HOCHTIEF UK CONSTRUCTION

SNOWDONIA VISUAL IMPACT PROVISION

WATER MANAGEMENT PLAN

C0233-HUK-PDR-ZZ-PL-W-0001

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1.0 Executive Summary

The Snowdonia Visual Impact Provision (SVIP) project in the Snowdonia National Park (ref.1) aims to reduce the visual impact of National Grid Electricity Transmission Plc's (NGET) overhead line across the Dwyryd Estuary from Penrhyndeudraeth to Cilfor near Porthmadog. NGET will remove a section of overhead line and replace it with electricity cables buried in a tunnel passing under the Dwyryd Estuary (Scheme).

This water management plan outlines the environmental risks associated with the Scheme and describes methods to be adopted by the principal contractor, Hochtief (UK) Construction Ltd (HUK) to control these risks in particular the risk of water pollution. In addition HUK's plan for using water efficiently during the Scheme's construction is described.

2.0 Introduction

2.1 Overview

NGET's project specific scope requires HUK to "..review the information in the outline CEMP and use it to develop the project specific water management plan for the design and construction phase. Information in the water management plan shall be updated to incorporate relevant findings from site investigations and any water quality monitoring" (ref. 2 page 95).

The water management plan has been informed by the findings detailed in the following documents:

- Flood Consequences Assessment (ref. 3)
- SUDs report (ref. 4)
- Site investigation (ref. 5)
- Hydrological impact assessment (ref.6)

2.2 Objective

The water management plan will demonstrate that effective pollution control measures will be put in place alongside appropriate water planning and management measures for the Scheme.

The water management plan will ensure that surface and ground water quality will not deteriorate because of the Scheme and that the quality of surface and ground water on either side of the Dwyryd Estuary will not be affected.

The Scheme's water management plan is informed by requirements and undertakings described in the following documents:

- CEMP (ref.7)
- Planning Doc (ref.8)
- Pollution prevention and control plan (ref.9)
- SVIP Tunnel Landowner Commitments Register rev. 12-10-21 (ref.10)

3.0 Local water resources and catchment

3.1.1 Garth drainage catchment

Ordinary watercourses controlled by Gwynedd Council are located to the north of the existing Garth Sealing End Compound (SEC) and to the south of the western tunnel head house and access road. These watercourses flow east to west into the River Glaslyn estuary (ref. 3 section 4.3). Both of these watercourses are manmade, so NRW have no information regarding the water availability in them.

"No sewers are present in the vicinity of the existing Garth SEC and western tunnel head house with the nearest sewer located at Syenite Terrace (foul) and at Osmond (surface water and combined)" (ref. 3 section 4.3).

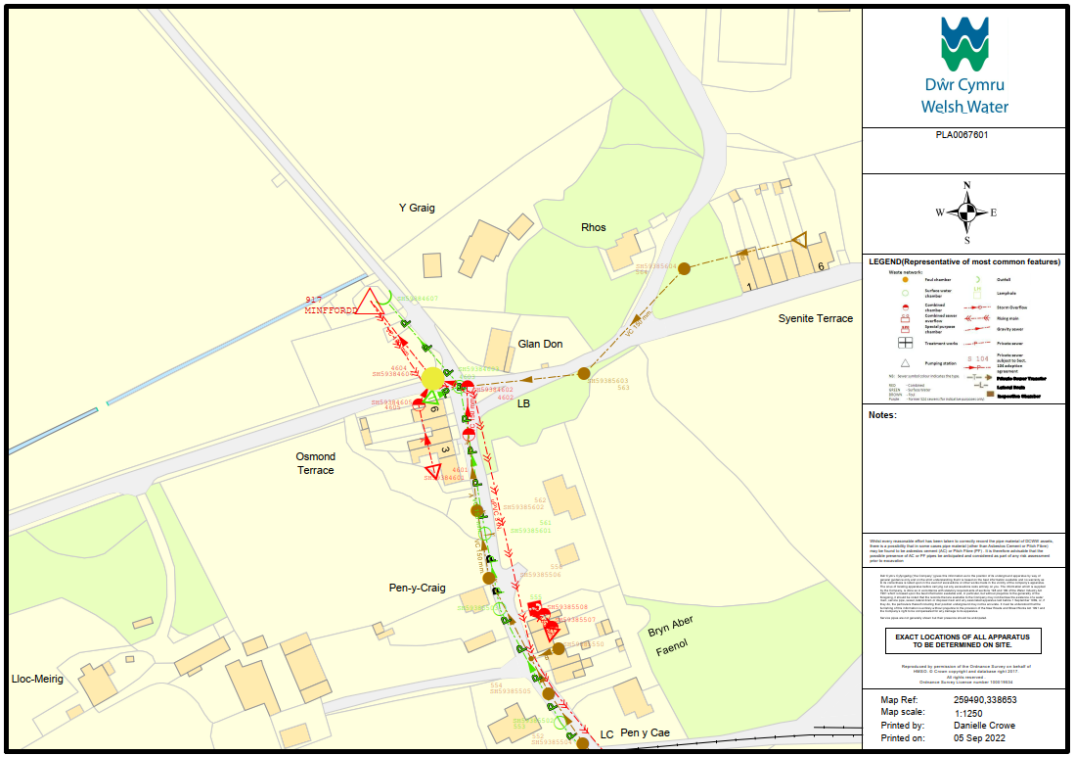


Fig 3.1.1 Public Sewerage adjacent to the Garth site

Any proposed discharge structure or discharge flow that is likely to affect a designated conservation site will require a detailed evaluation of its environmental impacts, particularly its impacts on the designated features and their conservation status. All of the land adjoining the river Glaslyn is an SSSI and adjacent riparian land is part of the Meirionnydd Oakwoods and Bat Sites SAC.

3.1.2 Garth mains water supply

The local water undertaker is Dwr Cymru Welsh Water (DCWW). HUK has applied to DCWW for both a small diameter and large diameter connection at Garth. The small diameter connection (application ref. NCW2531237) will be suitable for domestic use in construction site and for the permanent works subsequently.

Following construction a permanent water supply will be retained for use at the Garth Tunnel Head House (THH). NGETS project scope (ref. 2) describes the permanent requirement as follows: "The *Contractor* shall install an external tap at Garth THH.

The *Contractor* shall design and install the foul water system at Garth THH so that it discharges to the local foul drainage network" (ref. 2 page 52). However the foul water discharge tap has been removed from HTUK scope at the permanent Garth tunnel head house.

The TBM's peak fresh water demand is expected to be 480m^3 per 24 hours. Therefore a large diameter connection application (ID WMD0002609) requested a peak volume of 480m^3 per 24 hours. This represents 40% of DCWW's network demand in the Garth catchment area. DCWW have suggested that they could supply around 20% of the requested volume (approximately 96m^3 per 24 hours). Following a meeting with HUK on 10th October 2022 DCWW agreed to review their network to see if additional supply could be released. DCWW suggested that the balance of the potable water required could potentially be sourced from a suitable tanker point which could be many miles away. They also suggested that HUK may be able to abstract suitable water directly from the local water environment.

3.1.3 Garth water resources catchment

The Garth site is within the river Glaslyn catchment area. This is a sub-catchment of the wider Llŷn and Eryri catchment area. Natural Resources Wales's (NRW) Llŷn and Eryri Abstraction Licencing Strategy shows that a proposed abstraction will be situated in an unassessed area.

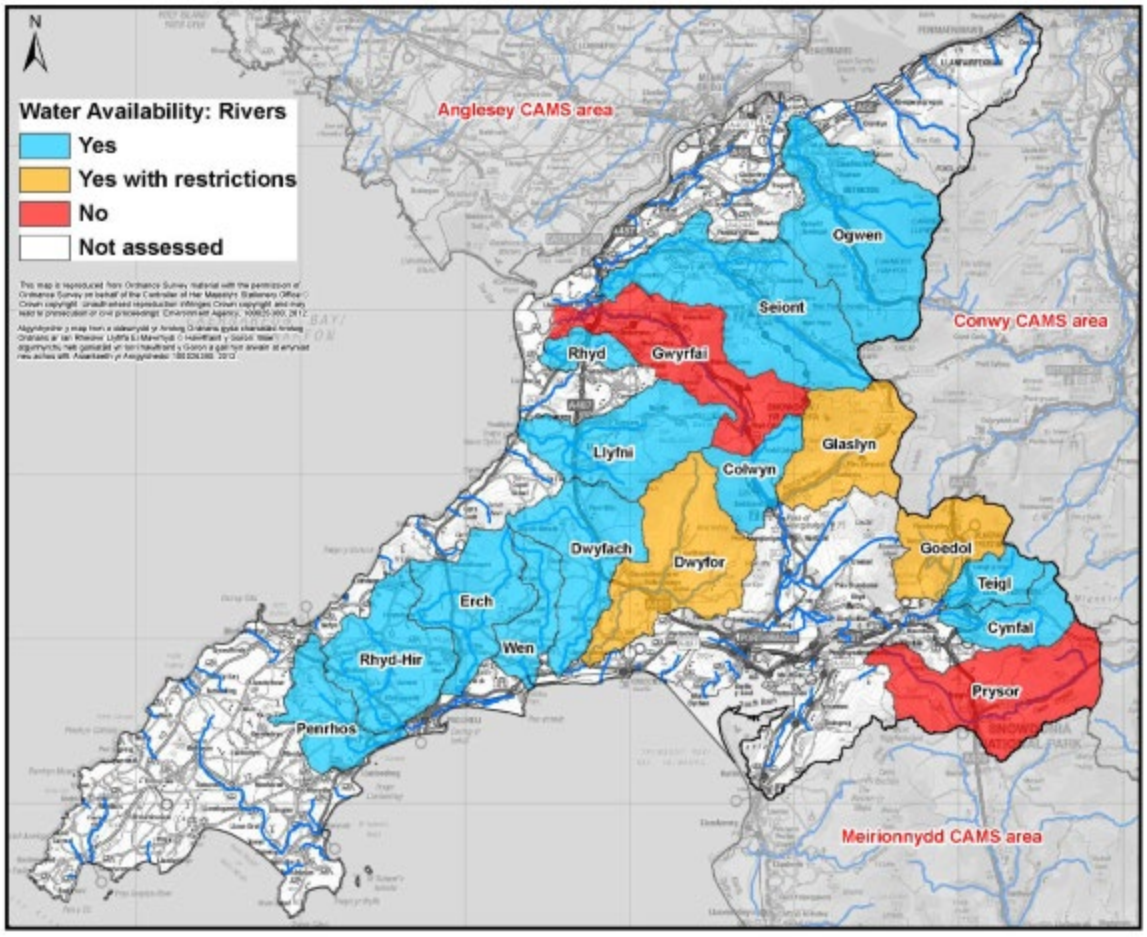


Fig 3.1.3a River water availability in the vicinity of the scheme

The Glaslyn has a tidal sluice gate at SH 57258 38564. The OS maps suggests that the river is tidal (saline) up to Pont Croesor at SH 59312 41350. NRW advised an independent assessment on the salinity of the waterbody for suitability with the

equipment to be used in the project. NRW have advised that a full abstraction licence would be required to facilitate an abstraction in the Scheme area.

