	0.0	2.1	2.1	100.6	Flood Risk
360 min Summer	9.846	0.646	0.0	2.1	2.1	102.6	Flood Risk
480 min Summer	9.845	0.645	0.0	2.1	2.1	102.5	Flood Risk
600 min Summer	9.844	0.644	0.0	2.1	2.1	101.8	Flood Risk
720 min Summer	9.841	0.641	0.0	2.1	2.1	100.8	Flood Risk
960 min Summer	9.834	0.634	0.0	2.1	2.1	98.1	Flood Risk
1440 min Summer	9.816	0.616	0.0	2.1	2.1	91.8	Flood Risk
2160 min Summer	9.788	0.588	0.0	2.0	2.0	82.4	Flood Risk
2880 min Summer	9.761	0.561	0.0	2.0	2.0	73.8	Flood Risk
4320 min Summer	9.708	0.508	0.0	1.9	1.9	58.8	Flood Risk
5760 min Summer	9.660	0.460	0.0	1.8	1.8	46.9	O K
7200 min Summer	9.617	0.417	0.0	1.7	1.7	37.6	O K
8640 min Summer	9.579	0.379	0.0	1.6	1.6	30.3	O K
10080 min Summer	9.545	0.345	0.0	1.5	1.5	24.5	O K
15 min Winter	9.687	0.487	0.0	1.9	1.9	53.4	O K
30 min Winter	9.749	0.549	0.0	2.0	2.0	70.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	49.3	23
30 min Summer	53.199	0.0	65.6	38
60 min Summer	33.892	0.0	83.6	66
120 min Summer	20.940	0.0	103.3	126
180 min Summer	15.610	0.0	115.6	184
240 min Summer	12.614	0.0	124.5	242
360 min Summer	9.343	0.0	138.3	354
480 min Summer	7.540	0.0	148.8	408
600 min Summer	6.381	0.0	157.4	470
720 min Summer	5.565	0.0	164.8	534
960 min Summer	4.481	0.0	176.9	668
1440 min Summer	3.298	0.0	195.3	944
2160 min Summer	2.424	0.0	215.3	1360
2880 min Summer	1.946	0.0	230.5	1756
4320 min Summer	1.427	0.0	253.5	2512
5760 min Summer	1.144	0.0	271.0	3240
7200 min Summer	0.964	0.0	285.5	3968
8640 min Summer	0.839	0.0	297.9	4672
10080 min Summer	0.745	0.0	308.9	5352
15 min Winter	79.950	0.0	55.2	23
30 min Winter	53.199	0.0	73.5	37

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	9.803	0.603	0.0	2.1	2.1	87.5	Flood Risk
120 min Winter	9.849	0.649	0.0	2.1	2.1	103.7	Flood Risk
180 min Winter	9.869	0.669	0.0	2.2	2.2	111.4	Flood Risk
240 min Winter	9.879	0.679	0.0	2.2	2.2	115.4	Flood Risk
360 min Winter	9.888	0.688	0.0	2.2	2.2	119.0	Flood Risk
480 min Winter	9.888	0.688	0.0	2.2	2.2	119.2	Flood Risk
600 min Winter	9.885	0.685	0.0	2.2	2.2	117.8	Flood Risk
720 min Winter	9.882	0.682	0.0	2.2	2.2	116.6	Flood Risk
960 min Winter	9.873	0.673	0.0	2.2	2.2	113.0	Flood Risk
1440 min Winter	9.848	0.648	0.0	2.1	2.1	103.6	Flood Risk
2160 min Winter	9.808	0.608	0.0	2.1	2.1	89.1	Flood Risk
2880 min Winter	9.768	0.568	0.0	2.0	2.0	76.0	Flood Risk
4320 min Winter	9.691	0.491	0.0	1.9	1.9	54.4	O K
5760 min Winter	9.622	0.422	0.0	1.7	1.7	38.5	O K
7200 min Winter	9.562	0.362	0.0	1.6	1.6	27.2	O K
8640 min Winter	9.510	0.310	0.0	1.5	1.5	19.4	O K
10080 min Winter	9.467	0.267	0.0	1.4	1.4	14.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	93.7	66
120 min Winter	20.940	0.0	115.7	122
180 min Winter	15.610	0.0	129.4	180
240 min Winter	12.614	0.0	139.4	238
360 min Winter	9.343	0.0	154.9	350
480 min Winter	7.540	0.0	166.7	454
600 min Winter	6.381	0.0	176.3	500
720 min Winter	5.565	0.0	184.5	568
960 min Winter	4.481	0.0	198.2	722
1440 min Winter	3.298	0.0	218.8	1026
2160 min Winter	2.424	0.0	241.1	1460
2880 min Winter	1.946	0.0	258.2	1876
4320 min Winter	1.427	0.0	283.9	2644
5760 min Winter	1.144	0.0	303.5	3400
7200 min Winter	0.964	0.0	319.7	4104
8640 min Winter	0.839	0.0	333.7	4760
10080 min Winter	0.745	0.0	346.0	5448

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.329

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	3	0.110	3	6	0.110	6	9	0.109

Model Details

Storage is Online Cover Level (m) 10.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	376.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.0
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	9.200	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.8		

Orifice Outflow Control

Diameter (m) 0.036 Discharge Coefficient 0.600 Invert Level (m) 9.200

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 437 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.660	0.460	0.0	1.8	1.8	42.6	O K
30 min Summer	9.717	0.517	0.0	1.9	1.9	55.9	Flood Risk
60 min Summer	9.767	0.567	0.0	2.0	2.0	69.2	Flood Risk
120 min Summer	9.806	0.606	0.0	2.1	2.1	81.1	Flood Risk
180 min Summer	9.822	0.622	0.0	2.1	2.1	86.2	Flood Risk
240 min Summer	9.828	0.628	0.0	2.1	2.1	88.4	Flood Risk
360 min Summer	9.831	0.631	0.0	2.1	2.1	89.3	Flood Risk
480 min Summer	9.830	0.630	0.0	2.1	2.1	89.0	Flood Risk
600 min Summer	9.828	0.628	0.0	2.1	2.1	88.1	Flood Risk
720 min Summer	9.824	0.624	0.0	2.1	2.1	87.0	Flood Risk
960 min Summer	9.815	0.615	0.0	2.1	2.1	84.1	Flood Risk
1440 min Summer	9.795	0.595	0.0	2.1	2.1	77.8	Flood Risk
2160 min Summer	9.765	0.565	0.0	2.0	2.0	68.8	Flood Risk
2880 min Summer	9.736	0.536	0.0	1.9	1.9	60.6	Flood Risk
4320 min Summer	9.679	0.479	0.0	1.8	1.8	46.8	O K
5760 min Summer	9.629	0.429	0.0	1.7	1.7	36.2	O K
7200 min Summer	9.584	0.384	0.0	1.6	1.6	28.2	O K
8640 min Summer	9.545	0.345	0.0	1.5	1.5	22.1	O K
10080 min Summer	9.511	0.311	0.0	1.5	1.5	17.6	O K
15 min Winter	9.684	0.484	0.0	1.8	1.8	47.8	O K
30 min Winter	9.744	0.544	0.0	2.0	2.0	62.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	44.4	23
30 min Summer	53.199	0.0	59.1	37
60 min Summer	33.892	0.0	75.2	66
120 min Summer	20.940	0.0	93.0	124
180 min Summer	15.610	0.0	104.0	184
240 min Summer	12.614	0.0	112.0	242
360 min Summer	9.343	0.0	124.4	330
480 min Summer	7.540	0.0	133.9	388
600 min Summer	6.381	0.0	141.7	452
720 min Summer	5.565	0.0	148.2	518
960 min Summer	4.481	0.0	159.2	656
1440 min Summer	3.298	0.0	175.7	930
2160 min Summer	2.424	0.0	193.7	1340
2880 min Summer	1.946	0.0	207.4	1732
4320 min Summer	1.427	0.0	228.1	2472
5760 min Summer	1.144	0.0	243.8	3224
7200 min Summer	0.964	0.0	256.8	3904
8640 min Summer	0.839	0.0	268.1	4664
10080 min Summer	0.745	0.0	277.9	5344
15 min Winter	79.950	0.0	49.7	23
30 min Winter	53.199	0.0	66.1	37

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	9.797	0.597	0.0	2.1	2.1	78.2	Flood Risk
120 min Winter	9.840	0.640	0.0	2.1	2.1	92.2	Flood Risk
180 min Winter	9.858	0.658	0.0	2.2	2.2	98.6	Flood Risk
240 min Winter	9.867	0.667	0.0	2.2	2.2	101.7	Flood Risk
360 min Winter	9.873	0.673	0.0	2.2	2.2	103.9	Flood Risk
480 min Winter	9.871	0.671	0.0	2.2	2.2	103.2	Flood Risk
600 min Winter	9.867	0.667	0.0	2.2	2.2	102.0	Flood Risk
720 min Winter	9.863	0.663	0.0	2.2	2.2	100.5	Flood Risk
960 min Winter	9.852	0.652	0.0	2.2	2.2	96.4	Flood Risk
1440 min Winter	9.824	0.624	0.0	2.1	2.1	86.9	Flood Risk
2160 min Winter	9.779	0.579	0.0	2.0	2.0	72.9	Flood Risk
2880 min Winter	9.736	0.536	0.0	1.9	1.9	60.7	Flood Risk
4320 min Winter	9.654	0.454	0.0	1.8	1.8	41.3	O K
5760 min Winter	9.582	0.382	0.0	1.6	1.6	27.8	O K
7200 min Winter	9.521	0.321	0.0	1.5	1.5	18.8	O K
8640 min Winter	9.470	0.270	0.0	1.4	1.4	12.9	O K
10080 min Winter	9.430	0.230	0.0	1.2	1.2	9.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	84.3	66
120 min Winter	20.940	0.0	104.1	122
180 min Winter	15.610	0.0	116.4	180
240 min Winter	12.614	0.0	125.5	236
360 min Winter	9.343	0.0	139.4	346
480 min Winter	7.540	0.0	150.0	446
600 min Winter	6.381	0.0	158.7	480
720 min Winter	5.565	0.0	166.0	556
960 min Winter	4.481	0.0	178.3	710
1440 min Winter	3.298	0.0	196.8	1012
2160 min Winter	2.424	0.0	217.0	1436
2880 min Winter	1.946	0.0	232.3	1848
4320 min Winter	1.427	0.0	255.4	2600
5760 min Winter	1.144	0.0	273.0	3336
7200 min Winter	0.964	0.0	287.6	4032
8640 min Winter	0.839	0.0	300.2	4672
10080 min Winter	0.745	0.0	311.3	5344

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.296

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	3	0.099	3	6	0.098	6	9	0.099

Model Details

Storage is Online Cover Level (m) 10.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	297.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.0
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	9.200	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.7		

Orifice Outflow Control

Diameter (m) 0.036 Discharge Coefficient 0.600 Invert Level (m) 9.200

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 215 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.704	0.404	0.0	1.9	1.9	25.1	Flood Risk
30 min Summer	9.752	0.452	0.0	2.0	2.0	32.7	Flood Risk
60 min Summer	9.790	0.490	0.0	2.1	2.1	39.6	Flood Risk
120 min Summer	9.815	0.515	0.0	2.1	2.1	44.6	Flood Risk
180 min Summer	9.820	0.520	0.0	2.1	2.1	45.5	Flood Risk
240 min Summer	9.820	0.520	0.0	2.1	2.1	45.5	Flood Risk
360 min Summer	9.816	0.516	0.0	2.1	2.1	44.7	Flood Risk
480 min Summer	9.809	0.509	0.0	2.1	2.1	43.4	Flood Risk
600 min Summer	9.802	0.502	0.0	2.1	2.1	41.9	Flood Risk
720 min Summer	9.794	0.494	0.0	2.1	2.1	40.4	Flood Risk
960 min Summer	9.778	0.478	0.0	2.0	2.0	37.4	Flood Risk
1440 min Summer	9.747	0.447	0.0	2.0	2.0	31.9	Flood Risk
2160 min Summer	9.702	0.402	0.0	1.9	1.9	24.9	Flood Risk
2880 min Summer	9.662	0.362	0.0	1.8	1.8	19.5	O K
4320 min Summer	9.594	0.294	0.0	1.6	1.6	12.1	O K
5760 min Summer	9.541	0.241	0.0	1.4	1.4	7.7	O K
7200 min Summer	9.500	0.200	0.0	1.3	1.3	5.1	O K
8640 min Summer	9.469	0.169	0.0	1.2	1.2	3.5	O K
10080 min Summer	9.444	0.144	0.0	1.1	1.1	2.5	O K
15 min Winter	9.725	0.425	0.0	1.9	1.9	28.3	Flood Risk
30 min Winter	9.776	0.476	0.0	2.0	2.0	37.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	27.0	22
30 min Summer	53.199	0.0	35.9	36
60 min Summer	33.892	0.0	45.8	64
120 min Summer	20.940	0.0	56.5	122
180 min Summer	15.610	0.0	63.2	168
240 min Summer	12.614	0.0	68.1	198
360 min Summer	9.343	0.0	75.7	262
480 min Summer	7.540	0.0	81.4	332
600 min Summer	6.381	0.0	86.1	400
720 min Summer	5.565	0.0	90.2	468
960 min Summer	4.481	0.0	96.8	606
1440 min Summer	3.298	0.0	106.9	870
2160 min Summer	2.424	0.0	117.8	1252
2880 min Summer	1.946	0.0	126.1	1616
4320 min Summer	1.427	0.0	138.7	2332
5760 min Summer	1.144	0.0	148.3	3008
7200 min Summer	0.964	0.0	156.2	3744
8640 min Summer	0.839	0.0	163.0	4416
10080 min Summer	0.745	0.0	169.0	5144
15 min Winter	79.950	0.0	30.2	22
30 min Winter	53.199	0.0	40.2	36

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	9.818	0.518	0.0	2.1	2.1	45.1	Flood Risk
120 min Winter	9.848	0.548	0.0	2.2	2.2	51.3	Flood Risk
180 min Winter	9.856	0.556	0.0	2.2	2.2	52.9	Flood Risk
240 min Winter	9.855	0.555	0.0	2.2	2.2	52.7	Flood Risk
360 min Winter	9.850	0.550	0.0	2.2	2.2	51.6	Flood Risk
480 min Winter	9.841	0.541	0.0	2.2	2.2	49.8	Flood Risk
600 min Winter	9.830	0.530	0.0	2.2	2.2	47.5	Flood Risk
720 min Winter	9.818	0.518	0.0	2.1	2.1	45.2	Flood Risk
960 min Winter	9.794	0.494	0.0	2.1	2.1	40.5	Flood Risk
1440 min Winter	9.748	0.448	0.0	2.0	2.0	32.1	Flood Risk
2160 min Winter	9.683	0.383	0.0	1.8	1.8	22.2	O K
2880 min Winter	9.625	0.325	0.0	1.7	1.7	15.2	O K
4320 min Winter	9.534	0.234	0.0	1.4	1.4	7.2	O K
5760 min Winter	9.472	0.172	0.0	1.2	1.2	3.6	O K
7200 min Winter	9.432	0.132	0.0	1.0	1.0	2.0	O K
8640 min Winter	9.406	0.106	0.0	0.9	0.9	1.3	O K
10080 min Winter	9.388	0.088	0.0	0.8	0.8	0.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	51.2	64
120 min Winter	20.940	0.0	63.3	120
180 min Winter	15.610	0.0	70.8	176
240 min Winter	12.614	0.0	76.3	226
360 min Winter	9.343	0.0	84.8	280
480 min Winter	7.540	0.0	91.2	358
600 min Winter	6.381	0.0	96.5	434
720 min Winter	5.565	0.0	101.0	510
960 min Winter	4.481	0.0	108.4	654
1440 min Winter	3.298	0.0	119.7	926
2160 min Winter	2.424	0.0	131.9	1304
2880 min Winter	1.946	0.0	141.3	1672
4320 min Winter	1.427	0.0	155.3	2340
5760 min Winter	1.144	0.0	166.0	3008
7200 min Winter	0.964	0.0	174.9	3680
8640 min Winter	0.839	0.0	182.6	4408
10080 min Winter	0.745	0.0	189.3	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.180

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	3	0.060	3	6	0.060	6	9	0.060

Model Details

Storage is Online Cover Level (m) 10.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	187.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.0
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	9.300	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.038 Discharge Coefficient 0.600 Invert Level (m) 9.300

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 447 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.605	0.505	0.0	1.8	1.8	42.7	O K
30 min Summer	9.665	0.565	0.0	1.9	1.9	56.1	O K
60 min Summer	9.717	0.617	0.0	2.0	2.0	69.5	Flood Risk
120 min Summer	9.759	0.659	0.0	2.0	2.0	81.5	Flood Risk
180 min Summer	9.775	0.675	0.0	2.1	2.1	86.6	Flood Risk
240 min Summer	9.782	0.682	0.0	2.1	2.1	88.9	Flood Risk
360 min Summer	9.785	0.685	0.0	2.1	2.1	89.9	Flood Risk
480 min Summer	9.784	0.684	0.0	2.1	2.1	89.5	Flood Risk
600 min Summer	9.781	0.681	0.0	2.1	2.1	88.6	Flood Risk
720 min Summer	9.778	0.678	0.0	2.1	2.1	87.5	Flood Risk
960 min Summer	9.769	0.669	0.0	2.1	2.1	84.6	Flood Risk
1440 min Summer	9.748	0.648	0.0	2.0	2.0	78.3	Flood Risk
2160 min Summer	9.717	0.617	0.0	2.0	2.0	69.3	Flood Risk
2880 min Summer	9.686	0.586	0.0	1.9	1.9	61.1	O K
4320 min Summer	9.627	0.527	0.0	1.8	1.8	47.2	O K
5760 min Summer	9.573	0.473	0.0	1.7	1.7	36.5	O K
7200 min Summer	9.525	0.425	0.0	1.6	1.6	28.3	O K
8640 min Summer	9.483	0.383	0.0	1.5	1.5	22.1	O K
10080 min Summer	9.446	0.346	0.0	1.5	1.5	17.5	O K
15 min Winter	9.630	0.530	0.0	1.8	1.8	48.0	O K
30 min Winter	9.694	0.594	0.0	1.9	1.9	63.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	44.5	23
30 min Summer	53.199	0.0	59.3	37
60 min Summer	33.892	0.0	75.5	66
120 min Summer	20.940	0.0	93.3	124
180 min Summer	15.610	0.0	104.3	184
240 min Summer	12.614	0.0	112.4	242
360 min Summer	9.343	0.0	124.9	334
480 min Summer	7.540	0.0	134.4	392
600 min Summer	6.381	0.0	142.1	456
720 min Summer	5.565	0.0	148.7	520
960 min Summer	4.481	0.0	159.7	658
1440 min Summer	3.298	0.0	176.3	930
2160 min Summer	2.424	0.0	194.4	1340
2880 min Summer	1.946	0.0	208.1	1732
4320 min Summer	1.427	0.0	228.8	2504
5760 min Summer	1.144	0.0	244.6	3224
7200 min Summer	0.964	0.0	257.7	3960
8640 min Summer	0.839	0.0	269.0	4664
10080 min Summer	0.745	0.0	278.9	5344
15 min Winter	79.950	0.0	49.9	23
30 min Winter	53.199	0.0	66.4	37

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	9.749	0.649	0.0	2.0	2.0	78.5	Flood Risk
120 min Winter	9.794	0.694	0.0	2.1	2.1	92.6	Flood Risk
180 min Winter	9.813	0.713	0.0	2.1	2.1	99.1	Flood Risk
240 min Winter	9.822	0.722	0.0	2.1	2.1	102.2	Flood Risk
360 min Winter	9.828	0.728	0.0	2.2	2.2	104.6	Flood Risk
480 min Winter	9.827	0.727	0.0	2.2	2.2	104.0	Flood Risk
600 min Winter	9.823	0.723	0.0	2.1	2.1	102.7	Flood Risk
720 min Winter	9.819	0.719	0.0	2.1	2.1	101.2	Flood Risk
960 min Winter	9.807	0.707	0.0	2.1	2.1	97.2	Flood Risk
1440 min Winter	9.778	0.678	0.0	2.1	2.1	87.7	Flood Risk
2160 min Winter	9.732	0.632	0.0	2.0	2.0	73.7	Flood Risk
2880 min Winter	9.687	0.587	0.0	1.9	1.9	61.4	O K
4320 min Winter	9.600	0.500	0.0	1.8	1.8	41.8	O K
5760 min Winter	9.523	0.423	0.0	1.6	1.6	28.0	O K
7200 min Winter	9.457	0.357	0.0	1.5	1.5	18.8	O K
8640 min Winter	9.401	0.301	0.0	1.4	1.4	12.7	O K
10080 min Winter	9.356	0.256	0.0	1.2	1.2	8.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	84.6	66
120 min Winter	20.940	0.0	104.5	122
180 min Winter	15.610	0.0	116.8	180
240 min Winter	12.614	0.0	125.9	236
360 min Winter	9.343	0.0	139.8	348
480 min Winter	7.540	0.0	150.5	448
600 min Winter	6.381	0.0	159.2	482
720 min Winter	5.565	0.0	166.6	558
960 min Winter	4.481	0.0	178.9	712
1440 min Winter	3.298	0.0	197.5	1014
2160 min Winter	2.424	0.0	217.7	1448
2880 min Winter	1.946	0.0	233.1	1848
4320 min Winter	1.427	0.0	256.3	2600
5760 min Winter	1.144	0.0	274.0	3336
7200 min Winter	0.964	0.0	288.6	4032
8640 min Winter	0.839	0.0	301.2	4672
10080 min Winter	0.745	0.0	312.3	5344

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.297

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	3	0.099	3	6	0.099	6	9	0.099

Model Details

Storage is Online Cover Level (m) 10.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	343.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.0
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	9.100	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.035 Discharge Coefficient 0.600 Invert Level (m) 9.100

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 110 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.719	0.319	0.0	1.7	1.7	13.4	Flood Risk
30 min Summer	9.764	0.364	0.0	1.9	1.9	17.1	Flood Risk
60 min Summer	9.796	0.396	0.0	1.9	1.9	20.0	Flood Risk
120 min Summer	9.808	0.408	0.0	2.0	2.0	21.2	Flood Risk
180 min Summer	9.807	0.407	0.0	2.0	2.0	21.1	Flood Risk
240 min Summer	9.802	0.402	0.0	2.0	2.0	20.6	Flood Risk
360 min Summer	9.789	0.389	0.0	1.9	1.9	19.3	Flood Risk
480 min Summer	9.775	0.375	0.0	1.9	1.9	18.1	Flood Risk
600 min Summer	9.761	0.361	0.0	1.9	1.9	16.8	Flood Risk
720 min Summer	9.747	0.347	0.0	1.8	1.8	15.7	Flood Risk
960 min Summer	9.721	0.321	0.0	1.7	1.7	13.5	Flood Risk
1440 min Summer	9.677	0.277	0.0	1.6	1.6	10.1	O K
2160 min Summer	9.626	0.226	0.0	1.4	1.4	6.6	O K
2880 min Summer	9.588	0.188	0.0	1.3	1.3	4.4	O K
4320 min Summer	9.535	0.135	0.0	1.1	1.1	2.1	O K
5760 min Summer	9.502	0.102	0.0	0.9	0.9	1.2	O K
7200 min Summer	9.480	0.080	0.0	0.8	0.8	0.7	O K
8640 min Summer	9.466	0.066	0.0	0.7	0.7	0.5	O K
10080 min Summer	9.456	0.056	0.0	0.6	0.6	0.3	O K
15 min Winter	9.741	0.341	0.0	1.8	1.8	15.1	Flood Risk
30 min Winter	9.790	0.390	0.0	1.9	1.9	19.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	15.0	21
30 min Summer	53.199	0.0	19.9	35
60 min Summer	33.892	0.0	25.4	62
120 min Summer	20.940	0.0	31.4	102
180 min Summer	15.610	0.0	35.1	134
240 min Summer	12.614	0.0	37.8	168
360 min Summer	9.343	0.0	42.0	238
480 min Summer	7.540	0.0	45.2	306
600 min Summer	6.381	0.0	47.9	372
720 min Summer	5.565	0.0	50.1	438
960 min Summer	4.481	0.0	53.8	568
1440 min Summer	3.298	0.0	59.4	812
2160 min Summer	2.424	0.0	65.4	1172
2880 min Summer	1.946	0.0	70.1	1528
4320 min Summer	1.427	0.0	77.1	2212
5760 min Summer	1.144	0.0	82.4	2936
7200 min Summer	0.964	0.0	86.8	3672
8640 min Summer	0.839	0.0	90.6	4400
10080 min Summer	0.745	0.0	93.9	4992
15 min Winter	79.950	0.0	16.8	22
30 min Winter	53.199	0.0	22.3	35

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	9.826	0.426	0.0	2.0	2.0	22.9	Flood Risk
120 min Winter	9.842	0.442	0.0	2.1	2.1	24.5	Flood Risk
180 min Winter	9.840	0.440	0.0	2.1	2.1	24.3	Flood Risk
240 min Winter	9.832	0.432	0.0	2.0	2.0	23.5	Flood Risk
360 min Winter	9.813	0.413	0.0	2.0	2.0	21.6	Flood Risk
480 min Winter	9.792	0.392	0.0	1.9	1.9	19.6	Flood Risk
600 min Winter	9.771	0.371	0.0	1.9	1.9	17.7	Flood Risk
720 min Winter	9.750	0.350	0.0	1.8	1.8	15.9	Flood Risk
960 min Winter	9.713	0.313	0.0	1.7	1.7	12.9	Flood Risk
1440 min Winter	9.651	0.251	0.0	1.5	1.5	8.3	O K
2160 min Winter	9.585	0.185	0.0	1.3	1.3	4.3	O K
2880 min Winter	9.540	0.140	0.0	1.1	1.1	2.3	O K
4320 min Winter	9.489	0.089	0.0	0.8	0.8	0.9	O K
5760 min Winter	9.465	0.065	0.0	0.7	0.7	0.5	O K
7200 min Winter	9.454	0.054	0.0	0.6	0.6	0.3	O K
8640 min Winter	9.449	0.049	0.0	0.5	0.5	0.3	O K
10080 min Winter	9.445	0.045	0.0	0.4	0.4	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	28.5	62
120 min Winter	20.940	0.0	35.2	114
180 min Winter	15.610	0.0	39.3	142
240 min Winter	12.614	0.0	42.4	182
360 min Winter	9.343	0.0	47.1	256
480 min Winter	7.540	0.0	50.7	330
600 min Winter	6.381	0.0	53.6	400
720 min Winter	5.565	0.0	56.1	468
960 min Winter	4.481	0.0	60.2	598
1440 min Winter	3.298	0.0	66.5	844
2160 min Winter	2.424	0.0	73.3	1192
2880 min Winter	1.946	0.0	78.5	1528
4320 min Winter	1.427	0.0	86.3	2208
5760 min Winter	1.144	0.0	92.2	2912
7200 min Winter	0.964	0.0	97.2	3656
8640 min Winter	0.839	0.0	101.4	4400
10080 min Winter	0.745	0.0	105.2	5016

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.100

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	3	0.033	3	6	0.033	6	9	0.034

Model Details

Storage is Online Cover Level (m) 10.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	87.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.0
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	9.400	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.039 Discharge Coefficient 0.600 Invert Level (m) 9.400

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 439 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.660	0.460	0.0	1.8	1.8	42.7	O K
30 min Summer	9.718	0.518	0.0	1.9	1.9	56.1	Flood Risk
60 min Summer	9.767	0.567	0.0	2.0	2.0	69.5	Flood Risk
120 min Summer	9.807	0.607	0.0	2.1	2.1	81.4	Flood Risk
180 min Summer	9.823	0.623	0.0	2.1	2.1	86.5	Flood Risk
240 min Summer	9.829	0.629	0.0	2.1	2.1	88.7	Flood Risk
360 min Summer	9.832	0.632	0.0	2.1	2.1	89.7	Flood Risk
480 min Summer	9.831	0.631	0.0	2.1	2.1	89.4	Flood Risk
600 min Summer	9.829	0.629	0.0	2.1	2.1	88.5	Flood Risk
720 min Summer	9.825	0.625	0.0	2.1	2.1	87.3	Flood Risk
960 min Summer	9.817	0.617	0.0	2.1	2.1	84.5	Flood Risk
1440 min Summer	9.797	0.597	0.0	2.1	2.1	78.2	Flood Risk
2160 min Summer	9.766	0.566	0.0	2.0	2.0	69.2	Flood Risk
2880 min Summer	9.737	0.537	0.0	1.9	1.9	61.0	Flood Risk
4320 min Summer	9.681	0.481	0.0	1.8	1.8	47.1	O K
5760 min Summer	9.630	0.430	0.0	1.7	1.7	36.5	O K
7200 min Summer	9.585	0.385	0.0	1.6	1.6	28.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	44.5	23
30 min Summer	53.199	0.0	59.3	37
60 min Summer	33.892	0.0	75.5	66
120 min Summer	20.940	0.0	93.3	124
180 min Summer	15.610	0.0	104.3	184
240 min Summer	12.614	0.0	112.4	242
360 min Summer	9.343	0.0	124.9	330
480 min Summer	7.540	0.0	134.4	390
600 min Summer	6.381	0.0	142.1	452
720 min Summer	5.565	0.0	148.7	518
960 min Summer	4.481	0.0	159.7	656
1440 min Summer	3.298	0.0	176.3	930
2160 min Summer	2.424	0.0	194.4	1340
2880 min Summer	1.946	0.0	208.1	1732
4320 min Summer	1.427	0.0	228.8	2476
5760 min Summer	1.144	0.0	244.6	3224
7200 min Summer	0.964	0.0	257.7	3904

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	9.546	0.346	0.0	1.5	1.5	22.3	O K
10080 min Summer	9.512	0.312	0.0	1.5	1.5	17.7	O K
15 min Winter	9.684	0.484	0.0	1.8	1.8	48.0	O K
30 min Winter	9.745	0.545	0.0	2.0	2.0	63.2	Flood Risk
60 min Winter	9.798	0.598	0.0	2.1	2.1	78.5	Flood Risk
120 min Winter	9.841	0.641	0.0	2.1	2.1	92.5	Flood Risk
180 min Winter	9.859	0.659	0.0	2.2	2.2	99.0	Flood Risk
240 min Winter	9.868	0.668	0.0	2.2	2.2	102.1	Flood Risk
360 min Winter	9.874	0.674	0.0	2.2	2.2	104.3	Flood Risk
480 min Winter	9.872	0.672	0.0	2.2	2.2	103.7	Flood Risk
600 min Winter	9.869	0.669	0.0	2.2	2.2	102.4	Flood Risk
720 min Winter	9.864	0.664	0.0	2.2	2.2	100.9	Flood Risk
960 min Winter	9.853	0.653	0.0	2.2	2.2	96.9	Flood Risk
1440 min Winter	9.825	0.625	0.0	2.1	2.1	87.3	Flood Risk
2160 min Winter	9.781	0.581	0.0	2.0	2.0	73.4	Flood Risk
2880 min Winter	9.737	0.537	0.0	1.9	1.9	61.1	Flood Risk
4320 min Winter	9.655	0.455	0.0	1.8	1.8	41.6	O K
5760 min Winter	9.583	0.383	0.0	1.6	1.6	28.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.839	0.0	269.0	4664
10080 min Summer	0.745	0.0	278.9	5344
15 min Winter	79.950	0.0	49.9	23
30 min Winter	53.199	0.0	66.4	37
60 min Winter	33.892	0.0	84.6	66
120 min Winter	20.940	0.0	104.5	122
180 min Winter	15.610	0.0	116.8	180
240 min Winter	12.614	0.0	125.9	236
360 min Winter	9.343	0.0	139.8	346
480 min Winter	7.540	0.0	150.5	446
600 min Winter	6.381	0.0	159.2	480
720 min Winter	5.565	0.0	166.6	556
960 min Winter	4.481	0.0	178.9	712
1440 min Winter	3.298	0.0	197.5	1012
2160 min Winter	2.424	0.0	217.7	1436
2880 min Winter	1.946	0.0	233.1	1848
4320 min Winter	1.427	0.0	256.3	2600
5760 min Winter	1.144	0.0	274.0	3336

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m^3)	Status
7200 min Winter	9.522	0.322	0.0	1.5	1.5	19.0	O K
8640 min Winter	9.472	0.272	0.0	1.4	1.4	13.0	O K
10080 min Winter	9.431	0.231	0.0	1.2	1.2	9.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
7200 min Winter	0.964	0.0	288.6	4032
8640 min Winter	0.839	0.0	301.2	4672
10080 min Winter	0.745	0.0	312.3	5344

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.297

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	3	0.099	3	6	0.099	6	9	0.099

Model Details

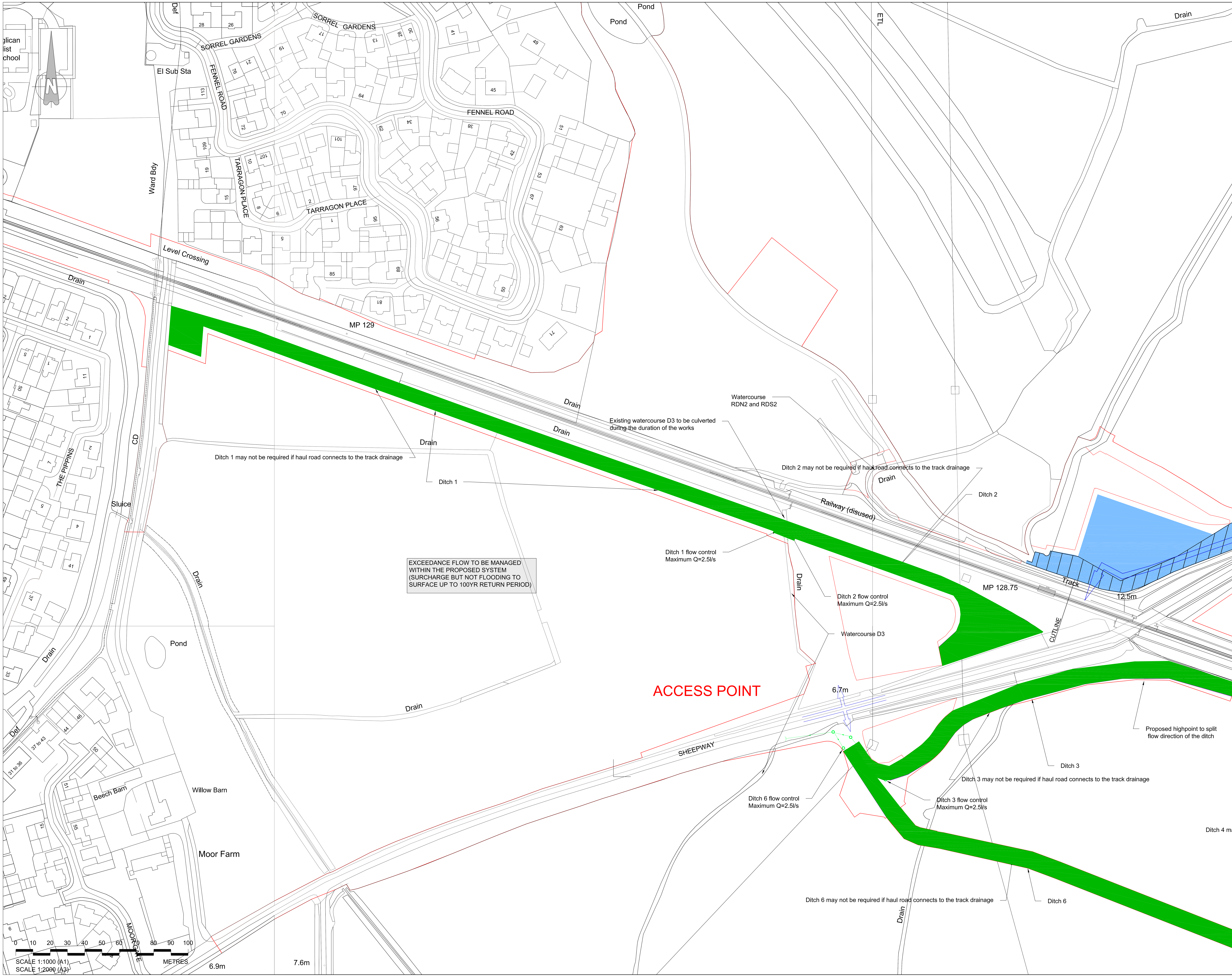
Storage is Online Cover Level (m) 10.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	296.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.0
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	9.200	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.7		

Orifice Outflow Control

Diameter (m) 0.036 Discharge Coefficient 0.600 Invert Level (m) 9.200



Notes:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout is based on available OS or topographical surveys.
6. Outfalls should be monitored on a regular basis nd equipped with shut-off valves.

KEY:

- Order limits
- Nationally Significant Infrastructure Project (NSIP)
- Construction compound
- Permanent access
- Haul Road
- Proposed ditch
- Proposed pipeline
- Proposed catchpit

FOR INFORMATION

Rev	By	Chkd	Apprvd	Date	
A	DFS	-	-	05/07/18	First Issue

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

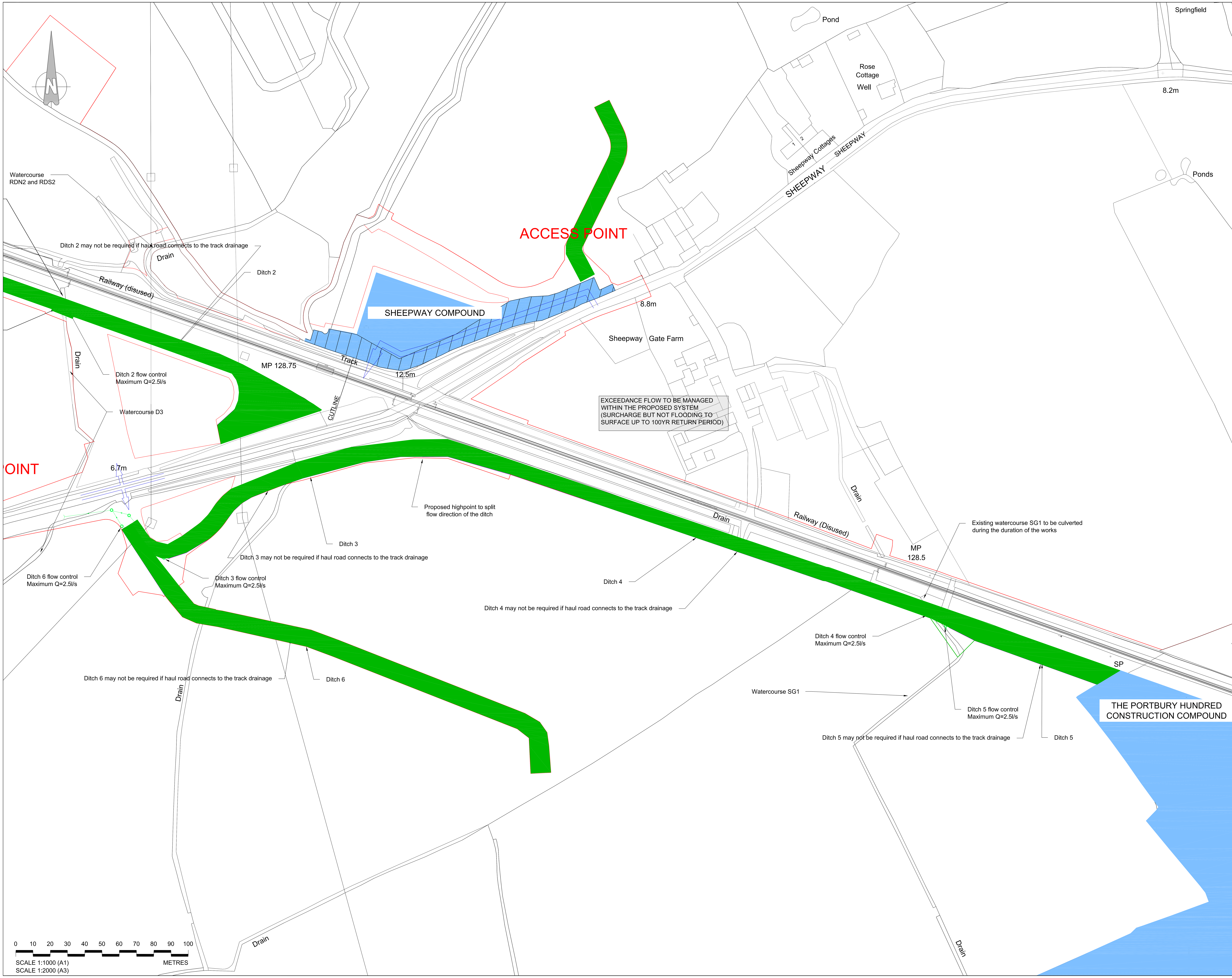
Drawing
HAUL ROADS DRAINAGE STRATEGY
SHEET 1 OF 2

Drawn by: DFS Date: 05/07/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No.
467470.BQ.04.20-DS-Haulroads A

Drawing Scale: 1:2000 @ A3

Drawing file path & name : \\EXTFPP01\Proj\Transportation\Projects\MetroWest\100 Drawings\Haul roads\ 467470.BQ.04.20-DS-Haulroads.dwg



Notes:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout is based on available OS or topographical surveys.
6. Outfalls should be monitored on a regular basis nd equipped with shut-off valves.