Any proposed abstraction that is likely to affect a designated conservation site will require a detailed evaluation of its environmental impacts. All of the land adjoining the river Glaslyn is an SSSI and adjacent riparian land is part of the Meirionnydd Oakwoods and Bat Sites SAC. The method of abstraction (location, screening of abstraction pump types) and access to the river (damage to the bank and any ecology at the bank/pipeline route) will need to be detailed in any abstraction application to NRW.

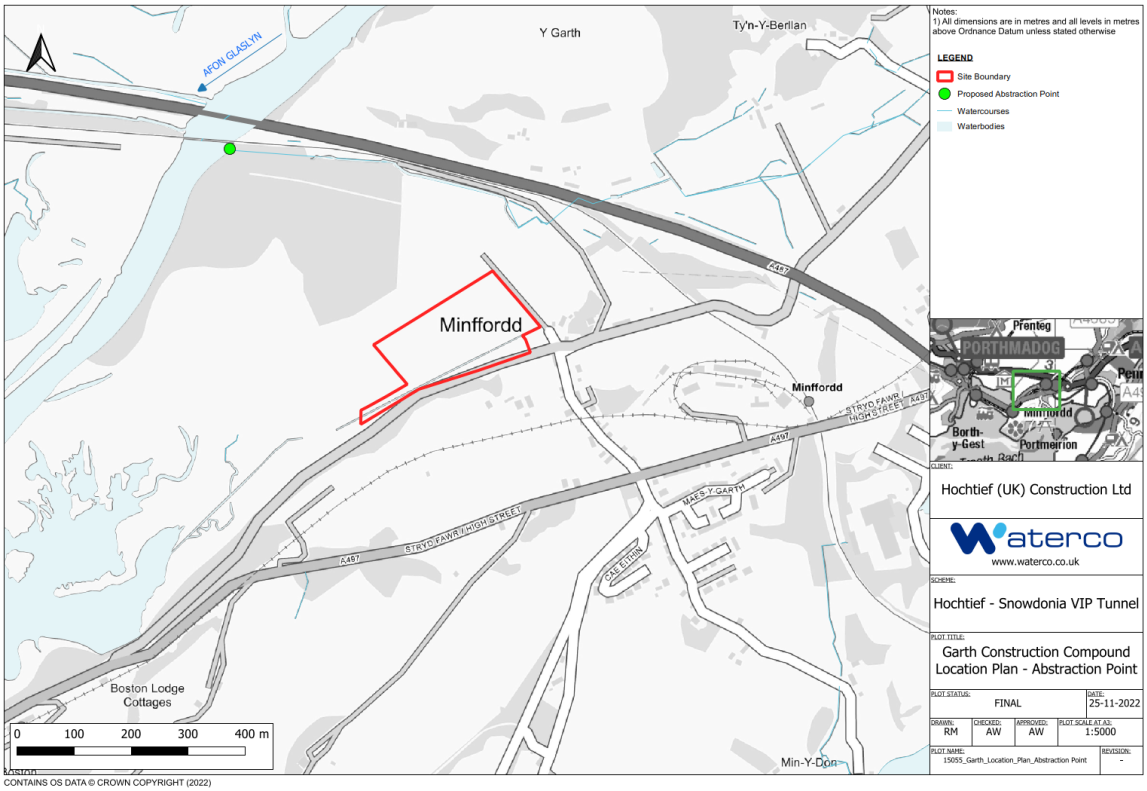


Fig 3.1.3b Proposed river water abstraction location

Minffordd Quarry adjacent to the site has an abstraction licence to abstract water from the River Glaslyn (NRW licence reference WA/065/0006/006). The quarry's owners, Breedon Group, have been approached by HTUK to investigate the possibility of using abstracted water from the quarry. Either water that has been abstracted from the Glaslyn and or water that will be abstracted from the ground when dewatering working areas at the quarry. HTUK has taken water samples from the quarry and discussions are ongoing (see section 4.2 below).

Dewatering activities on site at Garth will generate ad hoc volumes of water that will be treated on site prior to off site discharge under the terms of water discharge consent. Instead of being discharged off site some of the treated water may be suitable for use on site. Suitable treated water will be stored temporarily to facilitate its use on site.

3.2.1 Cilfor drainage catchment

The Cilfor site is within the Snowdonia National Park. "The Nant Yr Efail stream flows from northeast to southwest from the Llyn Tecwyn Uchaf reservoir across the proposed location of the new Cilfor SEC and eastern tunnel head house. Numerous

drains connect into the Nant Yr Efail stream from across the area. These are also ordinary watercourses that join the Dwyryd estuary further west" (ref. 3 section 4.3).

The Cilfor site is within an area controlled by the Harlech Internal Drainage Board (IDB). NRW manage the ditches and Nant Yr Efail stream on behalf of the IDB. The Nant Yr Efail stream skirting the northern and western boundary of the Cilfor site has not been maintained for several years and is becoming blocked in places with self setting shrubs and accumulated vegetation. This is causing some surface water from the stream to flow onto the north west corner of the site creating areas of ponding locally.

The Cilfor site has an area of ecologically desirable valley mire peat land which benefits from being poorly drained. The Scheme's Peat Management Plan (still in draft form) is expected to be informed by water management constraints. The Cilfor drainage strategy will be informed by the Peat Management Plan. The Peat Management Plan and the plan for water management in the Peat area including temporary works installation will be approved before the start of the topsoil strip at Cilfor.

"No sewers are present in the vicinity of the proposed SEC near Cilfor and eastern tunnel head house" (ref. 3 section 4.3).

Table 5.2.3 Variation in the volume of water discharged off site

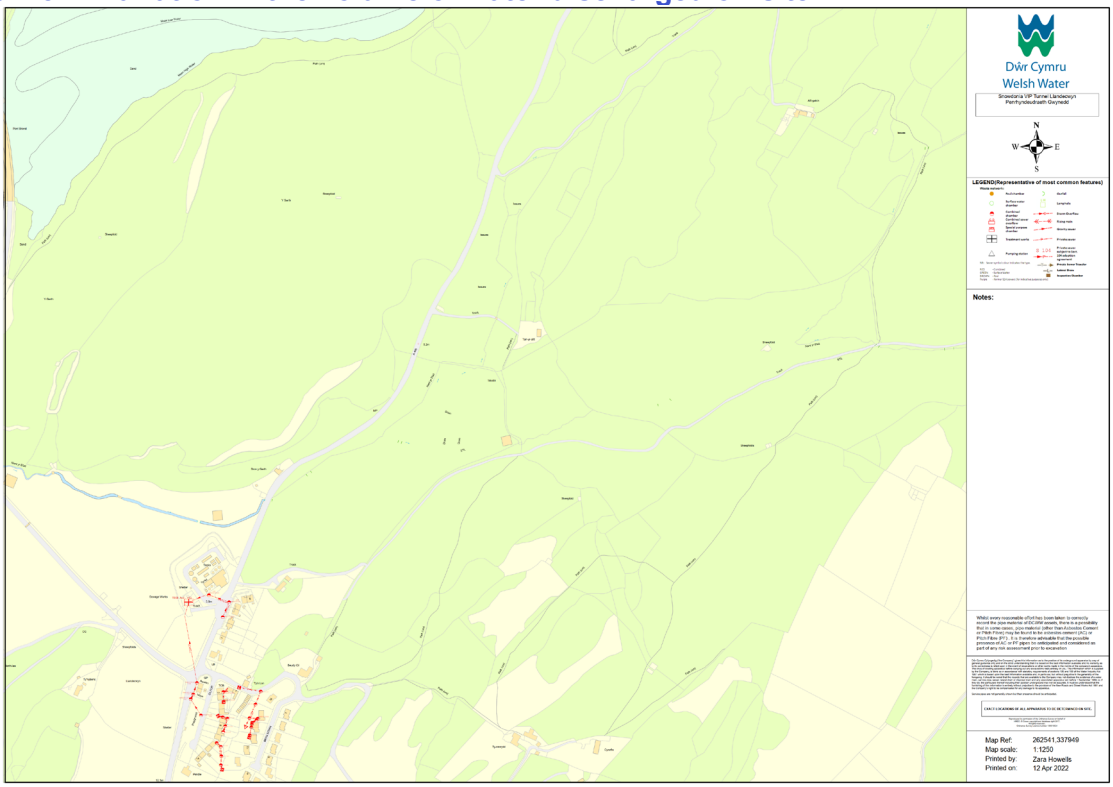


Fig 3.1.1 Public Sewerage adjacent to the Cilfor site

3.2.2 Cilfor mains water supply

HUK has applied to DCWW for small diameter connection at Cilfor (application ref. NCW2531571) for domestic use in the construction site and for the permanent works subsequently.

Following construction a permanent water supply will be retained for use at the Cilfor THH. NGETS project scope (ref. 2) describes the permanent requirement as follows:

- " Permanent potable water supply is required for Cilfor (THH) only" (ref. 2 page 12).
- "The *Contractor* shall install one standard WC, one disabled WC and an external tap at Cilfor THH. The *Contractor* shall design and install the foul water system so that it discharges to a cesspit or septic tank at Cilfor THH" (ref. 2 page 52).

The route selected for the water supply pipe from the water main to the site compound and permanent head works will be selected to facilitate ease of long term maintenance of the pipe when serving the permanent head works.

3.2.3 Cilfor water resources catchment

The Cilfor site is within the river Dwyryd river's catchment area. This is a sub-catchment of the wider Llŷn and Eryri catchment area. The Llŷn and Eryri Abstraction Licencing Strategy shows that the site is in an unassessed abstraction area.

3.3 Site Elevation and flood consequences assessment

Both site compounds are within flood risk zones. Both sites will require the construction compounds' ground level to be raised above the predicted flood levels to enable safe work conditions during the Scheme's construction. Construction sites' ground levels will be informed by the need for flood protection and will ensure vulnerable areas / equipment are protected by foreseeable flood events.

Garth Head House

"Existing ground levels in the area of the western tunnel head house and access road are at ca. 1.89m AOD." (ref. 3 section 4.1.1).

The expected 1000yr annual probability) fluvial (river) flood level is 2.53mAOD. (ref.3 section 9.1.1). The FCA (ref. 3) recommends 2.53mAOD as the appropriate design level. The temporary site compound will be constructed with a typical ground level of 2.66m AOD.

The developed level for the Garth head house and tunnel access shaft has been designed at 3.2m AOD, with the remainder of the head house compound at 3.0m AOD. At the head house the ground level would need to be raised by between ca. 1.11 to 1.31m above surrounding ground levels. This will provide a significant degree of inherent 'freeboard' and ensure that the Scheme remains safe and operational during times of flooding over their intended lifetime.

Cilfor Head House

Existing ground levels in the area of the eastern tunnel head house are at ca. 4.2m AOD. Ground levels along the route of the new access road range between ca. 2.8m to ca. 3.6m AOD. (ref. 3 section 4.1.2)

The expected 1000yr annual probability) river flood level is 5.70mAOD (ref.3 section 9.1.1). The FCA (ref.3) recommends 5.70mAOD as the appropriate design level.