KEY:

- Order limits
- Nationally Significant Infrastructure Project (NSIP)
- Construction compound
- Permanent access
- Haul Road
- Proposed ditch
- Proposed pipeline
- Proposed catchpit

FOR INFORMATION

Rev	By	Chkd	Apprvd	Date	Description
A	DFS	-	-	05/07/18	First Issue

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

HAUL ROADS DRAINAGE STRATEGY
SHEET 2 OF 2

Drawn by: DFS Date: 05/07/2018
Checked by: - Date: -
Approved by: - Date: -

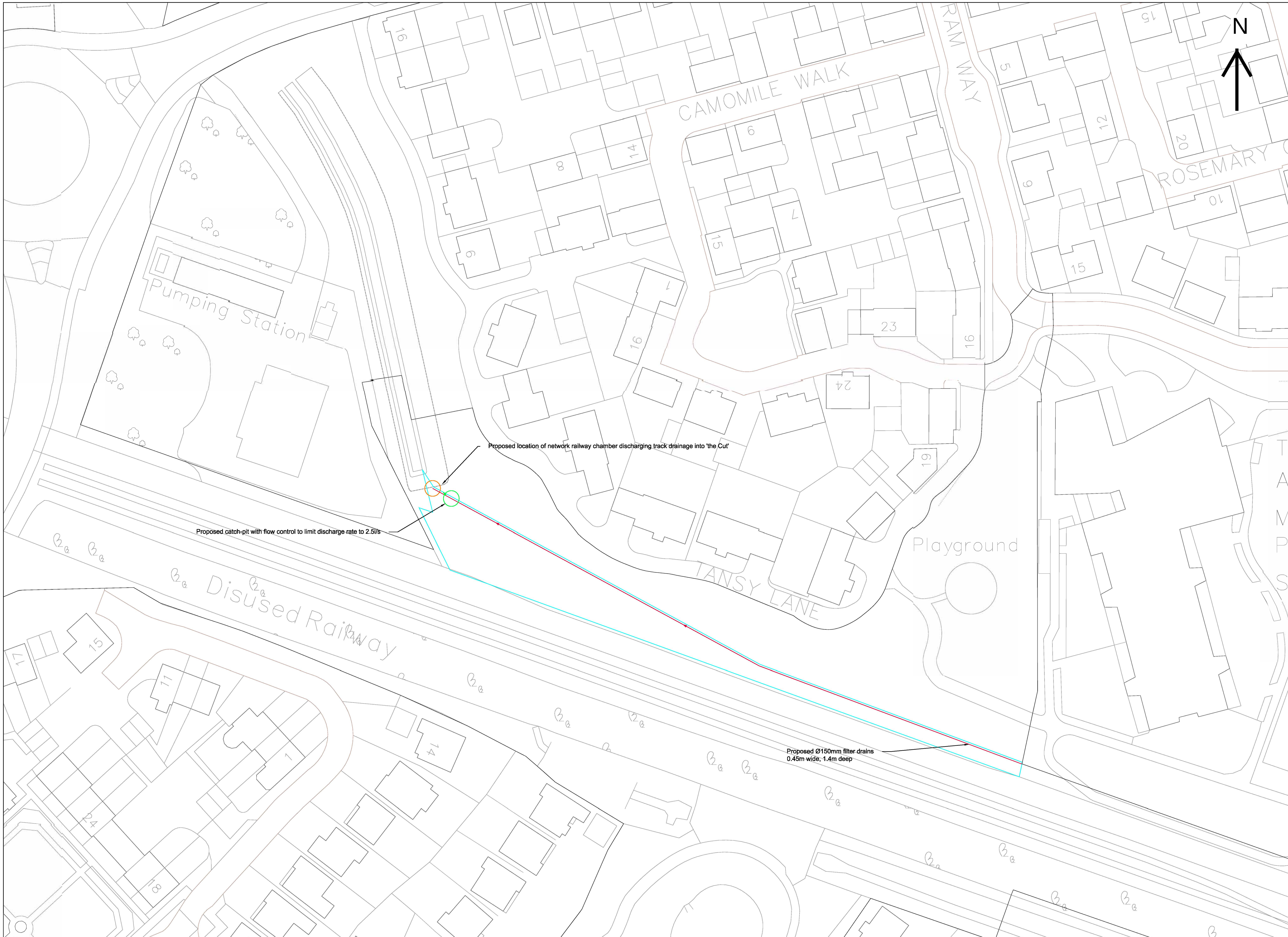
Drawing No. 467470.BQ.04.20-DS-Haulroads
Revision A

Drawing Scale: 1:2000 @ A3

Drawing file path & name : \\EXTFPP01\Proj\Transportation\Projects\MetroWest\100 Drawings\Haul roads\ 467470.BQ.04.20-DS-Haulroads.dwg

APPENDIX E

Compounds Drainage Strategy Drawings and Calculations



This drawing is to be read in conjunction with all relevant Architects, Engineers and specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

NOTES

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in meters unless noted otherwise.
5. The indicative layout based on available OS or topographical survey.
6. Outfalls should be monitored on a regular basis and equipped with shut-off valves.

- Red line boundary
- Compound boundaries
- Proposed drainage pipeline
- Proposed Filter Drain
- Proposed MH/Catchpit
- Proposed Chamber by others

FOR INFORMATION

Rev	By	Chkd	Apprvd	Date	Description
A	DFS	-	-	15/05/2018	FOR INFORMATION

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
EAST OF PORTISHEAD COMPOUND
DRAINAGE STRATEGY

Drawn by: IR Date: 02/07/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No. SK456
467470.BQ.04.20-DS-
Revision A

Drawing Scale: AS SHOWN

Drawing file path & name : \\EXTFPP01\Proj\Transportation\Projects\MetroWest\100 Drawings\Construction Compounds\East to Portishead\467470.BQ.04.20-DS-CompoundeastPortishead.dwg

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 4 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.691	1.091	0.0	43.2	43.2	13.8	O K
30 min Summer	5.741	1.141	0.0	44.2	44.2	14.6	Flood Risk
60 min Summer	5.581	0.981	0.0	40.9	40.9	12.2	O K
120 min Summer	5.292	0.692	0.0	33.9	33.9	7.9	O K
180 min Summer	5.107	0.507	0.0	28.6	28.6	4.9	O K
240 min Summer	4.997	0.397	0.0	24.9	24.9	3.2	O K
360 min Summer	4.869	0.269	0.0	19.7	19.7	1.6	O K
480 min Summer	4.805	0.205	0.0	16.5	16.5	1.0	O K
600 min Summer	4.783	0.183	0.0	14.0	14.0	0.8	O K
720 min Summer	4.768	0.168	0.0	12.3	12.3	0.7	O K
960 min Summer	4.746	0.146	0.0	9.9	9.9	0.5	O K
1440 min Summer	4.722	0.122	0.0	7.3	7.3	0.3	O K
2160 min Summer	4.698	0.098	0.0	5.4	5.4	0.2	O K
2880 min Summer	4.686	0.086	0.0	4.3	4.3	0.2	O K
4320 min Summer	4.675	0.075	0.0	3.2	3.2	0.1	O K
5760 min Summer	4.668	0.068	0.0	2.6	2.6	0.1	O K
7200 min Summer	4.662	0.062	0.0	2.2	2.2	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	40.5	16
30 min Summer	53.199	0.0	53.9	24
60 min Summer	33.892	0.0	68.6	40
120 min Summer	20.940	0.0	84.8	70
180 min Summer	15.610	0.0	94.8	100
240 min Summer	12.614	0.0	102.2	128
360 min Summer	9.343	0.0	113.5	188
480 min Summer	7.540	0.0	122.1	246
600 min Summer	6.381	0.0	129.2	306
720 min Summer	5.565	0.0	135.2	366
960 min Summer	4.481	0.0	145.2	488
1440 min Summer	3.298	0.0	160.3	728
2160 min Summer	2.424	0.0	176.7	1072
2880 min Summer	1.946	0.0	189.2	1464
4320 min Summer	1.427	0.0	208.0	2156
5760 min Summer	1.144	0.0	222.4	2888
7200 min Summer	0.964	0.0	234.3	3544

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	4.657	0.057	0.0	1.9	1.9	0.1	O K
10080 min Summer	4.654	0.054	0.0	1.7	1.7	0.1	O K
15 min Winter	5.833	1.233	0.0	46.1	46.1	16.0	Flood Risk
30 min Winter	5.830	1.230	0.0	46.0	46.0	15.9	Flood Risk
60 min Winter	5.544	0.944	0.0	40.0	40.0	11.7	O K
120 min Winter	5.151	0.551	0.0	29.9	29.9	5.7	O K
180 min Winter	4.970	0.370	0.0	23.9	23.9	2.8	O K
240 min Winter	4.869	0.269	0.0	19.8	19.8	1.6	O K
360 min Winter	4.790	0.190	0.0	14.8	14.8	0.8	O K
480 min Winter	4.765	0.165	0.0	12.0	12.0	0.6	O K
600 min Winter	4.749	0.149	0.0	10.2	10.2	0.5	O K
720 min Winter	4.737	0.137	0.0	8.9	8.9	0.4	O K
960 min Winter	4.721	0.121	0.0	7.2	7.2	0.3	O K
1440 min Winter	4.697	0.097	0.0	5.3	5.3	0.2	O K
2160 min Winter	4.682	0.082	0.0	3.9	3.9	0.2	O K
2880 min Winter	4.674	0.074	0.0	3.1	3.1	0.1	O K
4320 min Winter	4.664	0.064	0.0	2.3	2.3	0.1	O K
5760 min Winter	4.657	0.057	0.0	1.9	1.9	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.839	0.0	244.5	4312
10080 min Summer	0.745	0.0	253.5	5040
15 min Winter	79.950	0.0	45.3	16
30 min Winter	53.199	0.0	60.3	24
60 min Winter	33.892	0.0	76.9	40
120 min Winter	20.940	0.0	95.0	70
180 min Winter	15.610	0.0	106.2	100
240 min Winter	12.614	0.0	114.4	128
360 min Winter	9.343	0.0	127.1	186
480 min Winter	7.540	0.0	136.8	246
600 min Winter	6.381	0.0	144.7	306
720 min Winter	5.565	0.0	151.5	364
960 min Winter	4.481	0.0	162.6	486
1440 min Winter	3.298	0.0	179.5	728
2160 min Winter	2.424	0.0	197.9	1076
2880 min Winter	1.946	0.0	211.9	1472
4320 min Winter	1.427	0.0	233.0	2152
5760 min Winter	1.144	0.0	249.1	2984

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Winter	4.652	0.052	0.0	1.6	1.6	0.1	O K
8640 min Winter	4.649	0.049	0.0	1.4	1.4	0.1	O K
10080 min Winter	4.646	0.046	0.0	1.2	1.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	0.964	0.0	262.4	3736
8640 min Winter	0.839	0.0	273.9	4392
10080 min Winter	0.745	0.0	283.9	5000

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.270

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	3	0.090	3	6	0.090	6	9	0.090

Model Details

Storage is Online Cover Level (m) 6.000

Filter Drain Structure

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	4.600	Cap Infiltration Depth (m)	0.000
Trench Width (m)	0.5	Number of Pipes	1
Trench Length (m)	100.0		

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	4.600
Roughness k (mm)	0.600		

Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 6 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.002	1.402	0.0	49.3	49.3	20.5	FLOOD
30 min Summer	6.004	1.404	0.0	49.3	49.3	22.6	FLOOD
60 min Summer	6.001	1.401	0.0	49.2	49.2	19.5	FLOOD
120 min Summer	5.656	1.056	0.0	42.5	42.5	13.3	O K
180 min Summer	5.373	0.773	0.0	36.0	36.0	9.1	O K
240 min Summer	5.188	0.588	0.0	31.0	31.0	6.3	O K
360 min Summer	4.997	0.397	0.0	24.9	24.9	3.2	O K
480 min Summer	4.892	0.292	0.0	20.8	20.8	1.8	O K
600 min Summer	4.829	0.229	0.0	17.8	17.8	1.2	O K
720 min Summer	4.798	0.198	0.0	15.7	15.7	0.9	O K
960 min Summer	4.770	0.170	0.0	12.6	12.6	0.7	O K
1440 min Summer	4.739	0.139	0.0	9.2	9.2	0.4	O K
2160 min Summer	4.715	0.115	0.0	6.7	6.7	0.3	O K
2880 min Summer	4.698	0.098	0.0	5.4	5.4	0.2	O K
4320 min Summer	4.682	0.082	0.0	3.9	3.9	0.2	O K
5760 min Summer	4.675	0.075	0.0	3.2	3.2	0.1	O K
7200 min Summer	4.669	0.069	0.0	2.6	2.6	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	2.0	52.4	16
30 min Summer	69.587	4.1	70.5	24
60 min Summer	44.560	1.0	90.2	40
120 min Summer	27.503	0.0	111.4	70
180 min Summer	20.407	0.0	124.0	100
240 min Summer	16.403	0.0	132.9	130
360 min Summer	12.073	0.0	146.7	188
480 min Summer	9.697	0.0	157.1	248
600 min Summer	8.173	0.0	165.5	308
720 min Summer	7.104	0.0	172.6	366
960 min Summer	5.689	0.0	184.3	486
1440 min Summer	4.152	0.0	201.8	734
2160 min Summer	3.023	0.0	220.4	1076
2880 min Summer	2.411	0.0	234.3	1456
4320 min Summer	1.749	0.0	255.0	2140
5760 min Summer	1.391	0.0	270.4	2840
7200 min Summer	1.166	0.0	283.2	3544

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	4.663	0.063	0.0	2.3	2.3	0.1	O K
10080 min Summer	4.659	0.059	0.0	2.0	2.0	0.1	O K
15 min Winter	6.006	1.406	0.0	49.3	49.3	24.3	FLOOD
30 min Winter	6.007	1.407	0.0	49.4	49.4	25.6	FLOOD
60 min Winter	6.000	1.400	0.0	49.2	49.2	18.9	FLOOD
120 min Winter	5.467	0.867	0.0	38.3	38.3	10.5	O K
180 min Winter	5.166	0.566	0.0	30.4	30.4	5.9	O K
240 min Winter	5.010	0.410	0.0	25.4	25.4	3.3	O K
360 min Winter	4.855	0.255	0.0	19.1	19.1	1.4	O K
480 min Winter	4.796	0.196	0.0	15.4	15.4	0.9	O K
600 min Winter	4.774	0.174	0.0	13.0	13.0	0.7	O K
720 min Winter	4.759	0.159	0.0	11.4	11.4	0.6	O K
960 min Winter	4.739	0.139	0.0	9.1	9.1	0.4	O K
1440 min Winter	4.714	0.114	0.0	6.6	6.6	0.3	O K
2160 min Winter	4.692	0.092	0.0	4.9	4.9	0.2	O K
2880 min Winter	4.681	0.081	0.0	3.9	3.9	0.2	O K
4320 min Winter	4.672	0.072	0.0	2.9	2.9	0.1	O K
5760 min Winter	4.663	0.063	0.0	2.3	2.3	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.009	0.0	294.3	4344
10080 min Summer	0.893	0.0	303.9	5096
15 min Winter	103.597	5.7	58.7	17
30 min Winter	69.587	7.0	78.9	25
60 min Winter	44.560	0.4	101.1	40
120 min Winter	27.503	0.0	124.8	72
180 min Winter	20.407	0.0	138.9	102
240 min Winter	16.403	0.0	148.8	130
360 min Winter	12.073	0.0	164.3	188
480 min Winter	9.697	0.0	175.9	244
600 min Winter	8.173	0.0	185.4	306
720 min Winter	7.104	0.0	193.4	364
960 min Winter	5.689	0.0	206.4	484
1440 min Winter	4.152	0.0	226.0	732
2160 min Winter	3.023	0.0	246.8	1096
2880 min Winter	2.411	0.0	262.4	1444
4320 min Winter	1.749	0.0	285.6	2100
5760 min Winter	1.391	0.0	302.9	2784

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
7200 min Winter	4.657	0.057	0.0	1.9	1.9	0.1	O K
8640 min Winter	4.653	0.053	0.0	1.6	1.6	0.1	O K
10080 min Winter	4.650	0.050	0.0	1.4	1.4	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.166	0.0	317.2	3640
8640 min Winter	1.009	0.0	329.6	4296
10080 min Winter	0.893	0.0	340.4	4968

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.270

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	3	0.090	3	6	0.090	6	9	0.090

Model Details

Storage is Online Cover Level (m) 6.000

Filter Drain Structure

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.000
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	4.600	Cap Infiltration Depth (m)	0.000
Trench Width (m)	0.5	Number of Pipes	1
Trench Length (m)	100.0		

Pipe Outflow Control

Diameter (m)	0.150	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	4.600
Roughness k (mm)	0.600		

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 20 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.696	0.726	0.0	215.5	215.5	323.4	Flood Risk
30 min Summer	6.751	0.781	0.0	226.2	226.2	390.8	Flood Risk
60 min Summer	6.760	0.790	0.0	227.9	227.9	403.1	Flood Risk
120 min Summer	6.725	0.755	0.0	221.1	221.1	357.6	Flood Risk
180 min Summer	6.679	0.709	0.0	211.9	211.9	303.6	Flood Risk
240 min Summer	6.633	0.663	0.0	202.5	202.5	256.0	O K
360 min Summer	6.558	0.588	0.0	185.8	185.8	188.4	O K
480 min Summer	6.505	0.535	0.0	167.2	167.2	148.3	O K
600 min Summer	6.466	0.496	0.0	150.7	150.7	122.5	O K
720 min Summer	6.436	0.466	0.0	136.8	136.8	104.8	O K
960 min Summer	6.395	0.425	0.0	115.1	115.1	83.3	O K
1440 min Summer	6.337	0.367	0.0	81.7	81.7	58.2	O K
2160 min Summer	6.254	0.284	0.0	64.8	64.8	31.5	O K
2880 min Summer	6.214	0.244	0.0	52.4	52.4	22.1	O K
4320 min Summer	6.174	0.204	0.0	38.6	38.6	14.7	O K
5760 min Summer	6.156	0.186	0.0	31.0	31.0	11.8	O K
7200 min Summer	6.144	0.174	0.0	26.1	26.1	10.2	O K
8640 min Summer	6.130	0.160	0.0	22.6	22.6	8.4	O K
10080 min Summer	6.119	0.149	0.0	20.1	20.1	7.2	O K
15 min Winter	6.735	0.765	0.0	223.1	223.1	370.2	Flood Risk
30 min Winter	6.793	0.823	0.0	234.0	234.0	447.5	Flood Risk

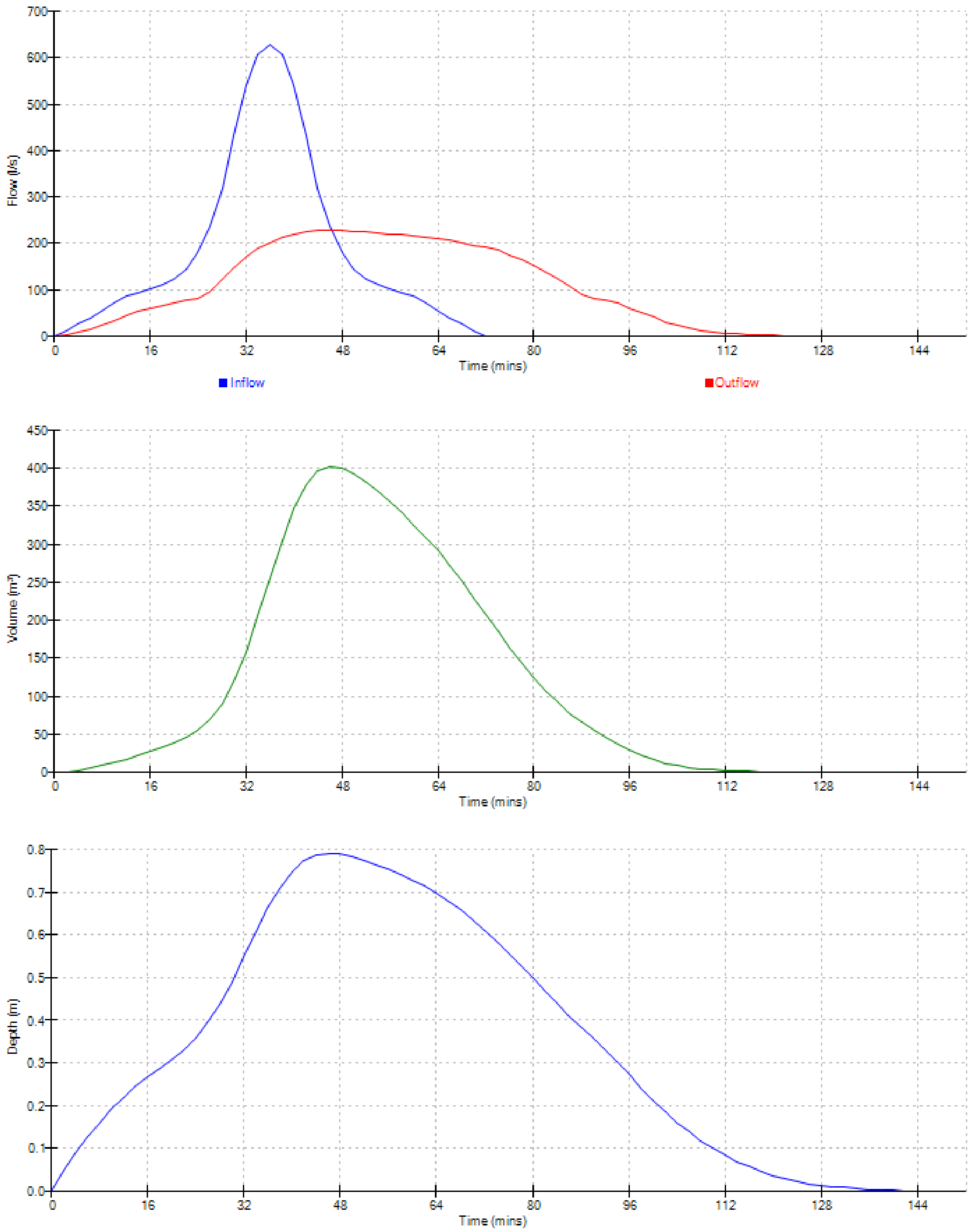
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	494.7	20
30 min Summer	53.199	0.0	658.3	30
60 min Summer	33.892	0.0	838.8	46
120 min Summer	20.940	0.0	1036.5	80
180 min Summer	15.610	0.0	1159.1	110
240 min Summer	12.614	0.0	1248.8	142
360 min Summer	9.343	0.0	1387.4	200
480 min Summer	7.540	0.0	1492.9	260
600 min Summer	6.381	0.0	1579.2	318
720 min Summer	5.565	0.0	1652.8	378
960 min Summer	4.481	0.0	1774.6	496
1440 min Summer	3.298	0.0	1959.1	746
2160 min Summer	2.424	0.0	2159.6	1100
2880 min Summer	1.946	0.0	2312.2	1468
4320 min Summer	1.427	0.0	2542.7	2188
5760 min Summer	1.144	0.0	2717.9	2928
7200 min Summer	0.964	0.0	2863.2	3576
8640 min Summer	0.839	0.0	2988.4	4368
10080 min Summer	0.745	0.0	3098.6	5120
15 min Winter	79.950	0.0	554.1	21
30 min Winter	53.199	0.0	737.3	31

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	6.794	0.824	0.0	234.2	234.2	449.2	Flood Risk
120 min Winter	6.734	0.764	0.0	222.8	222.8	368.7	Flood Risk
180 min Winter	6.662	0.692	0.0	208.4	208.4	285.1	O K
240 min Winter	6.595	0.625	0.0	194.1	194.1	219.6	O K
360 min Winter	6.501	0.531	0.0	165.4	165.4	145.2	O K
480 min Winter	6.443	0.473	0.0	140.1	140.1	108.8	O K
600 min Winter	6.406	0.436	0.0	121.3	121.3	88.8	O K
720 min Winter	6.381	0.411	0.0	106.7	106.7	76.9	O K
960 min Winter	6.348	0.378	0.0	83.7	83.7	62.5	O K
1440 min Winter	6.251	0.281	0.0	64.0	64.0	30.8	O K
2160 min Winter	6.197	0.227	0.0	47.2	47.2	18.7	O K
2880 min Winter	6.173	0.203	0.0	38.0	38.0	14.4	O K
4320 min Winter	6.148	0.178	0.0	27.9	27.9	10.8	O K
5760 min Winter	6.128	0.158	0.0	22.3	22.3	8.3	O K
7200 min Winter	6.114	0.144	0.0	18.8	18.8	6.6	O K
8640 min Winter	6.104	0.134	0.0	16.4	16.4	5.7	O K
10080 min Winter	6.096	0.126	0.0	14.6	14.6	5.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	939.5	50
120 min Winter	20.940	0.0	1160.9	84
180 min Winter	15.610	0.0	1298.1	116
240 min Winter	12.614	0.0	1398.6	146
360 min Winter	9.343	0.0	1553.9	202
480 min Winter	7.540	0.0	1672.1	260
600 min Winter	6.381	0.0	1768.7	318
720 min Winter	5.565	0.0	1851.1	378
960 min Winter	4.481	0.0	1987.5	514
1440 min Winter	3.298	0.0	2194.2	738
2160 min Winter	2.424	0.0	2418.7	1100
2880 min Winter	1.946	0.0	2589.6	1472
4320 min Winter	1.427	0.0	2847.8	2176
5760 min Winter	1.144	0.0	3044.1	2848
7200 min Winter	0.964	0.0	3206.8	3624
8640 min Winter	0.839	0.0	3347.1	4336
10080 min Winter	0.745	0.0	3470.5	5120

Event: 60 min Summer



Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 28 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.792	0.822	0.0	233.9	233.9	445.9	Flood Risk
30 min Summer	6.863	0.893	0.0	246.5	246.5	550.7	Flood Risk
60 min Summer	6.883	0.913	0.0	250.1	250.1	583.1	Flood Risk
120 min Summer	6.853	0.883	0.0	244.8	244.8	535.6	Flood Risk
180 min Summer	6.806	0.836	0.0	236.4	236.4	465.7	Flood Risk
240 min Summer	6.757	0.787	0.0	227.3	227.3	398.9	Flood Risk
360 min Summer	6.673	0.703	0.0	210.8	210.8	297.4	Flood Risk
480 min Summer	6.603	0.633	0.0	195.9	195.9	226.9	O K
600 min Summer	6.547	0.577	0.0	183.2	183.2	179.6	O K
720 min Summer	6.507	0.537	0.0	167.8	167.8	149.5	O K
960 min Summer	6.449	0.479	0.0	143.2	143.2	112.5	O K
1440 min Summer	6.386	0.416	0.0	109.8	109.8	79.1	O K
2160 min Summer	6.311	0.341	0.0	78.8	78.8	48.8	O K
2880 min Summer	6.254	0.284	0.0	64.8	64.8	31.5	O K
4320 min Summer	6.197	0.227	0.0	47.2	47.2	18.7	O K
5760 min Summer	6.172	0.202	0.0	37.6	37.6	14.3	O K
7200 min Summer	6.157	0.187	0.0	31.4	31.4	12.0	O K
8640 min Summer	6.147	0.177	0.0	27.3	27.3	10.6	O K
10080 min Summer	6.136	0.166	0.0	24.1	24.1	9.2	O K
15 min Winter	6.836	0.866	0.0	241.7	241.7	509.1	Flood Risk
30 min Winter	6.913	0.943	0.0	255.1	255.1	631.3	Flood Risk

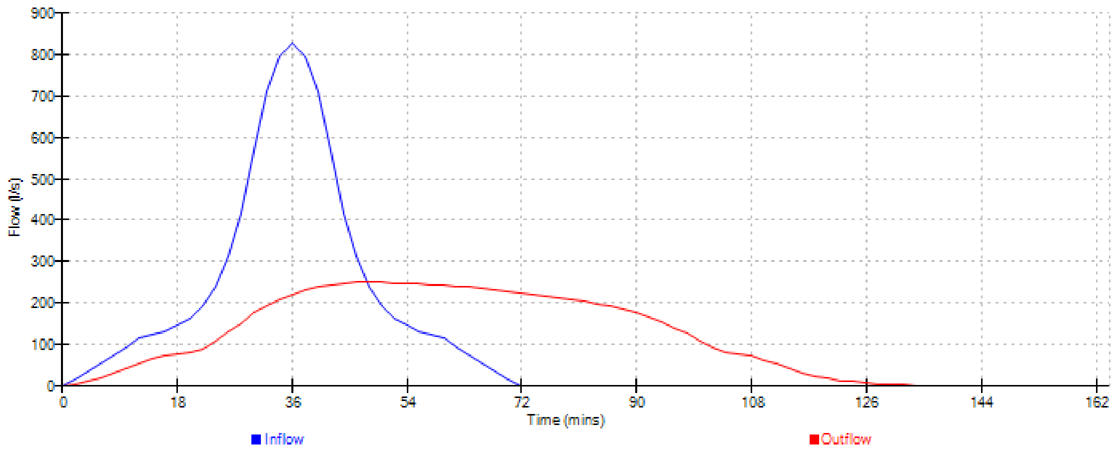
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	0.0	641.0	21
30 min Summer	69.587	0.0	861.1	31
60 min Summer	44.560	0.0	1102.9	48
120 min Summer	27.503	0.0	1361.4	82
180 min Summer	20.407	0.0	1515.2	114
240 min Summer	16.403	0.0	1623.9	144
360 min Summer	12.073	0.0	1792.8	206
480 min Summer	9.697	0.0	1919.9	264
600 min Summer	8.173	0.0	2022.9	322
720 min Summer	7.104	0.0	2110.0	380
960 min Summer	5.689	0.0	2252.9	498
1440 min Summer	4.152	0.0	2466.2	736
2160 min Summer	3.023	0.0	2693.7	1108
2880 min Summer	2.411	0.0	2864.0	1468
4320 min Summer	1.749	0.0	3116.7	2188
5760 min Summer	1.391	0.0	3305.3	2904
7200 min Summer	1.166	0.0	3461.6	3664
8640 min Summer	1.009	0.0	3596.4	4400
10080 min Summer	0.893	0.0	3714.5	5088
15 min Winter	103.597	0.0	717.9	21
30 min Winter	69.587	0.0	964.5	32

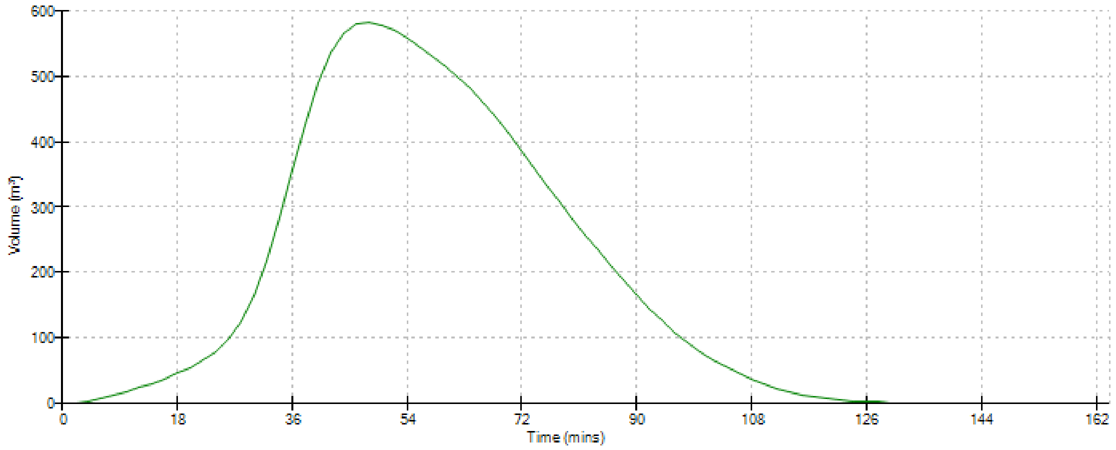
Summary of Results for 100 year Return Period (+10%)

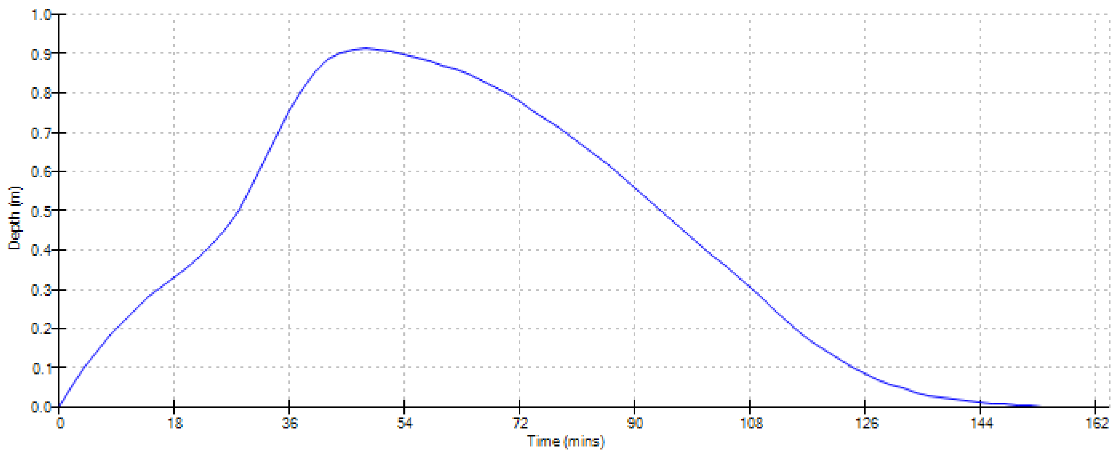
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	6.929	0.959	0.0	257.8	257.8	658.7	Flood Risk
120 min Winter	6.877	0.907	0.0	248.9	248.9	572.9	Flood Risk
180 min Winter	6.804	0.834	0.0	236.0	236.0	462.8	Flood Risk
240 min Winter	6.732	0.762	0.0	222.5	222.5	366.6	Flood Risk
360 min Winter	6.611	0.641	0.0	197.6	197.6	234.4	O K
480 min Winter	6.525	0.555	0.0	175.0	175.0	162.6	O K
600 min Winter	6.470	0.500	0.0	152.7	152.7	125.3	O K
720 min Winter	6.432	0.462	0.0	135.1	135.1	102.9	O K
960 min Winter	6.386	0.416	0.0	109.8	109.8	79.2	O K
1440 min Winter	6.313	0.343	0.0	79.4	79.4	49.6	O K
2160 min Winter	6.234	0.264	0.0	58.8	58.8	26.7	O K
2880 min Winter	6.196	0.226	0.0	47.0	47.0	18.5	O K
4320 min Winter	6.163	0.193	0.0	34.1	34.1	12.9	O K
5760 min Winter	6.146	0.176	0.0	27.1	27.1	10.5	O K
7200 min Winter	6.130	0.160	0.0	22.8	22.8	8.5	O K
8640 min Winter	6.117	0.147	0.0	19.6	19.6	7.0	O K
10080 min Winter	6.108	0.138	0.0	17.5	17.5	6.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	44.560	0.0	1235.2	50
120 min Winter	27.503	0.0	1524.8	86
180 min Winter	20.407	0.0	1697.1	120
240 min Winter	16.403	0.0	1818.8	152
360 min Winter	12.073	0.0	2008.0	210
480 min Winter	9.697	0.0	2150.3	266
600 min Winter	8.173	0.0	2265.6	324
720 min Winter	7.104	0.0	2363.2	380
960 min Winter	5.689	0.0	2523.2	498
1440 min Winter	4.152	0.0	2762.1	752
2160 min Winter	3.023	0.0	3016.9	1104
2880 min Winter	2.411	0.0	3207.7	1464
4320 min Winter	1.749	0.0	3490.7	2168
5760 min Winter	1.391	0.0	3701.9	2856
7200 min Winter	1.166	0.0	3877.0	3648
8640 min Winter	1.009	0.0	4028.0	4400
10080 min Winter	0.893	0.0	4160.3	5008

Event: 60 min Summer







Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 39 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.481	0.651	0.0	77.5	77.5	231.2	O K
30 min Summer	6.546	0.716	0.0	82.1	82.1	287.5	Flood Risk
60 min Summer	6.573	0.743	0.0	83.9	83.9	312.0	Flood Risk
120 min Summer	6.564	0.734	0.0	83.3	83.3	303.4	Flood Risk
180 min Summer	6.538	0.708	0.0	81.6	81.6	280.1	Flood Risk
240 min Summer	6.509	0.679	0.0	79.6	79.6	255.0	O K
360 min Summer	6.455	0.625	0.0	75.6	75.6	210.5	O K
480 min Summer	6.405	0.575	0.0	71.8	71.8	173.5	O K
600 min Summer	6.360	0.530	0.0	68.3	68.3	143.5	O K
720 min Summer	6.321	0.491	0.0	65.0	65.0	119.4	O K
960 min Summer	6.257	0.427	0.0	59.2	59.2	84.5	O K
1440 min Summer	6.168	0.338	0.0	50.0	50.0	47.9	O K
2160 min Summer	6.107	0.277	0.0	39.1	39.1	29.8	O K
2880 min Summer	6.071	0.241	0.0	31.8	31.8	21.6	O K
4320 min Summer	6.030	0.200	0.0	23.4	23.4	13.9	O K
5760 min Summer	6.005	0.175	0.0	18.8	18.8	10.3	O K
7200 min Summer	5.985	0.155	0.0	15.8	15.8	7.8	O K
8640 min Summer	5.971	0.141	0.0	13.8	13.8	6.3	O K
10080 min Summer	5.960	0.130	0.0	12.2	12.2	5.4	O K
15 min Winter	6.519	0.689	0.0	80.3	80.3	263.5	O K
30 min Winter	6.591	0.761	0.0	85.1	85.1	329.3	Flood Risk

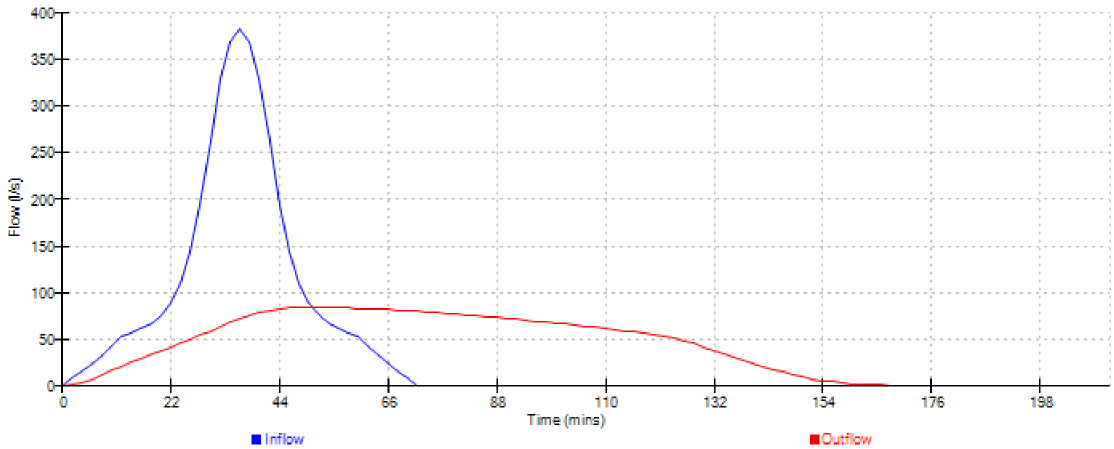
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	301.3	22
30 min Summer	53.199	0.0	401.0	32
60 min Summer	33.892	0.0	510.9	50
120 min Summer	20.940	0.0	631.3	84
180 min Summer	15.610	0.0	706.0	118
240 min Summer	12.614	0.0	760.6	152
360 min Summer	9.343	0.0	845.0	216
480 min Summer	7.540	0.0	909.3	278
600 min Summer	6.381	0.0	961.9	338
720 min Summer	5.565	0.0	1006.7	398
960 min Summer	4.481	0.0	1080.9	514
1440 min Summer	3.298	0.0	1193.3	746
2160 min Summer	2.424	0.0	1315.4	1104
2880 min Summer	1.946	0.0	1408.3	1468
4320 min Summer	1.427	0.0	1548.7	2200
5760 min Summer	1.144	0.0	1655.5	2912
7200 min Summer	0.964	0.0	1744.0	3608
8640 min Summer	0.839	0.0	1820.2	4384
10080 min Summer	0.745	0.0	1887.3	5136
15 min Winter	79.950	0.0	337.5	22
30 min Winter	53.199	0.0	449.1	33

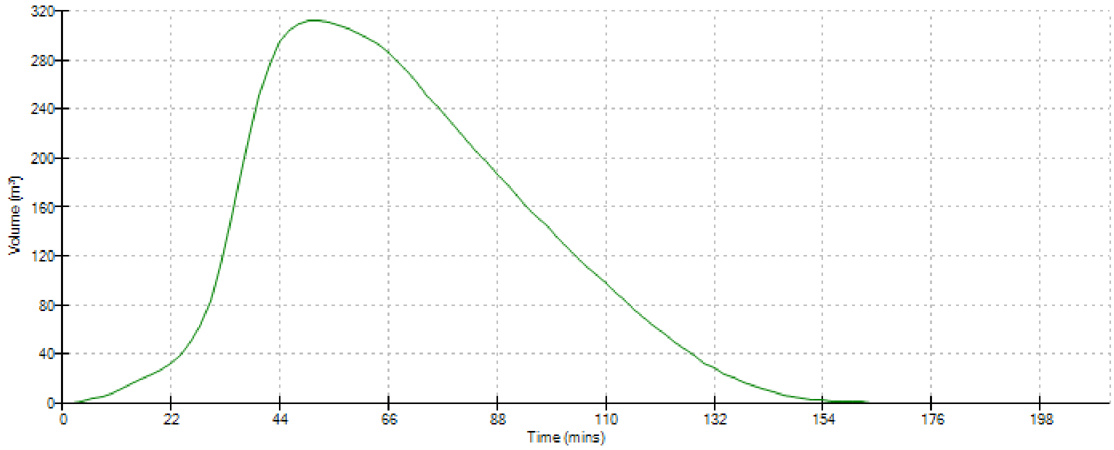
Summary of Results for 30 year Return Period (+10%)

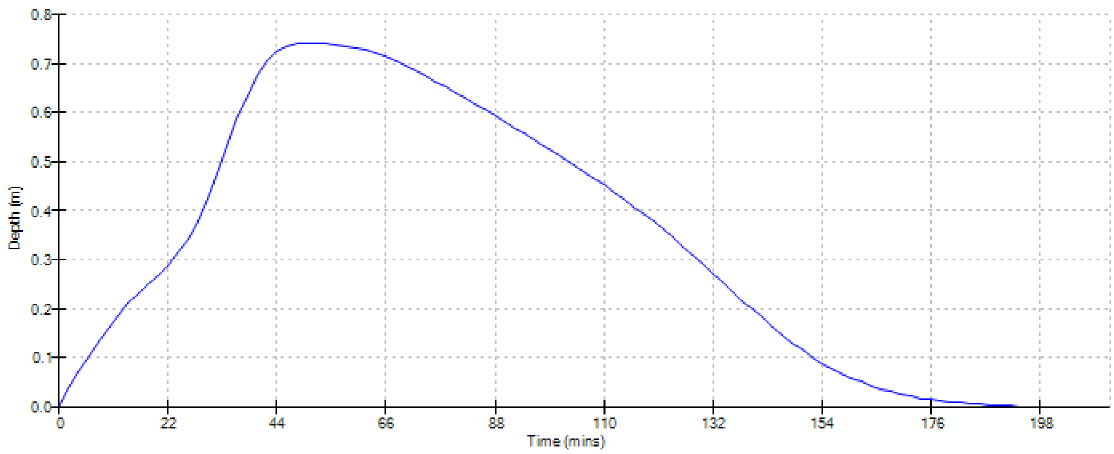
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	6.620	0.790	0.0	87.0	87.0	358.1	Flood Risk
120 min Winter	6.602	0.772	0.0	85.8	85.8	339.7	Flood Risk
180 min Winter	6.562	0.732	0.0	83.2	83.2	301.5	Flood Risk
240 min Winter	6.518	0.688	0.0	80.1	80.1	262.4	O K
360 min Winter	6.436	0.606	0.0	74.3	74.3	196.6	O K
480 min Winter	6.365	0.535	0.0	68.7	68.7	146.4	O K
600 min Winter	6.304	0.474	0.0	63.5	63.5	109.3	O K
720 min Winter	6.253	0.423	0.0	58.9	58.9	82.4	O K
960 min Winter	6.175	0.345	0.0	50.8	50.8	50.3	O K
1440 min Winter	6.105	0.275	0.0	38.8	38.8	29.4	O K
2160 min Winter	6.056	0.226	0.0	28.7	28.7	18.6	O K
2880 min Winter	6.028	0.198	0.0	23.1	23.1	13.7	O K
4320 min Winter	5.992	0.162	0.0	16.9	16.9	8.7	O K
5760 min Winter	5.969	0.139	0.0	13.6	13.6	6.2	O K
7200 min Winter	5.956	0.126	0.0	11.5	11.5	5.0	O K
8640 min Winter	5.948	0.118	0.0	9.9	9.9	4.4	O K
10080 min Winter	5.943	0.113	0.0	8.9	8.9	3.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	572.2	54
120 min Winter	20.940	0.0	707.1	92
180 min Winter	15.610	0.0	790.7	128
240 min Winter	12.614	0.0	851.9	162
360 min Winter	9.343	0.0	946.4	226
480 min Winter	7.540	0.0	1018.4	288
600 min Winter	6.381	0.0	1077.3	348
720 min Winter	5.565	0.0	1127.5	404
960 min Winter	4.481	0.0	1210.6	514
1440 min Winter	3.298	0.0	1336.5	742
2160 min Winter	2.424	0.0	1473.2	1104
2880 min Winter	1.946	0.0	1577.3	1468
4320 min Winter	1.427	0.0	1734.6	2200
5760 min Winter	1.144	0.0	1854.1	2872
7200 min Winter	0.964	0.0	1953.2	3568
8640 min Winter	0.839	0.0	2038.7	4400
10080 min Winter	0.745	0.0	2113.8	4960

Event: 60 min Summer







Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 51 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	6.573	0.743	0.0	83.9	83.9	312.0	Flood Risk
30 min Summer	6.657	0.827	0.0	89.3	89.3	395.6	Flood Risk
60 min Summer	6.698	0.868	0.0	91.8	91.8	440.0	Flood Risk
120 min Summer	6.696	0.866	0.0	91.7	91.7	438.4	Flood Risk
180 min Summer	6.671	0.841	0.0	90.2	90.2	411.2	Flood Risk
240 min Summer	6.641	0.811	0.0	88.3	88.3	379.4	Flood Risk
360 min Summer	6.585	0.755	0.0	84.7	84.7	322.9	Flood Risk
480 min Summer	6.531	0.701	0.0	81.1	81.1	273.8	Flood Risk
600 min Summer	6.482	0.652	0.0	77.6	77.6	232.3	O K
720 min Summer	6.438	0.608	0.0	74.4	74.4	197.6	O K
960 min Summer	6.362	0.532	0.0	68.4	68.4	144.4	O K
1440 min Summer	6.251	0.421	0.0	58.7	58.7	81.5	O K
2160 min Summer	6.152	0.322	0.0	48.0	48.0	42.6	O K
2880 min Summer	6.108	0.278	0.0	39.3	39.3	30.0	O K
4320 min Summer	6.056	0.226	0.0	28.7	28.7	18.6	O K
5760 min Summer	6.027	0.197	0.0	22.8	22.8	13.5	O K
7200 min Summer	6.008	0.178	0.0	19.2	19.2	10.7	O K
8640 min Summer	5.990	0.160	0.0	16.6	16.6	8.4	O K
10080 min Summer	5.977	0.147	0.0	14.7	14.7	7.0	O K
15 min Winter	6.617	0.787	0.0	86.8	86.8	354.5	Flood Risk
30 min Winter	6.709	0.879	0.0	92.5	92.5	452.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	0.0	390.4	22
30 min Summer	69.587	0.0	524.5	33
60 min Summer	44.560	0.0	671.7	54
120 min Summer	27.503	0.0	829.2	88
180 min Summer	20.407	0.0	922.9	122
240 min Summer	16.403	0.0	989.1	156
360 min Summer	12.073	0.0	1092.0	220
480 min Summer	9.697	0.0	1169.4	284
600 min Summer	8.173	0.0	1232.1	346
720 min Summer	7.104	0.0	1285.2	406
960 min Summer	5.689	0.0	1372.2	524
1440 min Summer	4.152	0.0	1502.1	758
2160 min Summer	3.023	0.0	1640.7	1108
2880 min Summer	2.411	0.0	1744.4	1468
4320 min Summer	1.749	0.0	1898.4	2200
5760 min Summer	1.391	0.0	2013.2	2912
7200 min Summer	1.166	0.0	2108.5	3664
8640 min Summer	1.009	0.0	2190.5	4400
10080 min Summer	0.893	0.0	2262.5	5072
15 min Winter	103.597	0.0	437.3	23
30 min Winter	69.587	0.0	587.5	34

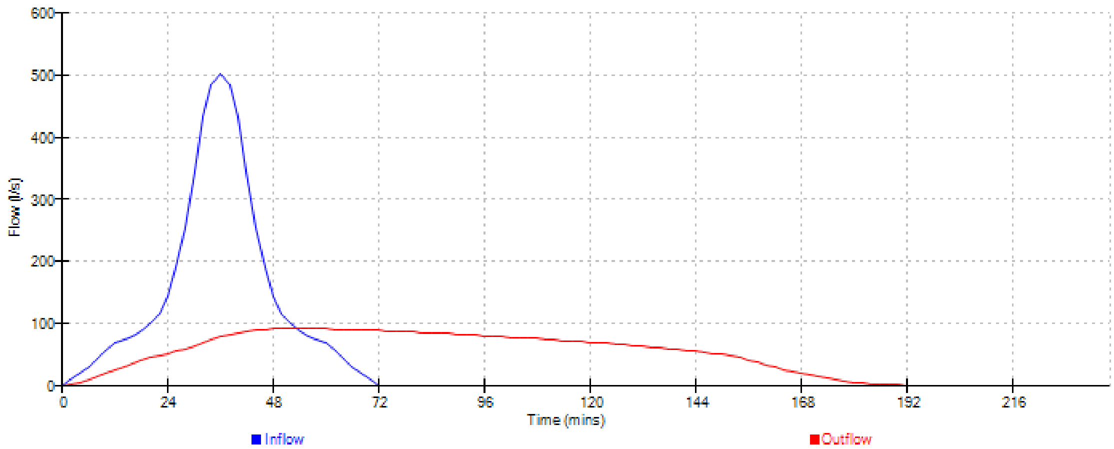
Summary of Results for 100 year Return Period (+10%)

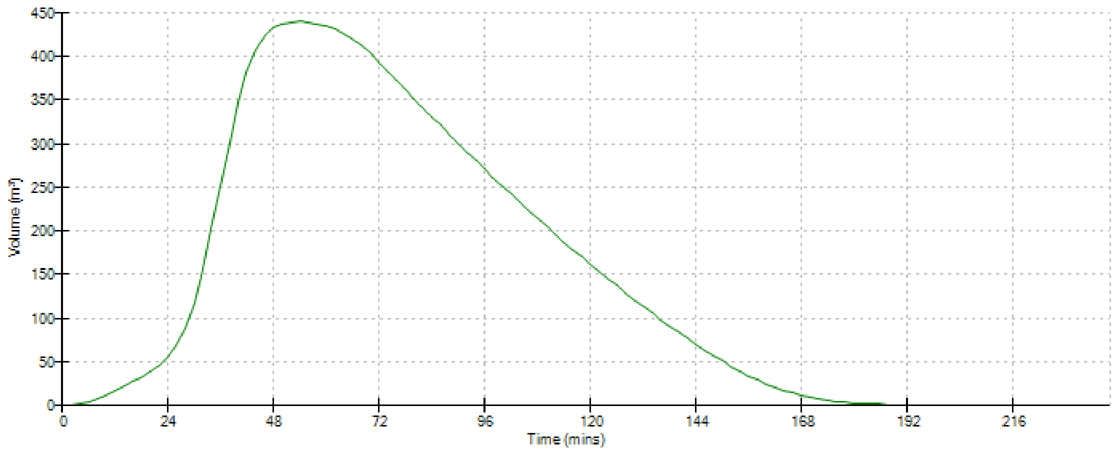
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	6.756	0.926	0.0	95.3	95.3	507.2	Flood Risk
120 min Winter	6.749	0.919	0.0	94.9	94.9	498.3	Flood Risk
180 min Winter	6.711	0.881	0.0	92.7	92.7	455.0	Flood Risk
240 min Winter	6.667	0.837	0.0	89.9	89.9	406.1	Flood Risk
360 min Winter	6.582	0.752	0.0	84.5	84.5	320.8	Flood Risk
480 min Winter	6.505	0.675	0.0	79.2	79.2	251.2	O K
600 min Winter	6.436	0.606	0.0	74.2	74.2	196.1	O K
720 min Winter	6.375	0.545	0.0	69.5	69.5	153.1	O K
960 min Winter	6.277	0.447	0.0	61.1	61.1	94.8	O K
1440 min Winter	6.154	0.324	0.0	48.3	48.3	43.4	O K
2160 min Winter	6.091	0.261	0.0	35.8	35.8	25.9	O K
2880 min Winter	6.056	0.226	0.0	28.6	28.6	18.5	O K
4320 min Winter	6.016	0.186	0.0	20.8	20.8	11.9	O K
5760 min Winter	5.989	0.159	0.0	16.5	16.5	8.4	O K
7200 min Winter	5.971	0.141	0.0	13.8	13.8	6.3	O K
8640 min Winter	5.959	0.129	0.0	12.0	12.0	5.2	O K
10080 min Winter	5.952	0.122	0.0	10.6	10.6	4.6	O K

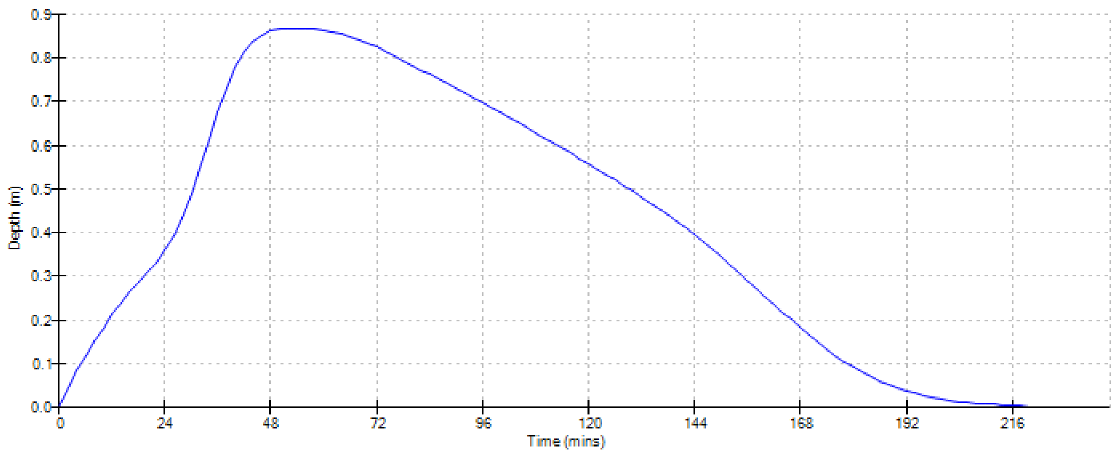
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	44.560	0.0	752.4	58
120 min Winter	27.503	0.0	928.7	94
180 min Winter	20.407	0.0	1033.7	132
240 min Winter	16.403	0.0	1107.8	166
360 min Winter	12.073	0.0	1223.0	234
480 min Winter	9.697	0.0	1309.7	298
600 min Winter	8.173	0.0	1380.0	360
720 min Winter	7.104	0.0	1439.4	418
960 min Winter	5.689	0.0	1536.9	532
1440 min Winter	4.152	0.0	1682.4	752
2160 min Winter	3.023	0.0	1837.6	1104
2880 min Winter	2.411	0.0	1953.8	1452
4320 min Winter	1.749	0.0	2126.2	2168
5760 min Winter	1.391	0.0	2254.8	2936
7200 min Winter	1.166	0.0	2361.5	3600
8640 min Winter	1.009	0.0	2453.4	4392
10080 min Winter	0.893	0.0	2534.0	5016

CH2M		Page 3
Ash House Falcon Road Exeter EX2 7LB		
Date 25/05/2018 13:44 File DITCH_D_2018-05-24.SRCX	Designed by MA047950 Checked by	
XP Solutions	Source Control 2017.1.2	

Event: 60 min Summer







Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	3.323	1.543	651.1	29.4	O K
30 min Summer	3.466	1.686	686.5	32.7	O K
60 min Summer	3.255	1.475	633.6	27.8	O K
120 min Summer	2.752	0.972	484.5	16.4	O K
180 min Summer	2.517	0.737	389.5	11.0	O K
240 min Summer	2.428	0.648	326.4	9.0	O K
360 min Summer	2.335	0.555	250.9	6.9	O K
480 min Summer	2.261	0.481	205.5	5.2	O K
600 min Summer	2.220	0.440	176.7	4.4	O K
720 min Summer	2.185	0.405	154.4	3.7	O K
960 min Summer	2.127	0.347	124.7	2.7	O K
1440 min Summer	2.069	0.289	91.8	1.8	O K
2160 min Summer	2.033	0.253	67.3	1.4	O K
2880 min Summer	2.008	0.228	54.1	1.1	O K
4320 min Summer	1.972	0.192	39.9	0.8	O K
5760 min Summer	1.953	0.173	32.5	0.6	O K
7200 min Summer	1.939	0.159	27.1	0.5	O K
8640 min Summer	1.927	0.147	23.5	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	509.7	15
30 min Summer	53.199	0.0	678.3	23
60 min Summer	33.892	0.0	864.3	38
120 min Summer	20.940	0.0	1068.0	68
180 min Summer	15.610	0.0	1194.2	96
240 min Summer	12.614	0.0	1286.6	126
360 min Summer	9.343	0.0	1429.4	186
480 min Summer	7.540	0.0	1538.2	246
600 min Summer	6.381	0.0	1627.1	306
720 min Summer	5.565	0.0	1702.8	366
960 min Summer	4.481	0.0	1828.4	486
1440 min Summer	3.298	0.0	2018.5	718
2160 min Summer	2.424	0.0	2225.0	1100
2880 min Summer	1.946	0.0	2382.2	1424
4320 min Summer	1.427	0.0	2619.8	2132
5760 min Summer	1.144	0.0	2800.3	2856
7200 min Summer	0.964	0.0	2950.0	3656
8640 min Summer	0.839	0.0	3079.0	4384

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	1.917	0.137	20.8	0.4	O K
15 min Winter	3.653	1.873	730.2	36.8	O K
30 min Winter	3.694	1.914	739.4	37.7	O K
60 min Winter	3.118	1.338	596.7	24.7	O K
120 min Winter	2.541	0.761	403.9	11.6	O K
180 min Winter	2.402	0.622	307.2	8.4	O K
240 min Winter	2.334	0.554	250.4	6.9	O K
360 min Winter	2.234	0.454	186.5	4.7	O K
480 min Winter	2.178	0.398	150.8	3.6	O K
600 min Winter	2.134	0.354	128.0	2.8	O K
720 min Winter	2.102	0.322	111.6	2.3	O K
960 min Winter	2.067	0.287	90.1	1.8	O K
1440 min Winter	2.032	0.252	66.6	1.4	O K
2160 min Winter	1.994	0.214	48.8	1.0	O K
2880 min Winter	1.970	0.190	39.3	0.8	O K
4320 min Winter	1.944	0.164	28.7	0.6	O K
5760 min Winter	1.925	0.145	23.1	0.4	O K
7200 min Winter	1.912	0.132	19.4	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.745	0.0	3192.5	5016
15 min Winter	79.950	0.0	570.9	15
30 min Winter	53.199	0.0	759.7	22
60 min Winter	33.892	0.0	968.0	38
120 min Winter	20.940	0.0	1196.1	66
180 min Winter	15.610	0.0	1337.5	96
240 min Winter	12.614	0.0	1441.0	128
360 min Winter	9.343	0.0	1601.0	186
480 min Winter	7.540	0.0	1722.8	248
600 min Winter	6.381	0.0	1822.3	308
720 min Winter	5.565	0.0	1907.2	368
960 min Winter	4.481	0.0	2047.8	490
1440 min Winter	3.298	0.0	2260.7	730
2160 min Winter	2.424	0.0	2492.0	1096
2880 min Winter	1.946	0.0	2668.1	1444
4320 min Winter	1.427	0.0	2934.1	2144
5760 min Winter	1.144	0.0	3136.3	2936
7200 min Winter	0.964	0.0	3304.0	3488

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Winter	1.904	0.124	17.0	0.3	O K
10080 min Winter	1.897	0.117	15.0	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	0.839	0.0	3448.5	4384
10080 min Winter	0.745	0.0	3575.6	5064

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 3.400

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.140	4	8	1.130	8	12	1.130

Model Details

Storage is Online Cover Level (m) 6.000

Pipe Structure

Diameter (m)	0.525	Length (m)	222.466
Slope (1:X)	100.210	Invert Level (m)	1.780

Pipe Outflow Control

Diameter (m)	0.525	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	1.780
Roughness k (mm)	0.600		

CH2M		Page 1
Ash House Falcon Road Exeter EX2 7LB		
Date 22/05/2018 17:07 File COLLECTOR PIPE_B.SRCX	Designed by GR061116 Checked by	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.164	2.384	837.9	48.0	O K
30 min Summer	4.565	2.785	913.8	50.9	O K
60 min Summer	4.117	2.337	828.6	47.1	O K
120 min Summer	3.262	1.482	635.3	28.0	O K
180 min Summer	2.819	1.039	507.0	17.9	O K
240 min Summer	2.583	0.803	422.9	12.5	O K
360 min Summer	2.424	0.644	323.4	8.9	O K
480 min Summer	2.349	0.569	264.6	7.2	O K
600 min Summer	2.311	0.531	226.5	6.4	O K
720 min Summer	2.249	0.469	197.1	5.0	O K
960 min Summer	2.192	0.412	158.0	3.8	O K
1440 min Summer	2.109	0.329	115.4	2.4	O K
2160 min Summer	2.058	0.278	83.9	1.7	O K
2880 min Summer	2.033	0.253	66.9	1.4	O K
4320 min Summer	1.994	0.214	48.8	1.0	O K
5760 min Summer	1.969	0.189	38.9	0.8	O K
7200 min Summer	1.954	0.174	32.9	0.7	O K
8640 min Summer	1.943	0.163	28.3	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	0.0	660.5	15
30 min Summer	69.587	0.0	887.3	22
60 min Summer	44.560	0.0	1136.4	38
120 min Summer	27.503	0.0	1402.7	68
180 min Summer	20.407	0.0	1561.2	98
240 min Summer	16.403	0.0	1673.2	126
360 min Summer	12.073	0.0	1847.2	186
480 min Summer	9.697	0.0	1978.1	246
600 min Summer	8.173	0.0	2084.2	308
720 min Summer	7.104	0.0	2173.9	366
960 min Summer	5.689	0.0	2321.2	488
1440 min Summer	4.152	0.0	2540.9	720
2160 min Summer	3.023	0.0	2775.3	1100
2880 min Summer	2.411	0.0	2950.8	1424
4320 min Summer	1.749	0.0	3211.2	2196
5760 min Summer	1.391	0.0	3405.4	2888
7200 min Summer	1.166	0.0	3566.6	3608
8640 min Summer	1.009	0.0	3705.3	4344

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	1.932	0.152	25.1	0.5	O K
15 min Winter	4.991	3.211	987.9	51.4	O K
30 min Winter	5.027	3.247	993.9	51.4	O K
60 min Winter	3.887	2.107	781.4	42.1	O K
120 min Winter	2.887	1.107	528.8	19.4	O K
180 min Winter	2.536	0.756	400.9	11.5	O K
240 min Winter	2.426	0.646	324.9	9.0	O K
360 min Winter	2.325	0.545	241.0	6.7	O K
480 min Winter	2.245	0.465	193.9	4.9	O K
600 min Winter	2.202	0.422	164.1	4.0	O K
720 min Winter	2.162	0.382	142.6	3.3	O K
960 min Winter	2.107	0.327	114.1	2.3	O K
1440 min Winter	2.057	0.277	83.6	1.7	O K
2160 min Winter	2.024	0.244	60.8	1.3	O K
2880 min Winter	1.994	0.214	48.6	1.0	O K
4320 min Winter	1.960	0.180	35.1	0.7	O K
5760 min Winter	1.942	0.162	28.1	0.6	O K
7200 min Winter	1.927	0.147	23.5	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.893	0.0	3827.1	5008
15 min Winter	103.597	0.0	739.7	13
30 min Winter	69.587	0.0	993.7	20
60 min Winter	44.560	0.0	1272.7	38
120 min Winter	27.503	0.0	1571.0	68
180 min Winter	20.407	0.0	1748.5	96
240 min Winter	16.403	0.0	1873.9	126
360 min Winter	12.073	0.0	2068.8	184
480 min Winter	9.697	0.0	2215.5	248
600 min Winter	8.173	0.0	2334.3	306
720 min Winter	7.104	0.0	2434.8	366
960 min Winter	5.689	0.0	2599.7	482
1440 min Winter	4.152	0.0	2845.8	732
2160 min Winter	3.023	0.0	3108.4	1072
2880 min Winter	2.411	0.0	3304.9	1460
4320 min Winter	1.749	0.0	3596.5	2212
5760 min Winter	1.391	0.0	3814.1	2888
7200 min Winter	1.166	0.0	3994.5	3608

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
8640 min Winter	1.916	0.136	20.4	0.4	O K
10080 min Winter	1.908	0.128	18.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
8640 min Winter	1.009	0.0	4150.0	4272
10080 min Winter	0.893	0.0	4286.3	5104

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 3.400

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.140	4	8	1.130	8	12	1.130

Model Details

Storage is Online Cover Level (m) 6.000

Pipe Structure

Diameter (m)	0.525	Length (m)	222.466
Slope (1:X)	100.210	Invert Level (m)	1.780

Pipe Outflow Control

Diameter (m)	0.525	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	1.780
Roughness k (mm)	0.600		

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	3.608	1.048	509.8	18.1	O K
30 min Summer	3.700	1.140	539.0	20.1	O K
60 min Summer	3.562	1.002	494.8	17.0	O K
120 min Summer	3.283	0.723	380.4	10.7	O K
180 min Summer	3.177	0.617	303.5	8.3	O K
240 min Summer	3.119	0.559	254.8	7.0	O K
360 min Summer	3.026	0.466	195.0	4.9	O K
480 min Summer	2.976	0.416	160.1	3.9	O K
600 min Summer	2.932	0.372	137.5	3.1	O K
720 min Summer	2.899	0.339	120.3	2.5	O K
960 min Summer	2.857	0.297	97.2	1.9	O K
1440 min Summer	2.819	0.259	71.4	1.4	O K
2160 min Summer	2.784	0.224	52.6	1.1	O K
2880 min Summer	2.758	0.198	42.2	0.8	O K
4320 min Summer	2.730	0.170	31.3	0.6	O K
5760 min Summer	2.712	0.152	25.1	0.5	O K
7200 min Summer	2.699	0.139	21.3	0.4	O K
8640 min Summer	2.688	0.128	18.3	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	397.3	15
30 min Summer	53.199	0.0	528.7	22
60 min Summer	33.892	0.0	673.7	38
120 min Summer	20.940	0.0	832.4	66
180 min Summer	15.610	0.0	930.8	96
240 min Summer	12.614	0.0	1002.8	126
360 min Summer	9.343	0.0	1114.1	186
480 min Summer	7.540	0.0	1198.9	246
600 min Summer	6.381	0.0	1268.2	306
720 min Summer	5.565	0.0	1327.2	366
960 min Summer	4.481	0.0	1425.1	484
1440 min Summer	3.298	0.0	1573.2	734
2160 min Summer	2.424	0.0	1734.2	1072
2880 min Summer	1.946	0.0	1856.7	1432
4320 min Summer	1.427	0.0	2041.9	2164
5760 min Summer	1.144	0.0	2182.6	2888
7200 min Summer	0.964	0.0	2299.3	3608
8640 min Summer	0.839	0.0	2399.8	4352

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	2.682	0.122	16.4	0.3	O K
15 min Winter	3.814	1.254	572.9	22.7	O K
30 min Winter	3.845	1.285	581.7	23.4	O K
60 min Winter	3.477	0.917	465.5	15.1	O K
120 min Winter	3.192	0.632	314.9	8.6	O K
180 min Winter	3.103	0.543	239.5	6.6	O K
240 min Winter	3.026	0.466	195.0	4.9	O K
360 min Winter	2.947	0.387	145.2	3.3	O K
480 min Winter	2.894	0.334	117.7	2.4	O K
600 min Winter	2.861	0.301	99.9	2.0	O K
720 min Winter	2.842	0.282	87.0	1.7	O K
960 min Winter	2.818	0.258	70.3	1.4	O K
1440 min Winter	2.782	0.222	51.8	1.0	O K
2160 min Winter	2.747	0.187	38.1	0.7	O K
2880 min Winter	2.729	0.169	30.7	0.6	O K
4320 min Winter	2.703	0.143	22.4	0.4	O K
5760 min Winter	2.688	0.128	18.1	0.4	O K
7200 min Winter	2.678	0.118	15.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.745	0.0	2488.3	5112
15 min Winter	79.950	0.0	444.9	15
30 min Winter	53.199	0.0	592.1	22
60 min Winter	33.892	0.0	754.4	38
120 min Winter	20.940	0.0	932.2	66
180 min Winter	15.610	0.0	1042.4	96
240 min Winter	12.614	0.0	1123.1	126
360 min Winter	9.343	0.0	1247.8	188
480 min Winter	7.540	0.0	1342.7	246
600 min Winter	6.381	0.0	1420.3	306
720 min Winter	5.565	0.0	1486.5	370
960 min Winter	4.481	0.0	1596.1	490
1440 min Winter	3.298	0.0	1762.0	720
2160 min Winter	2.424	0.0	1942.3	1076
2880 min Winter	1.946	0.0	2079.5	1464
4320 min Winter	1.427	0.0	2286.9	2212
5760 min Winter	1.144	0.0	2444.5	2880
7200 min Winter	0.964	0.0	2575.1	3672

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Winter	2.670	0.110	13.2	0.3	O K
10080 min Winter	2.663	0.103	11.7	0.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	0.839	0.0	2687.8	4280
10080 min Winter	0.745	0.0	2786.9	5160

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 2.650

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.890	4	8	0.880	8	12	0.880

Model Details

Storage is Online Cover Level (m) 6.000

Pipe Structure

Diameter (m)	0.525	Length (m)	144.000
Slope (1:X)	100.000	Invert Level (m)	2.560

Pipe Outflow Control

Diameter (m)	0.525	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	2.560
Roughness k (mm)	0.600		

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.134	1.574	658.8	29.7	O K
30 min Summer	4.337	1.777	708.0	32.4	O K
60 min Summer	4.097	1.537	649.4	29.1	O K
120 min Summer	3.566	1.006	496.0	17.1	O K
180 min Summer	3.309	0.749	397.0	11.3	O K
240 min Summer	3.213	0.653	330.5	9.1	O K
360 min Summer	3.116	0.556	252.4	6.9	O K
480 min Summer	3.042	0.482	206.2	5.3	O K
600 min Summer	2.999	0.439	176.0	4.4	O K
720 min Summer	2.964	0.404	153.7	3.6	O K
960 min Summer	2.904	0.344	123.1	2.6	O K
1440 min Summer	2.847	0.287	90.1	1.8	O K
2160 min Summer	2.811	0.251	65.6	1.4	O K
2880 min Summer	2.783	0.223	52.4	1.0	O K
4320 min Summer	2.747	0.187	38.1	0.7	O K
5760 min Summer	2.728	0.168	30.5	0.6	O K
7200 min Summer	2.713	0.153	25.4	0.5	O K
8640 min Summer	2.702	0.142	22.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	0.0	514.8	15
30 min Summer	69.587	0.0	691.5	22
60 min Summer	44.560	0.0	885.7	38
120 min Summer	27.503	0.0	1093.3	68
180 min Summer	20.407	0.0	1216.8	96
240 min Summer	16.403	0.0	1304.1	126
360 min Summer	12.073	0.0	1439.7	186
480 min Summer	9.697	0.0	1541.8	246
600 min Summer	8.173	0.0	1624.5	306
720 min Summer	7.104	0.0	1694.4	366
960 min Summer	5.689	0.0	1809.1	484
1440 min Summer	4.152	0.0	1980.4	722
2160 min Summer	3.023	0.0	2163.1	1072
2880 min Summer	2.411	0.0	2299.9	1444
4320 min Summer	1.749	0.0	2502.8	2156
5760 min Summer	1.391	0.0	2654.3	2856
7200 min Summer	1.166	0.0	2779.8	3600
8640 min Summer	1.009	0.0	2888.0	4312

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	2.693	0.133	19.6	0.4	O K
15 min Winter	4.527	1.967	751.1	33.1	O K
30 min Winter	4.657	2.097	779.2	33.3	O K
60 min Winter	3.951	1.391	611.2	25.8	O K
120 min Winter	3.337	0.777	412.8	11.9	O K
180 min Winter	3.189	0.629	312.7	8.6	O K
240 min Winter	3.117	0.557	253.3	6.9	O K
360 min Winter	3.016	0.456	188.0	4.7	O K
480 min Winter	2.959	0.399	151.4	3.6	O K
600 min Winter	2.913	0.353	127.7	2.8	O K
720 min Winter	2.881	0.321	111.1	2.2	O K
960 min Winter	2.846	0.286	89.4	1.8	O K
1440 min Winter	2.810	0.250	65.2	1.3	O K
2160 min Winter	2.771	0.211	47.4	0.9	O K
2880 min Winter	2.747	0.187	37.9	0.7	O K
4320 min Winter	2.721	0.161	27.5	0.5	O K
5760 min Winter	2.701	0.141	21.8	0.4	O K
7200 min Winter	2.688	0.128	18.3	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.893	0.0	2982.9	4960
15 min Winter	103.597	0.0	576.5	14
30 min Winter	69.587	0.0	774.5	21
60 min Winter	44.560	0.0	991.9	38
120 min Winter	27.503	0.0	1224.4	66
180 min Winter	20.407	0.0	1362.8	96
240 min Winter	16.403	0.0	1460.6	128
360 min Winter	12.073	0.0	1612.4	186
480 min Winter	9.697	0.0	1726.8	246
600 min Winter	8.173	0.0	1819.4	306
720 min Winter	7.104	0.0	1897.7	364
960 min Winter	5.689	0.0	2026.2	484
1440 min Winter	4.152	0.0	2218.0	726
2160 min Winter	3.023	0.0	2422.7	1092
2880 min Winter	2.411	0.0	2575.8	1428
4320 min Winter	1.749	0.0	2803.2	2140
5760 min Winter	1.391	0.0	2972.8	2912
7200 min Winter	1.166	0.0	3113.4	3624

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
8640 min Winter	2.680	0.120	15.9	0.3	O K
10080 min Winter	2.673	0.113	14.0	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
8640 min Winter	1.009	0.0	3234.6	4232
10080 min Winter	0.893	0.0	3340.8	5080

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 2.650

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.890	4	8	0.880	8	12	0.880

Model Details

Storage is Online Cover Level (m) 6.000

Pipe Structure

Diameter (m)	0.525	Length (m)	144.000
Slope (1:X)	100.000	Invert Level (m)	2.560

Pipe Outflow Control

Diameter (m)	0.525	Entry Loss Coefficient	0.500
Slope (1:X)	100.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	2.560
Roughness k (mm)	0.600		

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.968	0.468	27.6	981.2	O K
30 min Summer	5.106	0.606	32.1	1294.0	O K
60 min Summer	5.245	0.745	36.0	1619.2	O K
120 min Summer	5.374	0.874	39.3	1931.6	O K
180 min Summer	5.436	0.936	40.8	2086.9	O K
240 min Summer	5.471	0.971	41.6	2173.5	O K
360 min Summer	5.505	1.005	42.4	2259.2	O K
480 min Summer	5.518	1.018	42.7	2293.5	O K
600 min Summer	5.526	1.026	42.9	2313.6	O K
720 min Summer	5.530	1.030	42.9	2323.0	O K
960 min Summer	5.529	1.029	42.9	2320.3	O K
1440 min Summer	5.506	1.006	42.4	2262.8	O K
2160 min Summer	5.453	0.953	41.2	2128.7	O K
2880 min Summer	5.396	0.896	39.8	1985.2	O K
4320 min Summer	5.288	0.788	37.1	1722.9	O K
5760 min Summer	5.198	0.698	34.7	1508.2	O K
7200 min Summer	5.124	0.624	32.6	1335.0	O K
8640 min Summer	5.063	0.563	30.7	1193.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	905.5	26
30 min Summer	53.199	0.0	1218.7	40
60 min Summer	33.892	0.0	1651.9	70
120 min Summer	20.940	0.0	2048.1	128
180 min Summer	15.610	0.0	2293.2	186
240 min Summer	12.614	0.0	2472.2	244
360 min Summer	9.343	0.0	2747.7	360
480 min Summer	7.540	0.0	2956.2	414
600 min Summer	6.381	0.0	3125.5	476
720 min Summer	5.565	0.0	3268.6	538
960 min Summer	4.481	0.0	3502.0	672
1440 min Summer	3.298	0.0	3836.3	946
2160 min Summer	2.424	0.0	4350.0	1360
2880 min Summer	1.946	0.0	4653.4	1760
4320 min Summer	1.427	0.0	5097.3	2548
5760 min Summer	1.144	0.0	5501.6	3288
7200 min Summer	0.964	0.0	5792.0	4040
8640 min Summer	0.839	0.0	6036.5	4760

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
10080 min Summer	5.011	0.511	29.1	1076.0	O K
15 min Winter	5.021	0.521	29.4	1100.1	O K
30 min Winter	5.174	0.674	34.0	1452.2	O K
60 min Winter	5.328	0.828	38.1	1819.2	O K
120 min Winter	5.472	0.972	41.6	2175.5	O K
180 min Winter	5.543	1.043	43.2	2356.8	O K
240 min Winter	5.583	1.083	44.1	2460.8	O K
360 min Winter	5.626	1.126	45.1	2572.8	O K
480 min Winter	5.641	1.141	45.4	2611.5	O K
600 min Winter	5.643	1.143	45.4	2616.9	O K
720 min Winter	5.646	1.146	45.5	2622.7	O K
960 min Winter	5.638	1.138	45.3	2602.8	O K
1440 min Winter	5.596	1.096	44.4	2494.3	O K
2160 min Winter	5.512	1.012	42.5	2277.8	O K
2880 min Winter	5.426	0.926	40.5	2060.5	O K
4320 min Winter	5.273	0.773	36.7	1686.3	O K
5760 min Winter	5.151	0.651	33.4	1397.4	O K
7200 min Winter	5.056	0.556	30.5	1178.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
10080 min Summer	0.745	0.0	6238.5	5456
15 min Winter	79.950	0.0	1019.8	26
30 min Winter	53.199	0.0	1369.1	40
60 min Winter	33.892	0.0	1854.1	68
120 min Winter	20.940	0.0	2297.7	126
180 min Winter	15.610	0.0	2572.1	182
240 min Winter	12.614	0.0	2772.4	238
360 min Winter	9.343	0.0	3080.5	350
480 min Winter	7.540	0.0	3313.6	456
600 min Winter	6.381	0.0	3502.9	498
720 min Winter	5.565	0.0	3662.6	568
960 min Winter	4.481	0.0	3922.0	722
1440 min Winter	3.298	0.0	4287.8	1026
2160 min Winter	2.424	0.0	4874.5	1460
2880 min Winter	1.946	0.0	5214.8	1880
4320 min Winter	1.427	0.0	5713.7	2684
5760 min Winter	1.144	0.0	6163.9	3456
7200 min Winter	0.964	0.0	6489.8	4184

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Winter	4.981	0.481	28.0	1009.4	O K
10080 min Winter	4.921	0.421	25.9	877.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	0.839	0.0	6765.3	4928
10080 min Winter	0.745	0.0	6996.1	5648

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 6.700

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	2.233	4	8	2.233	8	12	2.233

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	1968.0	1.500	2850.0

Orifice Outflow Control

Diameter (m) 0.145 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	5.098	0.598	31.8	1273.9	O K
30 min Summer	5.278	0.778	36.9	1698.1	O K
60 min Summer	5.458	0.958	41.3	2140.4	O K
120 min Summer	5.622	1.122	45.0	2560.9	O K
180 min Summer	5.699	1.199	46.6	2764.5	O K
240 min Summer	5.740	1.240	47.4	2874.7	Flood Risk
360 min Summer	5.784	1.284	48.3	2991.7	Flood Risk
480 min Summer	5.796	1.296	48.5	3026.2	Flood Risk
600 min Summer	5.802	1.302	48.7	3041.5	Flood Risk
720 min Summer	5.804	1.304	48.7	3045.7	Flood Risk
960 min Summer	5.798	1.298	48.6	3031.7	Flood Risk
1440 min Summer	5.768	1.268	48.0	2948.8	Flood Risk
2160 min Summer	5.701	1.201	46.6	2770.2	Flood Risk
2880 min Summer	5.630	1.130	45.1	2581.1	O K
4320 min Summer	5.497	0.997	42.2	2238.5	O K
5760 min Summer	5.384	0.884	39.5	1955.7	O K
7200 min Summer	5.290	0.790	37.2	1727.1	O K
8640 min Summer	5.212	0.712	35.1	1540.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	0.0	1186.4	26
30 min Summer	69.587	0.0	1602.3	41
60 min Summer	44.560	0.0	2182.1	70
120 min Summer	27.503	0.0	2699.7	128
180 min Summer	20.407	0.0	3006.7	186
240 min Summer	16.403	0.0	3222.9	244
360 min Summer	12.073	0.0	3557.1	362
480 min Summer	9.697	0.0	3806.7	448
600 min Summer	8.173	0.0	4006.8	504
720 min Summer	7.104	0.0	4173.8	564
960 min Summer	5.689	0.0	4441.1	692
1440 min Summer	4.152	0.0	4795.7	968
2160 min Summer	3.023	0.0	5430.8	1372
2880 min Summer	2.411	0.0	5769.4	1788
4320 min Summer	1.749	0.0	6254.5	2560
5760 min Summer	1.391	0.0	6693.9	3344
7200 min Summer	1.166	0.0	7006.6	4048
8640 min Summer	1.009	0.0	7270.0	4832

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	5.147	0.647	33.3	1387.2	O K
15 min Winter	5.164	0.664	33.8	1428.3	O K
30 min Winter	5.363	0.863	39.0	1905.3	O K
60 min Winter	5.561	1.061	43.6	2403.9	O K
120 min Winter	5.744	1.244	47.5	2883.4	Flood Risk
180 min Winter	5.831	1.331	49.2	3120.1	Flood Risk
240 min Winter	5.879	1.379	50.2	3252.5	Flood Risk
360 min Winter	5.932	1.432	51.2	3401.9	Flood Risk
480 min Winter	5.952	1.452	51.5	3457.6	Flood Risk
600 min Winter	5.954	1.454	51.6	3463.6	Flood Risk
720 min Winter	5.950	1.450	51.5	3450.7	Flood Risk
960 min Winter	5.939	1.439	51.3	3421.9	Flood Risk
1440 min Winter	5.890	1.390	50.4	3283.4	Flood Risk
2160 min Winter	5.789	1.289	48.4	3007.1	Flood Risk
2880 min Winter	5.685	1.185	46.3	2727.1	O K
4320 min Winter	5.497	0.997	42.2	2238.8	O K
5760 min Winter	5.343	0.843	38.5	1856.0	O K
7200 min Winter	5.221	0.721	35.3	1563.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.893	0.0	7487.2	5544
15 min Winter	103.597	0.0	1333.1	26
30 min Winter	69.587	0.0	1793.1	40
60 min Winter	44.560	0.0	2447.6	68
120 min Winter	27.503	0.0	3026.9	126
180 min Winter	20.407	0.0	3370.2	182
240 min Winter	16.403	0.0	3611.9	240
360 min Winter	12.073	0.0	3985.3	352
480 min Winter	9.697	0.0	4263.5	462
600 min Winter	8.173	0.0	4486.0	564
720 min Winter	7.104	0.0	4671.2	590
960 min Winter	5.689	0.0	4964.1	738
1440 min Winter	4.152	0.0	5334.8	1044
2160 min Winter	3.023	0.0	6085.0	1492
2880 min Winter	2.411	0.0	6464.3	1908
4320 min Winter	1.749	0.0	7007.5	2728
5760 min Winter	1.391	0.0	7499.2	3512
7200 min Winter	1.166	0.0	7850.2	4256

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Winter	5.124	0.624	32.6	1334.9	O K
10080 min Winter	5.046	0.546	30.2	1155.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	1.009	0.0	8147.0	5008
10080 min Winter	0.893	0.0	8394.8	5664

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 6.700

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	2.233	4	8	2.233	8	12	2.233

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1968.0	1.500	2850.0

Orifice Outflow Control

Diameter (m) 0.145 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.994	0.494	19.5	681.7	O K
30 min Summer	5.136	0.636	22.4	899.1	O K
60 min Summer	5.278	0.778	25.1	1124.7	O K
120 min Summer	5.408	0.908	27.2	1340.8	O K
180 min Summer	5.471	0.971	28.2	1447.9	O K
240 min Summer	5.505	1.005	28.7	1507.3	O K
360 min Summer	5.538	1.038	29.2	1565.6	O K
480 min Summer	5.551	1.051	29.4	1587.5	O K
600 min Summer	5.558	1.058	29.5	1599.7	O K
720 min Summer	5.560	1.060	29.6	1604.7	O K
960 min Summer	5.558	1.058	29.5	1600.1	O K
1440 min Summer	5.533	1.033	29.2	1556.2	O K
2160 min Summer	5.477	0.977	28.3	1459.6	O K
2880 min Summer	5.418	0.918	27.4	1358.0	O K
4320 min Summer	5.308	0.808	25.6	1174.9	O K
5760 min Summer	5.216	0.716	24.0	1025.0	O K
7200 min Summer	5.140	0.640	22.5	904.4	O K
8640 min Summer	5.076	0.576	21.2	805.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	648.0	26
30 min Summer	53.199	0.0	868.1	40
60 min Summer	33.892	0.0	1159.8	70
120 min Summer	20.940	0.0	1436.3	128
180 min Summer	15.610	0.0	1607.4	186
240 min Summer	12.614	0.0	1732.4	244
360 min Summer	9.343	0.0	1925.1	360
480 min Summer	7.540	0.0	2071.1	416
600 min Summer	6.381	0.0	2189.7	478
720 min Summer	5.565	0.0	2290.2	540
960 min Summer	4.481	0.0	2454.5	674
1440 min Summer	3.298	0.0	2691.5	948
2160 min Summer	2.424	0.0	3033.3	1364
2880 min Summer	1.946	0.0	3245.6	1764
4320 min Summer	1.427	0.0	3559.0	2552
5760 min Summer	1.144	0.0	3830.3	3288
7200 min Summer	0.964	0.0	4033.3	4040
8640 min Summer	0.839	0.0	4205.5	4760

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	5.022	0.522	20.1	723.4	O K
15 min Winter	5.049	0.549	20.7	764.5	O K
30 min Winter	5.206	0.706	23.8	1009.2	O K
60 min Winter	5.362	0.862	26.5	1264.0	O K
120 min Winter	5.507	1.007	28.8	1510.9	O K
180 min Winter	5.578	1.078	29.8	1636.3	O K
240 min Winter	5.618	1.118	30.4	1708.0	O K
360 min Winter	5.661	1.161	31.0	1785.0	O K
480 min Winter	5.675	1.175	31.2	1811.1	O K
600 min Winter	5.676	1.176	31.2	1813.0	O K
720 min Winter	5.678	1.178	31.3	1815.7	O K
960 min Winter	5.669	1.169	31.1	1799.8	O K
1440 min Winter	5.626	1.126	30.5	1721.4	O K
2160 min Winter	5.539	1.039	29.3	1567.8	O K
2880 min Winter	5.451	0.951	27.9	1414.7	O K
4320 min Winter	5.295	0.795	25.3	1152.5	O K
5760 min Winter	5.169	0.669	23.1	950.5	O K
7200 min Winter	5.070	0.570	21.1	797.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.745	0.0	4349.9	5456
15 min Winter	79.950	0.0	728.3	26
30 min Winter	53.199	0.0	973.7	40
60 min Winter	33.892	0.0	1300.8	68
120 min Winter	20.940	0.0	1610.4	126
180 min Winter	15.610	0.0	1801.9	182
240 min Winter	12.614	0.0	1941.9	238
360 min Winter	9.343	0.0	2157.4	350
480 min Winter	7.540	0.0	2320.6	456
600 min Winter	6.381	0.0	2453.2	504
720 min Winter	5.565	0.0	2565.3	570
960 min Winter	4.481	0.0	2748.0	722
1440 min Winter	3.298	0.0	3006.6	1028
2160 min Winter	2.424	0.0	3398.5	1468
2880 min Winter	1.946	0.0	3636.4	1880
4320 min Winter	1.427	0.0	3988.1	2684
5760 min Winter	1.144	0.0	4290.9	3456
7200 min Winter	0.964	0.0	4518.6	4184