The developed level for the Cilfor head house and tunnel access shaft has been designed at 6.0m AOD. This will require the ground to raised by 1.8m above the surrounding ground level (ref.3 section 9.1.1).

4. Water use on site

4.1 Site activities that will use water

Table 4.1 Site activities that will use water

Activity	Water use to maintain operations.	Source: (potable or non-potable) and expected demand
Site cabin related activities	Drinking, kitchen, canteen, showers and hand washing	Potable. Up to 50m^3 /day required
	Toilets and urinals	Non-potable from rainwater collection.
Drainage	Flushing	Non-potable
General Cleaning	Tool rinsing, boot washing, plant and equipment washing	Non-potable
Dust Suppression	Dampening (bowsers) and misting	Non-potable
Wheel Wash		Water to recirculated and emptied weekly
Sweeper Tip		
Shaft construction Including secant piling	Piling fluids and grouting fluids to fill annulus between shaft wall and adjacent ground.	Non-potable **Supply capacity required: 50 m3/day 5 m3/hour maximum**
Drilling	Lubricant	Potable (if pressure required)
Tunnelling	Slurry TBM requires supporting fluids. **Supply capacity required: 480 m^3 /day 20 m^3 /hour maximum**	Both. Potable (if pressure required). Non-potable (sourced from abstraction from adjacent surface waters or groundwater dewatering).
Grouting of the tunnel annulus	Water used to mix grouts on site. Volume required part of the TBM supply (see above) 21m^3/day potable.	Both. Non-potable (sourced from the groundwater dewatering or abstraction from adjacent surface waters).
Fissure grouting / Ground treatment		Both. Non-potable (sourced from the groundwater dewatering or abstraction from adjacent surface waters).
Grout equipment wash out and TBM decommissioning		TBM to be cleaned on site upon removal prior to transportation off site.
Frame/Building	Concrete cooling	Non-potable
Concrete blocks	Silo Mixer	Both
Screed	Laying	Both
Concrete production	Concrete production.	Both. Guidance in EN 1008:2002
Concrete wash out	Concrete wash out	Non-potable
Commissioning	Fluid handling plant, pipes, water treatment plant, treatment lagoons, bund testing	Potable for pipe systems (reuse to be considered). Non-potable (sourced from the groundwater dewatering or abstraction from adjacent surface waters).
Permanent Head Houses	Separate supply at both sites **Supply capacity required: 50 m^3 /day 5 m^3 /hour maximum**.	Potable

The tunnel will be constructed between two shafts approximately 3km apart. The 4m outer diameter diameter tunnel will be constructed using a Slurry Tunnel Boring Machine (TBM) launched from a site at Garth. The TBM will bore under the Dwyryd Estuary to the reception site at Cilfor.

Table 4.1 identifies the key site activities that require water during the work's. An estimate of the key activities' water demand is made as is an assessment of whether a non-potable or potable source might be appropriate. Potential water efficiency opportunities are described in Table 11.

4.2 Sources of water

Potable water sources
Potable water will be piped to the two construction sites from DCWW's mains supply. As discussed in section 3.1.2 and 3.2.2 above the volume of water available is only suitable for the permanent works and the construction sites' domestic use.

The TBM will require up to 401m^3/day of fresh water during the TBM drive (see Appendix A). The TBM requires more water than can be supplied from DCWW's mains supply at Garth.

DCWW have suggested tankering water to the Garth site and or abstracting surface water locally.

Non-Potable water sources
A surface water abstraction from the River Glaslyn is being sought to supply up to 500m3 per day of non-potable water. An abstraction permit from NRW has been applied for.

Uncontaminated rainfall runoff from zones 1 – 3 at the TBM launch site compound (see Fig 5.1) will be channelled via fuel/oil interceptors into a SUDs system the overflow from which will discharge to adjacent surface water ditch.

Potentially contaminated surface water runoff from Zone 4 will be discharged to treatment lagoons on site. The treated surface water of suitable quality in the lagoons will be available to be re-used on site.

Temporary dewatering of excavations will produce abstracted groundwater the potential volumes of which have been estimated (see Table 5.2.1b). Subject to the quality of the abstracted ground water it will either be discharged directly off site or it will be stored on-site in water treatment lagoons prior to discharge offsite. Some of the treated groundwater of suitable quality in the lagoons will be available to be re-used on site.

The four water treatment lagoons will each have a storage capacity of 800m³ creating a maximum on site water storage capacity of 3200m³ (see Appendix B6.3 Settlement Lagoons)

A minimum water quality specification for TBM supply against which to assess quarry samples and / or develop cleansing methods if required has not currently been established. The suitability of available non-potable water sources for use by the TBM will be assessed using the results of chemical analysis of the given water sources.

5. Water discharges

5.1 Sources of water discharged off site

Table 5.1 Sources of water discharged off site

Activity	Expected contaminants
Agricultural drainage	Surface and groundwater entering the site from adjacent agricultural land via the site boundary will be intercepted with a culverts on site. The water will contain settleable solids from the soil that the intercepted water has passed through. The solids concentration will vary depending upon the receiving drains proximity to disturbed ground.
Rainfall runoff from grassland	The undisturbed sites are mainly grassland the runoff from which will contain some soil and sheep faecal matter.
Rainfall runoff from disturbed ground	Rainfall runoff flowing from disturbed ground such as that caused by machinery trafficking and soil striping will contain soil and silt materials (suspended solids). This is expected to be a feature of site set up.
Rainfall runoff from site compound hardstanding areas See Fig 5.1.1 below.	**Office building roofs and pedestrian areas (Zone 1)** Rainfall runoff from office building roofs and adjacent pedestrian areas is expected to be uncontaminated and will be collected for use in toilet flushing.
	Access roads and parking areas (Zone 2) Rainfall runoff from impermeable tarmac areas is expected to be uncontaminated and suitable for discharge via SUDs. Vehicle fuel/oil spill risk will however require discharge to SUDS via oil water separator(s).
	Material laydown and tunnel segment storage area (Zone 3) Rainfall runoff from the impermeable storage area is expected to be uncontaminated and suitable for discharge via SUDs. Vehicle fuel/oil spill risk will however require discharge to SUDS via oil water separator(s).
	Shaft and tunnel spoil treatment area (Zone 4) The spoil treatment area will have an impermeable concrete hardstanding and an isolated drainage area. Runoff will be contaminated with excavated materials, grout residues, concrete residues and water treatment chemical spillages. The area will also be contaminated with runoff from general cleaning, concrete wash out, tool rinsing, boot washing, plant and equipment washing. Sludges from a vehicle wheel wash, sweeper tip, and water treatment plant will be handled in this area and some may be spilt.
Dewatering flows	Groundwater will be abstracted from excavations on site. The dewatering water will be contaminated with soils, minerals, concrete and grouts reflecting the ground being dewatered and the adjacent construction activity.
TBM spoil treatment discharge.	The spoil excavated by the TBM will be pumped from the tunnel in a water slurry. The some of the water will be extracted from the slurry and re-circulated back to the TBM. Some of the water extracted will be unsuitable for reuse and will be treated for offsite discharge instead. The TBM is to be cleaned on site upon removal prior to transportation off site. Provision shall be made for the collection and treatment of associated wash off water that may be exposed to cementitious / grease contamination.
Flood water	The compound ground levels and on site bunding will be designed to reduce the risk of inundation from reasonably foreseeable flood events. Flood water affecting the compound is expected to be similar to rainfall runoff from disturbed ground and will be treated in a similar manner and be limited to the site periphery.
Site cabin activities	Foul water will be produced by site personnel using the site cabins. In particular the: toilet facilities, kitchens, canteen, and showers.