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Winter	4.992	0.492	19.4	678.9	O K
10080 min Winter	4.929	0.429	18.0	586.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	0.839	0.0	4712.3	4928
10080 min Winter	0.745	0.0	4876.4	5648

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 4.660

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.553	4	8	1.553	8	12	1.553

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1271.0	1.500	2000.0

Orifice Outflow Control

Diameter (m) 0.119 Discharge Coefficient 0.600 Invert Level (m) 4.500

CH2M		Page 1
Ash House Falcon Road Exeter EX2 7LB		
Date 22/05/2018 17:12 File BASIN_2.SRCX	Designed by GR061116 Checked by	
XP Solutions	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	5.127	0.627	22.3	885.4	O K
30 min Summer	5.312	0.812	25.6	1180.3	O K
60 min Summer	5.493	0.993	28.6	1487.4	O K
120 min Summer	5.658	1.158	31.0	1779.2	O K
180 min Summer	5.734	1.234	32.0	1920.3	Flood Risk
240 min Summer	5.775	1.275	32.6	1996.5	Flood Risk
360 min Summer	5.818	1.318	33.2	2077.5	Flood Risk
480 min Summer	5.830	1.330	33.3	2100.6	Flood Risk
600 min Summer	5.835	1.335	33.4	2109.5	Flood Risk
720 min Summer	5.835	1.335	33.4	2110.9	Flood Risk
960 min Summer	5.829	1.329	33.3	2098.7	Flood Risk
1440 min Summer	5.797	1.297	32.9	2037.5	Flood Risk
2160 min Summer	5.729	1.229	32.0	1910.1	Flood Risk
2880 min Summer	5.656	1.156	31.0	1776.9	O K
4320 min Summer	5.522	1.022	29.0	1536.8	O K
5760 min Summer	5.407	0.907	27.2	1340.0	O K
7200 min Summer	5.312	0.812	25.6	1180.4	O K
8640 min Summer	5.232	0.732	24.2	1050.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	0.0	845.3	26
30 min Summer	69.587	0.0	1137.3	41
60 min Summer	44.560	0.0	1529.6	70
120 min Summer	27.503	0.0	1890.8	128
180 min Summer	20.407	0.0	2105.3	186
240 min Summer	16.403	0.0	2256.3	244
360 min Summer	12.073	0.0	2490.1	362
480 min Summer	9.697	0.0	2664.9	454
600 min Summer	8.173	0.0	2805.2	506
720 min Summer	7.104	0.0	2922.5	568
960 min Summer	5.689	0.0	3110.7	694
1440 min Summer	4.152	0.0	3360.6	970
2160 min Summer	3.023	0.0	3785.7	1384
2880 min Summer	2.411	0.0	4022.5	1788
4320 min Summer	1.749	0.0	4365.1	2560
5760 min Summer	1.391	0.0	4659.6	3344
7200 min Summer	1.166	0.0	4878.2	4104
8640 min Summer	1.009	0.0	5063.6	4840

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	5.164	0.664	23.0	942.7	O K
15 min Winter	5.196	0.696	23.6	992.9	O K
30 min Winter	5.398	0.898	27.1	1324.5	O K
60 min Winter	5.598	1.098	30.1	1671.0	O K
120 min Winter	5.779	1.279	32.6	2004.1	Flood Risk
180 min Winter	5.865	1.365	33.8	2168.4	Flood Risk
240 min Winter	5.913	1.413	34.4	2260.4	Flood Risk
360 min Winter	5.966	1.466	35.1	2364.3	Flood Risk
480 min Winter	5.985	1.485	35.3	2403.1	Flood Risk
600 min Winter	5.987	1.487	35.3	2407.3	Flood Risk
720 min Winter	5.982	1.482	35.3	2395.9	Flood Risk
960 min Winter	5.971	1.471	35.1	2374.2	Flood Risk
1440 min Winter	5.921	1.421	34.5	2275.8	Flood Risk
2160 min Winter	5.820	1.320	33.2	2081.2	Flood Risk
2880 min Winter	5.715	1.215	31.8	1884.4	Flood Risk
4320 min Winter	5.525	1.025	29.0	1542.2	O K
5760 min Winter	5.368	0.868	26.6	1274.2	O K
7200 min Winter	5.243	0.743	24.4	1068.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.893	0.0	5218.7	5552
15 min Winter	103.597	0.0	948.3	26
30 min Winter	69.587	0.0	1271.0	40
60 min Winter	44.560	0.0	1714.8	68
120 min Winter	27.503	0.0	2119.1	126
180 min Winter	20.407	0.0	2359.0	182
240 min Winter	16.403	0.0	2527.8	240
360 min Winter	12.073	0.0	2789.0	354
480 min Winter	9.697	0.0	2983.8	462
600 min Winter	8.173	0.0	3139.8	566
720 min Winter	7.104	0.0	3269.8	596
960 min Winter	5.689	0.0	3475.4	740
1440 min Winter	4.152	0.0	3731.7	1046
2160 min Winter	3.023	0.0	4241.1	1492
2880 min Winter	2.411	0.0	4506.4	1912
4320 min Winter	1.749	0.0	4889.7	2728
5760 min Winter	1.391	0.0	5219.7	3512
7200 min Winter	1.166	0.0	5464.9	4256

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Winter	5.142	0.642	22.6	908.6	O K
10080 min Winter	5.061	0.561	20.9	782.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Winter	1.009	0.0	5673.5	5008
10080 min Winter	0.893	0.0	5849.7	5744

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 4.660

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.553	4	8	1.553	8	12	1.553

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	1271.0	1.500	2000.0

Orifice Outflow Control

Diameter (m) 0.119 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 80 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	7.469	0.869	0.0	2.3	2.3	13.0	O K
30 min Summer	7.620	1.020	0.0	2.3	2.3	16.4	O K
60 min Summer	7.713	1.113	0.0	2.3	2.3	18.5	Flood Risk
120 min Summer	7.707	1.107	0.0	2.3	2.3	18.3	Flood Risk
180 min Summer	7.676	1.076	0.0	2.3	2.3	17.6	O K
240 min Summer	7.637	1.037	0.0	2.3	2.3	16.7	O K
360 min Summer	7.553	0.953	0.0	2.3	2.3	14.9	O K
480 min Summer	7.468	0.868	0.0	2.3	2.3	12.9	O K
600 min Summer	7.389	0.789	0.0	2.3	2.3	11.1	O K
720 min Summer	7.318	0.718	0.0	2.3	2.3	9.3	O K
960 min Summer	7.180	0.580	0.0	2.2	2.2	6.3	O K
1440 min Summer	6.921	0.321	0.0	2.2	2.2	2.2	O K
2160 min Summer	6.600	0.000	0.0	2.1	2.1	0.0	O K
2880 min Summer	6.600	0.000	0.0	1.7	1.7	0.0	O K
4320 min Summer	6.600	0.000	0.0	1.2	1.2	0.0	O K
5760 min Summer	6.600	0.000	0.0	1.0	1.0	0.0	O K
7200 min Summer	6.600	0.000	0.0	0.8	0.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	15.8	21
30 min Summer	53.199	0.0	21.0	34
60 min Summer	33.892	0.0	26.6	62
120 min Summer	20.940	0.0	33.1	96
180 min Summer	15.610	0.0	36.8	130
240 min Summer	12.614	0.0	39.7	164
360 min Summer	9.343	0.0	44.1	232
480 min Summer	7.540	0.0	47.5	300
600 min Summer	6.381	0.0	50.2	364
720 min Summer	5.565	0.0	52.6	426
960 min Summer	4.481	0.0	56.4	548
1440 min Summer	3.298	0.0	62.3	772
2160 min Summer	2.424	0.0	68.7	0
2880 min Summer	1.946	0.0	73.6	0
4320 min Summer	1.427	0.0	80.9	0
5760 min Summer	1.144	0.0	86.5	0
7200 min Summer	0.964	0.0	91.1	0

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	6.600	0.000	0.0	0.7	0.7	0.0	O K
10080 min Summer	6.600	0.000	0.0	0.6	0.6	0.0	O K
15 min Winter	7.552	0.952	0.0	2.3	2.3	14.8	O K
30 min Winter	7.733	1.133	0.0	2.3	2.3	18.9	Flood Risk
60 min Winter	7.858	1.258	0.0	2.3	2.3	21.7	Flood Risk
120 min Winter	7.859	1.259	0.0	2.3	2.3	21.7	Flood Risk
180 min Winter	7.811	1.211	0.0	2.3	2.3	20.7	Flood Risk
240 min Winter	7.749	1.149	0.0	2.3	2.3	19.3	Flood Risk
360 min Winter	7.614	1.014	0.0	2.3	2.3	16.2	O K
480 min Winter	7.478	0.878	0.0	2.3	2.3	13.2	O K
600 min Winter	7.357	0.757	0.0	2.3	2.3	10.3	O K
720 min Winter	7.246	0.646	0.0	2.2	2.2	7.7	O K
960 min Winter	7.016	0.416	0.0	2.2	2.2	3.4	O K
1440 min Winter	6.600	0.000	0.0	2.0	2.0	0.0	O K
2160 min Winter	6.600	0.000	0.0	1.5	1.5	0.0	O K
2880 min Winter	6.600	0.000	0.0	1.2	1.2	0.0	O K
4320 min Winter	6.600	0.000	0.0	0.9	0.9	0.0	O K
5760 min Winter	6.600	0.000	0.0	0.7	0.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	0.839	0.0	95.1	0
10080 min Summer	0.745	0.0	98.6	0
15 min Winter	79.950	0.0	17.6	21
30 min Winter	53.199	0.0	23.5	34
60 min Winter	33.892	0.0	29.9	62
120 min Winter	20.940	0.0	37.0	104
180 min Winter	15.610	0.0	41.4	140
240 min Winter	12.614	0.0	44.4	178
360 min Winter	9.343	0.0	49.4	252
480 min Winter	7.540	0.0	53.1	322
600 min Winter	6.381	0.0	56.2	388
720 min Winter	5.565	0.0	59.0	450
960 min Winter	4.481	0.0	63.2	562
1440 min Winter	3.298	0.0	69.8	0
2160 min Winter	2.424	0.0	77.0	0
2880 min Winter	1.946	0.0	82.4	0
4320 min Winter	1.427	0.0	90.6	0
5760 min Winter	1.144	0.0	96.9	0

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
7200 min Winter	6.600	0.000	0.0	0.6	0.6	0.0	O K
8640 min Winter	6.600	0.000	0.0	0.5	0.5	0.0	O K
10080 min Winter	6.600	0.000	0.0	0.5	0.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	0.964	0.0	102.0	0
8640 min Winter	0.839	0.0	106.5	0
10080 min Winter	0.745	0.0	110.4	0

Summary of Results for 100 year Return Period (+10%)

Half Drain Time : 119 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	7.671	1.071	0.0	2.3	2.3	17.5	O K
30 min Summer	7.899	1.299	0.0	2.3	2.3	22.6	Flood Risk
60 min Summer	8.002	1.402	0.0	2.4	2.4	26.5	FLOOD
120 min Summer	8.002	1.402	0.0	2.4	2.4	27.3	FLOOD
180 min Summer	8.001	1.401	0.0	2.4	2.4	26.3	FLOOD
240 min Summer	8.000	1.400	0.0	2.4	2.4	25.2	FLOOD
360 min Summer	7.924	1.324	0.0	2.3	2.3	23.2	Flood Risk
480 min Summer	7.829	1.229	0.0	2.3	2.3	21.1	Flood Risk
600 min Summer	7.735	1.135	0.0	2.3	2.3	19.0	Flood Risk
720 min Summer	7.644	1.044	0.0	2.3	2.3	16.9	O K
960 min Summer	7.474	0.874	0.0	2.3	2.3	13.1	O K
1440 min Summer	7.213	0.613	0.0	2.2	2.2	7.0	O K
2160 min Summer	6.873	0.273	0.0	2.2	2.2	1.6	O K
2880 min Summer	6.600	0.000	0.0	2.1	2.1	0.0	O K
4320 min Summer	6.600	0.000	0.0	1.5	1.5	0.0	O K
5760 min Summer	6.600	0.000	0.0	1.2	1.2	0.0	O K
7200 min Summer	6.600	0.000	0.0	1.0	1.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.597	0.0	20.4	21
30 min Summer	69.587	0.0	27.4	35
60 min Summer	44.560	1.6	35.0	62
120 min Summer	27.503	2.3	43.4	108
180 min Summer	20.407	1.4	48.3	140
240 min Summer	16.403	0.3	51.7	172
360 min Summer	12.073	0.0	56.9	242
480 min Summer	9.697	0.0	61.2	310
600 min Summer	8.173	0.0	64.3	376
720 min Summer	7.104	0.0	67.2	442
960 min Summer	5.689	0.0	71.6	568
1440 min Summer	4.152	0.0	78.5	808
2160 min Summer	3.023	0.0	85.7	1132
2880 min Summer	2.411	0.0	91.1	0
4320 min Summer	1.749	0.0	99.2	0
5760 min Summer	1.391	0.0	105.2	0
7200 min Summer	1.166	0.0	110.1	0

Summary of Results for 100 year Return Period (+10%)

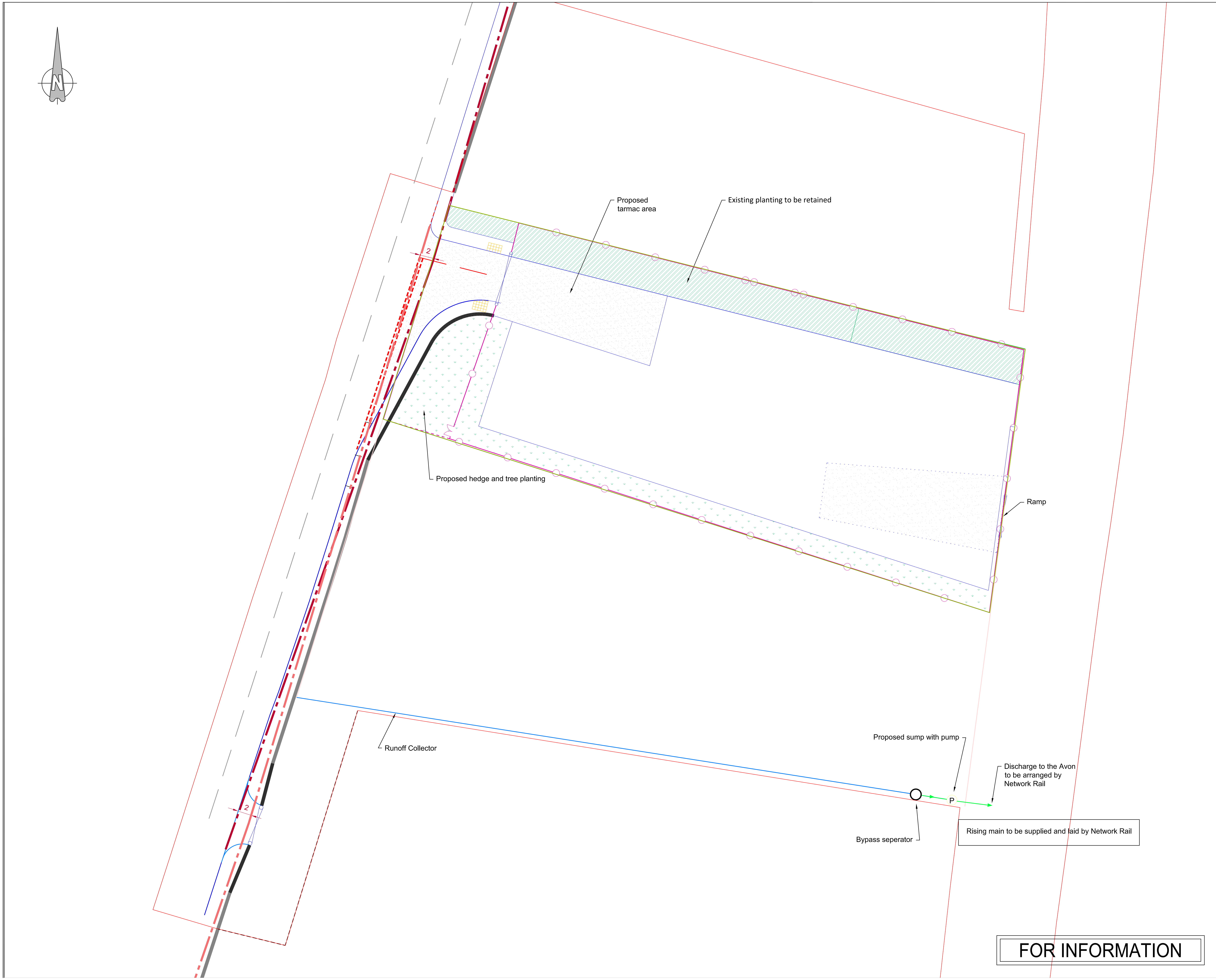
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	6.600	0.000	0.0	0.9	0.9	0.0	O K
10080 min Summer	6.600	0.000	0.0	0.8	0.8	0.0	O K
15 min Winter	7.779	1.179	0.0	2.3	2.3	20.0	Flood Risk
30 min Winter	8.001	1.401	0.0	2.4	2.4	26.0	FLOOD
60 min Winter	8.006	1.406	0.0	2.4	2.4	30.9	FLOOD
120 min Winter	8.008	1.408	0.0	2.4	2.4	32.7	FLOOD
180 min Winter	8.006	1.406	0.0	2.4	2.4	31.2	FLOOD
240 min Winter	8.005	1.405	0.0	2.4	2.4	29.7	FLOOD
360 min Winter	8.002	1.402	0.0	2.4	2.4	26.5	FLOOD
480 min Winter	7.922	1.322	0.0	2.3	2.3	23.2	Flood Risk
600 min Winter	7.774	1.174	0.0	2.3	2.3	19.8	Flood Risk
720 min Winter	7.633	1.033	0.0	2.3	2.3	16.7	O K
960 min Winter	7.385	0.785	0.0	2.3	2.3	11.0	O K
1440 min Winter	6.968	0.368	0.0	2.2	2.2	2.8	O K
2160 min Winter	6.600	0.000	0.0	1.9	1.9	0.0	O K
2880 min Winter	6.600	0.000	0.0	1.5	1.5	0.0	O K
4320 min Winter	6.600	0.000	0.0	1.1	1.1	0.0	O K
5760 min Winter	6.600	0.000	0.0	0.9	0.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.009	0.0	114.4	0
10080 min Summer	0.893	0.0	118.2	0
15 min Winter	103.597	0.0	22.9	22
30 min Winter	69.587	1.0	30.6	35
60 min Winter	44.560	5.8	39.4	62
120 min Winter	27.503	7.6	48.4	118
180 min Winter	20.407	6.1	54.1	150
240 min Winter	16.403	4.6	57.9	188
360 min Winter	12.073	1.6	63.8	262
480 min Winter	9.697	0.0	68.4	336
600 min Winter	8.173	0.0	72.1	406
720 min Winter	7.104	0.0	75.3	474
960 min Winter	5.689	0.0	80.2	600
1440 min Winter	4.152	0.0	87.8	816
2160 min Winter	3.023	0.0	96.0	0
2880 min Winter	2.411	0.0	102.1	0
4320 min Winter	1.749	0.0	111.1	0
5760 min Winter	1.391	0.0	117.8	0

Summary of Results for 100 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
7200 min Winter	6.600	0.000	0.0	0.7	0.7	0.0	O K
8640 min Winter	6.600	0.000	0.0	0.6	0.6	0.0	O K
10080 min Winter	6.600	0.000	0.0	0.6	0.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Winter	1.166	0.0	123.4	0
8640 min Winter	1.009	0.0	128.2	0
10080 min Winter	0.893	0.0	132.4	0



FOR INFORMATION

This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 5 10 15 20
SCALE 1:250 (A1) METRES
SCALE 1:500 (A3)

Notes:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in metres unless noted otherwise.
5. The indicative layout is based on a topographical survey.
6. Outfalls should be monitored on a regular basis and quipped with shut-off valves..
7. Proposed drainage concept to be subjected to Railway Network consent for discharge points.

KEY:

- Proposed catchpit
- Proposed pipeline
- Proposed Runoff collector
- Temporary compound
- Proposed fence
- Red line boundary
- Proposed road kerb

Rev	By	Chkd	Apprvd	Date	Description
A	GRM				

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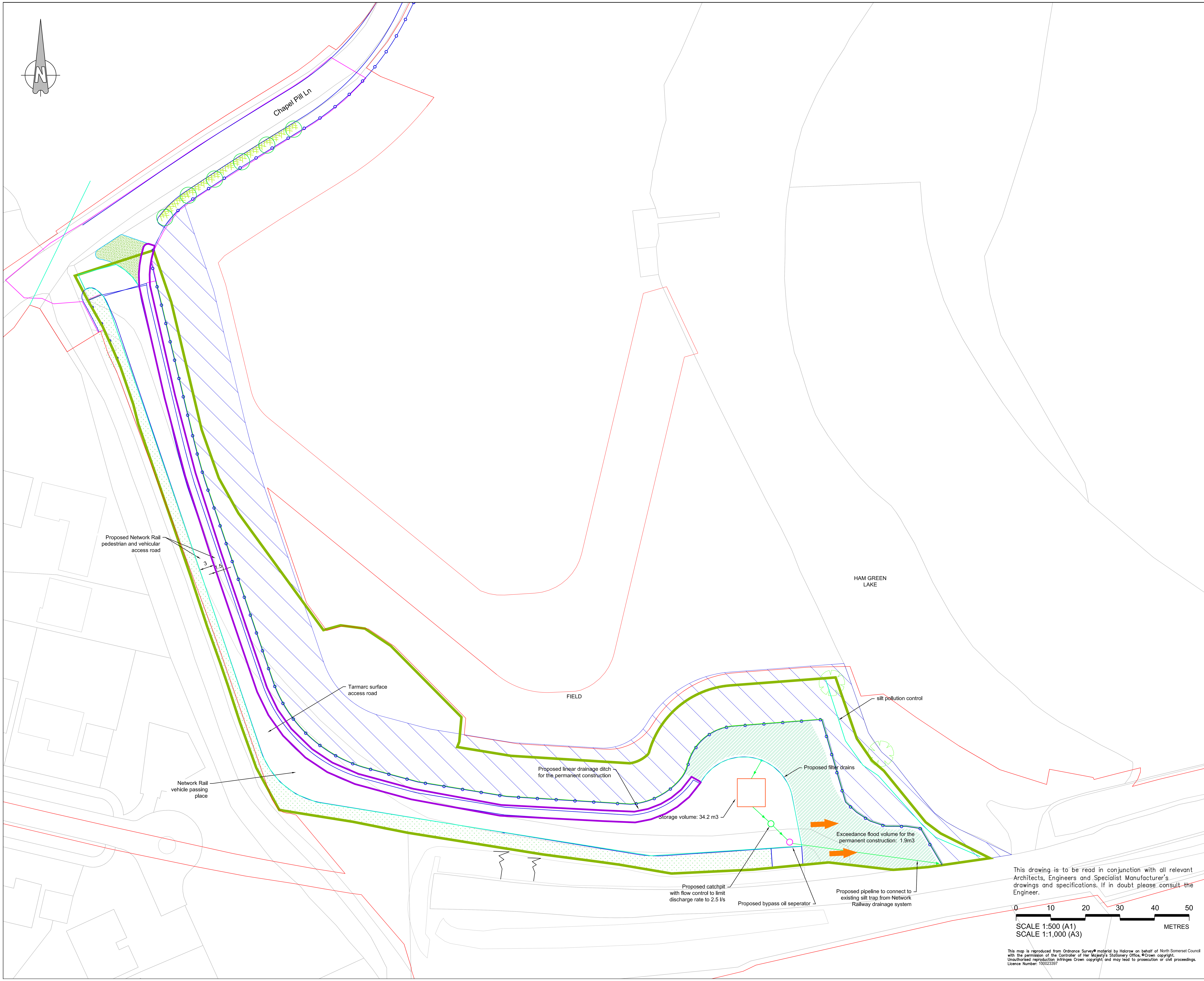
Project
PORTISHEAD BRANCH LINE
METROWEST PHASE 1

Drawing
CLANAGE ROAD
PERMANENT NETWORK RAIL
AND CONSTRUCTION COMPOUND

Drawn by: GRM Date: 29/06/2018
Checked by: Date:
Approved by: Date:

Drawing No. 467470.BQ.04.20-DS-C4 Revision A

Drawing Scale: 1:250 @ A1



This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 10 20 30 40 50
SCALE 1:500 (A1)
SCALE 1:1,000 (A3)
METRES

Notes:
1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in metres unless noted otherwise.
5. The indicative layout is based on a topographical survey.
6. Outfalls should be monitored on a regular basis and quipped with shut-off valves..

KEY:

- Proposed catchpit
- Proposed bypass oil seperator
- Proposed pipeline
- Proposed ditch
- Red line boundary
- Silt pollution control
- Proposed storage
- Sub-catchment B
- Exceedance route
- Filter Drain
- Highway works
- Network Rail works
- Right to be Acquired Permanently
- Proposed road kerb
- Grasscrete & dropped kerb
- Proposed fence
- Trees to be retained
- Proposed tree
- Proposed hedge

FOR INFORMATION

Rev	By	Chkd	Apprvd	Date	Description
A	DFS	-	-	15/05/2018	FOR INFORMATION

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
C9 HAM GREEN COMPOUND
DRAINAGE STRATEGY

Drawn by: MA Date: 02/07/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-DS-C9
Revision A

Drawing Scale: 1:250 @ A1

Drawing file path & name : \\EXTFPP01\Proj\Transportation\Projects\MetroWest\100 Drawings\Construction Compounds\Ham Green Compound\Revised\ 467470.BQ.04.20-DS-C9.dwg

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 308 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.642	0.442	0.0	1.8	1.8	31.0	O K
30 min Summer	5.695	0.495	0.0	1.9	1.9	40.6	O K
60 min Summer	5.740	0.540	0.0	2.0	2.0	49.8	Flood Risk
120 min Summer	5.775	0.575	0.0	2.0	2.0	57.3	Flood Risk
180 min Summer	5.786	0.586	0.0	2.0	2.0	59.7	Flood Risk
240 min Summer	5.788	0.588	0.0	2.0	2.0	60.2	Flood Risk
360 min Summer	5.787	0.587	0.0	2.0	2.0	59.9	Flood Risk
480 min Summer	5.783	0.583	0.0	2.0	2.0	59.0	Flood Risk
600 min Summer	5.777	0.577	0.0	2.0	2.0	57.8	Flood Risk
720 min Summer	5.771	0.571	0.0	2.0	2.0	56.4	Flood Risk
960 min Summer	5.757	0.557	0.0	2.0	2.0	53.4	Flood Risk
1440 min Summer	5.730	0.530	0.0	1.9	1.9	47.7	Flood Risk
2160 min Summer	5.691	0.491	0.0	1.9	1.9	39.9	O K
2880 min Summer	5.655	0.455	0.0	1.8	1.8	33.3	O K
4320 min Summer	5.590	0.390	0.0	1.6	1.6	23.1	O K
5760 min Summer	5.535	0.335	0.0	1.5	1.5	16.2	O K
7200 min Summer	5.489	0.289	0.0	1.4	1.4	11.6	O K
8640 min Summer	5.451	0.251	0.0	1.3	1.3	8.4	O K
10080 min Summer	5.419	0.219	0.0	1.2	1.2	6.2	O K
15 min Winter	5.665	0.465	0.0	1.8	1.8	34.9	O K
30 min Winter	5.721	0.521	0.0	1.9	1.9	45.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	32.8	23
30 min Summer	67.708	0.0	43.7	37
60 min Summer	43.136	0.0	55.6	66
120 min Summer	26.651	0.0	68.8	124
180 min Summer	19.868	0.0	76.9	182
240 min Summer	16.054	0.0	82.8	228
360 min Summer	11.891	0.0	92.0	286
480 min Summer	9.596	0.0	99.0	350
600 min Summer	8.121	0.0	104.8	420
720 min Summer	7.083	0.0	109.6	490
960 min Summer	5.703	0.0	117.7	626
1440 min Summer	4.198	0.0	130.0	898
2160 min Summer	3.085	0.0	143.3	1296
2880 min Summer	2.477	0.0	153.4	1672
4320 min Summer	1.816	0.0	168.7	2384
5760 min Summer	1.456	0.0	180.3	3112
7200 min Summer	1.227	0.0	189.9	3816
8640 min Summer	1.067	0.0	198.2	4496
10080 min Summer	0.948	0.0	205.6	5240
15 min Winter	101.754	0.0	36.8	23
30 min Winter	67.708	0.0	48.9	37

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	5.771	0.571	0.0	2.0	2.0	56.4	Flood Risk
120 min Winter	5.811	0.611	0.0	2.1	2.1	65.5	Flood Risk
180 min Winter	5.825	0.625	0.0	2.1	2.1	68.9	Flood Risk
240 min Winter	5.829	0.629	0.0	2.1	2.1	69.9	Flood Risk
360 min Winter	5.827	0.627	0.0	2.1	2.1	69.4	Flood Risk
480 min Winter	5.822	0.622	0.0	2.1	2.1	68.2	Flood Risk
600 min Winter	5.815	0.615	0.0	2.1	2.1	66.5	Flood Risk
720 min Winter	5.806	0.606	0.0	2.1	2.1	64.5	Flood Risk
960 min Winter	5.787	0.587	0.0	2.0	2.0	59.9	Flood Risk
1440 min Winter	5.746	0.546	0.0	2.0	2.0	51.0	Flood Risk
2160 min Winter	5.688	0.488	0.0	1.9	1.9	39.3	O K
2880 min Winter	5.635	0.435	0.0	1.7	1.7	29.9	O K
4320 min Winter	5.542	0.342	0.0	1.5	1.5	17.1	O K
5760 min Winter	5.468	0.268	0.0	1.4	1.4	9.8	O K
7200 min Winter	5.413	0.213	0.0	1.2	1.2	5.8	O K
8640 min Winter	5.372	0.172	0.0	1.1	1.1	3.6	O K
10080 min Winter	5.342	0.142	0.0	1.0	1.0	2.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.136	0.0	62.3	64
120 min Winter	26.651	0.0	77.0	122
180 min Winter	19.868	0.0	86.1	178
240 min Winter	16.054	0.0	92.8	232
360 min Winter	11.891	0.0	103.1	326
480 min Winter	9.596	0.0	110.9	376
600 min Winter	8.121	0.0	117.3	452
720 min Winter	7.083	0.0	122.8	530
960 min Winter	5.703	0.0	131.8	680
1440 min Winter	4.198	0.0	145.6	968
2160 min Winter	3.085	0.0	160.4	1368
2880 min Winter	2.477	0.0	171.8	1760
4320 min Winter	1.816	0.0	188.9	2468
5760 min Winter	1.456	0.0	201.9	3168
7200 min Winter	1.227	0.0	212.7	3816
8640 min Winter	1.067	0.0	222.0	4496
10080 min Winter	0.948	0.0	230.2	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.172

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	3	0.057	3	6	0.057	6	9	0.058

Model Details

Storage is Online Cover Level (m) 6.000

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	190.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	1.0
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	5.200	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.036 Discharge Coefficient 0.600 Invert Level (m) 5.200

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 145 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.561	0.761	0.0	1.8	1.8	21.7	O K
30 min Summer	5.566	0.766	0.0	1.8	1.8	21.8	O K
60 min Summer	5.578	0.778	0.0	1.8	1.8	22.2	O K
120 min Summer	5.606	0.806	0.0	1.9	1.9	23.0	O K
180 min Summer	5.637	0.837	0.0	1.9	1.9	23.8	O K
240 min Summer	5.680	0.880	0.0	2.0	2.0	25.1	O K
360 min Summer	5.783	0.983	0.0	2.1	2.1	28.0	Flood Risk
480 min Summer	5.840	1.040	0.0	2.2	2.2	29.6	Flood Risk
600 min Summer	5.878	1.078	0.0	2.2	2.2	30.7	Flood Risk
720 min Summer	5.905	1.105	0.0	2.3	2.3	31.5	Flood Risk
960 min Summer	5.916	1.116	0.0	2.3	2.3	31.8	Flood Risk
1440 min Summer	5.807	1.007	0.0	2.1	2.1	28.7	Flood Risk
2160 min Summer	5.594	0.794	0.0	1.8	1.8	22.6	O K
2880 min Summer	5.580	0.780	0.0	1.8	1.8	22.2	O K
4320 min Summer	5.569	0.769	0.0	1.8	1.8	21.9	O K
5760 min Summer	5.564	0.764	0.0	1.8	1.8	21.8	O K
7200 min Summer	5.561	0.761	0.0	1.8	1.8	21.7	O K
8640 min Summer	5.559	0.759	0.0	1.8	1.8	21.6	O K
10080 min Summer	5.557	0.757	0.0	1.8	1.8	21.6	O K
15 min Winter	5.562	0.762	0.0	1.8	1.8	21.7	O K
30 min Winter	5.569	0.769	0.0	1.8	1.8	21.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	93.0	580
30 min Summer	67.708	0.0	95.0	580
60 min Summer	43.136	0.0	97.4	502
120 min Summer	26.651	0.0	99.8	500
180 min Summer	19.868	0.0	101.3	500
240 min Summer	16.054	0.0	102.4	408
360 min Summer	11.891	0.0	104.1	364
480 min Summer	9.596	0.0	105.4	410
600 min Summer	8.121	0.0	106.5	430
720 min Summer	7.083	0.0	107.4	490
960 min Summer	5.703	0.0	108.9	584
1440 min Summer	4.198	0.0	111.2	794
2160 min Summer	3.085	0.0	113.7	584
2880 min Summer	2.477	0.0	115.5	584
4320 min Summer	1.816	0.0	118.4	584
5760 min Summer	1.456	0.0	120.5	584
7200 min Summer	1.227	0.0	122.3	584
8640 min Summer	1.067	0.0	123.8	576
10080 min Summer	0.948	0.0	125.2	576
15 min Winter	101.754	0.0	93.7	580
30 min Winter	67.708	0.0	96.0	580

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	5.584	0.784	0.0	1.8	1.8	22.3	O K
120 min Winter	5.617	0.817	0.0	1.9	1.9	23.3	O K
180 min Winter	5.656	0.856	0.0	1.9	1.9	24.4	O K
240 min Winter	5.704	0.904	0.0	2.0	2.0	25.8	Flood Risk
360 min Winter	5.825	1.025	0.0	2.2	2.2	29.2	Flood Risk
480 min Winter	5.884	1.084	0.0	2.2	2.2	30.9	Flood Risk
600 min Winter	5.920	1.120	0.0	2.3	2.3	31.9	Flood Risk
720 min Winter	5.941	1.141	0.0	2.3	2.3	32.5	Flood Risk
960 min Winter	5.928	1.128	0.0	2.3	2.3	32.2	Flood Risk
1440 min Winter	5.796	0.996	0.0	2.1	2.1	28.4	Flood Risk
2160 min Winter	5.609	0.809	0.0	1.9	1.9	23.1	O K
2880 min Winter	5.587	0.787	0.0	1.8	1.8	22.4	O K
4320 min Winter	5.574	0.774	0.0	1.8	1.8	22.1	O K
5760 min Winter	5.567	0.767	0.0	1.8	1.8	21.9	O K
7200 min Winter	5.562	0.762	0.0	1.8	1.8	21.7	O K
8640 min Winter	5.559	0.759	0.0	1.8	1.8	21.6	O K
10080 min Winter	5.556	0.756	0.0	1.8	1.8	21.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.136	0.0	98.6	502
120 min Winter	26.651	0.0	101.3	500
180 min Winter	19.868	0.0	103.0	410
240 min Winter	16.054	0.0	104.3	390
360 min Winter	11.891	0.0	106.2	356
480 min Winter	9.596	0.0	107.6	410
600 min Winter	8.121	0.0	108.8	452
720 min Winter	7.083	0.0	109.9	502
960 min Winter	5.703	0.0	111.5	620
1440 min Winter	4.198	0.0	114.1	786
2160 min Winter	3.085	0.0	116.9	648
2880 min Winter	2.477	0.0	119.0	584
4320 min Winter	1.816	0.0	122.1	584
5760 min Winter	1.456	0.0	124.5	584
7200 min Winter	1.227	0.0	126.5	584
8640 min Winter	1.067	0.0	128.2	584
10080 min Winter	0.948	0.0	129.7	584

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.032

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	3	0.011	3	6	0.011	6	9	0.010

Model Details

Storage is Online Cover Level (m) 6.000

Cellular Storage Structure

Invert Level (m) 4.800 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	1.201	0.0	0.0
1.200	30.0	0.0			

Orifice Outflow Control

Diameter (m) 0.034 Discharge Coefficient 0.600 Invert Level (m) 5.000

Notes:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in metres unless noted otherwise.
5. The indicative layout is based on a topographical survey.
6. Outfalls should be monitored on a regular basis and quipped with shut-off valves..
7. Due to possible lack of gradient in existing watercourses, pumping might be required for the proposed compound.

This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 10 20 30 40 50 60 70 80 90 100 METRES

SCALE 1:1,000 (A1)
SCALE 1:2,000 (A3)

KEY:

- Proposed catchpit
- Proposed bypass separator
- Proposed runoff collector
- Proposed pipeline
- Red line boundary
- Proposed basin
- Proposed filter drain
- Reptile Site
- Archaeology

Rev	By	Chkd	Apprvd	Date	Description
A	GRM	-	-	23/05/2018	First Issue

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Project
PORTISHEAD BRANCH LINE (METROWEST PHASE 1)

Drawing
C13 LODWAY FARM COMPOUND DRAINAGE STRATEGY

Drawn by: MA Date: 02/07/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-DS-C13
Revision A

Drawing Scale: AS SHOWN

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	13.997	0.497	29.0	925.2	O K
30 min Summer	14.142	0.642	33.6	1220.0	O K
60 min Summer	14.286	0.786	37.6	1525.0	O K
120 min Summer	14.417	0.917	40.9	1813.6	O K
180 min Summer	14.478	0.978	42.3	1953.3	O K
240 min Summer	14.511	1.011	43.1	2027.7	O K
360 min Summer	14.540	1.040	43.8	2094.9	O K
480 min Summer	14.553	1.053	44.0	2124.4	O K
600 min Summer	14.559	1.059	44.2	2138.9	O K
720 min Summer	14.561	1.061	44.2	2143.4	O K
960 min Summer	14.556	1.056	44.1	2130.8	O K
1440 min Summer	14.525	1.025	43.4	2059.2	O K
2160 min Summer	14.461	0.961	41.9	1914.5	O K
2880 min Summer	14.396	0.896	40.4	1768.3	O K
4320 min Summer	14.280	0.780	37.4	1512.1	O K
5760 min Summer	14.183	0.683	34.8	1307.1	O K
7200 min Summer	14.106	0.606	32.5	1146.2	O K
8640 min Summer	14.042	0.542	30.5	1015.8	O K
10080 min Summer	13.990	0.490	28.7	911.0	O K
15 min Winter	14.053	0.553	30.8	1037.6	O K
30 min Winter	14.213	0.713	35.6	1369.5	O K
60 min Winter	14.372	0.872	39.8	1714.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	876.9	30
30 min Summer	53.199	0.0	1179.0	44
60 min Summer	33.892	0.0	1578.0	72
120 min Summer	20.940	0.0	1955.5	128
180 min Summer	15.610	0.0	2189.1	186
240 min Summer	12.614	0.0	2359.8	244
360 min Summer	9.343	0.0	2623.0	344
480 min Summer	7.540	0.0	2822.6	398
600 min Summer	6.381	0.0	2985.0	462
720 min Summer	5.565	0.0	3122.6	526
960 min Summer	4.481	0.0	3348.2	662
1440 min Summer	3.298	0.0	3678.0	936
2160 min Summer	2.424	0.0	4136.9	1344
2880 min Summer	1.946	0.0	4426.2	1740
4320 min Summer	1.427	0.0	4851.2	2512
5760 min Summer	1.144	0.0	5225.3	3240
7200 min Summer	0.964	0.0	5501.9	3976
8640 min Summer	0.839	0.0	5735.8	4688
10080 min Summer	0.745	0.0	5930.2	5448
15 min Winter	79.950	0.0	986.9	30
30 min Winter	53.199	0.0	1324.2	43
60 min Winter	33.892	0.0	1770.5	72

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	14.518	1.018	43.3	2044.5	O K
180 min Winter	14.589	1.089	44.8	2208.4	O K
240 min Winter	14.627	1.127	45.7	2299.3	O K
360 min Winter	14.665	1.165	46.5	2389.7	O K
480 min Winter	14.675	1.175	46.7	2412.4	O K
600 min Winter	14.677	1.177	46.8	2418.1	O K
720 min Winter	14.677	1.177	46.7	2416.5	O K
960 min Winter	14.663	1.163	46.4	2382.8	O K
1440 min Winter	14.609	1.109	45.3	2256.2	O K
2160 min Winter	14.511	1.011	43.1	2028.3	O K
2880 min Winter	14.415	0.915	40.8	1810.6	O K
4320 min Winter	14.251	0.751	36.6	1450.6	O K
5760 min Winter	14.124	0.624	33.0	1182.8	O K
7200 min Winter	14.027	0.527	30.0	984.9	O K
8640 min Winter	13.952	0.452	27.4	836.1	O K
10080 min Winter	13.894	0.394	25.2	722.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	20.940	0.0	2193.2	128
180 min Winter	15.610	0.0	2454.8	184
240 min Winter	12.614	0.0	2645.9	240
360 min Winter	9.343	0.0	2940.5	350
480 min Winter	7.540	0.0	3163.9	450
600 min Winter	6.381	0.0	3345.6	484
720 min Winter	5.565	0.0	3499.4	560
960 min Winter	4.481	0.0	3751.4	714
1440 min Winter	3.298	0.0	4117.4	1014
2160 min Winter	2.424	0.0	4635.4	1448
2880 min Winter	1.946	0.0	4959.7	1856
4320 min Winter	1.427	0.0	5438.5	2644
5760 min Winter	1.144	0.0	5854.0	3400
7200 min Winter	0.964	0.0	6164.3	4112
8640 min Winter	0.839	0.0	6427.7	4848
10080 min Winter	0.745	0.0	6649.2	5552

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 6.360

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.590	4	8	1.590	8	12	1.590	12	16	1.590

Model Details

Storage is Online Cover Level (m) 15.000

Tank or Pond Structure

Invert Level (m) 13.500

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	1728.0	1.500	2601.0

Orifice Outflow Control

Diameter (m) 0.146 Discharge Coefficient 0.600 Invert Level (m) 13.500

Notes:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in metres unless noted otherwise.
5. The indicative layout is based on a topographical survey.
6. Outfalls should be monitored on a regular basis and quipped with shut-off valves..
7. Due to possible lack of gradient in existing watercourses, pumping might be required for the proposed compound.

This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 10 20 30 40 50 60 70 80 90 100

SCALE 1:1,000 (A1) METRES
SCALE 1:2,000 (A3)

KEY:

- Proposed catchpit
- Proposed pipeline
- Red line boundary
- Proposed ditch
- Proposed basin
- Proposed filter drain
- Sub-catchment A
- Sub-catchment B
- Sub-catchment C
- Sub-catchment D
- Exceedance route
- Proposed kerb
- Proposed fence
- Proposed gate
- Tree to be retained
- Tree to be removed

Rev	By	Chkd	Apprvd	Date	Description
A	GRM	-	-	23/05/2018	First Issue

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
C14 PORTBURY HUNDRED COMPOUND DRAINAGE STRATEGY

Drawn by: GRM Date: 02/07/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-DS-C14
Revision A

Drawing Scale: AS SHOWN

Summary of Results for 5 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.824	0.324	22.0	665.7	O K
30 min Summer	4.915	0.415	25.7	863.8	O K
60 min Summer	5.007	0.507	28.9	1069.0	O K
120 min Summer	5.096	0.596	31.7	1269.2	O K
180 min Summer	5.140	0.640	33.1	1372.4	O K
240 min Summer	5.166	0.666	33.8	1432.0	O K
360 min Summer	5.191	0.691	34.5	1490.8	O K
480 min Summer	5.206	0.706	34.9	1525.9	O K
600 min Summer	5.215	0.715	35.2	1547.5	O K
720 min Summer	5.220	0.720	35.3	1559.8	O K
960 min Summer	5.222	0.722	35.4	1564.8	O K
1440 min Summer	5.209	0.709	35.0	1532.6	O K
2160 min Summer	5.171	0.671	34.0	1445.4	O K
2880 min Summer	5.130	0.630	32.8	1349.9	O K
4320 min Summer	5.054	0.554	30.5	1175.2	O K
5760 min Summer	4.992	0.492	28.4	1033.7	O K
7200 min Summer	4.940	0.440	26.6	919.6	O K
8640 min Summer	4.898	0.398	25.0	826.5	O K
10080 min Summer	4.863	0.363	23.6	749.3	O K
15 min Winter	4.861	0.361	23.6	746.2	O K
30 min Winter	4.963	0.463	27.4	969.4	O K
60 min Winter	5.066	0.566	30.8	1201.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	54.369	0.0	599.3	26
30 min Summer	35.674	0.0	802.2	40
60 min Summer	22.554	0.0	1088.1	68
120 min Summer	13.956	0.0	1354.0	126
180 min Summer	10.476	0.0	1528.2	184
240 min Summer	8.532	0.0	1661.7	242
360 min Summer	6.379	0.0	1866.1	318
480 min Summer	5.186	0.0	2023.6	382
600 min Summer	4.414	0.0	2153.4	444
720 min Summer	3.869	0.0	2264.4	512
960 min Summer	3.142	0.0	2448.6	650
1440 min Summer	2.342	0.0	2724.1	924
2160 min Summer	1.744	0.0	3124.7	1328
2880 min Summer	1.415	0.0	3377.4	1732
4320 min Summer	1.054	0.0	3753.9	2504
5760 min Summer	0.855	0.0	4108.0	3232
7200 min Summer	0.727	0.0	4362.1	3968
8640 min Summer	0.637	0.0	4576.0	4672
10080 min Summer	0.569	0.0	4753.2	5440
15 min Winter	54.369	0.0	677.6	26
30 min Winter	35.674	0.0	904.4	40
60 min Winter	22.554	0.0	1222.7	68

Summary of Results for 5 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.165	0.665	33.8	1430.1	O K
180 min Winter	5.216	0.716	35.2	1550.6	O K
240 min Winter	5.246	0.746	36.0	1622.7	O K
360 min Winter	5.276	0.776	36.8	1694.6	O K
480 min Winter	5.287	0.787	37.1	1720.5	O K
600 min Winter	5.295	0.795	37.3	1739.9	O K
720 min Winter	5.298	0.798	37.4	1746.3	O K
960 min Winter	5.293	0.793	37.2	1733.7	O K
1440 min Winter	5.261	0.761	36.4	1658.6	O K
2160 min Winter	5.199	0.699	34.7	1509.5	O K
2880 min Winter	5.136	0.636	32.9	1361.7	O K
4320 min Winter	5.027	0.527	29.6	1112.8	O K
5760 min Winter	4.943	0.443	26.7	925.5	O K
7200 min Winter	4.879	0.379	24.3	785.3	O K
8640 min Winter	4.830	0.330	22.3	678.8	O K
10080 min Winter	4.792	0.292	20.5	596.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	13.956	0.0	1520.5	124
180 min Winter	10.476	0.0	1715.7	180
240 min Winter	8.532	0.0	1865.2	238
360 min Winter	6.379	0.0	2094.1	344
480 min Winter	5.186	0.0	2270.5	400
600 min Winter	4.414	0.0	2415.7	470
720 min Winter	3.869	0.0	2540.0	548
960 min Winter	3.142	0.0	2746.1	702
1440 min Winter	2.342	0.0	3053.4	1000
2160 min Winter	1.744	0.0	3502.4	1428
2880 min Winter	1.415	0.0	3785.8	1828
4320 min Winter	1.054	0.0	4211.0	2604
5760 min Winter	0.855	0.0	4602.9	3352
7200 min Winter	0.727	0.0	4888.3	4104
8640 min Winter	0.637	0.0	5129.6	4832
10080 min Winter	0.569	0.0	5332.3	5544

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 6.700

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	2.233	4	8	2.233	8	12	2.233

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1968.0	1.500	2850.0

Orifice Outflow Control

Diameter (m) 0.145 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 5 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.843	0.343	15.7	462.1	O K
30 min Summer	4.938	0.438	18.2	599.7	O K
60 min Summer	5.034	0.534	20.4	741.7	O K
120 min Summer	5.124	0.624	22.2	879.6	O K
180 min Summer	5.169	0.669	23.1	950.0	O K
240 min Summer	5.194	0.694	23.5	990.3	O K
360 min Summer	5.218	0.718	24.0	1029.0	O K
480 min Summer	5.232	0.732	24.2	1051.4	O K
600 min Summer	5.241	0.741	24.4	1064.6	O K
720 min Summer	5.245	0.745	24.5	1071.5	O K
960 min Summer	5.245	0.745	24.5	1072.0	O K
1440 min Summer	5.229	0.729	24.2	1045.5	O K
2160 min Summer	5.189	0.689	23.4	981.3	O K
2880 min Summer	5.145	0.645	22.6	913.4	O K
4320 min Summer	5.066	0.566	21.0	791.0	O K
5760 min Summer	5.001	0.501	19.6	692.3	O K
7200 min Summer	4.947	0.447	18.4	612.7	O K
8640 min Summer	4.903	0.403	17.3	547.6	O K
10080 min Summer	4.866	0.366	16.4	494.0	O K
15 min Winter	4.882	0.382	16.8	518.2	O K
30 min Winter	4.988	0.488	19.4	673.1	O K
60 min Winter	5.094	0.594	21.6	833.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	54.369	0.0	432.8	26
30 min Summer	35.674	0.0	575.5	40
60 min Summer	22.554	0.0	766.5	68
120 min Summer	13.956	0.0	952.1	126
180 min Summer	10.476	0.0	1073.8	184
240 min Summer	8.532	0.0	1167.0	242
360 min Summer	6.379	0.0	1309.9	318
480 min Summer	5.186	0.0	1420.1	382
600 min Summer	4.414	0.0	1511.0	444
720 min Summer	3.869	0.0	1589.0	512
960 min Summer	3.142	0.0	1718.6	650
1440 min Summer	2.342	0.0	1913.7	926
2160 min Summer	1.744	0.0	2180.5	1328
2880 min Summer	1.415	0.0	2357.3	1732
4320 min Summer	1.054	0.0	2623.5	2508
5760 min Summer	0.855	0.0	2860.9	3232
7200 min Summer	0.727	0.0	3038.6	3968
8640 min Summer	0.637	0.0	3189.5	4680
10080 min Summer	0.569	0.0	3316.2	5440
15 min Winter	54.369	0.0	487.8	26
30 min Winter	35.674	0.0	647.3	40
60 min Winter	22.554	0.0	860.4	68

Summary of Results for 5 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.195	0.695	23.6	991.7	O K
180 min Winter	5.247	0.747	24.5	1074.4	O K
240 min Winter	5.277	0.777	25.0	1123.5	O K
360 min Winter	5.307	0.807	25.6	1171.7	O K
480 min Winter	5.316	0.816	25.7	1187.9	O K
600 min Winter	5.324	0.824	25.8	1199.8	O K
720 min Winter	5.325	0.825	25.9	1202.8	O K
960 min Winter	5.319	0.819	25.8	1191.5	O K
1440 min Winter	5.285	0.785	25.2	1135.7	O K
2160 min Winter	5.218	0.718	24.0	1028.5	O K
2880 min Winter	5.152	0.652	22.8	923.9	O K
4320 min Winter	5.039	0.539	20.5	749.2	O K
5760 min Winter	4.951	0.451	18.5	618.4	O K
7200 min Winter	4.884	0.384	16.8	520.6	O K
8640 min Winter	4.832	0.332	15.4	446.2	O K
10080 min Winter	4.791	0.291	14.2	389.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	13.956	0.0	1068.3	124
180 min Winter	10.476	0.0	1204.5	180
240 min Winter	8.532	0.0	1309.0	238
360 min Winter	6.379	0.0	1469.0	346
480 min Winter	5.186	0.0	1592.4	400
600 min Winter	4.414	0.0	1694.2	470
720 min Winter	3.869	0.0	1781.4	548
960 min Winter	3.142	0.0	1926.4	702
1440 min Winter	2.342	0.0	2143.9	1000
2160 min Winter	1.744	0.0	2443.3	1428
2880 min Winter	1.415	0.0	2641.6	1844
4320 min Winter	1.054	0.0	2941.7	2604
5760 min Winter	0.855	0.0	3205.1	3352
7200 min Winter	0.727	0.0	3404.5	4104
8640 min Winter	0.637	0.0	3574.3	4840
10080 min Winter	0.569	0.0	3718.6	5544

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 4.660

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.553	4	8	1.553	8	12	1.553

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1271.0	1.500	2000.0

Orifice Outflow Control

Diameter (m) 0.119 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 10 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.874	0.374	24.1	773.4	O K
30 min Summer	4.981	0.481	28.1	1010.0	O K
60 min Summer	5.089	0.589	31.5	1255.1	O K
120 min Summer	5.192	0.692	34.5	1493.2	O K
180 min Summer	5.243	0.743	35.9	1614.1	O K
240 min Summer	5.272	0.772	36.7	1683.1	O K
360 min Summer	5.299	0.799	37.4	1749.2	O K
480 min Summer	5.314	0.814	37.8	1785.1	O K
600 min Summer	5.323	0.823	38.0	1806.6	O K
720 min Summer	5.328	0.828	38.1	1818.4	O K
960 min Summer	5.329	0.829	38.2	1821.2	O K
1440 min Summer	5.312	0.812	37.7	1780.6	O K
2160 min Summer	5.269	0.769	36.6	1677.5	O K
2880 min Summer	5.223	0.723	35.4	1565.8	O K
4320 min Summer	5.135	0.635	32.9	1361.5	O K
5760 min Summer	5.063	0.563	30.7	1193.9	O K
7200 min Summer	5.003	0.503	28.8	1059.7	O K
8640 min Summer	4.954	0.454	27.1	949.4	O K
10080 min Summer	4.913	0.413	25.6	860.0	O K
15 min Winter	4.917	0.417	25.7	867.0	O K
30 min Winter	5.036	0.536	29.9	1133.4	O K
60 min Winter	5.157	0.657	33.5	1410.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	63.115	0.0	704.2	26
30 min Summer	41.638	0.0	944.5	40
60 min Summer	26.403	0.0	1279.5	68
120 min Summer	16.328	0.0	1589.8	126
180 min Summer	12.224	0.0	1788.7	184
240 min Summer	9.925	0.0	1938.4	242
360 min Summer	7.394	0.0	2168.2	336
480 min Summer	5.994	0.0	2344.1	392
600 min Summer	5.090	0.0	2488.1	454
720 min Summer	4.453	0.0	2610.8	520
960 min Summer	3.604	0.0	2813.4	658
1440 min Summer	2.673	0.0	3112.1	932
2160 min Summer	1.981	0.0	3551.6	1344
2880 min Summer	1.601	0.0	3823.5	1736
4320 min Summer	1.185	0.0	4226.2	2512
5760 min Summer	0.957	0.0	4599.6	3240
7200 min Summer	0.811	0.0	4868.0	3968
8640 min Summer	0.708	0.0	5093.9	4688
10080 min Summer	0.632	0.0	5280.8	5448
15 min Winter	63.115	0.0	794.9	26
30 min Winter	41.638	0.0	1063.3	40
60 min Winter	26.403	0.0	1437.1	68

Summary of Results for 10 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.271	0.771	36.7	1682.2	O K
180 min Winter	5.330	0.830	38.2	1823.3	O K
240 min Winter	5.364	0.864	39.0	1906.7	O K
360 min Winter	5.398	0.898	39.9	1992.0	O K
480 min Winter	5.410	0.910	40.2	2020.1	O K
600 min Winter	5.416	0.916	40.3	2036.7	O K
720 min Winter	5.419	0.919	40.4	2043.3	O K
960 min Winter	5.413	0.913	40.2	2028.3	O K
1440 min Winter	5.378	0.878	39.4	1941.6	O K
2160 min Winter	5.307	0.807	37.6	1769.0	O K
2880 min Winter	5.236	0.736	35.7	1597.3	O K
4320 min Winter	5.111	0.611	32.2	1305.3	O K
5760 min Winter	5.014	0.514	29.2	1083.3	O K
7200 min Winter	4.939	0.439	26.6	916.3	O K
8640 min Winter	4.881	0.381	24.4	788.8	O K
10080 min Winter	4.835	0.335	22.5	690.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	16.328	0.0	1784.6	124
180 min Winter	12.224	0.0	2007.3	182
240 min Winter	9.925	0.0	2175.0	238
360 min Winter	7.394	0.0	2432.3	348
480 min Winter	5.994	0.0	2629.1	444
600 min Winter	5.090	0.0	2790.2	478
720 min Winter	4.453	0.0	2927.5	554
960 min Winter	3.604	0.0	3153.9	710
1440 min Winter	2.673	0.0	3485.9	1010
2160 min Winter	1.981	0.0	3980.5	1436
2880 min Winter	1.601	0.0	4285.4	1848
4320 min Winter	1.185	0.0	4739.7	2640
5760 min Winter	0.957	0.0	5153.5	3400
7200 min Winter	0.811	0.0	5454.8	4112
8640 min Winter	0.708	0.0	5709.5	4848
10080 min Winter	0.632	0.0	5923.3	5552

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 6.700

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	2.233	4	8	2.233	8	12	2.233

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1968.0	1.500	2850.0

Orifice Outflow Control

Diameter (m) 0.145 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 10 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.895	0.395	17.1	537.1	O K
30 min Summer	5.007	0.507	19.8	701.4	O K
60 min Summer	5.118	0.618	22.1	871.3	O K
120 min Summer	5.223	0.723	24.1	1035.5	O K
180 min Summer	5.274	0.774	25.0	1118.4	O K
240 min Summer	5.303	0.803	25.5	1165.3	O K
360 min Summer	5.329	0.829	25.9	1209.3	O K
480 min Summer	5.343	0.843	26.2	1232.2	O K
600 min Summer	5.351	0.851	26.3	1245.3	O K
720 min Summer	5.355	0.855	26.4	1251.9	O K
960 min Summer	5.354	0.854	26.4	1251.0	O K
1440 min Summer	5.335	0.835	26.0	1218.7	O K
2160 min Summer	5.289	0.789	25.3	1143.5	O K
2880 min Summer	5.240	0.740	24.4	1064.2	O K
4320 min Summer	5.150	0.650	22.7	921.3	O K
5760 min Summer	5.075	0.575	21.2	804.3	O K
7200 min Summer	5.013	0.513	19.9	710.9	O K
8640 min Summer	4.962	0.462	18.7	634.2	O K
10080 min Summer	4.919	0.419	17.7	571.8	O K
15 min Winter	4.940	0.440	18.2	602.3	O K
30 min Winter	5.064	0.564	21.0	787.3	O K
60 min Winter	5.187	0.687	23.4	979.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	63.115	0.0	506.5	26
30 min Summer	41.638	0.0	675.5	40
60 min Summer	26.403	0.0	900.0	68
120 min Summer	16.328	0.0	1116.6	126
180 min Summer	12.224	0.0	1255.5	184
240 min Summer	9.925	0.0	1360.1	242
360 min Summer	7.394	0.0	1520.7	336
480 min Summer	5.994	0.0	1643.8	392
600 min Summer	5.090	0.0	1744.8	456
720 min Summer	4.453	0.0	1830.9	520
960 min Summer	3.604	0.0	1973.4	658
1440 min Summer	2.673	0.0	2185.1	932
2160 min Summer	1.981	0.0	2477.6	1344
2880 min Summer	1.601	0.0	2667.9	1736
4320 min Summer	1.185	0.0	2952.4	2512
5760 min Summer	0.957	0.0	3202.8	3248
7200 min Summer	0.811	0.0	3390.5	3976
8640 min Summer	0.708	0.0	3549.7	4752
10080 min Summer	0.632	0.0	3683.4	5448
15 min Winter	63.115	0.0	570.3	26
30 min Winter	41.638	0.0	759.0	40
60 min Winter	26.403	0.0	1009.9	68

Summary of Results for 10 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.304	0.804	25.5	1167.3	O K
180 min Winter	5.363	0.863	26.5	1264.5	O K
240 min Winter	5.397	0.897	27.0	1321.5	O K
360 min Winter	5.431	0.931	27.6	1379.4	O K
480 min Winter	5.441	0.941	27.8	1397.5	O K
600 min Winter	5.447	0.947	27.8	1407.1	O K
720 min Winter	5.449	0.949	27.9	1410.4	O K
960 min Winter	5.441	0.941	27.8	1397.6	O K
1440 min Winter	5.404	0.904	27.2	1333.8	O K
2160 min Winter	5.330	0.830	26.0	1210.4	O K
2880 min Winter	5.256	0.756	24.7	1089.2	O K
4320 min Winter	5.127	0.627	22.3	884.5	O K
5760 min Winter	5.026	0.526	20.2	729.3	O K
7200 min Winter	4.947	0.447	18.4	612.5	O K
8640 min Winter	4.886	0.386	16.9	523.5	O K
10080 min Winter	4.838	0.338	15.6	454.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	16.328	0.0	1252.5	124
180 min Winter	12.224	0.0	1408.0	182
240 min Winter	9.925	0.0	1525.1	238
360 min Winter	7.394	0.0	1704.9	348
480 min Winter	5.994	0.0	1842.7	446
600 min Winter	5.090	0.0	1955.6	478
720 min Winter	4.453	0.0	2052.0	556
960 min Winter	3.604	0.0	2211.2	710
1440 min Winter	2.673	0.0	2446.4	1012
2160 min Winter	1.981	0.0	2776.1	1440
2880 min Winter	1.601	0.0	2989.4	1852
4320 min Winter	1.185	0.0	3309.7	2640
5760 min Winter	0.957	0.0	3588.1	3400
7200 min Winter	0.811	0.0	3798.6	4112
8640 min Winter	0.708	0.0	3977.8	4848
10080 min Winter	0.632	0.0	4129.9	5552

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 4.660

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.553	4	8	1.553	8	12	1.553

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1271.0	1.500	2000.0

Orifice Outflow Control

Diameter (m) 0.119 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.740	0.240	17.9	487.2	O K
30 min Summer	4.812	0.312	21.5	640.2	O K
60 min Summer	4.884	0.384	24.5	796.7	O K
120 min Summer	4.950	0.450	27.0	941.0	O K
180 min Summer	4.979	0.479	28.0	1006.1	O K
240 min Summer	4.993	0.493	28.5	1036.6	O K
360 min Summer	5.007	0.507	28.9	1067.4	O K
480 min Summer	5.014	0.514	29.2	1084.1	O K
600 min Summer	5.018	0.518	29.3	1091.6	O K
720 min Summer	5.018	0.518	29.3	1092.6	O K
960 min Summer	5.013	0.513	29.1	1081.9	O K
1440 min Summer	4.993	0.493	28.4	1036.3	O K
2160 min Summer	4.955	0.455	27.1	951.6	O K
2880 min Summer	4.918	0.418	25.8	869.7	O K
4320 min Summer	4.856	0.356	23.4	735.0	O K
5760 min Summer	4.809	0.309	21.4	634.6	O K
7200 min Summer	4.774	0.274	19.7	559.6	O K
8640 min Summer	4.747	0.247	18.3	502.7	O K
10080 min Summer	4.726	0.226	17.2	458.1	O K
15 min Winter	4.768	0.268	19.4	545.9	O K
30 min Winter	4.848	0.348	23.0	718.3	O K
60 min Winter	4.930	0.430	26.2	895.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	426.6	30
30 min Summer	53.199	0.0	584.7	43
60 min Summer	33.892	0.0	809.2	72
120 min Summer	20.940	0.0	1007.3	128
180 min Summer	15.610	0.0	1129.8	184
240 min Summer	12.614	0.0	1219.3	240
360 min Summer	9.343	0.0	1357.2	300
480 min Summer	7.540	0.0	1461.6	362
600 min Summer	6.381	0.0	1546.5	428
720 min Summer	5.565	0.0	1618.5	498
960 min Summer	4.481	0.0	1736.3	634
1440 min Summer	3.298	0.0	1908.8	908
2160 min Summer	2.424	0.0	2164.0	1304
2880 min Summer	1.946	0.0	2313.6	1684
4320 min Summer	1.427	0.0	2527.1	2432
5760 min Summer	1.144	0.0	2743.2	3176
7200 min Summer	0.964	0.0	2886.6	3896
8640 min Summer	0.839	0.0	3005.3	4584
10080 min Summer	0.745	0.0	3099.3	5256
15 min Winter	79.950	0.0	484.1	29
30 min Winter	53.199	0.0	661.3	43
60 min Winter	33.892	0.0	910.3	70

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.004	0.504	28.8	1060.6	O K
180 min Winter	5.038	0.538	29.9	1137.2	O K
240 min Winter	5.054	0.554	30.5	1175.2	O K
360 min Winter	5.067	0.567	30.9	1204.8	O K
480 min Winter	5.072	0.572	31.0	1216.4	O K
600 min Winter	5.073	0.573	31.1	1218.0	O K
720 min Winter	5.070	0.570	31.0	1210.9	O K
960 min Winter	5.057	0.557	30.6	1181.6	O K
1440 min Winter	5.020	0.520	29.4	1098.1	O K
2160 min Winter	4.961	0.461	27.4	965.8	O K
2880 min Winter	4.908	0.408	25.4	848.5	O K
4320 min Winter	4.826	0.326	22.1	669.5	O K
5760 min Winter	4.769	0.269	19.4	548.0	O K
7200 min Winter	4.729	0.229	17.4	465.4	O K
8640 min Winter	4.704	0.204	15.8	413.3	O K
10080 min Winter	4.689	0.189	14.2	382.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	20.940	0.0	1132.3	126
180 min Winter	15.610	0.0	1269.5	182
240 min Winter	12.614	0.0	1369.8	236
360 min Winter	9.343	0.0	1524.3	338
480 min Winter	7.540	0.0	1641.3	382
600 min Winter	6.381	0.0	1736.5	458
720 min Winter	5.565	0.0	1817.2	536
960 min Winter	4.481	0.0	1949.3	686
1440 min Winter	3.298	0.0	2142.7	976
2160 min Winter	2.424	0.0	2426.5	1388
2880 min Winter	1.946	0.0	2594.8	1788
4320 min Winter	1.427	0.0	2836.4	2520
5760 min Winter	1.144	0.0	3074.4	3240
7200 min Winter	0.964	0.0	3235.7	3960
8640 min Winter	0.839	0.0	3370.0	4592
10080 min Winter	0.745	0.0	3478.4	5344

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 3.350

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.837	4	8	0.837	8	12	0.838	12	16	0.838

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1968.0	1.500	2850.0

Orifice Outflow Control

Diameter (m) 0.145 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.754	0.254	13.0	337.6	O K
30 min Summer	4.830	0.330	15.4	443.8	O K
60 min Summer	4.906	0.406	17.4	552.2	O K
120 min Summer	4.973	0.473	19.0	651.1	O K
180 min Summer	5.003	0.503	19.7	695.0	O K
240 min Summer	5.016	0.516	20.0	714.8	O K
360 min Summer	5.029	0.529	20.2	734.2	O K
480 min Summer	5.035	0.535	20.4	743.9	O K
600 min Summer	5.037	0.537	20.4	747.3	O K
720 min Summer	5.037	0.537	20.4	746.3	O K
960 min Summer	5.030	0.530	20.3	735.9	O K
1440 min Summer	5.006	0.506	19.8	700.0	O K
2160 min Summer	4.964	0.464	18.8	637.4	O K
2880 min Summer	4.924	0.424	17.9	578.6	O K
4320 min Summer	4.858	0.358	16.2	483.2	O K
5760 min Summer	4.808	0.308	14.7	412.6	O K
7200 min Summer	4.770	0.270	13.6	359.7	O K
8640 min Summer	4.741	0.241	12.6	319.1	O K
10080 min Summer	4.718	0.218	11.8	287.0	O K
15 min Winter	4.784	0.284	14.0	378.5	O K
30 min Winter	4.869	0.369	16.4	498.3	O K
60 min Winter	4.953	0.453	18.5	620.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	311.4	29
30 min Summer	53.199	0.0	422.7	43
60 min Summer	33.892	0.0	572.0	72
120 min Summer	20.940	0.0	710.2	128
180 min Summer	15.610	0.0	795.8	184
240 min Summer	12.614	0.0	858.4	240
360 min Summer	9.343	0.0	954.8	300
480 min Summer	7.540	0.0	1028.0	362
600 min Summer	6.381	0.0	1087.6	428
720 min Summer	5.565	0.0	1138.1	498
960 min Summer	4.481	0.0	1221.1	634
1440 min Summer	3.298	0.0	1343.7	908
2160 min Summer	2.424	0.0	1511.7	1304
2880 min Summer	1.946	0.0	1616.9	1688
4320 min Summer	1.427	0.0	1769.0	2432
5760 min Summer	1.144	0.0	1911.5	3176
7200 min Summer	0.964	0.0	2012.2	3896
8640 min Summer	0.839	0.0	2096.5	4592
10080 min Summer	0.745	0.0	2164.8	5344
15 min Winter	79.950	0.0	351.9	29
30 min Winter	53.199	0.0	476.4	43
60 min Winter	33.892	0.0	642.5	70

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.029	0.529	20.2	734.3	O K
180 min Winter	5.063	0.563	21.0	786.2	O K
240 min Winter	5.080	0.580	21.3	811.4	O K
360 min Winter	5.092	0.592	21.6	829.8	O K
480 min Winter	5.096	0.596	21.6	836.2	O K
600 min Winter	5.095	0.595	21.6	835.5	O K
720 min Winter	5.091	0.591	21.6	829.0	O K
960 min Winter	5.076	0.576	21.2	805.9	O K
1440 min Winter	5.035	0.535	20.4	743.8	O K
2160 min Winter	4.971	0.471	19.0	648.0	O K
2880 min Winter	4.914	0.414	17.6	564.6	O K
4320 min Winter	4.826	0.326	15.3	438.3	O K
5760 min Winter	4.765	0.265	13.4	352.7	O K
7200 min Winter	4.723	0.223	11.9	294.2	O K
8640 min Winter	4.693	0.193	10.8	253.0	O K
10080 min Winter	4.672	0.172	9.9	224.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	20.940	0.0	797.4	126
180 min Winter	15.610	0.0	893.3	182
240 min Winter	12.614	0.0	963.4	236
360 min Winter	9.343	0.0	1071.4	338
480 min Winter	7.540	0.0	1153.4	382
600 min Winter	6.381	0.0	1220.2	458
720 min Winter	5.565	0.0	1276.8	536
960 min Winter	4.481	0.0	1369.9	686
1440 min Winter	3.298	0.0	1507.1	976
2160 min Winter	2.424	0.0	1694.4	1388
2880 min Winter	1.946	0.0	1812.6	1788
4320 min Winter	1.427	0.0	1984.4	2548
5760 min Winter	1.144	0.0	2141.9	3280
7200 min Winter	0.964	0.0	2254.9	3968
8640 min Winter	0.839	0.0	2350.2	4672
10080 min Winter	0.745	0.0	2428.5	5336

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 2.330

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.582	4	8	0.582	8	12	0.583	12	16	0.583

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	1271.0	1.500	2000.0

Orifice Outflow Control

Diameter (m) 0.119 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.855	0.355	23.3	731.8	O K
30 min Summer	4.961	0.461	27.3	964.2	O K
60 min Summer	5.067	0.567	30.9	1204.7	O K
120 min Summer	5.166	0.666	33.8	1431.8	O K
180 min Summer	5.212	0.712	35.1	1540.8	O K
240 min Summer	5.236	0.736	35.8	1598.0	O K
360 min Summer	5.258	0.758	36.3	1649.9	O K
480 min Summer	5.269	0.769	36.6	1675.8	O K
600 min Summer	5.274	0.774	36.8	1689.1	O K
720 min Summer	5.276	0.776	36.8	1694.0	O K
960 min Summer	5.273	0.773	36.7	1685.6	O K
1440 min Summer	5.250	0.750	36.1	1630.5	O K
2160 min Summer	5.202	0.702	34.8	1516.5	O K
2880 min Summer	5.152	0.652	33.4	1400.7	O K
4320 min Summer	5.064	0.564	30.8	1197.7	O K
5760 min Summer	4.994	0.494	28.5	1038.3	O K
7200 min Summer	4.938	0.438	26.5	913.5	O K
8640 min Summer	4.892	0.392	24.8	813.7	O K
10080 min Summer	4.855	0.355	23.3	732.1	O K
15 min Winter	4.895	0.395	24.9	820.4	O K
30 min Winter	5.013	0.513	29.1	1082.2	O K
60 min Winter	5.132	0.632	32.8	1353.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	666.3	30
30 min Summer	53.199	0.0	903.0	44
60 min Summer	33.892	0.0	1230.6	72
120 min Summer	20.940	0.0	1527.8	128
180 min Summer	15.610	0.0	1711.7	186
240 min Summer	12.614	0.0	1846.0	244
360 min Summer	9.343	0.0	2052.9	330
480 min Summer	7.540	0.0	2209.8	390
600 min Summer	6.381	0.0	2337.2	452
720 min Summer	5.565	0.0	2445.0	518
960 min Summer	4.481	0.0	2621.5	656
1440 min Summer	3.298	0.0	2878.6	930
2160 min Summer	2.424	0.0	3257.1	1332
2880 min Summer	1.946	0.0	3483.9	1732
4320 min Summer	1.427	0.0	3812.2	2508
5760 min Summer	1.144	0.0	4122.4	3232
7200 min Summer	0.964	0.0	4339.3	3968
8640 min Summer	0.839	0.0	4520.7	4680
10080 min Summer	0.745	0.0	4668.1	5440
15 min Winter	79.950	0.0	752.5	30
30 min Winter	53.199	0.0	1016.9	43
60 min Winter	33.892	0.0	1382.3	72

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.242	0.742	35.9	1613.1	O K
180 min Winter	5.296	0.796	37.3	1740.7	O K
240 min Winter	5.324	0.824	38.1	1810.5	O K
360 min Winter	5.352	0.852	38.7	1877.8	O K
480 min Winter	5.358	0.858	38.9	1892.9	O K
600 min Winter	5.362	0.862	39.0	1902.1	O K
720 min Winter	5.361	0.861	39.0	1900.4	O K
960 min Winter	5.350	0.850	38.7	1872.3	O K
1440 min Winter	5.308	0.808	37.6	1770.2	O K
2160 min Winter	5.232	0.732	35.6	1588.9	O K
2880 min Winter	5.159	0.659	33.6	1417.0	O K
4320 min Winter	5.037	0.537	29.9	1135.9	O K
5760 min Winter	4.945	0.445	26.8	930.0	O K
7200 min Winter	4.877	0.377	24.2	779.7	O K
8640 min Winter	4.825	0.325	22.0	667.5	O K
10080 min Winter	4.785	0.285	20.2	582.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	20.940	0.0	1715.2	126
180 min Winter	15.610	0.0	1921.1	184
240 min Winter	12.614	0.0	2071.6	240
360 min Winter	9.343	0.0	2303.3	348
480 min Winter	7.540	0.0	2478.8	440
600 min Winter	6.381	0.0	2621.4	476
720 min Winter	5.565	0.0	2742.0	554
960 min Winter	4.481	0.0	2939.4	706
1440 min Winter	3.298	0.0	3225.7	1006
2160 min Winter	2.424	0.0	3650.6	1432
2880 min Winter	1.946	0.0	3905.1	1844
4320 min Winter	1.427	0.0	4276.3	2608
5760 min Winter	1.144	0.0	4619.1	3352
7200 min Winter	0.964	0.0	4862.7	4104
8640 min Winter	0.839	0.0	5067.6	4832
10080 min Winter	0.745	0.0	5237.0	5544

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 5.025

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.256	4	8	1.256	8	12	1.256	12	16	1.257

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1968.0	1.500	2850.0

Orifice Outflow Control

Diameter (m) 0.145 Discharge Coefficient 0.600 Invert Level (m) 4.500

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	4.875	0.375	16.6	508.0	O K
30 min Summer	4.986	0.486	19.3	669.5	O K
60 min Summer	5.096	0.596	21.6	836.1	O K
120 min Summer	5.196	0.696	23.6	992.8	O K
180 min Summer	5.242	0.742	24.4	1067.3	O K
240 min Summer	5.266	0.766	24.8	1106.0	O K
360 min Summer	5.287	0.787	25.2	1140.0	O K
480 min Summer	5.297	0.797	25.4	1156.0	O K
600 min Summer	5.301	0.801	25.5	1163.4	O K
720 min Summer	5.302	0.802	25.5	1165.1	O K
960 min Summer	5.297	0.797	25.4	1156.3	O K
1440 min Summer	5.271	0.771	24.9	1113.8	O K
2160 min Summer	5.220	0.720	24.0	1031.0	O K
2880 min Summer	5.168	0.668	23.1	948.9	O K
4320 min Summer	5.077	0.577	21.3	806.8	O K
5760 min Summer	5.003	0.503	19.7	695.4	O K
7200 min Summer	4.944	0.444	18.3	608.4	O K
8640 min Summer	4.897	0.397	17.2	538.7	O K
10080 min Summer	4.857	0.357	16.1	481.9	O K
15 min Winter	4.918	0.418	17.7	569.6	O K
30 min Winter	5.040	0.540	20.5	751.6	O K
60 min Winter	5.162	0.662	22.9	939.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	479.9	30
30 min Summer	53.199	0.0	646.3	44
60 min Summer	33.892	0.0	865.9	72
120 min Summer	20.940	0.0	1073.4	128
180 min Summer	15.610	0.0	1201.8	186
240 min Summer	12.614	0.0	1295.6	244
360 min Summer	9.343	0.0	1440.3	332
480 min Summer	7.540	0.0	1550.0	390
600 min Summer	6.381	0.0	1639.4	452
720 min Summer	5.565	0.0	1715.1	518
960 min Summer	4.481	0.0	1839.4	656
1440 min Summer	3.298	0.0	2021.8	930
2160 min Summer	2.424	0.0	2272.6	1336
2880 min Summer	1.946	0.0	2431.5	1736
4320 min Summer	1.427	0.0	2664.2	2508
5760 min Summer	1.144	0.0	2870.9	3232
7200 min Summer	0.964	0.0	3022.7	3968
8640 min Summer	0.839	0.0	3151.0	4680
10080 min Summer	0.745	0.0	3257.1	5440
15 min Winter	79.950	0.0	540.5	30
30 min Winter	53.199	0.0	726.4	43
60 min Winter	33.892	0.0	971.7	72

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
120 min Winter	5.274	0.774	25.0	1119.2	O K
180 min Winter	5.328	0.828	25.9	1206.9	O K
240 min Winter	5.357	0.857	26.4	1254.4	O K
360 min Winter	5.384	0.884	26.8	1299.6	O K
480 min Winter	5.389	0.889	26.9	1308.6	O K
600 min Winter	5.392	0.892	27.0	1313.1	O K
720 min Winter	5.390	0.890	26.9	1310.5	O K
960 min Winter	5.377	0.877	26.7	1288.5	O K
1440 min Winter	5.332	0.832	26.0	1213.8	O K
2160 min Winter	5.253	0.753	24.6	1084.2	O K
2880 min Winter	5.177	0.677	23.2	962.7	O K
4320 min Winter	5.049	0.549	20.7	765.4	O K
5760 min Winter	4.953	0.453	18.5	621.5	O K
7200 min Winter	4.881	0.381	16.8	516.5	O K
8640 min Winter	4.826	0.326	15.3	438.3	O K
10080 min Winter	4.784	0.284	14.0	379.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
120 min Winter	20.940	0.0	1204.1	126
180 min Winter	15.610	0.0	1347.8	184
240 min Winter	12.614	0.0	1452.9	240
360 min Winter	9.343	0.0	1614.9	348
480 min Winter	7.540	0.0	1737.8	442
600 min Winter	6.381	0.0	1837.8	478
720 min Winter	5.565	0.0	1922.5	554
960 min Winter	4.481	0.0	2061.4	708
1440 min Winter	3.298	0.0	2264.4	1008
2160 min Winter	2.424	0.0	2546.5	1432
2880 min Winter	1.946	0.0	2724.6	1848
4320 min Winter	1.427	0.0	2987.1	2632
5760 min Winter	1.144	0.0	3216.4	3360
7200 min Winter	0.964	0.0	3386.7	4112
8640 min Winter	0.839	0.0	3531.2	4840
10080 min Winter	0.745	0.0	3652.3	5544

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 3.495

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.874	4	8	0.874	8	12	0.874	12	16	0.873

Model Details

Storage is Online Cover Level (m) 6.000

Tank or Pond Structure

Invert Level (m) 4.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1271.0	1.500	2000.0

Orifice Outflow Control

Diameter (m) 0.119 Discharge Coefficient 0.600 Invert Level (m) 4.500

Notes:

1. This drawing should be read in conjunction with the Drainage Strategy Report.
2. Drainage system design based on 1:30 year return period plus climate change allowance.
3. Exceedance flow design based on 1:100 year return period plus climate change allowance.
4. All dimensions are in metres unless noted otherwise.
5. The indicative layout is based on a topographical survey.
6. Outfalls should be monitored on a regular basis and quipped with shut-off valves.
7. Due to possible lack of gradient in existing watercourses, pumping might be required for the proposed compound.
8. GSM-R mast to be located in compound

KEY:

- Proposed catchpit
- Proposed pipeline
- Proposed french drain
- Proposed timber fence
- Exceedance route
- Existing fence
- Proposed fence
- Red line boundary
- Trees to be retained

This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 5 10 15 20

SCALE 1:250 (A1)
SCALE 1:500 (A3)
METRES

Rev	By	Chkd	Apprvd	Date	Description
A	DFS	-	-	15/05/2018	FOR INFORMATION

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

SHEEPWAY COMPOUND
DRAINAGE STRATEGY

Drawn by: Date: 02/07/2018
Checked by: - Date: -
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-DS-C15 | Revision A

Drawing Scale: 1:250 @ A1

Drawing file path & name: \\EXTPP01\Proj\Transportation\Projects\MetroWest\100 Drawings\Construction Compounds\Sheepway Compound\Revised\ 467470.BQ.04.20-DS-C15 rev2.dwg

Summary of Results for 30 year Return Period (+40%)

Half Drain Time : 85 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.533	0.533	0.0	1.7	1.7	10.7	O K
30 min Summer	5.654	0.654	0.0	1.9	1.9	13.6	O K
60 min Summer	5.740	0.740	0.0	2.1	2.1	15.6	Flood Risk
120 min Summer	5.767	0.767	0.0	2.1	2.1	16.3	Flood Risk
180 min Summer	5.756	0.756	0.0	2.1	2.1	16.0	Flood Risk
240 min Summer	5.732	0.732	0.0	2.0	2.0	15.4	Flood Risk
360 min Summer	5.682	0.682	0.0	2.0	2.0	14.2	O K
480 min Summer	5.634	0.634	0.0	1.9	1.9	13.1	O K
600 min Summer	5.590	0.590	0.0	1.8	1.8	12.0	O K
720 min Summer	5.549	0.549	0.0	1.8	1.8	11.1	O K
960 min Summer	5.483	0.483	0.0	1.6	1.6	9.4	O K
1440 min Summer	5.389	0.389	0.0	1.5	1.5	6.7	O K
2160 min Summer	5.299	0.299	0.0	1.3	1.3	4.1	O K
2880 min Summer	5.241	0.241	0.0	1.1	1.1	2.6	O K
4320 min Summer	5.165	0.165	0.0	0.9	0.9	1.1	O K
5760 min Summer	5.118	0.118	0.0	0.8	0.8	0.6	O K
7200 min Summer	5.090	0.090	0.0	0.7	0.7	0.3	O K
8640 min Summer	5.072	0.072	0.0	0.6	0.6	0.2	O K
10080 min Summer	5.061	0.061	0.0	0.5	0.5	0.2	O K
15 min Winter	5.591	0.591	0.0	1.8	1.8	12.1	O K
30 min Winter	5.732	0.732	0.0	2.0	2.0	15.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	101.754	0.0	12.4	23
30 min Summer	67.708	0.0	16.5	36
60 min Summer	43.136	0.0	21.0	60
120 min Summer	26.651	0.0	26.0	94
180 min Summer	19.868	0.0	29.1	128
240 min Summer	16.054	0.0	31.3	162
360 min Summer	11.891	0.0	34.8	232
480 min Summer	9.596	0.0	37.4	298
600 min Summer	8.121	0.0	39.6	364
720 min Summer	7.083	0.0	41.4	428
960 min Summer	5.703	0.0	44.5	556
1440 min Summer	4.198	0.0	49.1	800
2160 min Summer	3.085	0.0	54.1	1156
2880 min Summer	2.477	0.0	58.0	1504
4320 min Summer	1.816	0.0	63.7	2208
5760 min Summer	1.456	0.0	68.1	2936
7200 min Summer	1.227	0.0	71.8	3672
8640 min Summer	1.067	0.0	74.9	4320
10080 min Summer	0.948	0.0	77.7	5120
15 min Winter	101.754	0.0	13.9	24
30 min Winter	67.708	0.0	18.5	36

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	5.837	0.837	0.0	2.2	2.2	17.9	Flood Risk
120 min Winter	5.867	0.867	0.0	2.2	2.2	18.6	Flood Risk
180 min Winter	5.848	0.848	0.0	2.2	2.2	18.2	Flood Risk
240 min Winter	5.811	0.811	0.0	2.2	2.2	17.3	Flood Risk
360 min Winter	5.733	0.733	0.0	2.0	2.0	15.4	Flood Risk
480 min Winter	5.660	0.660	0.0	1.9	1.9	13.7	O K
600 min Winter	5.595	0.595	0.0	1.8	1.8	12.2	O K
720 min Winter	5.537	0.537	0.0	1.7	1.7	10.8	O K
960 min Winter	5.449	0.449	0.0	1.6	1.6	8.4	O K
1440 min Winter	5.331	0.331	0.0	1.4	1.4	5.0	O K
2160 min Winter	5.229	0.229	0.0	1.1	1.1	2.3	O K
2880 min Winter	5.166	0.166	0.0	0.9	0.9	1.2	O K
4320 min Winter	5.100	0.100	0.0	0.7	0.7	0.4	O K
5760 min Winter	5.071	0.071	0.0	0.6	0.6	0.2	O K
7200 min Winter	5.055	0.055	0.0	0.5	0.5	0.1	O K
8640 min Winter	5.047	0.047	0.0	0.4	0.4	0.1	O K
10080 min Winter	5.043	0.043	0.0	0.4	0.4	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.136	0.0	23.6	62
120 min Winter	26.651	0.0	29.1	100
180 min Winter	19.868	0.0	32.5	138
240 min Winter	16.054	0.0	35.1	176
360 min Winter	11.891	0.0	39.0	248
480 min Winter	9.596	0.0	41.9	318
600 min Winter	8.121	0.0	44.3	386
720 min Winter	7.083	0.0	46.4	454
960 min Winter	5.703	0.0	49.8	582
1440 min Winter	4.198	0.0	55.0	826
2160 min Winter	3.085	0.0	60.6	1168
2880 min Winter	2.477	0.0	64.9	1504
4320 min Winter	1.816	0.0	71.4	2204
5760 min Winter	1.456	0.0	76.3	2912
7200 min Winter	1.227	0.0	80.4	3584
8640 min Winter	1.067	0.0	83.9	4408
10080 min Winter	0.948	0.0	87.0	4976