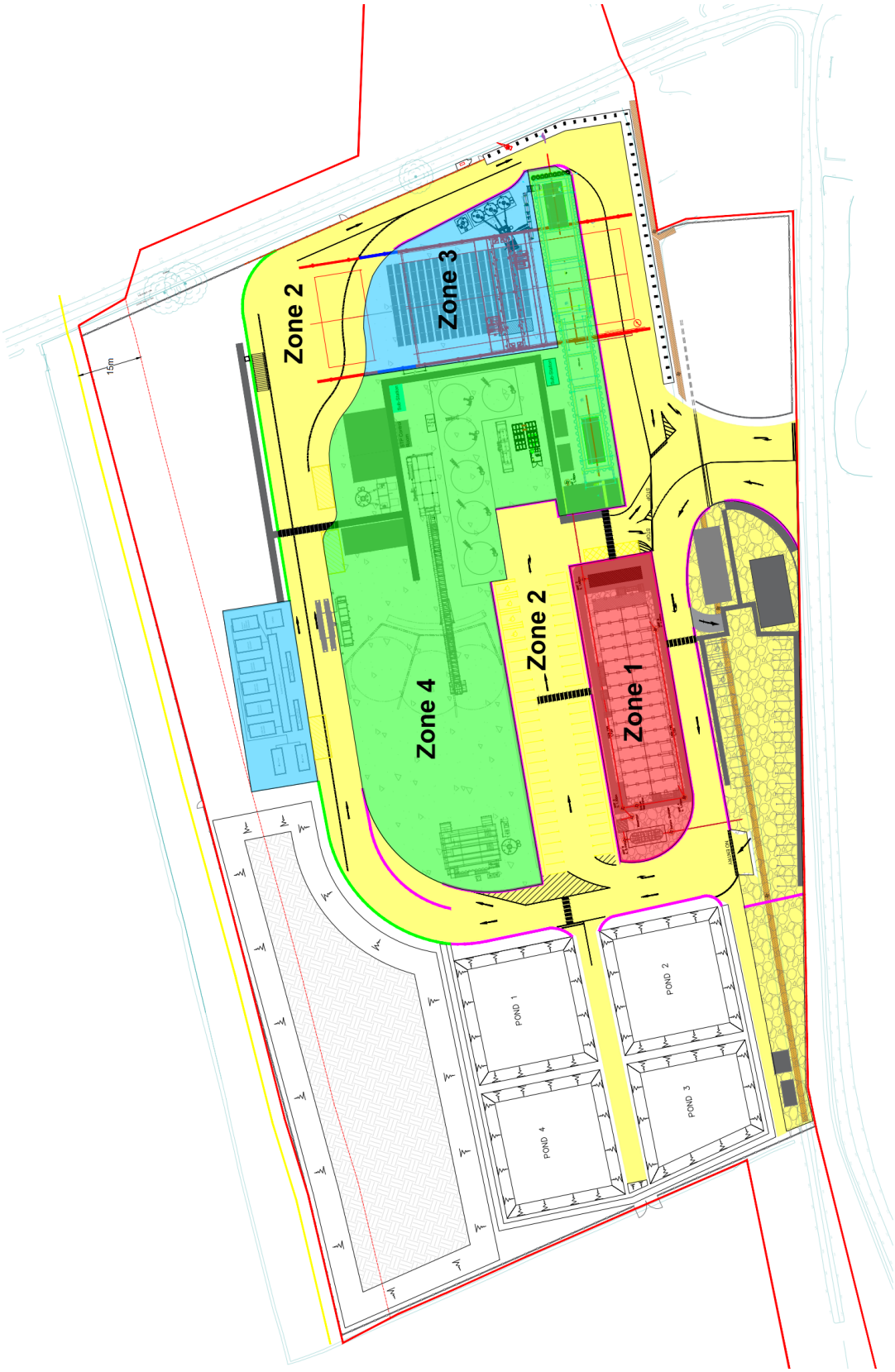


Fig 5.1.1 Garth Rainfall Runoff Zones

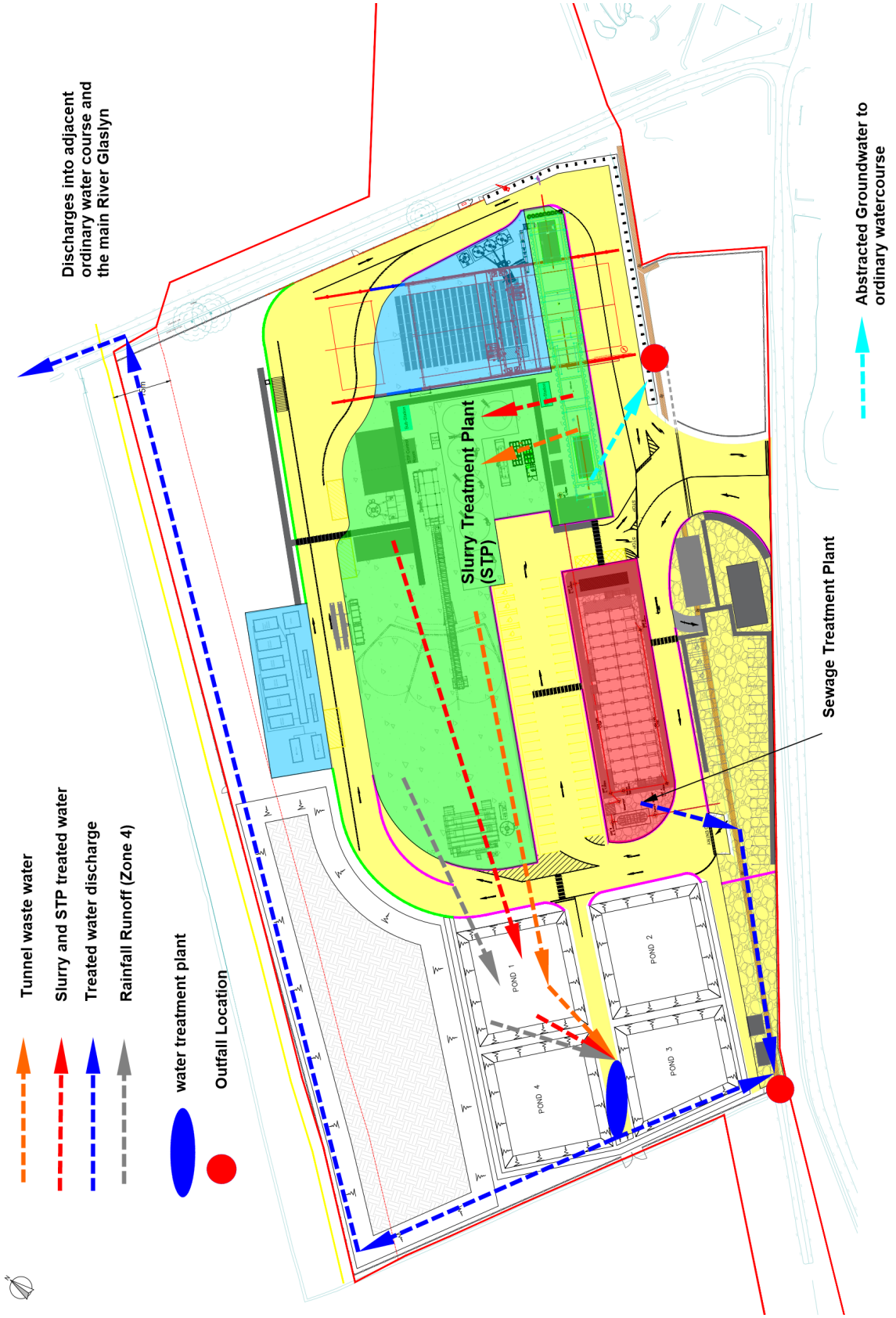


Fig 5.1.2 Garth Water Discharge Schematic

5.2 Estimated volume of water discharged off site

5.2.1 Garth water discharge

As shown in Table 5.2.1b and 5.2.1c below the water discharge from Garth site will be derived from four main sources

- Abstracted groundwater 110 – 500 m^3/day;
- Slurry treatment plant discharge 100 – 760 m^3/day;
- TBM tunnel waste water 115 - 170 m^3/day;
- Rainfall runoff 170 m^3/day;

The water discharge volume will vary during the construction works from 60m^3 /day potentially up to 1210 m^3 /day. The maximum daily discharge rate is expected during a four month period between December 2023 and March 2024 when the TBM will encounter clay deposits.

The average (non-rainfall) daily discharge rate is expected to be approximately 300 m^3/day.

The water discharged will be treated on site to remove sediment and to balance the pH to achieve a neutral pH between 6 – 10. The water treatment plant will be designed and operated to achieve a suspended solids concentration of less than 60mg/l.

The estimated volume of treated sewage to be discharged from the Garth site is shown in Table 5.2.1a below.

Table 5.2.1a Volumes of treated sewage discharged off site at Garth.

Garth site cabin related activities	Supply capacity required: 50 m^3/day, 5 m^3/hour maximum. Rainwater use for toilet flushing will reduce potable water demand but not foul water discharge volume. Estimated daily sewage volume created at Garth site during construction with peak staffing levels Ref. British Water, Code of Practice Flows and Loads – 4, Sizing criteria, treatment capacity for sewage treatment systems. Rev 2013. • average sewage generated per person per day on site = 90 litre /day • plus supplement of 40 litre for each shower taken Assuming up to 150 staff on site per day and 40 showers taken 150 x 90 = 13,500 litres sewage per day assuming no showers 40 x 40 litre / shower = 1,600 litres per day from 40 showers Estimated average volume of sewage produced per day by 150 personnel on site = 15.1m^3/day Package sewage treatment plant will be sized to treat up to 15 m^3 / day

Table 5.2.1b Volume of dewatering and process water discharged off site at Garth

Activity	
Rainfall runoff from Garth site compound hardstanding areas See Fig 5.1.1 above.	**Office building roofs and pedestrian areas (Zone 1)** Area = 1321m^2 Discharged to collection sump for use in WC's Volume based on 1in10year rainfall event (M10-60minutes) = 37.4m^3
	Access roads and parking areas (Zone 2) Area = 11072m^2 Discharged to SUDs via Fuel/Oil interceptors. Volume based on 1in10year rainfall event (M10-60minutes) = 313.33m^3
	Material laydown and tunnel segment storage area (Zone 3) Area = 2100m^2 Discharged to SUDs via Fuel/Oil interceptors. Volume based on 1in10year rainfall event (M10-60minutes) = 59.4m^3
	Shaft and tunnel spoil treatment area (Zone 4) Area = 5917m^2 Discharged to lagoons for treatment. Volume based on 1in10year rainfall event (M10-60minutes) = 167.45m^3
Secant Pile and grouting groundwater displacement	**Shaft Construction.** Aug-Oct 2023 up to 40m3/day from washwater from concrete and grout mixing and piling equipment plus water displaced by secant piles used in shaft wall (grout block + 9 No. 1.2m diameter 18m long piles). Oct-Nov 2024 up to 40m3/day from washwater from concrete and grout mixing and piling equipment plus water displaced by secant piles used in headhouse (9 No. 0.6m diameter 15m long piles)
Shaft pump test	**Shaft pump test.** Up to 100m^3/day during the pump tests.
Dewatering flows	**Western (Garth) shaft** During the three month excavation of the Garth shaft the water ingress requiring dewatering is expected to range between 137 - 500m3/day. Once constructed the groundwater flowing into the Garth shaft via the base slab's pressure relief valves will range between 80-110 m3 /day once moderated by injections of sealing grout. **Tunnel** During construction tunnel seepage rate between 0.001 and 4.67m3/day over 280 days (increasing as the tunnel lengthens) not including occasional large water flows from fissures at the face
Garth TBM spoil treatment discharge.	TBM Slurry Treatment Plant discharge 100 – 760m^3/day (see Appendix B7.1) Discharged to lagoons for treatment.
Garth TBM tunnel waste water	115 - 170 m^3/day derived from booster pumps and cooling water circuit. Discharged to lagoons for treatment.
Permanent Head Houses	Separate potable supply at both sites (50 m^3/day 5 m^3/hour maximum). No permanent discharge from Garth head house.
Flood water	TBC

Table 5.2.1c Variation in the volume of water discharged off site at Garth

Garth	2023									2024													2025											
	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Platform Construction																																	
Sheet Piling																																	
Secant Piling																																	
Pump Test																																	
Shaft Excavation																																	
Base Slab Construction																																	
TBM - Tunnel Arisings																																	
Shaft backfilling																																	
Platform removal																																	

	Maximum volume (Cubic metres) of water discharged off site at Garth per day																																
Secant Pile and Grout Block wash water (note 1)					40	40	40												40	40													
Dewatering - pump test (note 2)							100	100																									
Dewatering - shaft excavation (note 3)								500	500	500																							
Dewatering - Base slab - pressure relief (note 4)										110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110
Slurry Treatment Plant discharge (note 5)												100	100	100	100	100	100	100	100	100	760	760	760	760	100	100							
Tunnel waste water (note 6)												115	115	115	115	115	135	135	135	135	170	170	170	170	170	170							
Rainfall water runoff (note 7)									170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170	170
Total daily discharge					**40**	**40**	**140**	**600**	**670**	**780**	**280**	**495**	**495**	**495**	**495**	**495**	**515**	**515**	**555**	**555**	**1210**	**1210**	**1210**	**1210**	**550**	**550**	**280**	**280**	**280**	**280**	**280**	**280**		

Notes

1. Washwater from concrete and grout mixing and piling equipment plus water displaced by piles.
   Aug-Oct 2023 = Grout block + 9 No. 1.2m diameter 18m long piles (shaft wall).
   Oct-Nov 2024 9 No. 0.6m diameter 15m long piles (head house)
2. Groundwater abstracted during pumping tests to confirm shaft wall impermeability
3. Groundwater abstracted during shaft construction
4. Groundwater abstracted from pressure relief valves in the shaft base slab.
5. STP discharge varies with geology see Appendix B7
   - Geology 1+2 15th March 2024 - 22nd May 2025
   - Geology 3 24th Jan 2025 - 11th Feb 2025
6. Ref. Appendix A. Discharge from booster pumps (60 - 120m3) , tyre wash (12.5m3), grout cleaning (20m3), seepage (20m3)
7. Ref. Table 5.2 Estimated volume of rainwater discharged off site from the impermeable hardstanding in the slurry treatment area - zone 4

5.2.2 Cilfor water discharge

The Cilfor water discharge will be derived from two main sources

- Abstracted groundwater 40 – 120 m^3/day;
- Contaminated rainfall runoff 114 m^3/day;

The Cilfor water discharge volume will vary during the construction works from 40m^3 /day potentially up to 274 m^3 /day. The maximum daily discharge rate is expected during a seven month period between July 2024 and February 2025 when the shaft is being excavated. The average (non-rainfall) daily discharge rate at Cilfor site during shaft excavation is expected to be approximately 120 m^3/day.