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.065

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.021	4	8	0.022	8	12	0.022

Model Details

Storage is Online Cover Level (m) 6.000

Filter Drain Structure

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	5.000	Cap Infiltration Depth (m)	0.000
Trench Width (m)	0.7	Number of Pipes	1
Trench Length (m)	113.0		

Orifice Outflow Control

Diameter (m) 0.034 Discharge Coefficient 0.600 Invert Level (m) 5.000

Summary of Results for 30 year Return Period (+10%)

Half Drain Time : 38 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.460	0.460	0.0	1.6	1.6	4.7	O K
30 min Summer	5.525	0.525	0.0	1.7	1.7	5.9	O K
60 min Summer	5.554	0.554	0.0	1.8	1.8	6.3	O K
120 min Summer	5.540	0.540	0.0	1.7	1.7	6.1	O K
180 min Summer	5.511	0.511	0.0	1.7	1.7	5.6	O K
240 min Summer	5.482	0.482	0.0	1.6	1.6	5.1	O K
360 min Summer	5.431	0.431	0.0	1.6	1.6	4.2	O K
480 min Summer	5.387	0.387	0.0	1.5	1.5	3.5	O K
600 min Summer	5.351	0.351	0.0	1.4	1.4	2.8	O K
720 min Summer	5.320	0.320	0.0	1.3	1.3	2.3	O K
960 min Summer	5.271	0.271	0.0	1.2	1.2	1.6	O K
1440 min Summer	5.199	0.199	0.0	1.0	1.0	0.7	O K
2160 min Summer	5.132	0.132	0.0	0.8	0.8	0.3	O K
2880 min Summer	5.093	0.093	0.0	0.7	0.7	0.2	O K
4320 min Summer	5.058	0.058	0.0	0.5	0.5	0.1	O K
5760 min Summer	5.046	0.046	0.0	0.4	0.4	0.0	O K
7200 min Summer	5.041	0.041	0.0	0.3	0.3	0.0	O K
8640 min Summer	5.037	0.037	0.0	0.3	0.3	0.0	O K
10080 min Summer	5.035	0.035	0.0	0.3	0.3	0.0	O K
15 min Winter	5.499	0.499	0.0	1.7	1.7	5.4	O K
30 min Winter	5.581	0.581	0.0	1.8	1.8	6.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	79.950	0.0	6.3	22
30 min Summer	53.199	0.0	8.4	32
60 min Summer	33.892	0.0	10.7	50
120 min Summer	20.940	0.0	13.2	84
180 min Summer	15.610	0.0	14.8	118
240 min Summer	12.614	0.0	15.9	152
360 min Summer	9.343	0.0	17.7	216
480 min Summer	7.540	0.0	19.0	278
600 min Summer	6.381	0.0	20.1	340
720 min Summer	5.565	0.0	21.0	398
960 min Summer	4.481	0.0	22.6	516
1440 min Summer	3.298	0.0	24.9	748
2160 min Summer	2.424	0.0	27.5	1104
2880 min Summer	1.946	0.0	29.4	1468
4320 min Summer	1.427	0.0	32.4	2188
5760 min Summer	1.144	0.0	34.6	2896
7200 min Summer	0.964	0.0	36.4	3552
8640 min Summer	0.839	0.0	38.0	4408
10080 min Summer	0.745	0.0	39.4	5128
15 min Winter	79.950	0.0	7.1	22
30 min Winter	53.199	0.0	9.4	33

Summary of Results for 30 year Return Period (+10%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
60 min Winter	5.620	0.620	0.0	1.9	1.9	7.3	O K
120 min Winter	5.590	0.590	0.0	1.8	1.8	6.9	O K
180 min Winter	5.539	0.539	0.0	1.7	1.7	6.1	O K
240 min Winter	5.493	0.493	0.0	1.7	1.7	5.3	O K
360 min Winter	5.417	0.417	0.0	1.5	1.5	4.0	O K
480 min Winter	5.356	0.356	0.0	1.4	1.4	2.9	O K
600 min Winter	5.309	0.309	0.0	1.3	1.3	2.1	O K
720 min Winter	5.270	0.270	0.0	1.2	1.2	1.5	O K
960 min Winter	5.207	0.207	0.0	1.1	1.1	0.8	O K
1440 min Winter	5.130	0.130	0.0	0.8	0.8	0.3	O K
2160 min Winter	5.079	0.079	0.0	0.6	0.6	0.1	O K
2880 min Winter	5.057	0.057	0.0	0.5	0.5	0.1	O K
4320 min Winter	5.043	0.043	0.0	0.4	0.4	0.0	O K
5760 min Winter	5.037	0.037	0.0	0.3	0.3	0.0	O K
7200 min Winter	5.033	0.033	0.0	0.2	0.2	0.0	O K
8640 min Winter	5.031	0.031	0.0	0.2	0.2	0.0	O K
10080 min Winter	5.029	0.029	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	33.892	0.0	12.0	54
120 min Winter	20.940	0.0	14.8	90
180 min Winter	15.610	0.0	16.5	128
240 min Winter	12.614	0.0	17.8	162
360 min Winter	9.343	0.0	19.8	228
480 min Winter	7.540	0.0	21.3	290
600 min Winter	6.381	0.0	22.5	350
720 min Winter	5.565	0.0	23.6	406
960 min Winter	4.481	0.0	25.3	518
1440 min Winter	3.298	0.0	27.9	742
2160 min Winter	2.424	0.0	30.8	1096
2880 min Winter	1.946	0.0	33.0	1468
4320 min Winter	1.427	0.0	36.2	2196
5760 min Winter	1.144	0.0	38.7	2856
7200 min Winter	0.964	0.0	40.8	3600
8640 min Winter	0.839	0.0	42.6	4096
10080 min Winter	0.745	0.0	44.2	5152

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.042

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.014	4	8	0.014	8	12	0.014

Model Details

Storage is Online Cover Level (m) 6.000

Filter Drain Structure

Infiltration Coefficient Base (m/hr)	0.00000	Pipe Diameter (m)	0.150
Infiltration Coefficient Side (m/hr)	0.00000	Pipe Depth above Invert (m)	0.150
Safety Factor	2.0	Slope (1:X)	400.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	5.000	Cap Infiltration Depth (m)	0.000
Trench Width (m)	0.3	Number of Pipes	1
Trench Length (m)	139.0		

Orifice Outflow Control

Diameter (m) 0.034 Discharge Coefficient 0.600 Invert Level (m) 5.000

APPENDIX F

Water Quality Risk Management

Appendix F
Water Quality Risk Management

Contents

List of Tables

List of figures

1. Water quality management approaches

Table 4.3 in Chapter 4 of the SuDS Manual 2015 (C753) outlines the minimum water quality management approaches/ considerations. This has been reproduced in Figure 1 below:

TABLE 4.3 Minimum water quality management requirements for discharges to receiving surface waters and groundwater

Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries[2]	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]*	
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]*	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]* In England and Wales, Risk Screening[4] must be undertaken first to determine whether consultation with the environmental regulator is required. In Northern Ireland, the need for risk screening should be agreed with the environmental regulator.
Trunk roads and motorways	High	Follow the guidance and risk assessment process set out in HA (2009)	
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured, industrial sites	High	Discharges may require an environmental licence or permit[6]. Obtain pre-permitting advice from the environmental regulator. Risk assessment is likely to be required[5].	

Notes

The minimum water quality management requirements for discharges to receiving surface waters and groundwater are presented here. (For Northern Ireland, this guidance should be considered as interim until such time as Northern Ireland publishes its own legislation/policy/guidance.)

1 These are not required in Scotland and Northern Ireland. For England and Wales, see Step 3 of the simple index approach (Section 26.7.1).
Protected surface water resources will include those designated for drinking water abstraction or for other environmental protection reasons. Protected groundwater resources are represented by SPZ1s in England and Wales.

2 In Scotland, the Water Environment (Controlled Activities) (Scotland) Regulations (CAR) 2011 General Binding Rules, Rule 10 (d) (iv) effectively provides an exemption from requiring SuDS for coastal discharges. However, control of any contaminants likely to be present in surface water runoff is still required, but can be delivered using alternative methods such as proprietary treatment products. As the term 'SuDS' in this manual includes proprietary treatment products, this exemption is not valid in this context.

3 The application of the simple index approach should follow the approach outlined in Section 26.7.1 (or equivalent approved).

4 Risk screening is an assessment to identify high risk scenarios where the Environment Agency or Natural Resources Wales (NRW) would wish to be consulted regarding infiltration of water from surface runoff in order to agree the proposed design approach. The risk screening method is provided in Section 26.7.2.

5 The risk assessment should determine the appropriate design approach to mitigate risk to acceptable levels following the guidance outlined in Section 26.7.3. This assessment should be approved by the environmental regulator.

Figure 1: Minimum water quality management requirements; reproduced from p63 of the SuDS Manual 2015 (C753).

Due to the different land use of the proposed sites, each development has been assessed independently as shown in Table 1 below.

Development	Description	Pollution hazard level – SuDS Manual	Assessment method
Carparks Portishead Station	The Portishead carparks are considered as commercial areas. Additionally, the traffic estimation for the carparks and drop off area showed that 225 users will arrive by car seeking to park at the station and 106 users will use the drop off areas. These figures, together with the users using taxis or public transport, reveal that more than 300 traffic movements/day are expected[1]. Therefore, they are classed as medium hazard level.	Medium	Simple Index Method
Roads and roundabout Portishead Station	The traffic forecast showed that up to 1905 turning movements are estimated for the peak hours at the realigned roundabout (Phoenix Way/ Quays Avenue/Harbour Road). Consequently, these roads do not correspond to low traffic roads and are classified as medium hazard level.	Medium	Simple Index Method
Carparks Pill station	The traffic forecast for the carpark showed that only 60 traffic movements per day are expected which less than the 300 traffic movements limit indicated in the SuDS Manual. However, the carpark is to serve the new Pill Station (which is considered as 'commercial yard and delivery areas') and is the access to the attached Railway Network Depot next to the carpark. Hence, the carpark is classed as medium hazard level.	Medium	Simple Index Method
Haul roads	The haul roads will be used by heavy vehicles, therefore high pollution hazard level is anticipated.	High	Consultation to environmental regulator
Compounds	The compounds will be used by heavy vehicles, therefore high pollution hazard level is anticipated.	High	Consultation to environmental regulator

Table 1: Pollution hazard level and risk assessment method

2. Portishead and Pill Stations

As the development within these sites will be discharged to surface water, and is classed as medium (non-residential car parking with frequent change (eg hospitals, retail), the Simple Index Approach has been used to identify the pollution hazard and mitigation measures appropriate for the site based on land use.

The steps followed are as outlined in Box 26.2 of Chapter 26 of the SuDS Manual 2015 (C753), as reproduced in Figure 2 below:

[1] Based on *467470.BQ.04.20_MetroWest Phase 1 - Harbour Rd-Quays Ave Options Modelling_April 2015.docx and 467470.BQ.04.20_MetroWest Phase 1 - Harbour Rd-Quays Ave Modelling_June 2015 Update.docx*

BOX 26.2 **Steps of the simple index approach**

Step 1 – Allocate suitable pollution hazard indices for the proposed land use

Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index

Step 3 – Where the discharge is to protected[1] surface waters or groundwater, consider the need for a more precautionary approach

Note:

1 Designated as those protected for the supply of drinking water (Table 4.3).

Figure 2: Steps of the simple index approach; reproduced from p567 of the SuDS Manual 2015 (C753).

Step 1: Allocate suitable pollution hazard indices for the proposed land use

The pollution hazard indices are presented in Table 26.2 of C753. This has been reproduced in Figure 3 below:

TABLE 26.2 **Pollution hazard indices for different land use classifications**

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Figure 3: Pollution hazard indices; reproduced from p568 of the SuDS Manual 2015 (C753).

Based on this, the development proposed within the stations has been assessed and Table 2 shows the associated pollution hazard Level/ Indices for each land use type.

Development site	Catchment	Pollution hazard level	Total suspended solids	Metals	Hydro-carbons
	Cat A.1	Medium	0.7	0.6	0.7

Development site	Catchment	Pollution hazard level	Total suspended solids	Metals	Hydro-carbons
Portishead Station	Cat A.2	Medium	0.7	0.6	0.7
	Cat A.3	Medium	0.7	0.6	0.7
	Cat A.4	Medium	0.7	0.6	0.7
Pill Station	Carpark	Medium	0.7	0.6	0.7

Table 2. Pollution hazard level/ indices for proposed development

Step 2: Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index

The total SuDS mitigation indices should be equal to or exceed the pollution hazard indices. Where multiple components are proposed to provide mitigation, it is suggested that a factor of 0.5 is applied to secondary or tertiary components to account for a reduction in performance due to already reduced inflow concentrations.

As the runoff will be discharged to surface water, Table 26.3 in Chapter 26 of the SuDS manual is recommended to determine the mitigation indices/ SuDS components that will provide sufficient water quality improvement. Table 26.3 has been reproduced in Figure 4 below:

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Notes

1 SuDS components only deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters.

2 Filter drains can remove coarse sediments, but their use for this purpose will have significant implications with respect to maintenance requirements, and this should be taken into account in the design and Maintenance Plan.

3 Ponds and wetlands can remove coarse sediments, but their use for this purpose will have significant implications with respect to the maintenance requirements and amenity value of the system. Sediment should normally be removed upstream, unless they are specifically designed to retain sediment in a separate part of the component, where it cannot easily migrate to the main body of water.

4 Where a wetland is not specifically designed to provide significantly enhanced treatment, it should be considered as having the same mitigation indices as a pond.

5 See Chapter 14 for approaches to demonstrate product performance. A British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **http://tinyurl.com/qf7yuj7**

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. SEPA (2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

Figure 4: Mitigation indices; reproduced from p570 of the SuDS Manual 2015 (C753).

Table 3 provides a summary of the proposed drainage components that will be used to provide water quality mitigation.

As can be seen from a review of Table 2 and Table 3 mitigation measure/ proposed drainage features are sufficient to offset the pollution hazard level for each land use.

Development site	**Catchment**	**Proposed drainage component**	**Total suspended solids**	**Metals**	**Hydro-carbons**
Portishead Station	Cat A.1	Permeable pavement	0.7	0.6	0.7
		Swale	0.25 = (0.5x0.5)	0.3 = (0.6x0.5)	0.3 = (0.6x0.5)
		Total	0.95	0.9	1
Portishead Station	Cat A.2	Bioretention system	0.8	0.8	0.8
		Total	0.8	0.8	0.8
Portishead Station	Cat A.3	Swale	0.5	0.6	0.6
		Filter drain	0.2 = (0.5x0.4)	0.2 = (0.5x0.4)	0.2 = (0.5x0.4)
		Total	0.7	0.8	0.8
Portishead Station	Cat A.4	Permeable pavement	0.7	0.6	0.7
		Total	0.7	0.6	0.7
Pill Station	Carpark	Permeable pavement	0.7	0.6	0.7
		Total	0.7	0.6	0.7

Table 3. Mitigation indices for chosen components for the proposed developments.

Step 3: Where the discharge is to protected surface waters or groundwater, consider the need for a more precautionary approach

As the discharge of the sites is at locations very close to the coast, no water abstraction for drinking water purpose is expected, therefore a more precautionary approach is not required (see note 1 of Table 4.3, which is reproduced in Figure 1 for information).

3. Compounds

The design of the compounds is still on progress and the only available information at the moment was abstracted from the document 'MetroWest 1 Construction Strategy' and is shown on Table 4. Details of construction compounds below.

Compound	**Description - facilities**
C-15 Sheepway compound	Additional localised storage and welfare. There will be a small amount of parking, materials storage and toilets.
C-14 The Portbury Hundred Compound	Large amount of parking for staff vehicles, materials storage, toilets, changing facilities, canteen and offices. Space for storage of sleepers, drainage, troughing, energy recovery units for vegetation removal, spoil, ballast and track formation. Dumpers, excavators, dozers, lorries will be using the compound.
Turning area for construction vehicles east to C-14	Approximate 500m^2 of turning area available for construction vehicles

Compound	Description - facilities
C-13 Lodway Farm	A medium level of parking will be provided for staff, materials storage, toilets, changing facilities, canteen and offices. Personal vehicles, small vans, minibuses and HGV access will be using the compound.
C-9 Ham Green Compound	Low loaders to drop off RRVs will be using the compound. Mitigation measures may be necessary to ensure run off and sediment does not enter the lake.
C-4 Clanage Road	Medium sized parking area, materials storage, toilets, changing facilities; canteen and site offices.

Table 4. Details of construction compounds

As the development within these sites will be discharged to surface water, and is classed as high risk (sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels are to be delivered, handled, stored, used or manufactured, industrial sites), the pollution hazard has been identified and consultation with North Somerset Levels Internal Drainage Board has been undertaken to agree the appropriate mitigation measures. Those measure will need to be accepted by the Environmental Regulator prior to detail design. See appendix A for further details.

The water pollution hazards identified in relation to the compounds use and how they are mitigated are described in Table 5. Nevertheless, the potential hazards should be examined when the detail design of the compounds is completed.

Pollution hazard	Mitigation measure
Sedimentation	Filter drains are proposed as the conveyance system for most part of the compounds. The flows from the filter drains will be then directed to ditches located around the perimeter of the compounds that will also allow sedimentation. Additionally, silt trap chambers are promoted to capture the silt. Detention basins are proposed as the most downstream drainage feature before the discharge (at the greenfield runoff peak) to the watercourses to provide water storage but also a secondary water treatment (sedimentation and pollution removal). Storage materials areas should be under cover to prevent wash down.
Fuel and oils	For the areas of fuel and oil handling, oil separators will be provided to remove hydrocarbons from high-risk areas of runoff. In addition, penstock chambers will be proposed downstream of the oil separators and at other locations of the network to enable shut down of the surface water drainage network in case of a spill occurs. Besides, the legal requirement when the capacity of the storage tank is more than 200 litres and there is risk of an oil spillage reaching a public water source, the tank needs to be bunded.
Water from wash down areas	Wash down areas should be isolated and appropriate water treatment to be provided as required.

Table 5. Mitigation measure for compounds

4. Haul roads

The proposed haul roads between Portishead and Portbury Hundred construction compound sites will discharge to existing watercourses, and are classed as high risk (sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites). the pollution hazard has been identified and consultation with North Somerset Levels Internal Drainage Board has been undertaken to agree the appropriate mitigation measures. Those measure will need to be accepted by the Environmental Regulator prior to detail design. See appendix A for further details.

The main pollution hazard for the haul roads is the silt derived by the construction vehicles movements. Runoff will be collected by ditches with check dams to capture sediment and prevent any contaminated water being discharged to the watercourses. The accumulated silt will need to be removed periodical basis. As runoff peaks are going to be attenuated at greenfield rates, the removal of contaminants through settling, adsorption will be enhanced.

APPENDIX G

Concept Drainage Design Report Rev 01 from January 2017

REPORT

Concept Drainage Design for Portishead and Pill Stations

Prepared for

Travelwest

January 2017

CH2M HILL
1 The Square
Temple Quay
Bristol
BL1 6DG

Contents

1 Introduction

This report covers the concept drainage design for the proposed Portishead and Pill station car parks and associated new highways for the Metrowest scheme.

2 Design Constraints and Parameters

The drainage design life for the car parks and new road drainage systems shall be 60 years.

The drainage system for all the new roads and parking areas shall be designed to North Somerset Council (NSC)requirements for a 1 in 30 year rainfall event with an allowance for climate change (refer to Appendix A) . Exceedance routes up to the 1 in 100 year rainfall event, with an allowance for climate change will be required to demonstrate that no flooding to property occurs. Tide locking will need to be taken into account in the drainage design.

The NPPF Planning Practice Guidance states that “Generally the aim should be to discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

1. into the ground (infiltration);

2. to a surface water body;

3. to a surface water sewer, or other drainage system;

4. to a combined sewer.

Following this hierarchy, NSC would like to see the drainage from both the car parks and the new sections of road discharging either via infiltration or to the existing / new ditch network, rather than going into the highway drainage system.

If this is not possible, the capacity of the existing highway system will need to be checked and potentially upgraded to ensure no flooding for up to the 1 in 30 year event with an allowance for climate change.

Car park drainage systems should include pollution control and NSC would like to see this achieved through the use of bio-retention where practicable.

The normal requirement would be to restrict flows to greenfield rates on previously undeveloped land, or as close to greenfield as practicable, but not exceeding existing rates on previously develop land.

As the Portishead site is so close to the coast, NSC do not require restriction to the discharge rate, however a capacity check will be required to demonstrate that the drainage system maintains a 1 in 30 year with climate change capacity under tide locked conditions.

For Pill Station car park, the standard principles will apply, which is assumed to be greenfield rates or a minimum 5 l/s.

3 Portishead Station

The proposed drainage for the carparks and highways work have been analysed on a catchment basis. Four catchment areas have been identified as shown on drawing SK105 Drainage Catchment Areas (refer to Appendix B)

3.1 Cat A.1

This is catchment the area to the west of the proposed rail station and includes the proposed main car park and footpaths. This area is an existing field.

Without GI results it is assumed that the soil is heavy clay , WRAP class 4 potentially 3 and with a shallow groundwater level (ie 1 to 2m below ground level). As such it is assumed that infiltration is not an option and therefore impermeable surfacing shall be proposed for the car park and footways. Total impermeable area is 5,825m^2.

The drainage proposal for this catchment area is for the car park to discharge via gullies to a swale (refer to Appendix B drawing SK106 –Drainage Strategy) . The footpaths shall have filter drains along the edge which shall also discharge to the swale.

The swale shall be located along the southern edge of the site and have a French drain with check dams. Rye grass shall line the swale to provide pollution control.

The proposed outfall for the swale shall be the Portbury ditch, which is an open watercourse, under the EA jurisdiction. The EA has verbally advised that the discharge rate into the ditch shall be set by NSC flood authority (refer to Appendix A).

The analysis of water levels, in vicinity of the proposed Portbury Ditch outfall, for 25 year and 50 year climate change (assumed to be 20%) scenarios are 4.85m and 7.05m respectively (refer to Appendix A). For a 1 in 30 year event this has been interpolated as 5.29m. It is therefore recommended that a microdrainage design is undertaken to confirm the required size of swale for this tide lock level of 5.29m.

The outfall structure to the Portbury Ditch will require a flood defence permit from the EA. This shall be subject to more detailed design but a precast concrete headwall is considered by the EA to be an appropriate solution.

3.2 Cat A.2

This catchment area lies to the north of the proposed rail station and includes new roads and footways The new roads shall tie into Harbour Road to the east and Phoenix Road to the west. This shall be an impermeable area of 3966m^2.

There is an existing surface water drainage network in this catchment area, which is identified on Wessex Water services plan as a highway drain, suggesting it is owned by NSC. The existing highway runoff discharges to “The Cut” via a 225mm pipe and the existing impermeable area that is drained by this system is approximately 5000m^2 (refer to Appendix B drawing SK107 – Existing Drainage).

Given the proposed impermeable area is less than the existing, it is proposed that this catchment area discharges into the existing highway system. A swale is also proposed along the west side of the new roundabout and entry /exit arm, which shall discharge in to the existing highway drainage (refer to Appendix B drawing SK106 –Drainage Strategy).

Bio-retention areas are proposed in vicinity of the new road including the centre island of the new roundabout.

3.3 Cat A.3

This catchment area is to the south of the proposed rail station and includes a new road and footways that tie-into Quays Avenue. The impermeable area for this catchment is 2982m^2.

There are no available records of an existing surface water network or outfall on Quays Avenue, other than gullies so it is assumed that a highway pipe network is present. The existing impermeable area is 2235m^2.(Refer to Appendix B drawing SK107 – Existing Drainage)

For the new section of Quays road , drainage shall be provided with positive drainage network with a filter drain along the toe of the embankment (refer to Appendix B drawing SK106 –Drainage Strategy). This system shall outfall into the existing drainage network on Quays road.

A bio-retention area is proposed in vicinity of the green space to the east of the re-aligned Quays Road.

The proposed footway that shall run along the existing Quays Avenue , shall drain into the proposed green space.

3.4 Cat A.4

This catchment area is the car parking and hardstanding by the Portishead station which covers an area of 3690m^2 . It is proposed that permeable pavement is used, with a gravel tank system and membrane under the car park . This shall discharge to an existing manhole and outfall to The Cut (refer to Appendix B drawing SK106 –Drainage Strategy)

4 Pill Station

4.1 Cat B.1

The catchment area for Pill Station is the car park area B.1 (Refer to Appendix C drawing SK10 Pill Station Drainage Strategy). This area is currently an informal private car park with a mix of grass, asphalt and gravel surfacing.

Existing drainage records of the area have not been received but a streetview visual suggests no existing gullies on Monmouth Road. This is supported by anecdotal evidence of localized flooding on the Monmouth Road. Gullies are found further down Avon Road, where Monmouth road changes name.

The proposed drainage strategy for this catchment area of 1488 m^2 is for a permeable pavement with a gravel tank system and membrane under the car park . This shall discharge into a proposed new highway drainage system to be provided on Monmouth Road and shall connect into an existing system on Avon Road.

5 Recommendations

5.1 Portishead

1 Review drainage options once GI information is available

2 Carry out further design work to size the swales to meet NSC requirements

3 Assess the capacity of the existing highway network of catchment area A.2.

4 Assess capacity of the outfall system to “The Cut”

5 Carry out a survey of existing highway drainage in catchment area A.3 and assess the capacity of the network

5.2 Pill Station

1 Carrry out a survey of existing highway drainage on Monmouth and Avon Road and assess the capacity of the network.

Appendix A

Lillie, Penny/UKS

From: Bellamy, Dave/EXT
Sent: 06 December 2016 14:56
To: Lillie, Penny/UKS
Subject: RE: Proposed Portishead MetroWest Station

Hi Penny,
I spoke with Dave Pring earlier regarding the Portishead Metrowest station drainage discharge to the main river. Discharge rate will be set by the Lead Local Flood Authority, in this case North Somerset Council. As I said to you on phone last week, this will almost certainly be restricted to the greenfield run-off rate.
The only consultation required with the Environment Agency is in obtaining a flood defence permit for the outfall structure. I asked when would be a good time to talk with them about this and he advised that once we have a design for the structure we can run it past them. I mentioned that it would likely be a precast concrete headwall, and his opinion was that there would be no issue with obtaining a permit on this basis.
The number to phone once we have a design is 03708 506506
Hope this helps.
Kind regards
Dave

From: Lillie, Penny/UKS
Sent: 02 December 2016 12:23
To: Bellamy, Dave/EXT <Dave.Bellamy@ch2m.com>
Subject: RE: Proposed Portishead MetroWest Station

ok many thanks
kind regards

Penny Lillie
Project Engineer

Direct +44 (0)1793 816671
Mobile +44 (0)7547 190959

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From: Bellamy, Dave/EXT
Sent: 02 December 2016 12:21
To: Lillie, Penny/UKS <Penny.Lillie@ch2m.com>
Subject: RE: Proposed Portishead MetroWest Station

Hi Penny,
No nothing yet but I will chase them up again. Cheers
Dave

From: Lillie, Penny/UKS
Sent: 02 December 2016 12:19
To: Bellamy, Dave/EXT <Dave.Bellamy@ch2m.com>
Subject: RE: Proposed Portishead MetroWest Station

Hi Dave
any news ? if not I am happy to follow up .

Lillie, Penny/UKS

From: Jennifer Devereux <Jennifer.Devereux@n-somerset.gov.uk>
Sent: 16 December 2016 08:49
To: Lillie, Penny/UKS
Cc: Linfoot, Andrew/BRS
Subject: FW: highway drainage designs [EXTERNAL]
Attachments: Pill Station Existing Highway Gullies.pdf; Portishead Station Existing Highway Gullies.pdf

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Penny

Please find below the drainage detail.

Kind Regards
Jenny

From: Lucy Nicholson
Sent: Thursday, December 15, 2016 5:08 PM
To: Jennifer Devereux <Jennifer.Devereux@n-somerset.gov.uk>; Richard Matthews <Richard.Matthews@n-somerset.gov.uk>
Subject: RE: highway drainage designs

Hi Jenny / Richard,

Sorry it's taken me so long to get back to you on this – I 've been completely overwhelmed by Town centre and other planning issues!

Unfortunately we do not hold very much information on the highway drainage networks, all we have is a GIS layer showing the location of gullies (attached for each of the locations in your email) but there is no information on pipe connections or dimensions etc.

The drainage system for all the new roads and parking areas should be designed to manage a 1 in 30 year rainfall event with an allowance for climate change. Exceedance routes up to the 1 in 100 year rainfall event, with an allowance for climate change will be required to demonstrate that no flooding to property occurs. Tide locking will need to be taken into account in the drainage design.

The NPPF Planning Practice Guidance states that "Generally the aim should be to discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:
1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, or other drainage system;
4. to a combined sewer.

Following this hierarchy we would like to see the drainage from both the car parks and the new sections of road discharging either via infiltration or to the existing / new ditch network, rather than going into the highway drainage system.

If this is not possible, the capacity of the existing highway system will need to be checked and potentially upgraded to ensure no flooding for up to the 1 in 30 year event with and allowance for climate change.

Car park drainage systems should include pollution control and we would like to see this achieved through the use of bio-retention where practicable.

The normal requirement would be to restrict flows to greenfield rates on previously undeveloped land, or as close to greenfield as practicable, but net exceeding existing rates on previously develop land.
As the Portishead site is so close to the coast, we do not need to restrict the discharge rate, however a capacity check will be required to demonstrate that the drainage system maintains a 1 in 30 year with climate change capacity under tide locked conditions.

For the other locations the standard principles will apply.

Hope this makes sense, let me know if you have any queries.

Kind regards

Lucy Nicholson
Senior Flood Risk Officer
Development & Environment
North Somerset Council

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E-Mail: Lucy.Nicholson@n-somerset.gov.uk
Post: Town Hall, Walliscote Grove Road, Weston-super-Mare, BS23 1UJ
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From: Jennifer Devereux
Sent: Thursday, December 08, 2016 12:16 PM
To: Lucy Nicholson <Lucy.Nicholson@n-somerset.gov.uk>
Subject: FW: highway drainage designs

Hi Lucy

They would like any details you have on the existing highway drainage at Pill and Ashton as well. They haven't asked, but I'll send you the draft drawings showing where we have permanent compounds too.

Thanks
Jenny

From: Penny.Lillie@ch2m.com [mailto:Penny.Lillie@ch2m.com]
Sent: Thursday, December 08, 2016 11:59 AM
To: Jennifer Devereux <Jennifer.Devereux@n-somerset.gov.uk>
Cc: Andrew.Linfoot@ch2m.com
Subject: highway drainage designs

Hi Jenny
Yes we will need existing highway drainage for Pill and Ashton as well please.
kind regards

Penny Lillie
Project Engineer

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Mobile +44 (0)7547 190959

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From: Jennifer Devereux [mailto:Jennifer.Devereux@n-somerset.gov.uk]
Sent: 08 December 2016 11:15
To: Lillie, Penny/UKS <Penny.Lillie@ch2m.com>
Cc: Linfoot, Andrew/BRS <Andrew.Linfoot@ch2m.com>; Cooper, Robert/UKS <Robert.Cooper@ch2m.com>
Subject: RE: Portishead : highway drainage designs [EXTERNAL]

Thanks Penny

I'll have a word with our drainage team. With regard to your second point do you need details of the system in just the Portishead area, or where there are maintenance access points, at Pill and at Ashton as well.

Kind Regards
Jenny

From: Penny.Lillie@ch2m.com [mailto:Penny.Lillie@ch2m.com]
Sent: Thursday, December 08, 2016 10:56 AM
To: Jennifer Devereux <Jennifer.Devereux@n-somerset.gov.uk>
Cc: Andrew.Linfoot@ch2m.com; Robert.Cooper@ch2m.com
Subject: Portishead : highway drainage designs

Hi Jenny
I'm assisting Andrew and yes thank you that would be very helpful.

We are looking to outfall the carpark catchment area to the Portbury Ditch as shown on the attached. The EA advised, on Tuesday, that the discharge rate will be set by the Lead Local Flood Authority. The only consultation required with the EA will be in obtaining a flood defence permit for the outfall structure.

Also for the remaining new highway catchment areas we propose to tie-in to the existing surface highway drainage system. We have details of the system north of the proposed rail line but not on south side. Wessex water do not own this system so we are assuming it belongs to NSC?

Grateful if you can advise or put me in touch with someone that can.

kind regards

Penny Lillie
Project Engineer

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From: Jennifer Devereux [mailto:Jennifer.Devereux@n-somerset.gov.uk]
Sent: 08 December 2016 10:38
To: Linfoot, Andrew/BRS <Andrew.Linfoot@ch2m.com>
Cc: Fabisiak, Magda/BRS <Magda.Fabisiak@ch2m.com>; Lillie, Penny/UKS <Penny.Lillie@ch2m.com>
Subject: RE: Car park drainage designs [EXTERNAL]

Thanks

If you need me ask our drainage team about the discharge rates or anything else let me know.

Kind Regards
Jenny

From: Andrew.Linfoot@ch2m.com [mailto:Andrew.Linfoot@ch2m.com]
Sent: Thursday, December 08, 2016 10:32 AM
To: Jennifer Devereux <Jennifer.Devereux@n-somerset.gov.uk>
Cc: Magda.Fabisiak@ch2m.com; Penny.Lillie@ch2m.com
Subject: RE: Car park drainage designs

Jenny
We are struggling a bit with this at the moment going round and round; the concept designs are in place, but trying to get someone to decide on discharge rates is proving to be a challenge. The EA now say it is NSC…
We are working on it.
Regards

Andrew Linfoot BA PGDipUD MPhil CMLI
Landscape and urban design lead UK
D 0117 910 2580
M 07921 495322

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From: Jennifer Devereux [mailto:Jennifer.Devereux@n-somerset.gov.uk]
Sent: 08 December 2016 10:21
To: Linfoot, Andrew/BRS <Andrew.Linfoot@ch2m.com>
Subject: Car park drainage designs [EXTERNAL]

Hi Andrew

I was just wondering when the drainage designs for the Highway elements of MetroWest would be available. We are looking to meet the drainage officers and IDB probably in Feb, so there is no immediate rush, but I know they would like to comment on the outline designs.

Kind Regards
Jenny

Jennifer Devereux
Transport Policy Officer (MetroWest Phase 1)
Development & Environment
North Somerset Council

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E-Mail: Jennifer.Devereux@n-somerset.gov.uk
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Web: http://secure-web.cisco.com/13qQppBnFKFMA20JQY8_UC9cfdYrLMnIPfdC5hZUHcNMo92azjKkfXUU_HvoC4SR8Bx6lsCo-rFx5DRBDvJRnjRMYaEI7gt_K8-_6jaajKqQMc8hebxOclw4jWeTSAJ0hexHAj-av-seR_UND69j1mFWh3t8cuXT1BmFF7K8S1QS6ppHBAFm4HgSy64BLPBTU5eAvyVfRp86_5JI2rHqRpe4vDWSVKnTM2VHrh6_xhKyWDRnfKg7iVbrljQeGnuctIuX_fMVwmPRYs1jVXW4aDZjMRaqt26rZt_QE8yy7nAGqFm9X64Xg7Q5I5qPmQ05Ems3ZKaV9N9B0KgmrWKNGiJIZXpwWigXpac-pHJfc-71EOMs9dTgFe3EAHsxQeU1verRGypwG_ACeOaMgCsbvsdnMheNRHwp1H_vdGAMkTgpZARY5jaY0xtNuEo-g-zIwgHwch1PH_WKtGc8dGZOn5atlEewr_g3qMHermZo2knA/http%3A%2F%2Fwww.n-somerset.gov.uk

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Lillie, Penny/UKS

From: Vasilyev, Kostya/UKS
Sent: 18 January 2017 13:36
To: Lillie, Penny/UKS
Cc: Cooper, Robert/UKS; Bird, Robert/UKS
Subject: RE: Portishead -tide locked level
Attachments: Scanned from a Xerox Multifunction Printer.pdf

Penny

Thank you for your enquiry.

Following the location of points on the scan sent to me and Robert Bird on 16/01/2017 13:13 by Robert Cooper, I can say that the water levels for the 25 year and 50 year events (climate change scenario) are as follows:

The **left point** as per the scan referenced above (please also find it attached) (near the drain , the location is to the south of Harbour Road):

50 year event: 7.05m
25 year event: 4.85m

The levels are the same for both pre-development and post development situation for each of the return periods listed above.

It looks like the water stays within the ditch or is not overtopping the planned ground levels (in post development situation).

There is no water level information in the model for the **right point** (to the north of Phoenix Road).

In order to provide some estimate for this point we looked at the downstream end of this drain (at its confluence with the Portbury? Drain, the location is to the east of Newfoundland Way, see the red star on the map below). These levels will provide a very conservative approximation of levels at the right point on the scan provided. Taking this information from the downstream end of this drain allows us to estimate levels further upstream of this drain as this drain is not represented in a model.

The downstream side of the brook that flows by the r**ight point**:

50 year event:
7.06m (post development situation)
7.05m (pre-development situation)
25 year event:
5.24m (both pre and post development situation)

It looks like the water stays within the ditch or is not overtopping the planned ground levels (in post development situation).

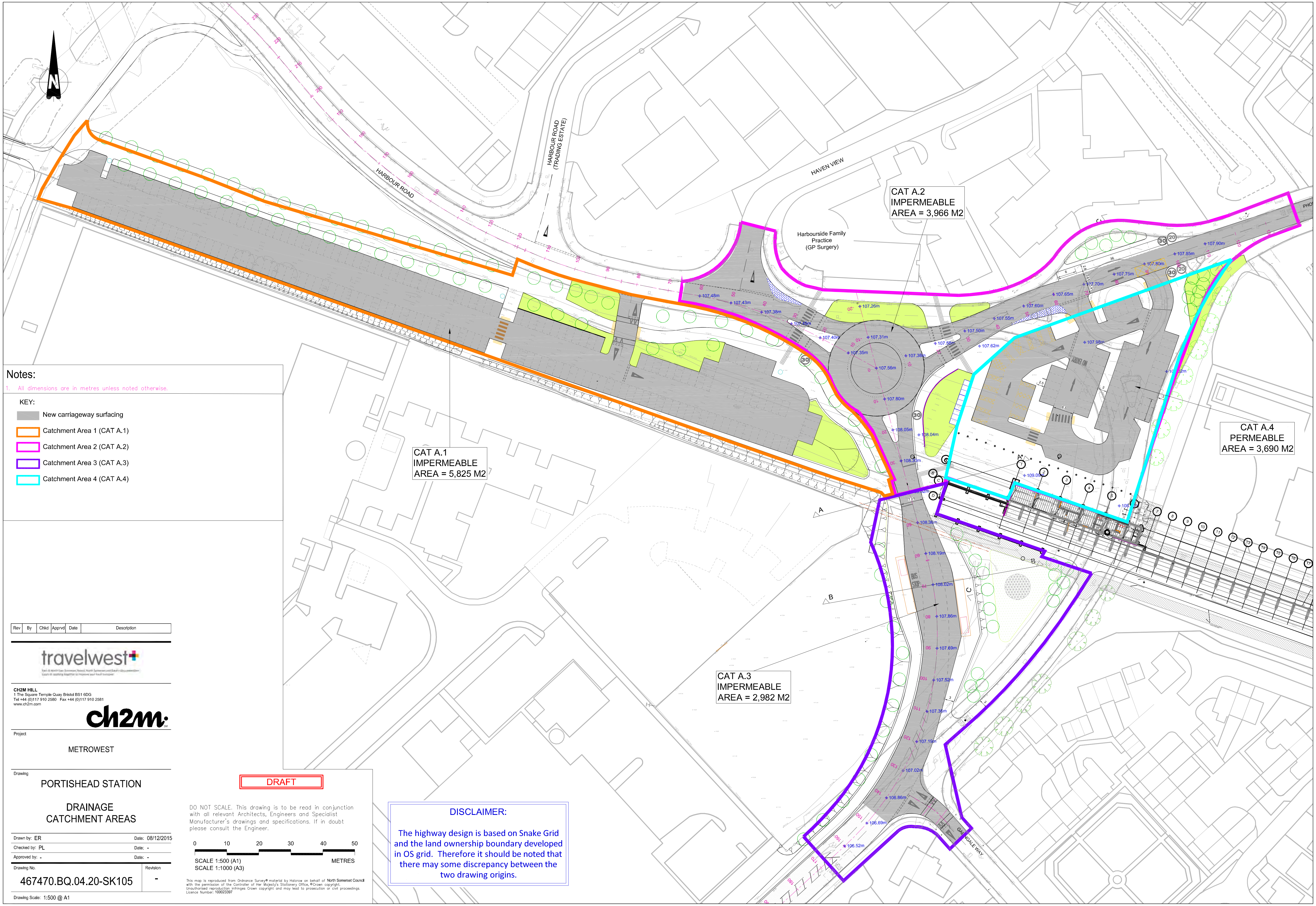
Hope it helps.

Please let us know if there are more questions.

Many thanks.

Kind regards

Appendix B



Notes:

1. All dimensions are in metres unless noted otherwise.

KEY:

- New carriageway surfacing
- Catchment Area 1 (CAT A.1)
- Catchment Area 2 (CAT A.2)
- Catchment Area 3 (CAT A.3)
- Catchment Area 4 (CAT A.4)

Rev	By	Chkd	Apprvd	Date	Description

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Project

METROWEST

Drawing

PORTISHEAD STATION

DRAINAGE
CATCHMENT AREAS

Drawn by: ER Date: 08/12/2015
Checked by: PL Date: -
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-SK105 Revision -

Drawing Scale: 1:500 @ A1

DRAFT

DO NOT SCALE. This drawing is to be read in conjunction with all relevant Architects, Engineers and Specialist Manufacturer's drawings and specifications. If in doubt please consult the Engineer.

0 10 20 30 40 50
SCALE 1:500 (A1) METRES
SCALE 1:1000 (A3)

DISCLAIMER:

The highway design is based on Snake Grid and the land ownership boundary developed in OS grid. Therefore it should be noted that there may some discrepancy between the two drawing origins.

Notes:

1. All dimensions are in metres unless noted otherwise.

KEY:

- New carriageway surfacing
- Catchment Area 1 (CAT A.1)
- Catchment Area 2 (CAT A.2)
- Catchment Area 3 (CAT A.3)
- Catchment Area 4 (CAT A.4)
- Areas of Bioretention and Management of Exceedance flows
- Direction of Flows
- Swale
- Filter Drain (toe to embankment)

Rev	By	Chkd	Apprvd	Date	Description
A	MF	MF	AL	22.11.17	Minor changes.