The water discharged will be treated on site to remove sediment and to balance the pH to achieve a neutral pH between 6 – 10. The water treatment plant will be designed and operated to achieve a suspended solids concentration of less than 60mg/l.

The estimated volume of sewage generated at Cilfor site during the construction works is less than one cubic metre per day. This will be collected in a tank on site that will be emptied by a tanker vehicle periodically and taken off site to a permitted sewage treatment works for treatment.

Table 5.2.2a Volume of dewatering and process water discharged off site at Cilfor

Activity	
Rainfall runoff from Cilfor site compound areas	**Office building roofs and pedestrian areas (Zone 1)** Area = 220m^2 Discharged to collection sump for use in WC's Volume based on 1in10year rainfall event (M10-60minutes) = 6.30m^3
	Access roads and parking areas (Zone 2) Area = 8470 m^2 Discharged to SUDs via Fuel/Oil interceptors. Volume based on 1in10year rainfall event (M10-60minutes) = 239.80 m^3
	Shaft spoil transfer area (Zone 4) Area = 4026 m^2 Discharged to a balancing tank or lagoon prior to treatment. Volume based on 1in10year rainfall event (M10-60minutes) = 114 m^3
Secant Pile and grouting groundwater displacement	**Shaft Construction.** Washwater from concrete and grout mixing and piling equipment plus water displaced by 56 number 0.6m diameter 24m long piles forming the shaft wall will generate up to 40m3/day during this element of the works. Later in the project the piling associated with the permanent works will also generate up to 40m3/day (Oct - Dec 2024 = 44 No.0.6m diameter 15m long piles (head house) + 54 No.0.6m diameter 15m long piles (SEC))
Shaft pump test	**Shaft pump test.** Up to 100m^3/day during the pump tests.
Dewatering flows	**Eastern (Cilfor) shaft** During the 5 month excavation of the Cilfor shaft the volume of groundwater expected to flow into the shaft will range between 50 - 120m3/day. Once constructed the shaft will be sealed and the discharge into the shaft is expected to less than 5m^3 per day. **Permanent Structure** The water seepage into the permanent structure comprising both shafts and the tunnel is expected to be up to 5 m3/day. The seepage water will be continuously pumped from the Cilfor shaft to maintain dry conditions in the tunnel.
Permanent Head Houses	Separate potable supply at both sites (50 m^3/day 5 m^3/hour maximum). Discharge from Cilfor shaft will reflect the permanent water ingress. Allowable daily leakage range: 4.80 m^3/day tunnel; 0.35 m^3/day eastern shaft (Cilfor); 0.19 m^3/day western shaft (Garth) (Ref 3 section 9.1.1)
Flood water	TBC

Fig 5.2.2 Cilfor Rainfall Runoff Zones and proposed water treatment schematic

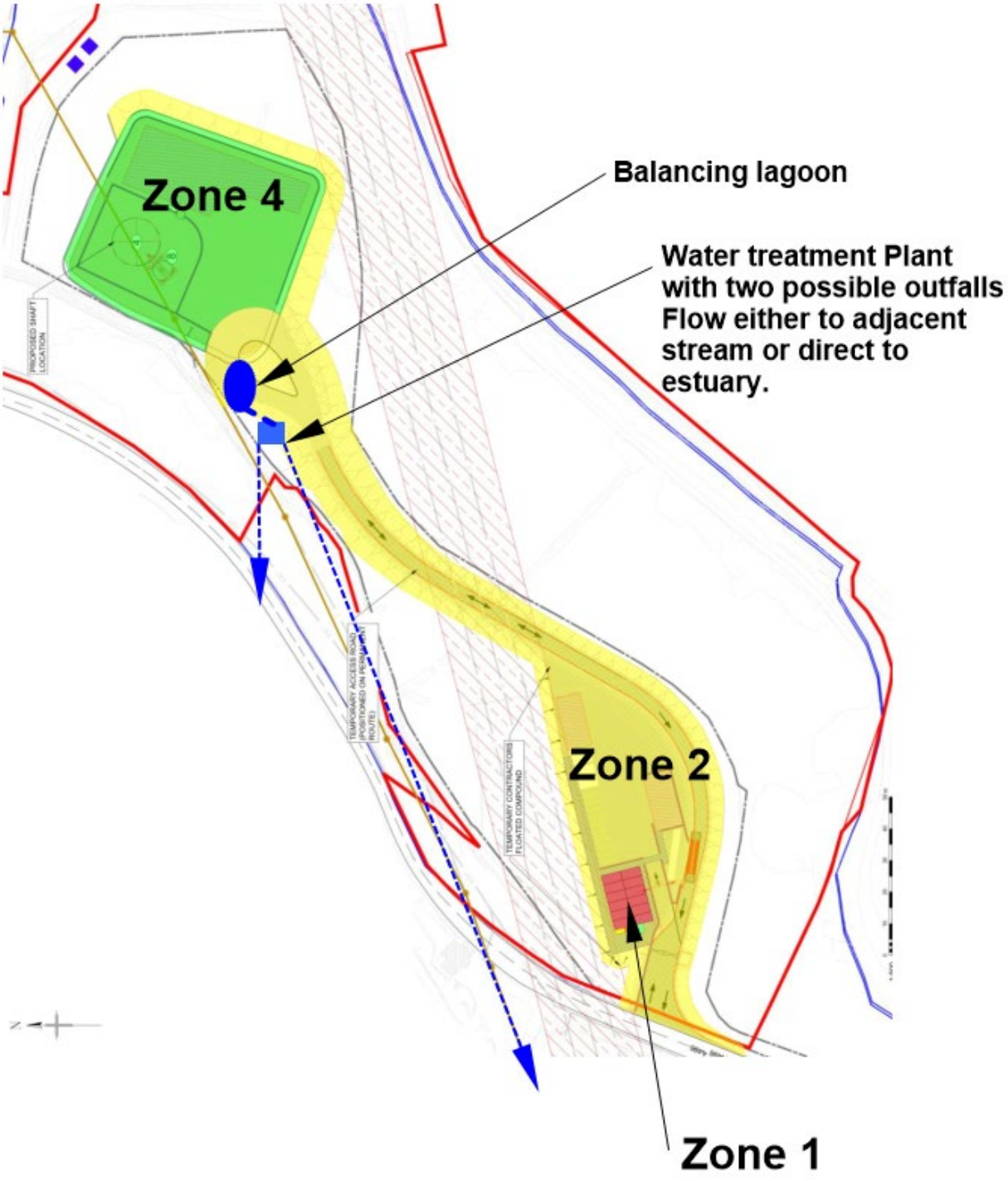
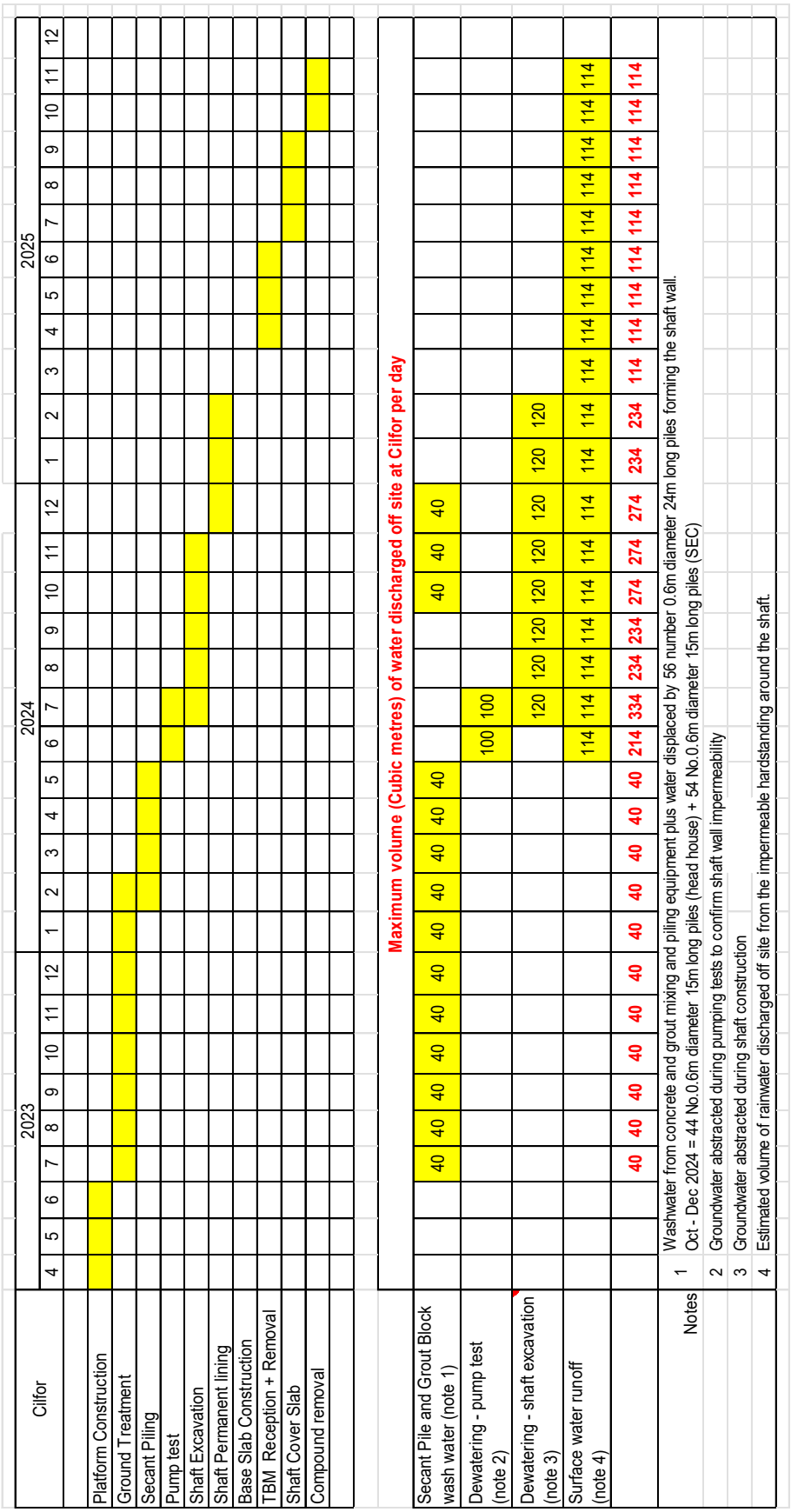


Table 5.2.2b Variation in the volume of water discharged off site at Cilfor



Cilfor	2023 4	5	6	7	8	9	10	11	12	2024 1	2	3	4	5	6	7	8	9	10	11	12	2025 1	2	3	4	5	6	7	8	9	10	11	12
Platform Construction																																
Ground Treatment																																
Secant Piling																																
Pump test																																
Shaft Excavation																																
Shaft Permanent lining																																
Base Slab Construction																																
TBM Reception + Removal																																
Shaft Cover Slab																																
Compound removal																																

Maximum volume (Cubic metres) of water discharged off site at Cilfor per day

Secant Pile and Grout Block wash water (note 1)				40	40	40	40	40	40	40	40	40	40	40					40	40	40											
Dewatering - pump test (note 2)															100	100																
Dewatering - shaft excavation (note 3)																120	120	120	120	120	120	120	120									
Surface water runoff (note 4)															114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114	114
				40	40	40	40	40	40	40	40	40	40	40	214	334	234	234	274	274	274	234	234	114	114	114	114	114	114	114	114	114

Notes

1. Washwater from concrete and grout mixing and piling equipment plus water displaced by 56 number 0.6m diameter 24m long piles forming the shaft wall. Oct - Dec 2024 = 44 No.0.6m diameter 15m long piles (head house) + 54 No.0.6m diameter 15m long piles (SEC)
2. Groundwater abstracted during pumping tests to confirm shaft wall impermeability
3. Groundwater abstracted during shaft construction
4. Estimated volume of rainwater discharged off site from the impermeable hardstanding around the shaft.