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METROWEST

Drawing

PORTISHEAD STATION

DRAINAGE STRATEGY

Drawn by: ER Date: 17/01/2017
Checked by: PL Date: -
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-SK106

Revision A

Drawing Scale: 1:500 @ A1

DRAFT

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Manufacturer's drawings and specificatior
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0 10 20 30

SCALE 1:500 (A1)
SCALE 1:1000 (A3)

DISCLAIMER:

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Notes:

1. All dimensions are in metres unless noted otherwise.

Key:

- Existing highway drainage
- Impermeable area 1
- Impermeable area 2

Rev	By	Chkd	Apprvd	Date	Description
-	PC	PL	-	-	First issue

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METROWEST

Drawing

PORTISHEAD STATION

EXISTING DRAINAGE

Drawn by: PC Date: 18/01/2017
Checked by: PL Date: 18/01/2017
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-SK107
Revision -

Drawing Scale: 1:500 @ A1

DRAFT

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0 10 20 30 40 50
SCALE 1:500 (A1) METRES
SCALE 1:1000 (A3)

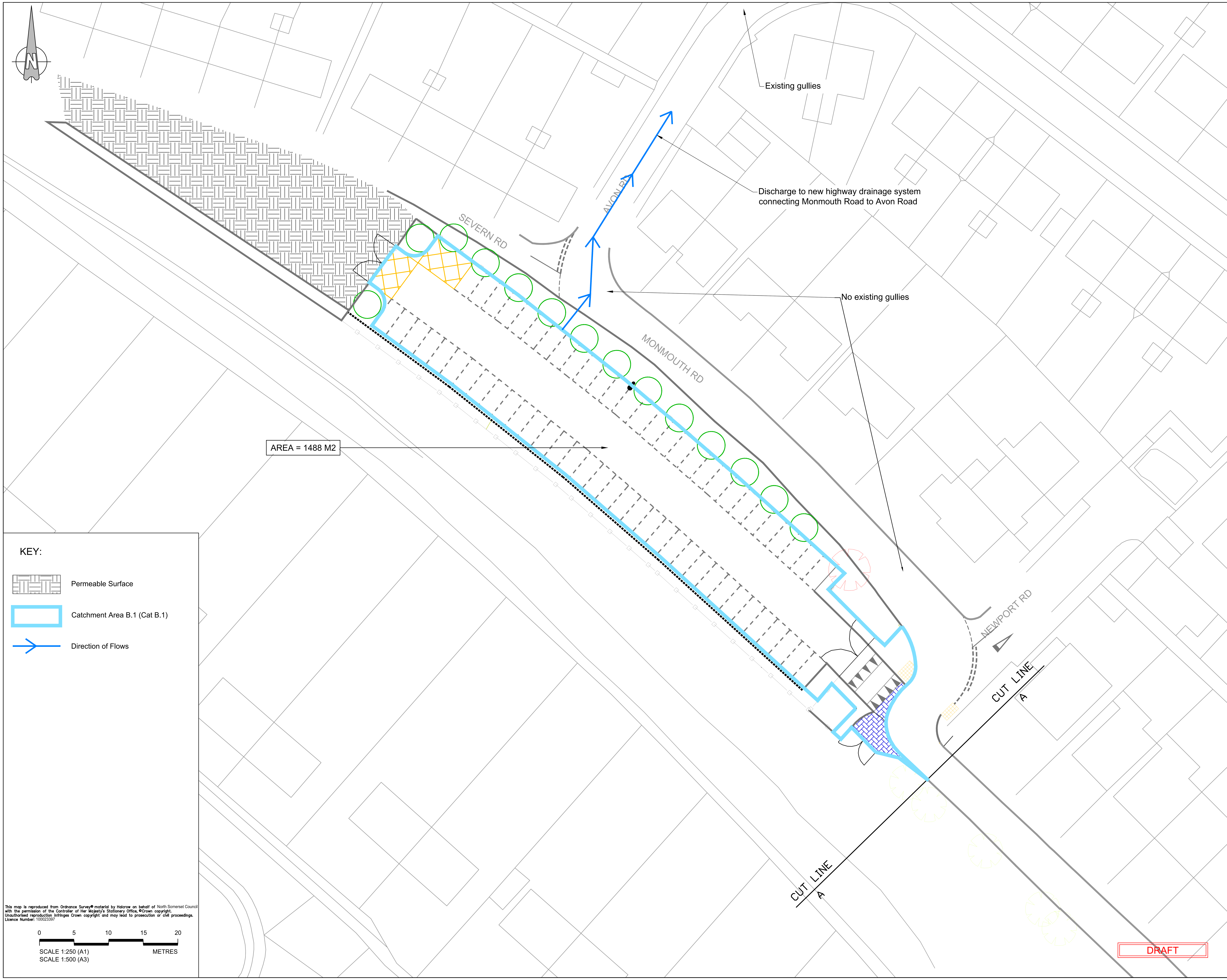
DISCLAIMER:

The highway design is based on Snake Grid and the land ownership boundary developed in OS grid. Therefore it should be noted that there may some discrepancy between the two drawing origins.

Appendix C

NOTES:

1. All dimensions are in metres unless noted otherwise.



KEY:

- Permeable Surface
- Catchment Area B.1 (Cat B.1)
- Direction of Flows

0 5 10 15 20

SCALE 1:250 (A1) METRES
SCALE 1:500 (A3)

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Rev	By	Chkd	Apprvd	Date	Description

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Project

METROWEST

Drawing

PILL STATION

DRAINAGE STRATEGY

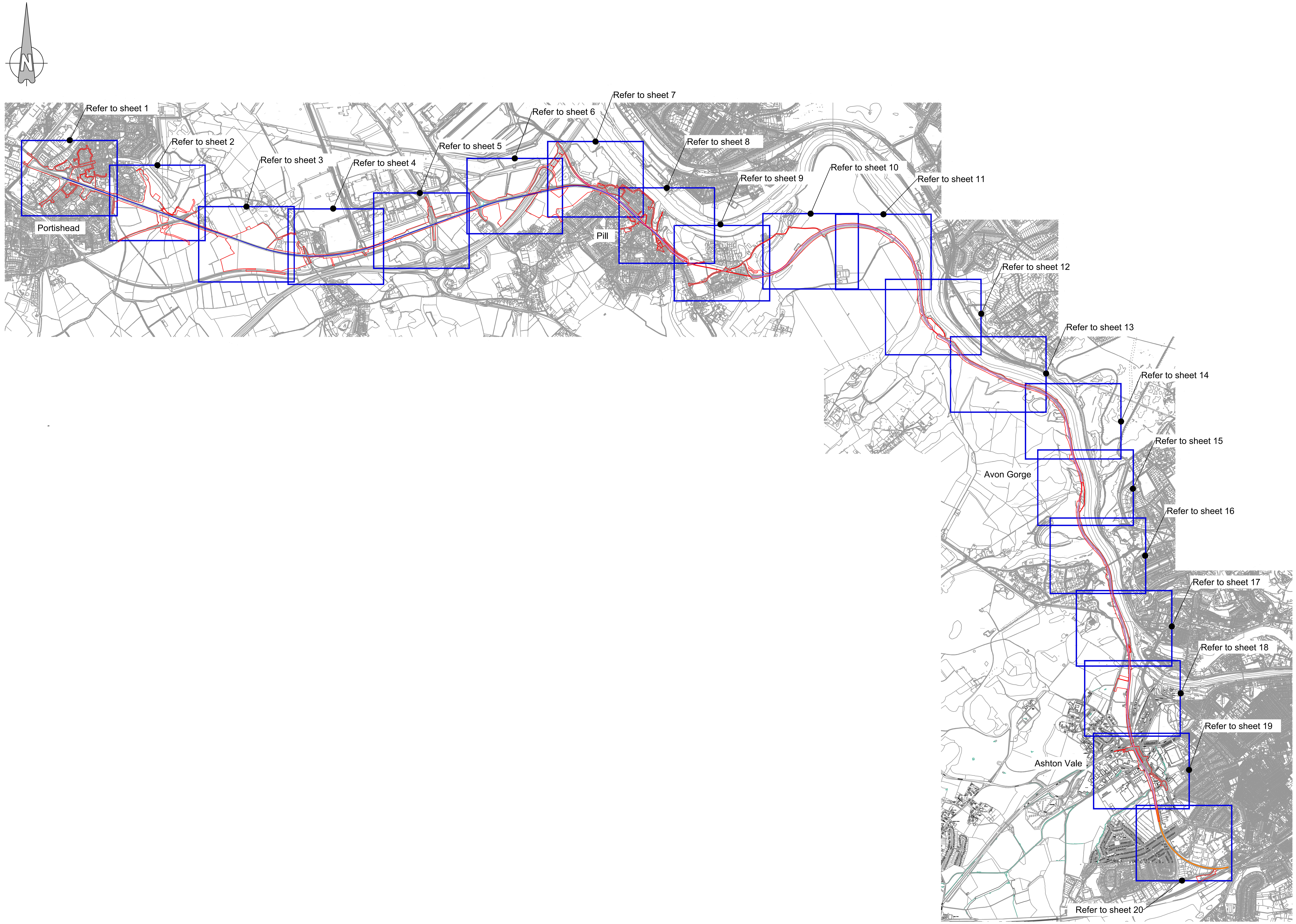
Drawn by: ER Date: 14.12.2016
Checked by: PL Date: 14.12.2016
Approved by: - Date: -

Drawing No. 467470.BQ.04.20-200-SK10 Revision -

Drawing Scale: 1:250 @ A1

APPENDIX H

Project Summary Plans



KEY:

- Order limits
- Nationally Significant Infrastructure project (NSIP)
- Existing railway
- Permitted development works

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

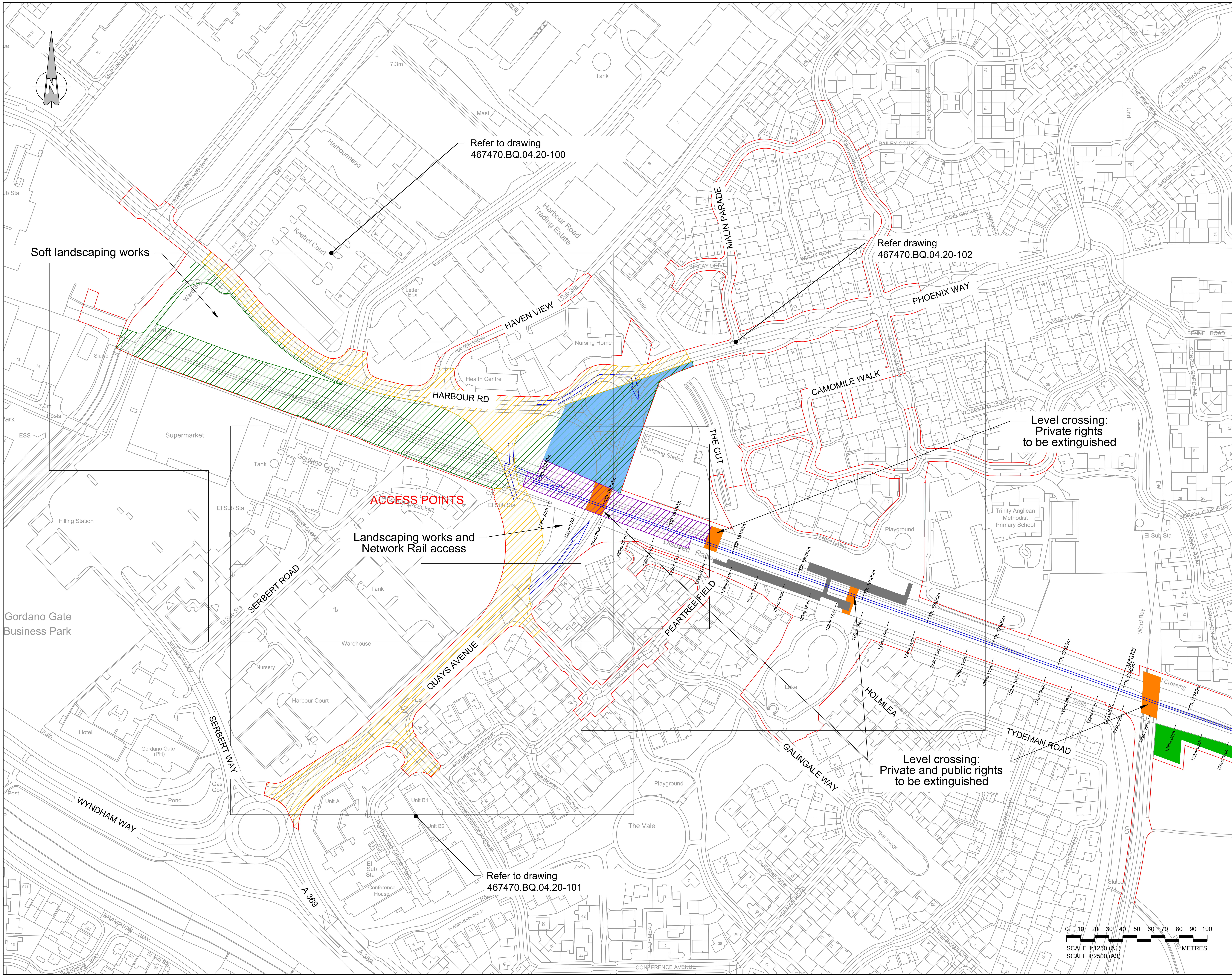
PROJECT SUMMARY PLANS
SHEET 0 OF 20
KEY PLAN

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-450
Revision A

Drawing Scale: 1:32000 @ A3

Drawing file path & name : \\brsfpp01\proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BQ.42 MW PM support Nov 16 to Mar 17\90 AutoCAD\91 AutoCAD\Project Summary Plans\ 674946.BQ.42.01-450 to 461 Rev A.dwg



KEY:

- Order limits
- Access point
- Construction compound
- Haul Road
- Area of proposed station
- Area of proposed car park
- Proposed highway works
- Proposed Foot/ Cycle bridge
- Level crossing to be extinguished
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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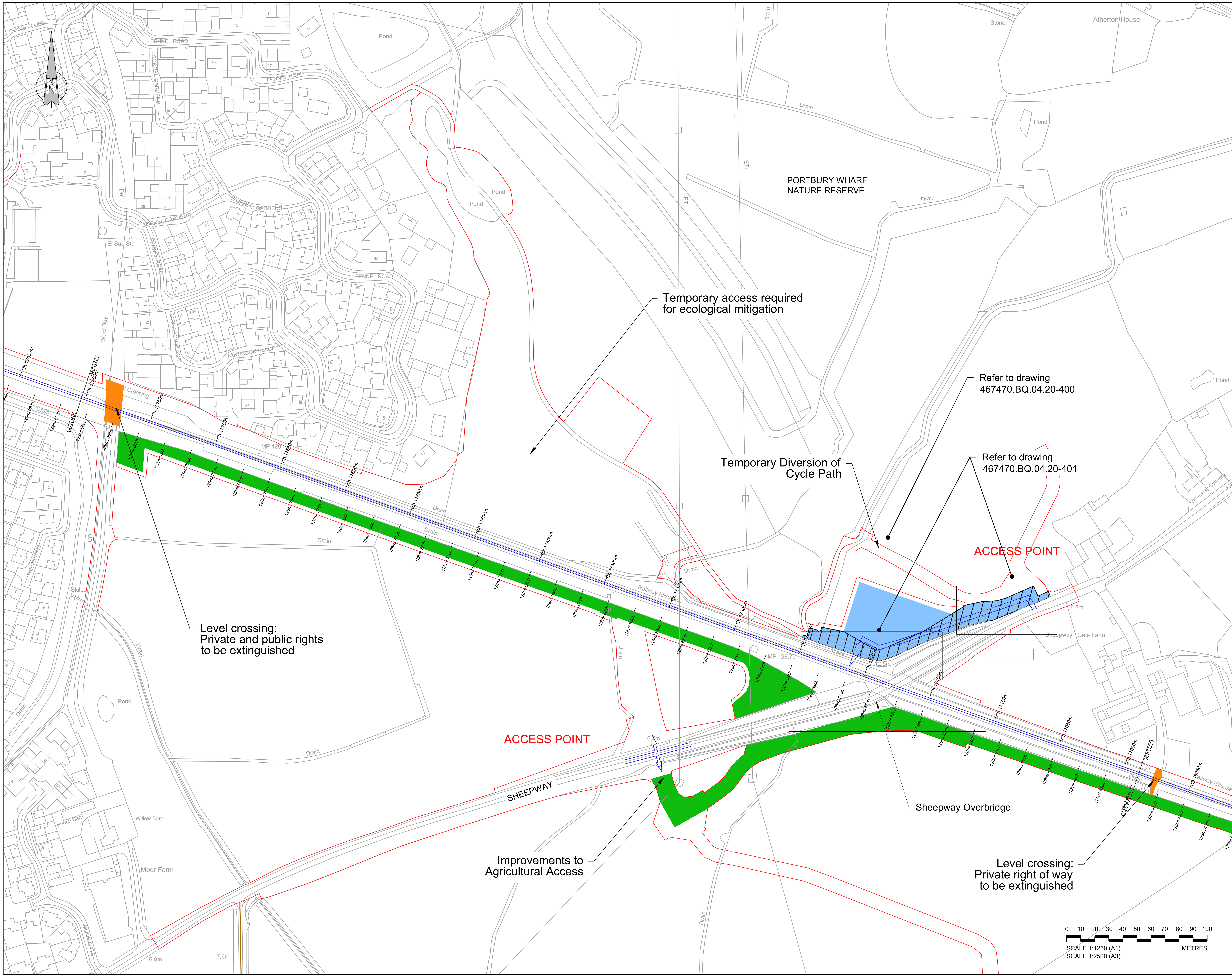
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 1 OF 20
PORTISHEAD

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-451
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Access point
- Construction compound
- Permanent access
- Haul Road
- Level crossing to be extinguished
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

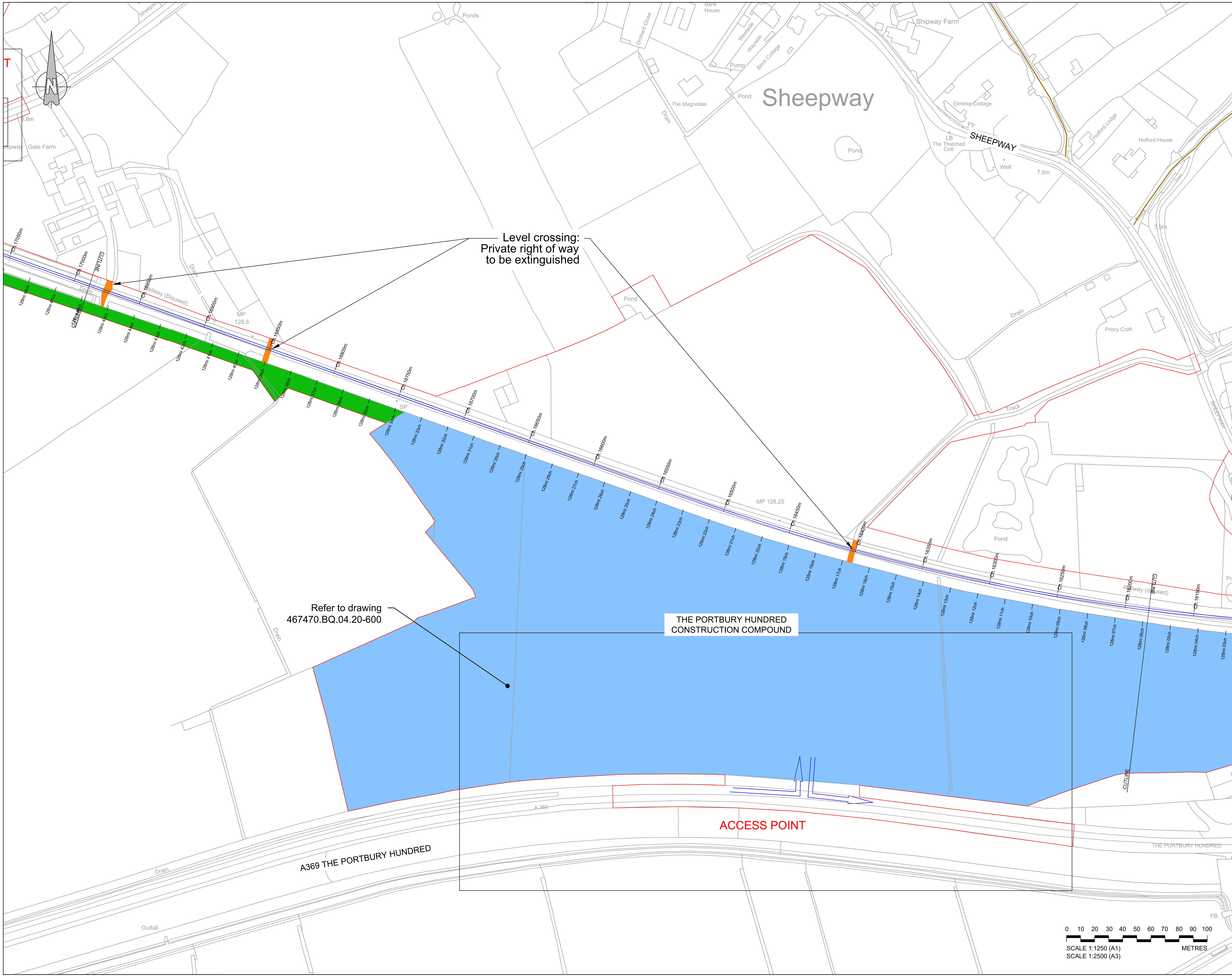
PROJECT SUMMARY PLANS
SHEET 2 OF 20
SHEEPWAY 1

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-452

Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Access point
- Construction compound
- Haul Road
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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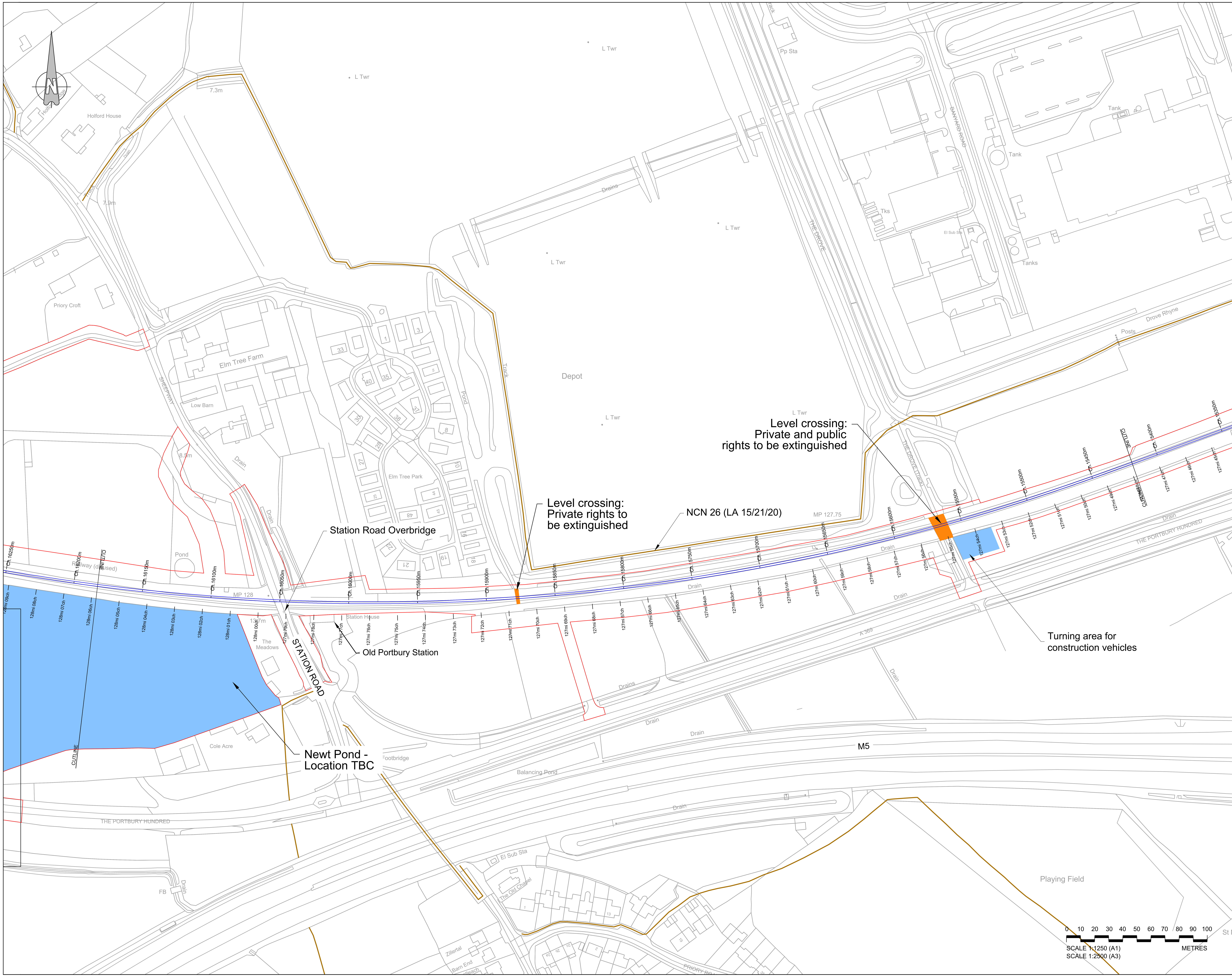
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 3 OF 20
SHEEPWAY 2

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-453
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Construction compound
- Level crossing to be extinguished
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

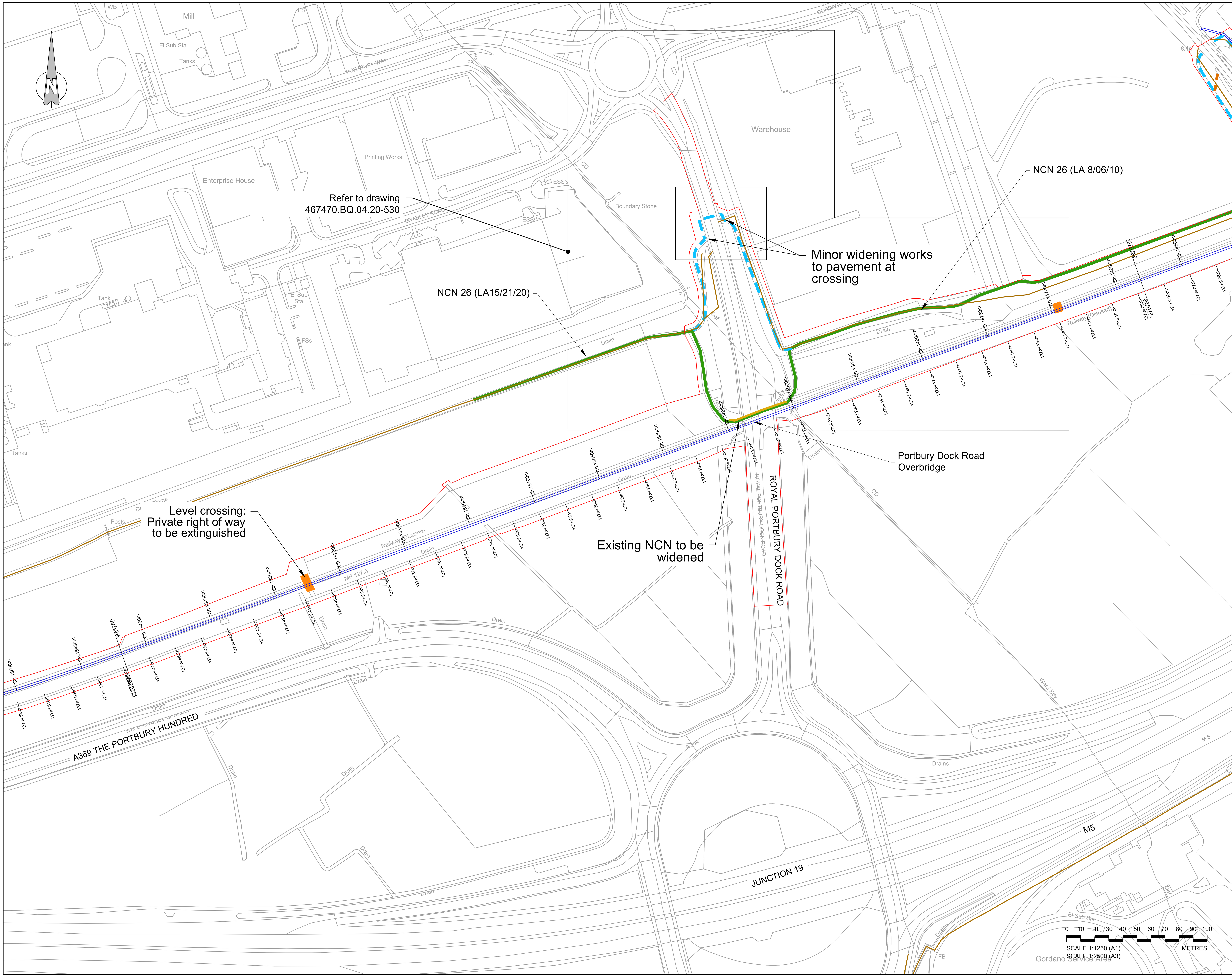
PROJECT SUMMARY PLANS
SHEET 4 OF 20
OLD PORTBURY STATION

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No.: 674946.BQ.42.01-454
Revision: A

Drawing Scale: 1:2500 @ A3

Drawing file path & name : \\brsfpp01\proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BQ.42 MW PM support Nov 16 to Mar 17\90 AutoCAD\91 AutoCAD\Project Summary Plans\674946.BQ.42.01-450 to 461 Rev A.dwg



KEY:

- Order limits
- Level crossing to be extinguished
- Existing NCN to remain
- NCN to be widened
- Existing bridleway to remain
- Proposed extension of bridleway
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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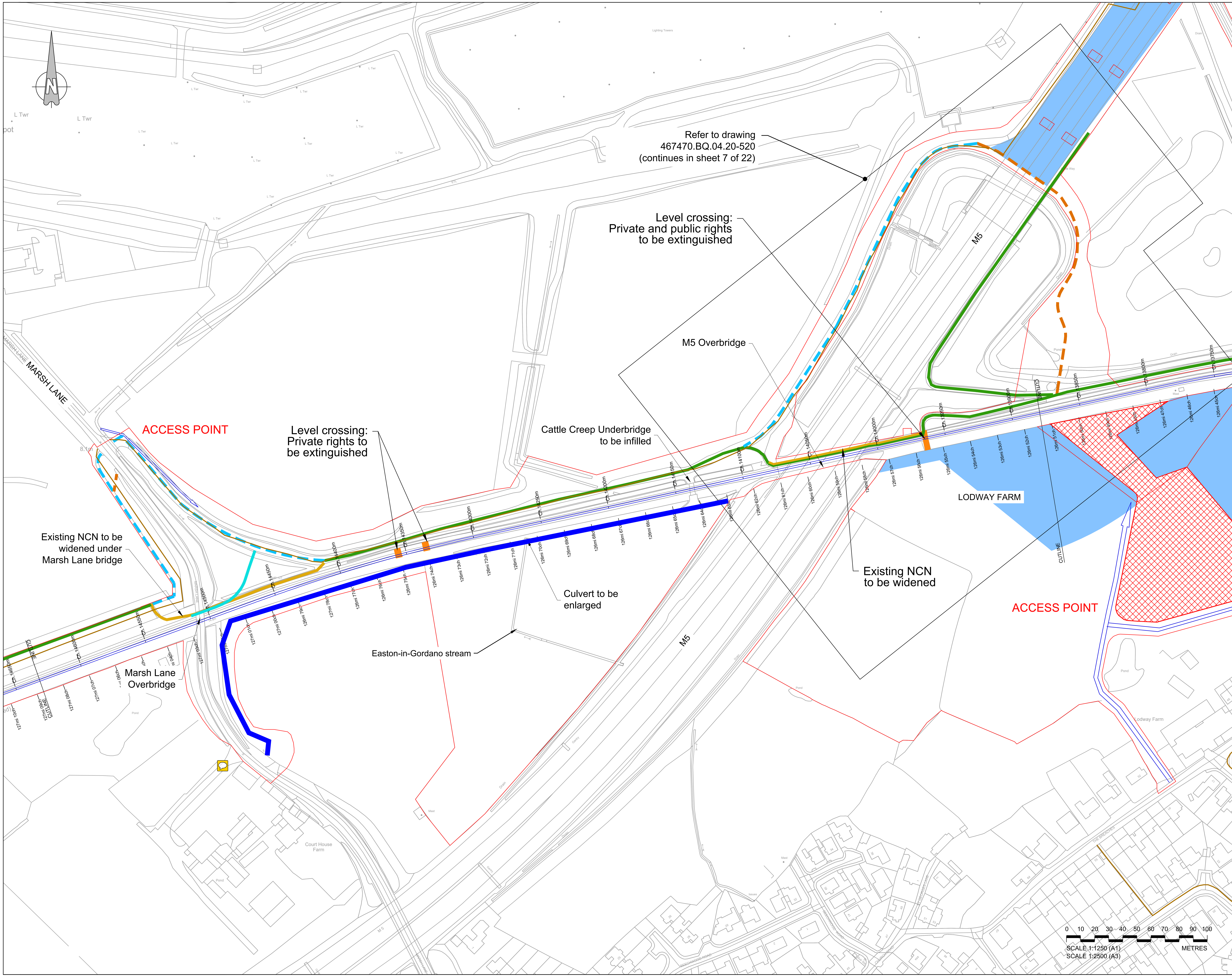
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 5 OF 20
JUNCTION 19

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-455 Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Area excluded from acquisition
- Construction compound
- Level crossing to be extinguished
- Existing NCN to remain
- NCN to be widened
- Existing bridleway to remain
- Proposed extension of bridleway
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)
- Proposed realigned cycle route

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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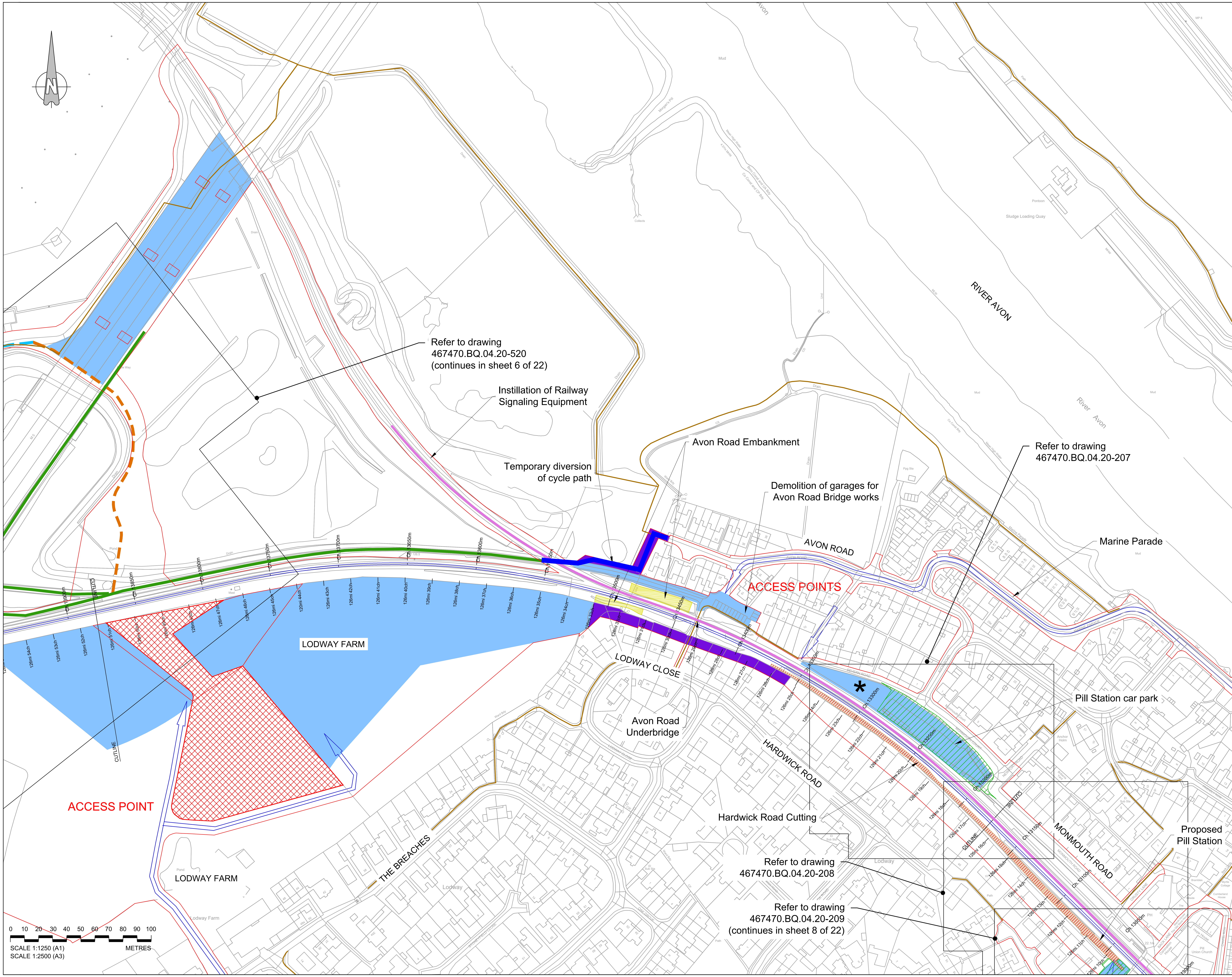
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 6 OF 20
M5 OVERBRIDGE

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-456 Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Area excluded from acquisition
- Access point
- Construction compound
- Temporary construction access
- Area of proposed car park
- Existing NCN to remain
- Proposed extension of bridleway
- Proposed area of soil nailing
- Proposed works to cutting
- Proposed works to embankment
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)
- Existing railway
- * Proposed location of the principal supply point building

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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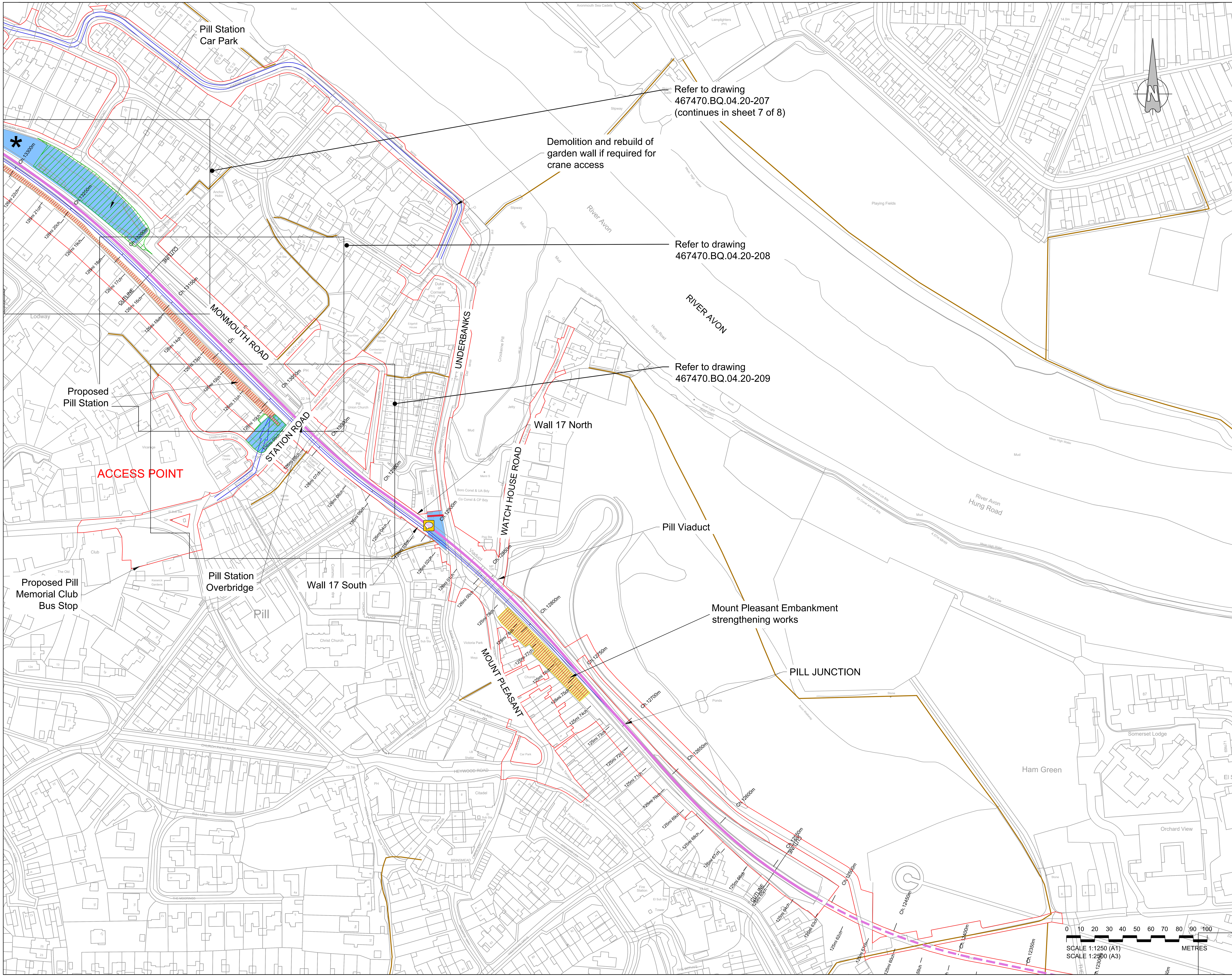
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 7 OF 20
WEST PILL

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-457
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Access point
- Construction compound
- Area of proposed car park
- Proposed area of soil nailing
- Proposed works to cutting
- Proposed works to embankment
- Retaining wall
- Public rights of way
- Nationally Significant Infrastructure Project (NSIP)
- Existing railway
- * Proposed location of the principal supply point building

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

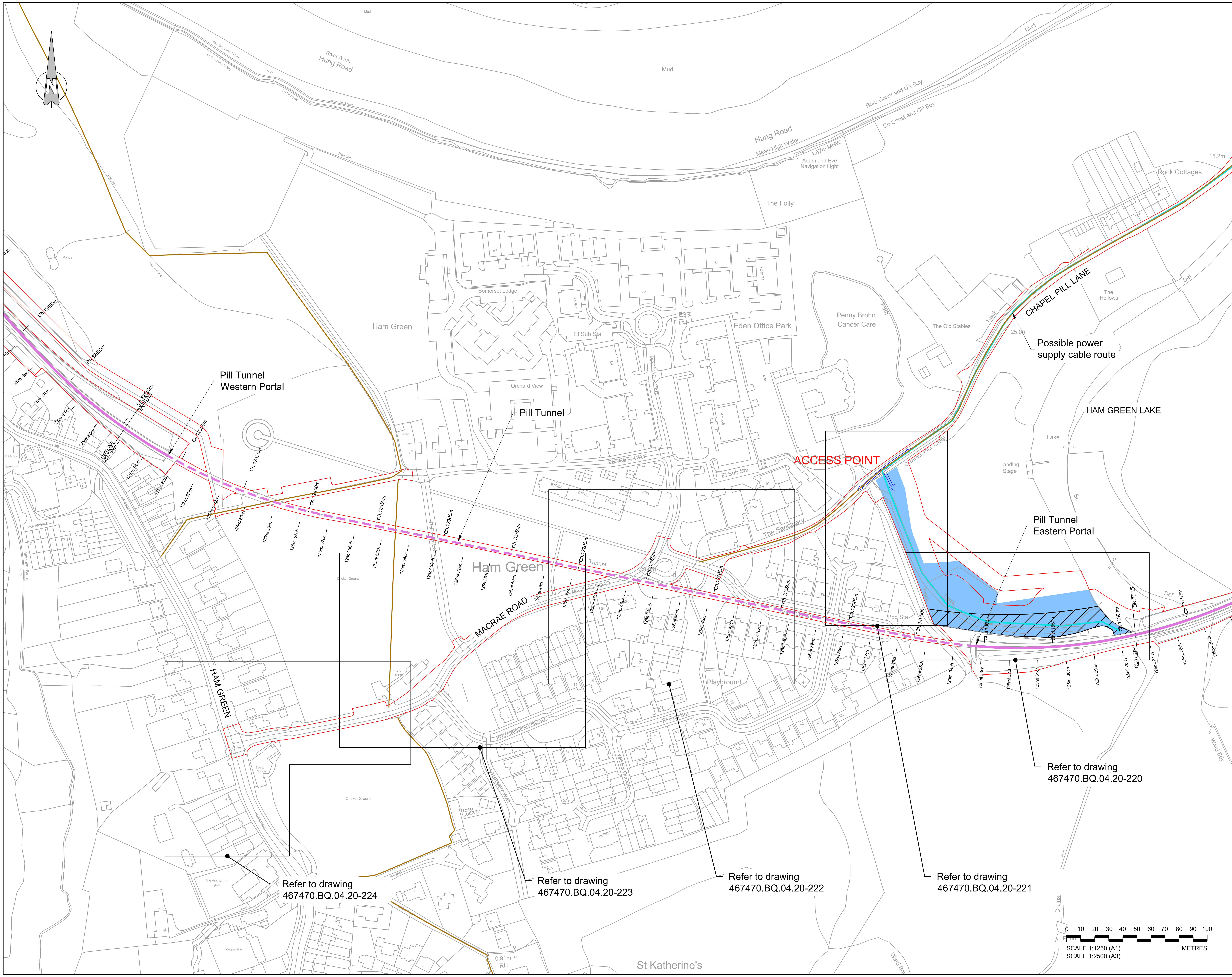
Drawing
PROJECT SUMMARY PLANS
SHEET 8 OF 20
EAST PILL

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No.
674946.BQ.42.01-458

Revision
A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Access point
- Construction compound
- Permanent access
- Public rights of way
- Possible power supply cable route
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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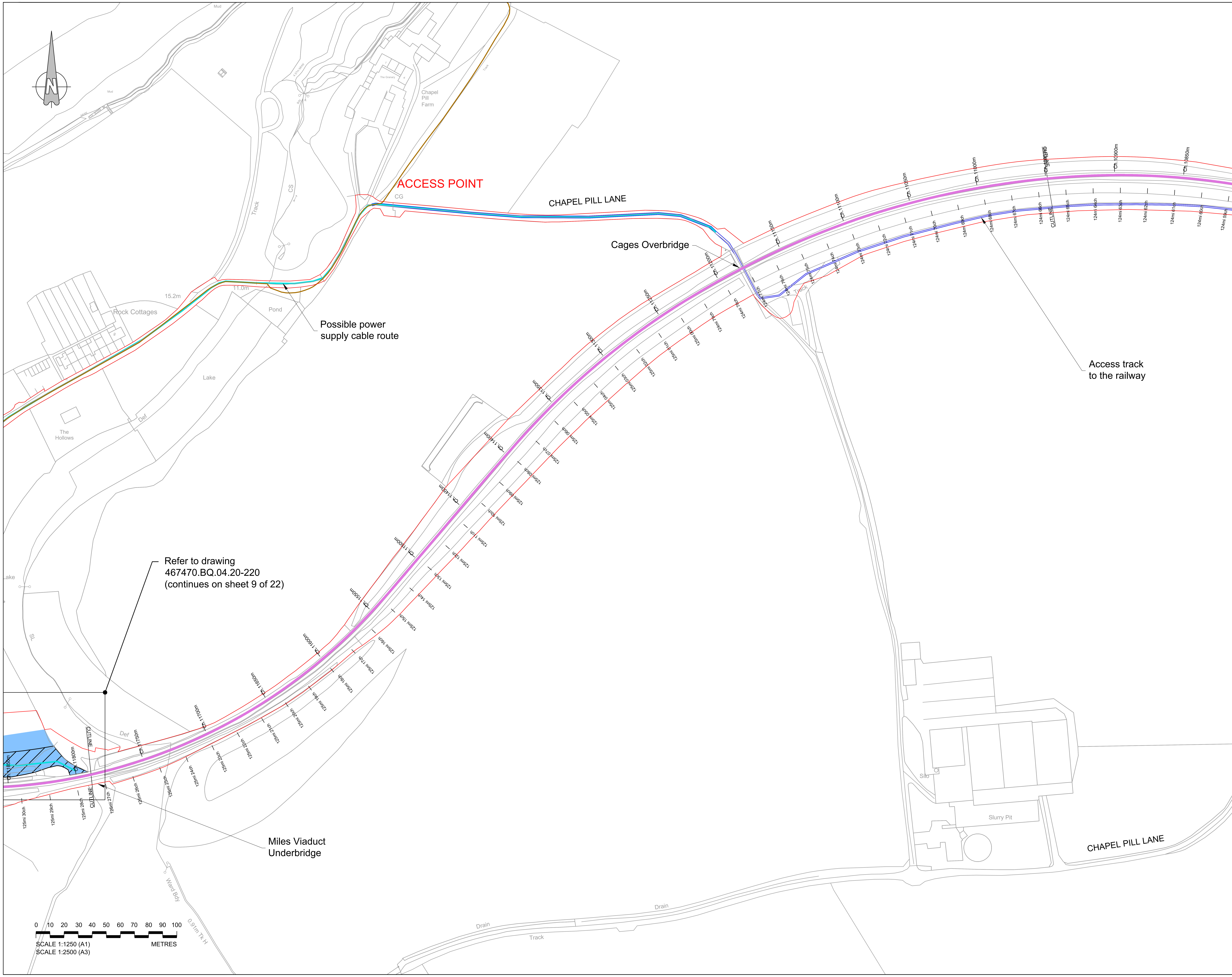
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 9 OF 20
HAM GREEN

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-459
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Access point
- Construction compound
- Permanent access
- Public rights of way
- Possible power supply cable route
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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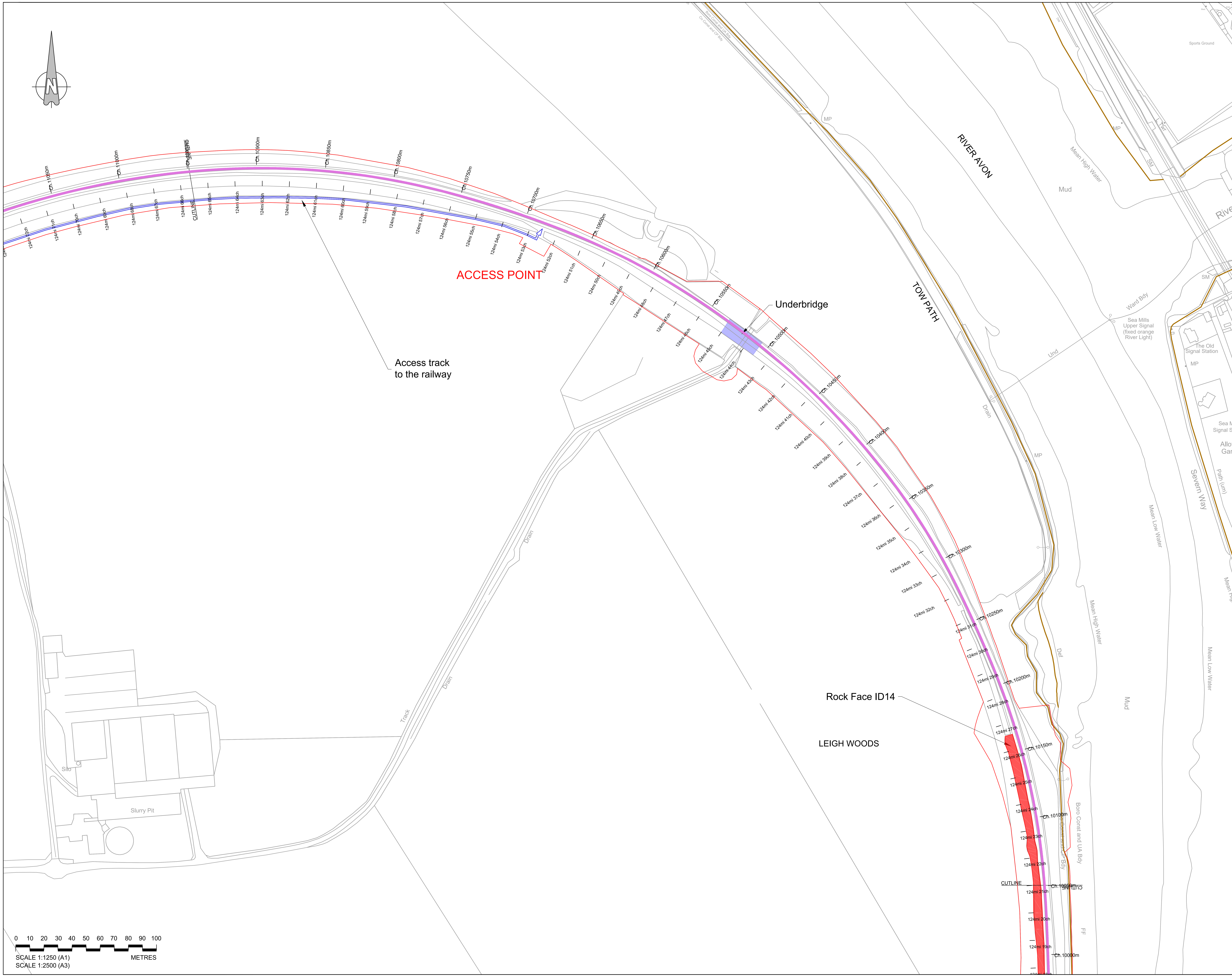
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 10 OF 20
CHAPEL HILL

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-460
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Access point
- Micro compound
- Proposed works to rock face
- Public rights of way
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

PROJECT SUMMARY PLANS
SHEET 11 OF 20
LEIGH WOODS 1

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No.: 674946.BQ.42.01-461
Revision: A

Drawing Scale: 1:2500 @ A3

KEY:

- Order limits
- Micro compound
- Proposed works to rock face
- Retaining wall
- Public rights of way
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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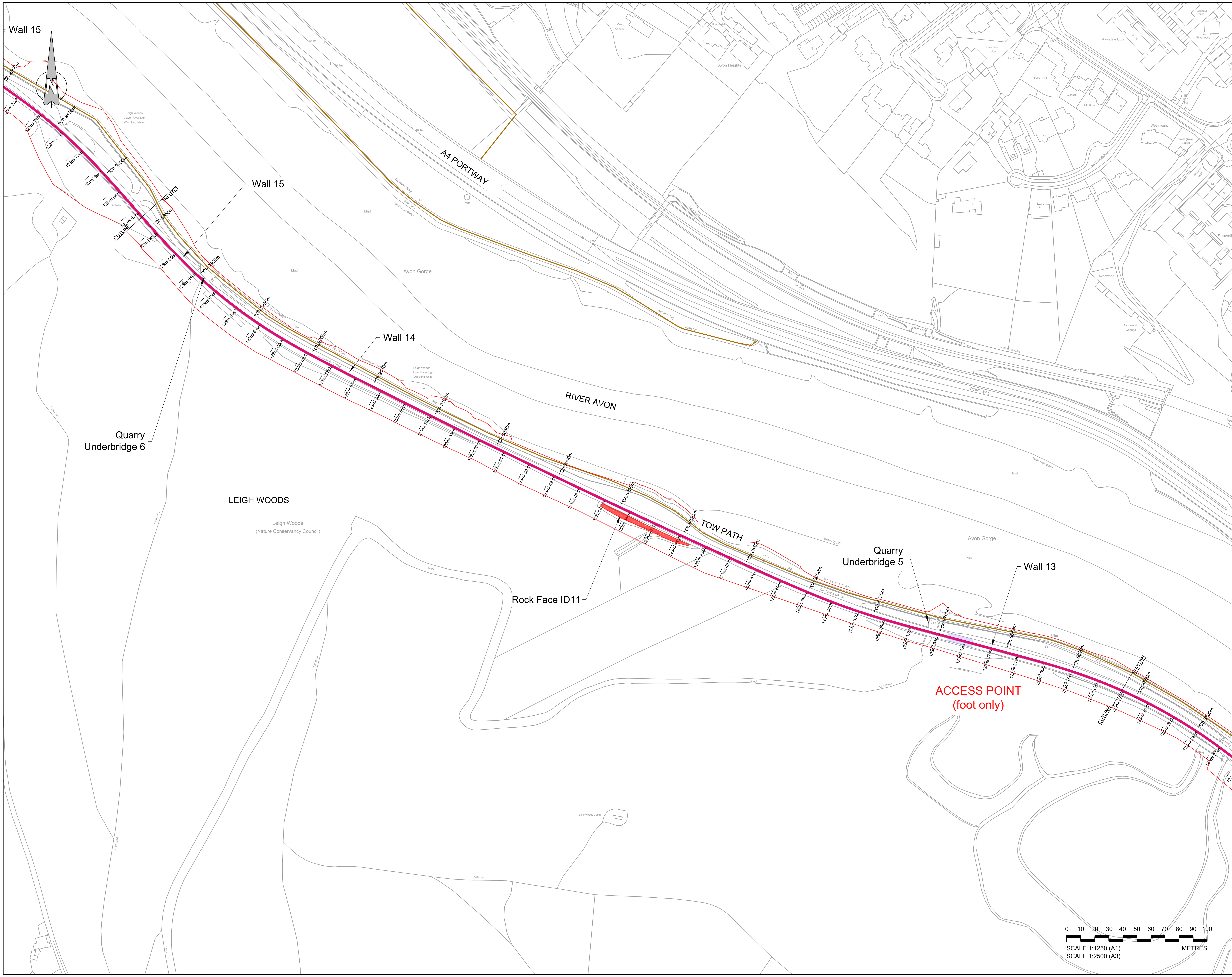
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 12 OF 20
SANDSTONE TUNNEL

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-462
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Micro compound
- Proposed works to rock face
- Retaining wall
- Public rights of way
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

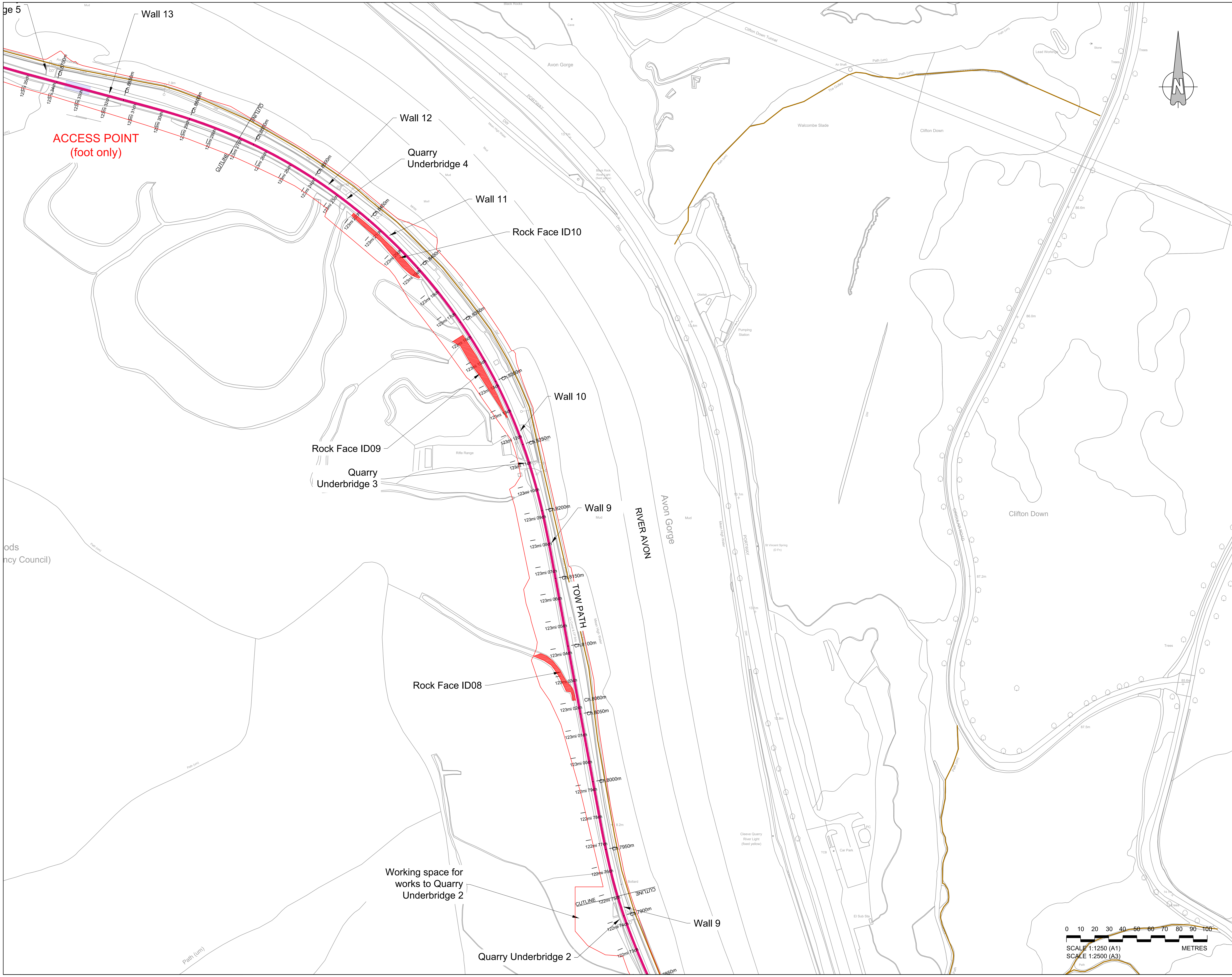
Drawing
PROJECT SUMMARY PLANS
SHEET 13 OF 20
LEIGH WOODS 2

Drawn by: FG — Date: 23/04/2018
Checked by: KS — Date: 23/04/2018
Approved by: ADL — Date: 23/04/2018

Drawing No. 674946.BQ.42.01-463 — Revision A

Drawing Scale: 1:2500 @ A3

Drawing file path & name : \\brsfpp01\proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BQ.42 MW PM support Nov 16 to Mar 17\90 AutoCAD\91 AutoCAD\Project Summary Plans\674946.BQ.42.01-462 to 470 Rev A.dwg



KEY:

- Order limits
- Micro compound
- Proposed works to rock face
- Retaining wall
- Public rights of way
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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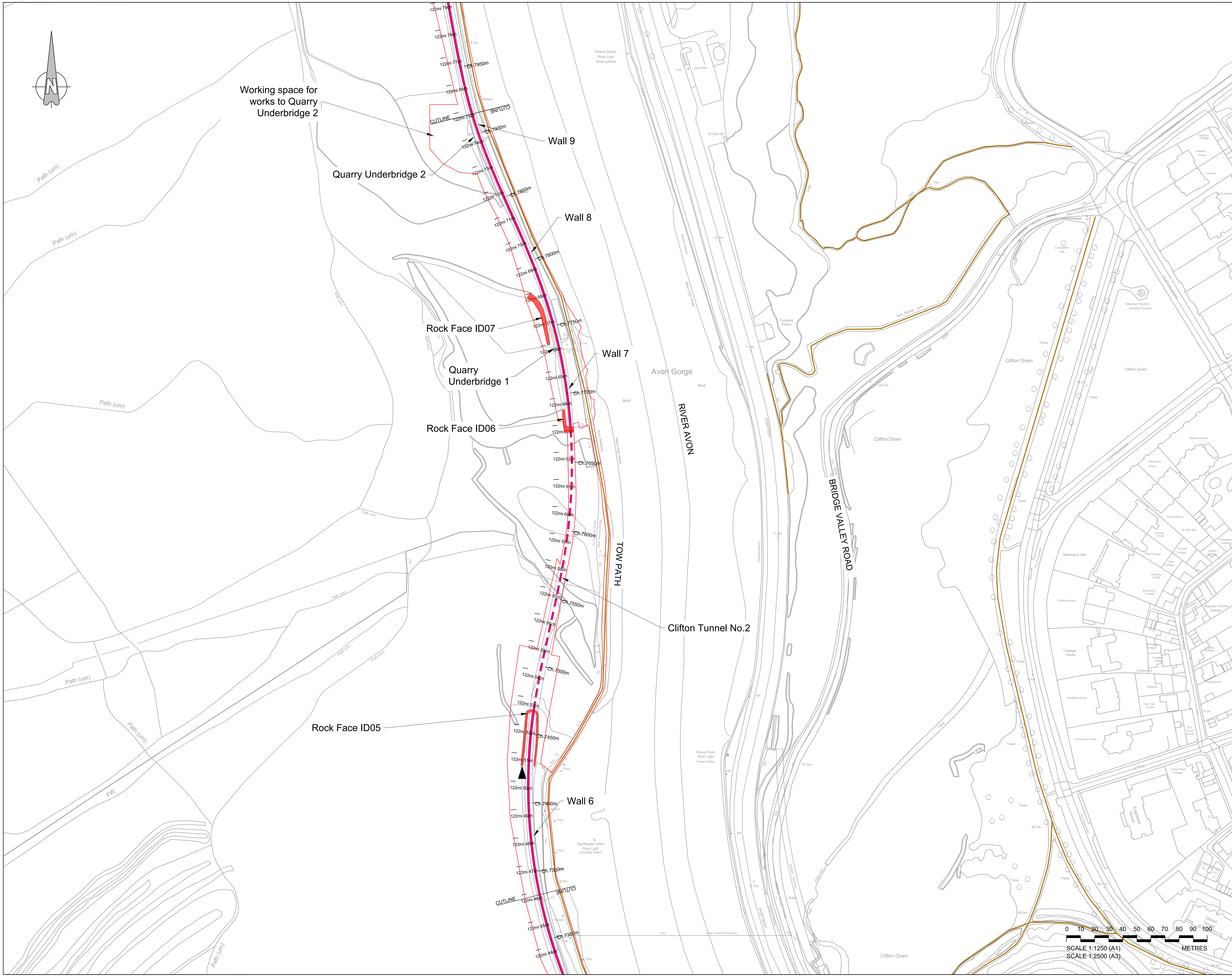
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 14 OF 20
LEIGH WOODS 3

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-464
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

Order limits

Proposed works to rock face

Retaining wall

Public rights of way

Existing railway

GSM-R mast

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project

PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing

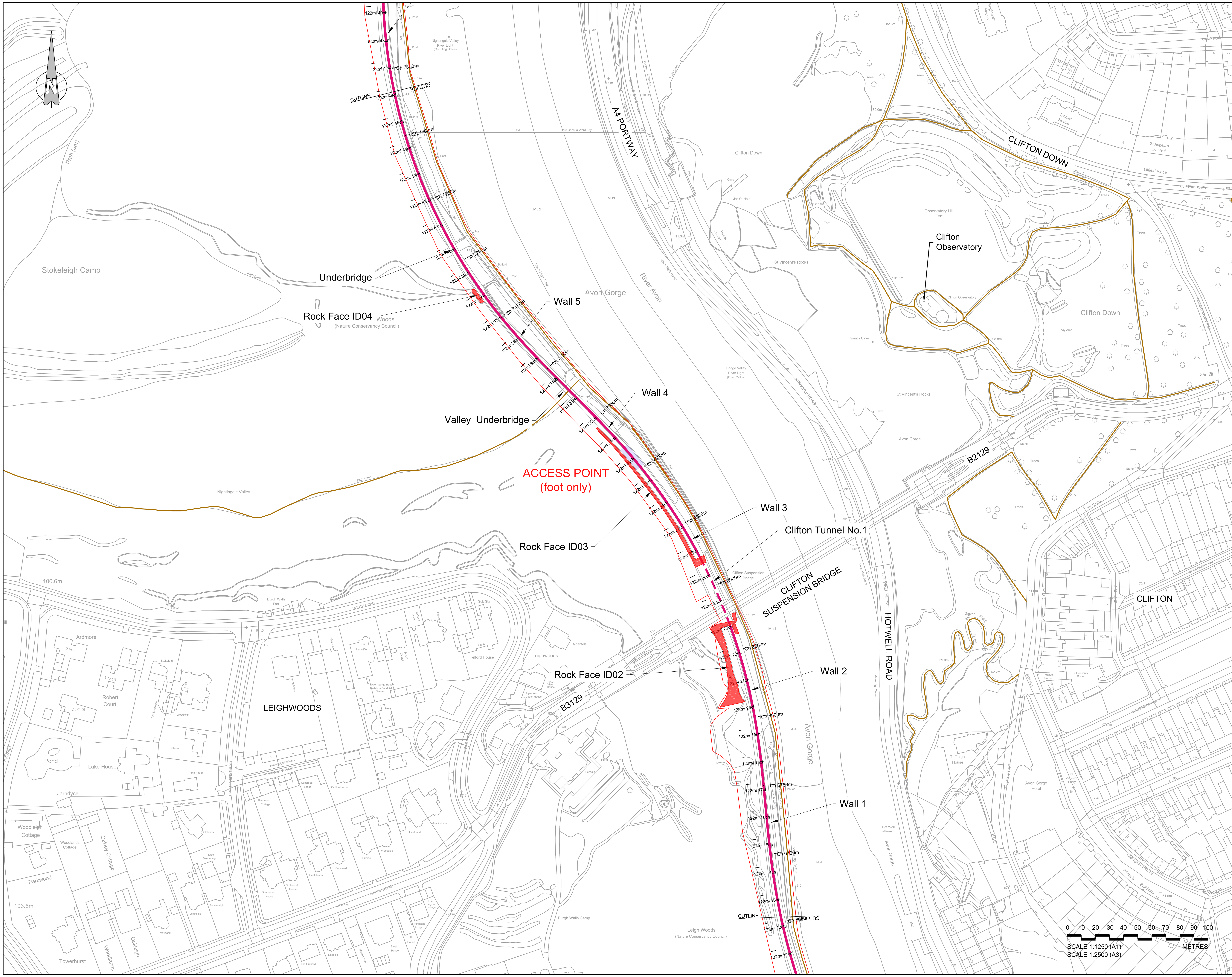
PROJECT SUMMARY PLANS
SHEET 15 OF 20
CLIFTON TUNNEL No. 2

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-465
Revision A

Drawing Scale: 1:2500 @ A3

Drawing file path & name : \\brsfpp01\proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BQ.42 MW PM support Nov 16 to Mar 17\90 AutoCAD\91 AutoCAD\Project Summary Plans\674946.BQ.42.01-462 to 470 Rev A.dwg



KEY:

- Order limits
- Micro compound
- Proposed works to rock face
- Retaining wall
- Public rights of way
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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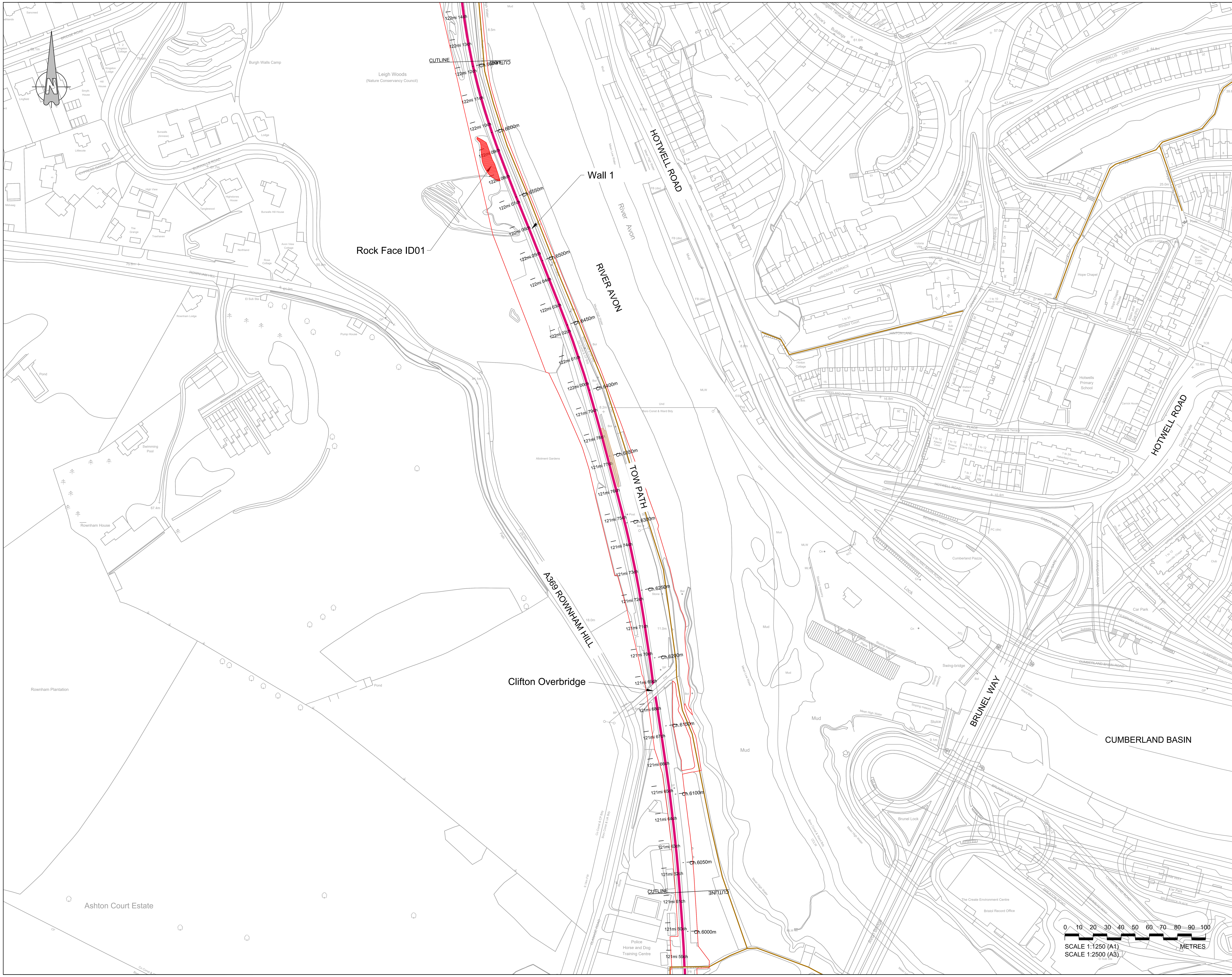
Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 16 OF 20
LEIGH WOODS

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No.: 674946.BQ.42.01-466
Revision: A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Proposed works to cutting
- Proposed works to rock face
- Retaining wall
- Public rights of way
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

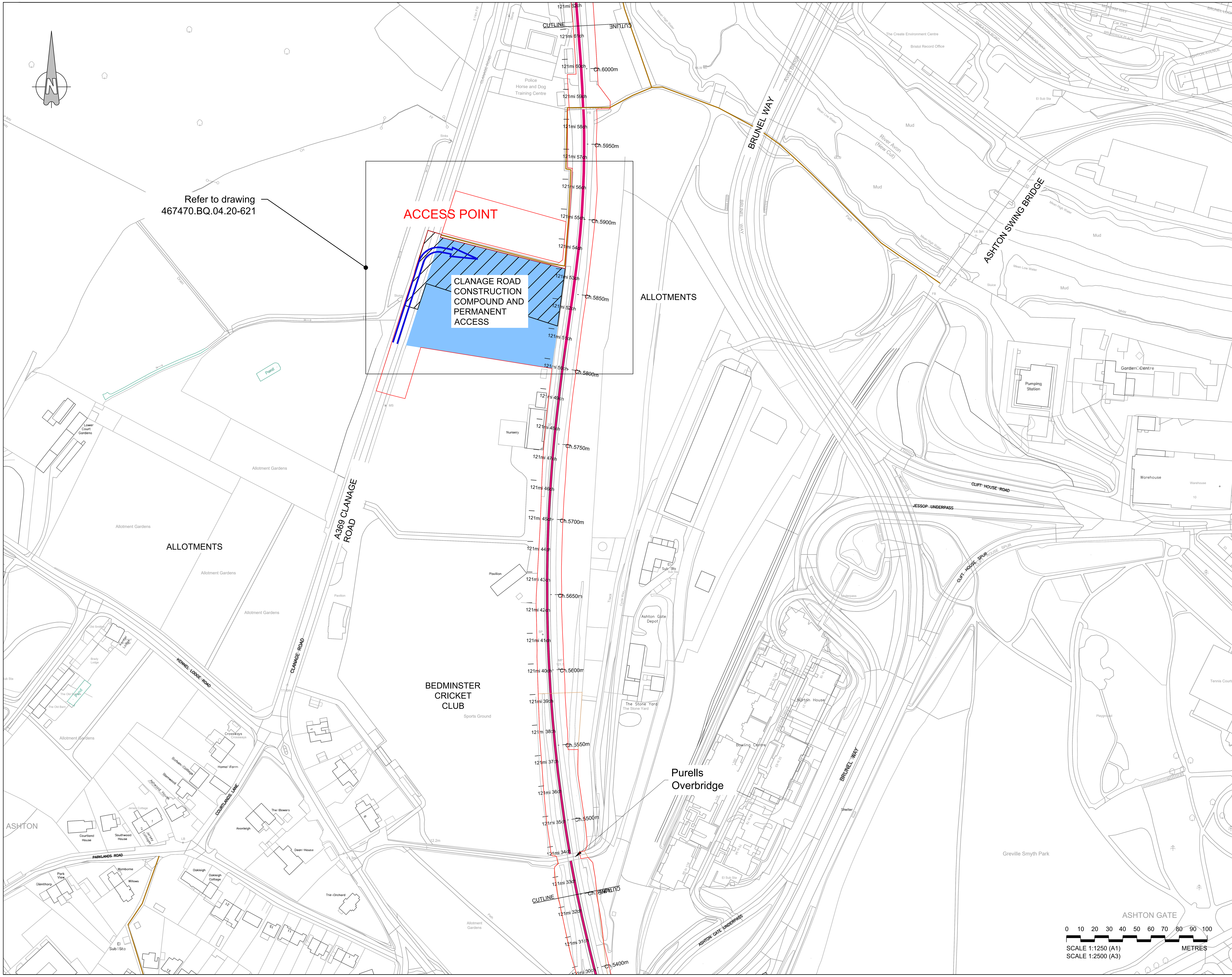
Drawing
PROJECT SUMMARY PLANS
SHEET 17 OF 20
ROWNHAM HILL

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No.: 674946.BQ.42.01-467
Revision: A

Drawing Scale: 1:2500 @ A3

Drawing file path & name : \\brsfpp01\proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BQ.42 MW PM support Nov 16 to Mar 17\90 AutoCAD\91 AutoCAD\Project Summary Plans\674946.BQ.42.01-462 to 470 Rev A.dwg



KEY:

- Order limits
- Access point
- Construction compound
- Permanent access
- Public rights of way
- Existing railway

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

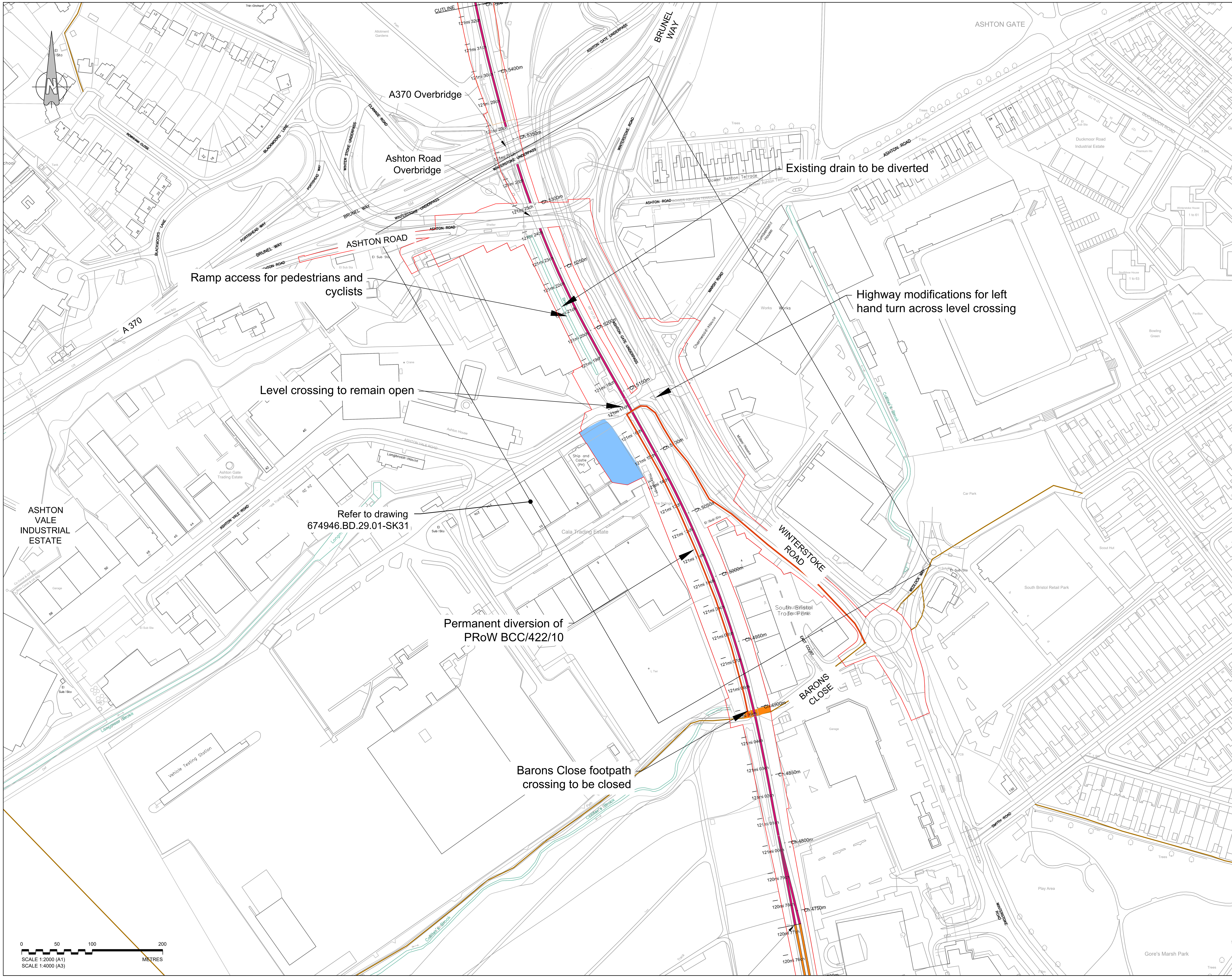
Drawing
PROJECT SUMMARY PLANS
SHEET 18 OF 20
BOWER ASHTON

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-468
Revision A

Drawing Scale: 1:2500 @ A3

Drawing file path & name: \\brsfpp01\proj\Consulting\Projects\674946 NSC - 2016 Bristol Framework\674946.BQ.42 MW PM support Nov 16 to Mar 17\90 AutoCAD\91 AutoCAD\Project Summary Plans\674946.BQ.42.01-462 to 470 Rev A.dwg



KEY:

- Order limits
- Construction compound
- Level crossing to be extinguished
- Proposed ramp
- Proposed highway works
- Public rights of way
- Permanent diversion of public right of way
- Existing railway
- Permitted development works

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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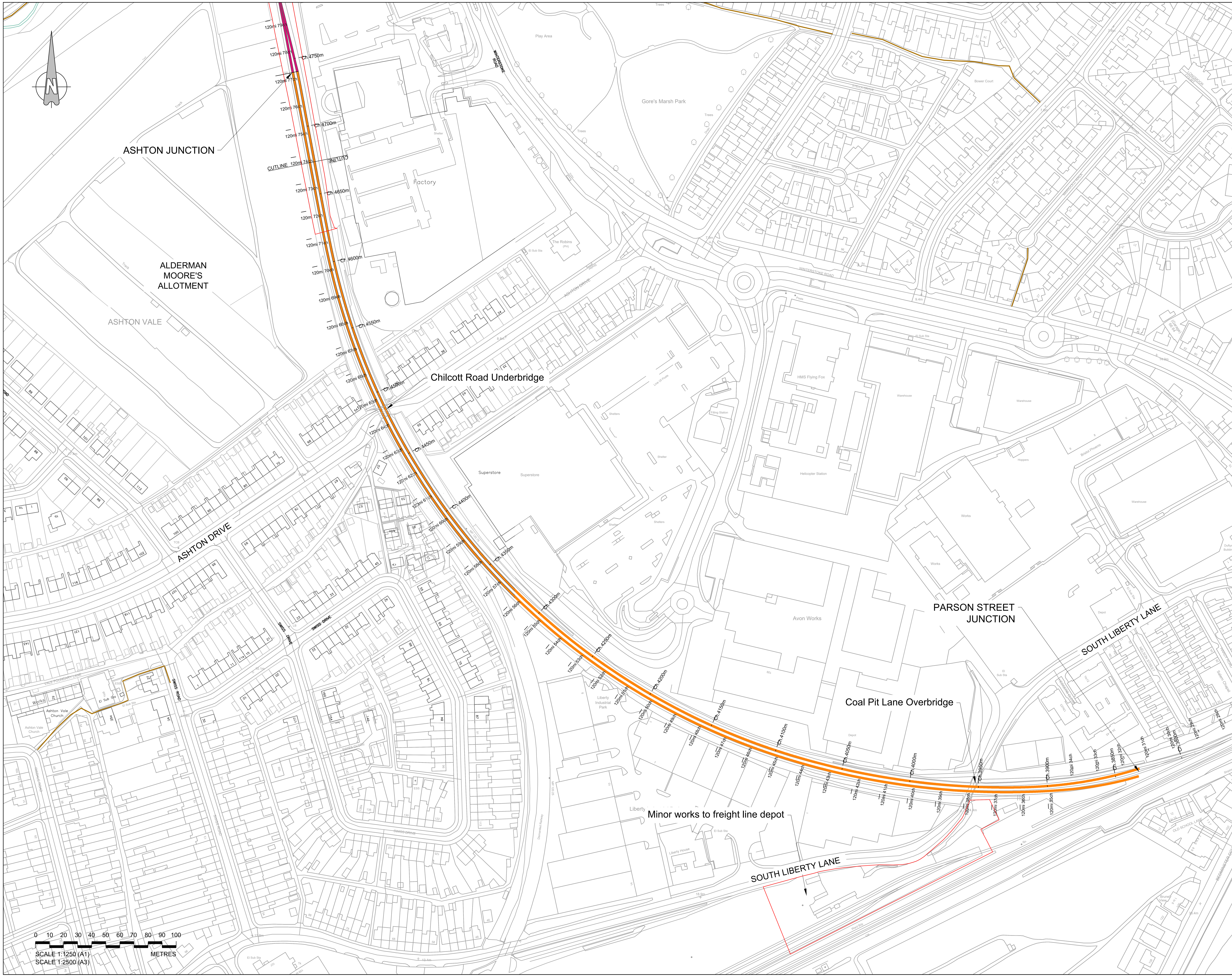
Project
PORTISHEAD BRANCH LINE (METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 19 OF 20
ASHTON VALE OPTION A

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
Approved by: ADL Date: 23/04/2018

Drawing No. 674946.BQ.42.01-469
Revision A

Drawing Scale: 1:2500 @ A3



KEY:

- Order limits
- Public rights of way
- Existing railway
- Permitted development works

Rev	By	Chkd	Apprvd	Date	Description
A	FG	KS	ADL	23/04/2018	First Issue

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Project
PORTISHEAD BRANCH LINE
(METROWEST PHASE 1)

Drawing
PROJECT SUMMARY PLANS
SHEET 20 OF 20
PARSON STREET

Drawn by: FG Date: 23/04/2018
Checked by: KS Date: 23/04/2018
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