5.3 Proposed surface water discharge locations

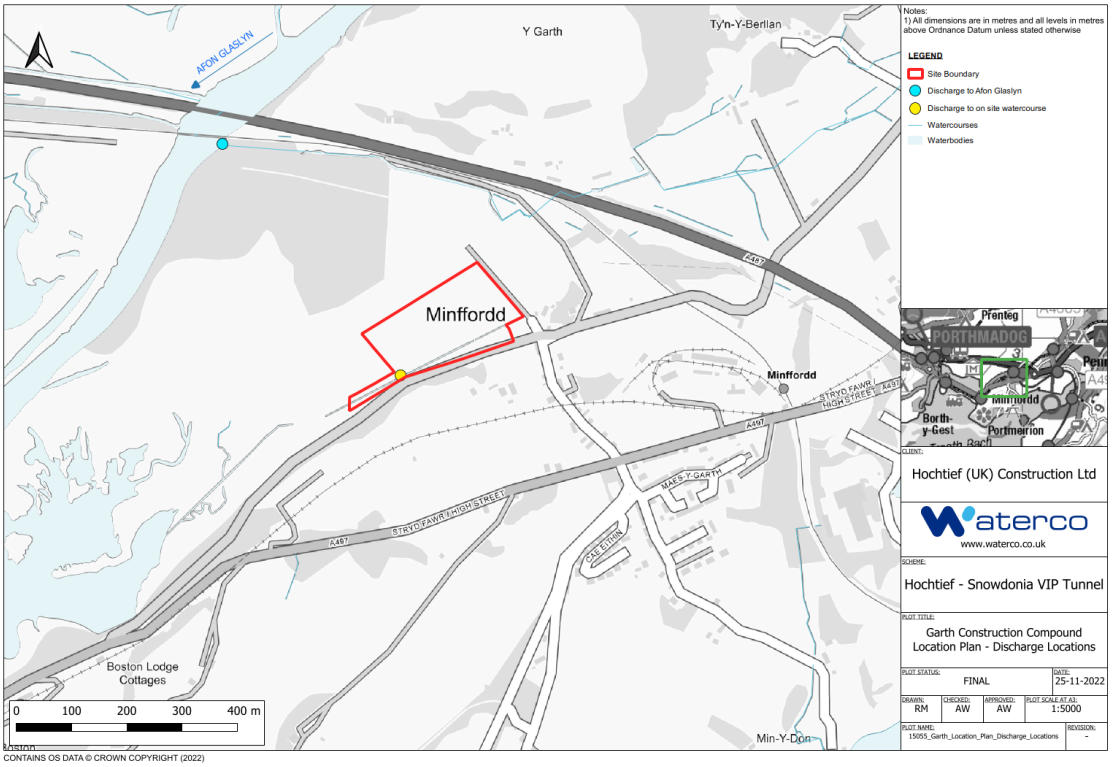


Fig 5.3.1 Proposed water discharge locations at Garth

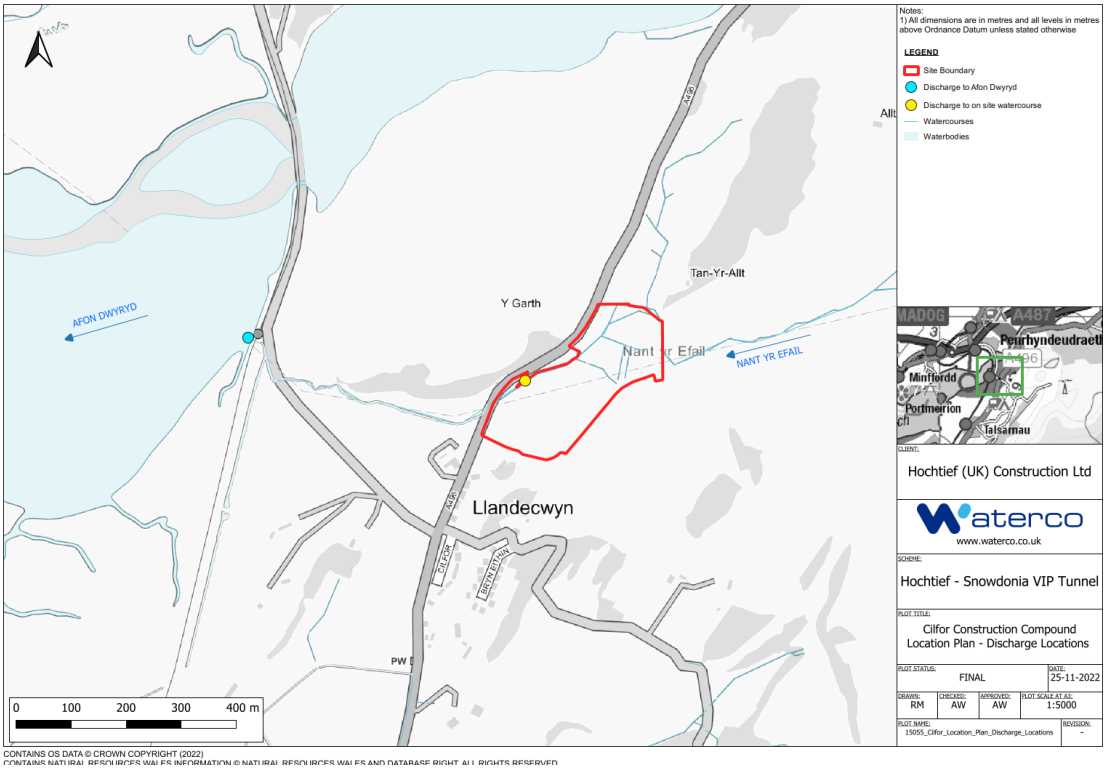


Fig 5.3.2 Proposed water discharge locations at Cilfor

6. Water pollution control *(sections to be updated in later revisions)*

6.1 Soil strip surface water management

Site set up activities have the potential to generate silt and sediment contaminated runoff as a result of soil stripping. The management of agricultural drainage is described in Appendix B1. Silt and sediment control measures are described in Appendix B3.

Construction activities will not be undertaken during extreme wet weather in order to minimise the erosion of sediments.

Topsoil stripping will be stopped approximately 3-5 metres from the top of the bank of water course where possible to allow the remaining vegetation to act as filter media to prevent sediment entering watercourses. Where possible buffer zones next to watercourse banks will be extended to 10m wide to provide unrestricted access for maintenance of water courses.

The Scheme's CEMP requires that excavated material will be stored at least 10m away from watercourses, and gaps will be provided in stored material to prevent the impoundment of flood waters.

In order to protect vulnerable temporary infrastructure e.g. diesel generators, the construction site compounds will have their ground levels elevated to enable sensitive equipment to be installed above the expected flood levels (see Section 3.3). In addition sensitive equipment will be placed within bunded storage.

6.2 Sustainable urban drainage scheme

The construction sites will increase the area of impermeable surfaces. This has the potential to result in localised increases in the rates of rainfall run off generated during storm events. If not appropriately managed this can lead to an increase in flood water levels in receiving ditches increasing the risk of onsite flooding and localised offsite flooding.

SUDS will be used to manage surface water flood risk on site and to ensure no increased rates of rainwater runoff are discharged off site into the surrounding land drainage ditches.

NGET has gained consent from Gwynedd Council as the SuDS Approving Body (SAB) for a sustainable drainage system for the permanent works (ref 3 and 4). Any variations to the approved permanent design will require HUK to liaise with the SuDS Approving Body and potentially submit a new consent application. HUK will facilitate three visits by the SAB which shall attend site to review the implementation of the SuDS strategy. This is a requirement of the SAB approval. ref. 2 page 52

The SuDS measures within the scheme include:

- The main compounds will adopt SUDS drainage for localised areas of with low risk of water contamination. Approval will be sought from the SUDS approving body for the use of SUDS in the temporary compounds;
- Stone and gravel e.g. permeable granular material for the working areas will facilitate soakaway into underlying ground and provide storage attenuation of some impermeable surfaces e.g. parking areas, welfare cabins and offices;
- Surface water attenuation ponds will collect surface water runoff prior to offside discharge. Whilst in storage the water will be available for use by the tunnel

boring machine and will undergo some settlement to reduce the pollution load of the water finally discharged;
- Culverts will be installed under site access tracks to maintain existing overland drainage pathways and prevent site access tracks impeding existing runoff routes.

At Cilfor the drainage ditches that cross the site will be culverted in all locations where they are crossed by a site access road and reptile exclusion fences. The culverts will ensure that the site boundary fence does not impeded flows across or from the site. In addition during the Cilfor site clearance and reptile fence installation site vehicles will be restricted to low ground pressure vehicles. This is to avoid soil compaction and the associated increased likelihood of surface water runoff.

All SUDS features in addition to outfalls will be monitored by works staff (see Section 9)

6.3 Water discharge pollution control

Water discharge pollution control measures and water treatment methods are described in Appendix B

Potentially contaminated water to be discharged off site will be temporarily stored in a flow balancing lagoons. The water to be discharged offsite from a flow balancing lagoon will pumped to a three stage treatment process to remove oil, suspended solids and adjust the pH.

The Garth water discharge treatment process will comprise:
- Siltbuster HB50 (or similar) tilted plate oil water separator which will remove free floating oil and light non-aqueous phase liquids (LNAPLs);
- Suspended solids reduction units using Siltbuster HB50 units (or similar) with the following chemical pre-treatment:
  - Coagulant (poly Aluminum Chloride). This will cause the fine particles to aggregate together into larger particles;
  - Flocculant (Anionic Polymer) will be added to bind the particles together and increase the particle size to enhance the settlement rate;
- pH adjustment unit using Carbon Dioxide.

The Cilfor water discharge treatment process will include the same elements as the Garth site but will also have an additional process using Caustic Soda to neutralise acidic waters should these be encountered. This will maintain neutral pH and minimise the risk of acidic conditions that may be encountered in peatlands.

The water treatment plant will be operated in accordance with an environmental permit. The treated water will be discharged to either an ordinary water course or a main river.

6.4 Garth site set up

The Garth site set up is shown in Appendix C.

The initial site set up will include the connection of existing land drainage into new culverts (Appendix B1). Overland flow pollution control measures described in Appendix B3 will be adopted during soil stripping.

At least one Settlement Lagoon (Appendix B6.3) will be constructed at the start of site established so that it can be used to treat surface water discharged off site during

the top soil strip and compound hardstanding construction. This will reduce the water discharges adverse impact on receiving waters. The lagoon will be maintained on a regular basis. Soils exposed during the site establishment soil strip are to be quickly covered with Terram fabric (or similar) and granular material to reduce the period of time that exposed soil is vulnerable to rainfall runoff scour. I addition silt fencing is to be used to isolate the working areas. Therefore soil strip pollution control will not rely only on a single lagoon but will be also be controlled at source.

Initial compound runoff will be drained into a SUDS scheme using the compounds underlying granular material as a drainage field. The SUDs overflow will be to a sedimentation lagoon which will discharge to the adjacent ordinary water course.

The site compound will include four impermeable catchment areas capable of being drained independently (see Appendix B5). Initially all uncontaminated discharges will flow to SUDS.

Once shaft construction begins dewatering flows and wash water from concrete equipment will be created. These discharges will bypass SUDS and will be diverted to water treatment infrastructure. Uncontaminated compound areas will continue to discharge to SUDS to minimise the volume of water requiring treatment.

6.5 Cilfor site set up

The Cilfor site set up is shown in Appendix C.

Initial compound drainage will be drained into a SUDS scheme using the compounds underlying granular material as a drainage field. The SUDs overflow will be to a sedimentation lagoon which will discharge to the adjacent ordinary water course.

Once shaft construction begins dewatering flows and wash water from concrete equipment will be created. These discharges will bypass SUDS and will be diverted to water treatment infrastructure. Uncontaminated compound areas will continue to discharge to SUDS to minimise the volume of water requiring treatment.

6.6 TBM water management

HUK shall provide water treatment sufficient to ensure that water discharged off site complies with NRW's discharge consent conditions.

The water treatment system to be installed at the Garth site will include settlement lagoons to facilitate water reuse.

The water flow through the settlement lagoons will be arranged so that water flows in a series configuration. This will facilitate progressive sedimentation as the water passes through the lagoons. Tanker vehicle access and suitable hardstanding will be provided to enable accumulated sediment to be removed using vacuum tanker vehicles.

The water storage lagoons will be the intermediate water treatment process at Garth once the site is fully established. The preliminary water treatment processes will be provided by the TBM Slurry Treatment Plant (STP). The most polluted water is expected to be produced by the TBM slurry and its runoff (see Appendix B7.1 TBM STP)

The flow from Settlement Lagoons will be further treated using a three stage treatment process prior to discharge off site. This will comprise initial chemical dosing with flocculants followed by sedimentation and pH adjustment. The treatment plant will be procured as a separate water treatment package. The details of which are to be confirmed (see Appendix B7.2 Treatment of STP discharge)

6.7 Demobilisation.

Following tunnel completion and the removal of the TBM the launch shaft will be partially infilled. As sources of water contamination are removed from site the water treatment infrastructure will be gradually demobilisied and removed from site. During site reinstatement it is expected that reliance will again be placed on SUDS drainage and treatment of overland flows. In effect reversing the approach to site establishment.

Post construction restoration
Following the completion of all construction works, the land within the working areas will be reinstated equal to, or better than original pre-construction condition. Where possible all reinstated surfaces will have the same runoff properties and elevation as existing or as agreed with landowners and stakeholders in advance. This would include the reinstatement of modified watercourses/drainage ditches.

A permanent drainage systems will be constructed during the post construction restoration phase. At Garth an on site ditch will be reinstated and two permanent culverts installed within the ditch. One culvert will provide field access across the ditch and one culvert will provide road access to the Garth head house. The surface water drainage systems at both head houses will comprise a SUDs system.

The Cilfor site's permanent drainage system discharge dewatering flows from the completed tunnel. The dewatering flows will be discharged to the adjacent surface water stream via an oil water interceptor and settlement pond.

The permanent drainage systems will require land drainage consents for the permanent culverts and permanent outfalls and a water discharge consent for the permanent dewatering flow at Cilfor.

7. Groundwater management

7.1 Shaft and tunnel construction materials

HUK shall develop detailed method statements to describe the construction of the main components of the tunnel (shafts, tunnel, culverts, drive site) and define the chemical composition of materials to be used.

HUK shall implement detailed quality assurance and control procedures for the construction of the tunnel to ensure that all chemicals stored at ground surface and within the tunnel are within sealed, bunded units in accordance with relevant legislation.

HUK shall implement a grout injection system for the tunnel that ensures consistent grout is mixed and placed evenly around the tunnel annulus to prevent potential pollution pathways being created during the excavation cycle. The grout mixes selected shall exclude any ingredient that includes additives that are classified as List I under the Groundwater Regulations1998 (SI 2746). Grout mixes containing PFA or

ingredients that might be List II, shall be subjected to leaching tests prior to their placement in the Works.

All shaft and tunnel construction materials including cement and chemical grouts and soil conditioning agents and polymers shall be collated in an inventory document (ref. 14). The inventory will include product data demonstrating that materials coming into direct contact with groundwater as a consequence of the Works have been assessed for compliance with the Groundwater Regulations1998. This inventory shall be made available to NRW and NGET audit.

Drilling / tunnelling fluids shall be limited to either clean water or water-based muds with inert and nontoxic additives only. HUK will supply details of all such additives to NRW for their acceptance at least three months prior to any procurement of such additives.

HUK will comply with the following guidance documents;

- CIRIA C648- Control of Water Pollution for linear construction projects. Technical Guidance dated 2006.
- CIRIA C649- Control of Water Pollution for linear construction projects site guide.

In accordance with the Groundwater Regulations) HUK will :

- Prohibit the use of construction materials containing List I substances that come into contact with groundwater;
- Control the use of construction materials containing List II substances that come into contact with groundwater by demonstrating that List II substances do not leach out such as to create groundwater pollution, or otherwise prohibit their use.

Where necessary HUK shall conduct tests to demonstrate that listed substances do not leach out of construction materials in order to satisfy the requirements of the contract and NRW.

HUK shall ensure that grout does not seal natural fractures within the ground over excessive distances disturbing groundwater flow-paths a long distance away from the tunnel (e.g. by careful control of grout, the use of designed grout mixes and appropriate setting/reaction times).

HUK shall, as a minimum, provide sealed welfare facilities (which do not discharge outside the tunnel or shafts); within the shafts, and where appropriate at 1km intervals within the tunnel and on the TBM backup trailers.

Groundwater monitoring was undertaken within the Cilfor site from December 2019 to March 2022. For this study ten dipwells were installed across the site to get an indication of the groundwater levels. All equipment for this purpose will be removed from site before construction work commences.

7.2 Shaft Construction

Groundwater will be abstracted from excavations on site. The abstracted water may be contaminated with soils, minerals, concrete and grouts reflecting the ground being dewatered and the adjacent construction activity. The dewatering flows will be treated in a water treatment plant (see B6 and B7 below) operated in accordance with an environmental permit. The treated water will be discharged to either an ordinary water course or a main river.

Water inflows into the shafts will vary depending on the shaft depth (see Table 5.2). It is not known whether the water to be abstracted will be fresh or saline due to proximity to the Glaslyn and Dwyryd Estuaries. It is also not known what minerals may be dissolved in the groundwater abstracted.

Groundwater inflow into the two shafts during construction will be abstracted with sump pumps discharging into the compounds' water treatment system. The sump pump will be brought to the surface for maintenance. The abstracted water will be discharged to settlement ponds from where it will be available for reuse. Alternatively treated water will be discharged from settlement lagoons into a local surface water under the terms of a NRW water discharge consent.

Should the water abstracted be saline then after treatment it is expected that it will need to be pumped to a point on a local watercourse where brackish waters are encountered i.e. at a suitable location closer to the tidal estuaries. Therefore each construction site will have two water discharge locations as shown in section 5.3 Proposed water discharge locations.

Groundwater flows into the two shafts and tunnel will be controlled by combining the following approaches:

- cut off walls (secant and sheet piling);
- pre-grouting of rock fissures;
- deep well dewatering;
- sump pumping;
- passive relief wells in the base of the pit.

7.3 Tunnel Construction

As the TBM progresses the tunnel will be lined with pre-cast concrete rings and grouted into the rock so that groundwater will be excluded from the tunnel.

The tunnel lining specification stipulates leakage class 3 rating characterised as "capilliary dampness" which is defined as having occasional damp patches in the tunnelling but no drops of water. The allowable daily leakage rate is 0.1 litres per metre squared. This class rating would also prevent any fines / materials from entering the tunnel (see Table 5.2). Tunnel-seepage will run down towards the TBM and will get mixed-in with the water used by the TBM and be extracted with the slurry.

7.4 Groundwater removal from the permanent structure.

On completion the tunnel and shafts' drainage system will drain water by gravity to a sump located at the Cilfor head house, the deepest shaft. The tunnel drainage system will keep the tunnel and shaft base dry under all expected water ingress rates to ensure no drops of water are evident in the tunnel (Ref.2 page 51).

The water pumped from the Cilfor head house will be discharged into local surface water drainage via a valve chamber containing a flow meter. The water discharge may contain suspended solids therefore a primary treatment system (settlement lagoon or similar) will be installed. The permanent surface water drainage system at Cilfor will also include an oil water separator. The potential permanent water ingress into the tunnel which will need to be pumped out of the Cilfor shaft is 5340 litres over a 24-hour period (see Table 5.2).

8 Permits

Table 8 provides an outline of the types of water related consents required for the scheme. Where a consent, licence or permit has been supplied the site is required to operate within the relevant requirements.

Appropriate procedures will be followed for surrendering permits, consents and licence following the end of the construction phase.

Table 8 Water related consents, licences, permits and regulatory requirements

Type of Permission	Details	Rationale	Timing of Submission
Marine Licence	Licence required from Marine Management Organisation (MMO)	works within the tidal estuary below the mean highwater level.	HUK required to adhere to conditions. 6 week determination period
Ordinary Water Land Drainage Consent (LDC) and FRAP for main river.	Consent from Gwynedd Council and NRW	Required where drainage ditches are crossed, culverted or headwalls installed	8 week determination period.
Sustainable Urban Drainage consent.	Consent from Gwynedd Council	Uncontaminated rainfall runoff discharged to ground	8 week determination period.
Permit for discharge of treated process waters to surface waters	Environmental permit to from NRW	Environmental permit required under schedule 22 of EPR 2010	6 months prior to construction. Minimum of two water discharge permits required.
Consent to carry out construction work in the flood plain	Flood defence consent from NRW		NRW confirmed not required.
Water abstraction licence.	Licence required under section 24 Water Resources Act 1991	groundwater dewatering volumes more than 20 m3/day	6 months prior to construction. Minimum of two permits required.
Surface water abstraction licence	Water resources Act 1991	Proposed abstraction from River Glaslyn for TBM water supply.	6 months prior to construction
Groundwater activity permit		Minimum of one permit required.	6 months prior to construction
Transfer Licence		Discharge of groundwater to surface water	6 months prior to construction
Groundwater investigation consent	S32 Water Resources Act 1991	One needed for each shaft prior to shaft excavation	2 months prior to construction
Environmental Permit for soil treatment plant		Waste treatment permit	Discussions with NRW ongoing.
Environmental permit for water treatment plant		Water treatment permit	Discussions with NRW ongoing.
Foul water	Environmental permit to from NRW	Package sewage treatment plant discharge permit	6 months prior to construction.
Materials Management Plan		Enables excavated materials to be reused	Set up before materials reused on site of origin or before removal from site of origin.

9 Water Monitoring

Water sampling will be undertaken prior to construction to ascertain baseline conditions for water courses within the Scheme boundary. All discharge outfalls shall be tagged and monitored. Corrective and preventative measure will be implemented as required. During the construction phase to ensure the adherence to water quality standards HUK will undertake visual daily checks, weekly inspections and monthly audits of nearby watercourses.

In addition HUK will install water monitoring equipment at the eastern and western construction compounds downstream of construction and discharge activities. The water quality monitoring equipment will provide 24hr monitoring of surface water discharge quality with a live alarm system. The parameters to be monitored will include:

- dissolved oxygen,
- conductivity,
- pH,
- salinity,
- oxidation-reduction potential (ORP),
- temperature, and
- turbidity.

The NRW water discharge consent conditions will inform the water discharge quality testing specification and sampling frequency.

Each surface water discharge will be sampled at least monthly and analysed for the following parameters:

- Chemical Oxygen Demand (mg O_2/l)
- Biochemical Oxygen Demand (mg O_2/l)
- Suspended Solids (mg/l)
- Settleable Solids (mg/l)
- Total Solids (mg/l)
- Fats / Oil / Grease (mg/l)
- pH
- Ammoniacal Nitrogen (mg/l)
- Nitrogen (mg/l)
- Phosphates (mg/l)
- Salinity (mg/l)
- Conductivity (uS/cm)
- Redox Potential (mV)
- Turbidity (NTU)
- Iron (ug/l)

Water samples will be collected by the HTUK environmental manager or a person trained and delegated by them to collect suitable water samples. Water samples will be temporarily stored under refrigerated conditions pending collection by the analytical laboratory tasked with undertaking the chemical analysis of the water samples. Initially the chemical analysis laboratory will be:

ALS Laboratories (UK) Ltd, Torrington Avenue, Coventry, CV4 9GU
www.alsenvironmntal.co.uk T: +44 (0)24 7642 1213
A stock of water sample bottles will be stored on site to enable adhoc water samples to be collected. In the event of a water pollution incident additional water samples will be taken to both assess the impact of the incident and demonstrate the effectiveness of the resulting clean up and or mitigation works.

All SUDS features in addition to outfalls will be monitored by works staff to ensure blockages do not occur during construction. A suitable monitoring programme will be implemented by HUK with records kept of any maintenance requirements to be undertaken on a reasonable timescale by a suitably qualified person. A monitoring checklist would include:

- Water quality monitoring at discharge points to local drains;
- Visual inspection of ditches;
- Visual inspection of above ground drainage and water supply infrastructure.

Silt fencing locations will be marked drawings (see Appendix F) included in appropriate RAMs such as Garth site establishment RAMs to be developed by the sub-contractor Jennings Ltd. The location of silt fencing will be informed by the location of sensitive receptors which will be described in pre-start briefings.

The silt fencing will be inspected on a weekly basis by the environmental manager or engineer in their absence. All engineers completing checks will complete a full inspection of water courses and environmental mitigation measures on site with the environmental manager prior to carrying out an unsupervised inspection.

Silt fencing location drawings to be included in the temporary works register.

During dewatering operations the mitigation measures will be inspected at regular intervals and maintained as required. All such dewatering operations will be subject to HTUK's Permit to Pump procedures.

10 Contingency Planning

10.1 Potential risks requiring contingency plans

In the preparation of the contingency planning potential risks of the proposed works include:

- Hydrological uncertainties;
- Water quality commitments;
- Abstraction uncertainties;
- Consents and licencing constraints;
- Flood risk (Fluvial, Coastal, Surface and Groundwater Risk);
- Potential deterioration of SuDs performance;
- Water monitoring uncertainties.

HTUK will produce a contingency action plan to identify management actions for the following scenarios:

- Complaints about the appearance of waste water discharge;
- Unexpected contaminants found during monitoring;
- Failure of treatment methods;
- Failure of pumping systems;
- Excess ground water seepage into construction area;
- Heavy rainfall;
- Impacts on the stability of adjacent structures;
- Release of any toxic materials.

The contingency action plan will include the following Actions:

- Notification of the NRW as soon as possible;
- determine the causes of any exceedances;

- evaluation of location, likely scale duration and effect;
- identification of appropriate mitigation or remediation measures.

Potential solutions are to be identified by HTUK in advance and an emergency preparedness plan drawn up. The contingency plans will be developed separately from the water management plan but referred to in the water management plan as these become available.

10.2 Planning for the management of a flood incident

A Flood Consequence Assessment report (ref. 3) has been prepared for the Scheme in order to manage the risk of flooding from coastal, fluvial and artificial (lagoons and storage tanks) sources. The compound ground levels will be designed to reduce the risk of inundation from reasonably foreseeable flood events (see Section 3.3 above).

Bund (flood) walls will be constructed around various tunnel supporting operations such as: the generators, STP and workshops. Generators will be placed on a bunded concrete hardstanding. The bunding around Generators will be sized to contain at least 110% of the fuel stored within the bund. Any rainwater that accumulates in the flood walls will be manage as follows:

- Generator, and workshop flood walls – water will be pumped to the lagoons and through the three stage treatment prior to discharge in accordance with an environmental permit.;
- STP, muck bays, grout mixing area and silos – water will be drained via channel drains into a sump and pumped back into the STP plant for reuse.

HUK will produce a Flood Incident Response Plan (FIRP) that will describe the actions to be taken following flood risk notification from the NRW's advance flood warning system. Site operatives will assess the need to put evacuation and site shutdown procedures into action. The FRIP will be submitted to National Grid for approval separately to the Water Management Plan. The FIRP will be finalised prior to the construction phase and periodically reviewed throughout the construction phase.

Following a flood event water may need to be removed from open excavations. This will be carried out using pumps and hoses. Such dewatering operations will be controlled by using the HUK Permit to Pump process supported by a tagging system using a scafftag or similar. A scafftag or similar will be installed and regularly inspected by the HUK environmental manager. This process will comprise a register identifying all pumping operations, points of discharge, type of discharge, and mitigation requirements at discharge points, the plant tagged identification number a, the responsible attendant, dates of discharge and permit numbers.

10.3 Emergency contacts should incidents occur

A Pollution Incident is an occurrence that requires an immediate response to prevent and control damage to the environment.

A suitable number of Incident Controllers (minimum of one per site per shift) shall be appointed in accordance with 00000-HUK-GHS-XX-PC-Z-0048 Appointment of Key Personnel with SHE Responsibilities, with responsibilities for liaison, supervision, and control in the event of an emergency.

Contact details for HTUK supervisors will be maintained on the SHE Notice Board(s) and identified during start of shift briefings

The Project Manager is the SVIP project's principal Incident Controller. Hochtief staff that deputise for the principal Incident Controller include the SVIP project's Site Agents and the Works Manager.

Project Manager	David Murray	david.murray@hochtief.co.uk
Site Agent	Rhys Davis	rhys.davis@hochtief.co.uk
Site Agent	Iwan Rowlands	iwan.rowlands@hochtief.co.uk
Site Agent	Charles Enston	charles.enston@hochtief.co.uk
Works Manager	Kevin O'Brian	kevin.obrian@hochtief.co.uk

10.4 Responsibilities

The Pollution Incident Response Plan is described in the following document: Pollution Incident Control Plan doc ref. C0233-ATM-GES-XX-PL-X-0008. The document is updated at least six monthly and reviewed and accepted by a project director prior to re-issue.

In summary the procedure is Stop, Contain and Report. The HTUK staff responsible for the various aspects of the Pollution Incident Response Plan is outlined in Table 10.4 below.

10.5 Environmental incident reporting

Incident reporting shall be carried out in accordance with HTUK procedure 0000-HUK-GHS-XX-PC-Z-0021 Incident and Accident Reporting Investigation and NG INV01.

Table 10.4 Pollution Incident Response Plan Responsibilities

	Action	Responsibility
1	**Stop** the Spill if you can by standing up the drum, stopping the flow, turning off the tap etc. as appropriate, decant any remaining liquid into a secure vessel and label. Try not to stand in the spill	All site staff/ site supervisor
2	**Contain** the spillage using an appropriate spill kit, so preventing the spillage from spreading and/or entering a drainage system or water course	All site staff/ site supervisor
3	**Inform** the site supervisor (Incident Controller for major if major pollution incident) who will take charge of the process and ensure the spill has been effectively stopped and contained.	All site staff
4	Escalation the site supervisor/ Incident Controller will inform: • Environmental Manager • Ecological Clerk of Works • HTUK Project Director • NG Project Manager (within 1 hour)	Site supervisor / incident controller
5	Assess the risk that the spillage poses to: the health and safety of people on site and in the surrounding vicinity; and the environment	All site staff/ site supervisor
6	Assess whether the spillage can be cleaned up by site staff or if a major pollution incident requires specialist contractor (e.g. DARCY GROUP 01732 441019)	Site supervisor / incident controller
7	As appropriate inform the Emergency Services, local police, NRW, water supplier. NRW must be informed in the event of a spillage entering a live drainage system or watercourse (use 24hour Incident Hotline Number: 0300 065 3000). Assistance to be provided to the authorities should they attend site. HTUK must be notified immediately of any such event	Site supervisor / incident controller
8	Obtain the appropriate PPE (in accordance with the material COSHH sheet and the nature of the clean-up works to be undertaken).___	All site staff/ site supervisor
9	Clean up the spill using the appropriate spill kit. Treat all material in contact with the spill as contaminated	All site staff/ site supervisor/ specialist contractor
10	Re-assess the situation. Do you have the appropriate PPE? Have all of the relevant parties been informed	All site staff/ site supervisor/ specialist contractor
11	Decontaminate the site and all personnel that have come into contact with the spill. Dispose of PPE, all contaminated materials and the used spill kits as hazardous waste	All site staff/ site supervisor/ specialist contractor
12	Replace spill kits used and remove all contaminated material	Site supervisor
13	Project Director and SHESQ Manager will instigate an investigation into the incident's cause. An action plan will be prepared to determine why the incident occurred and whether any modifications to working practices are required to prevent a recurrence. If necessary the CE&SMP, PICP and Construction Phase Plan will be updated (and any other plans as appropriate) and all workers will be notified.	Project Director/ HSQE Manager

11 Water Efficiency Plan

11.1 Water efficiency opportunities

Table 11 describes opportunities to reduce water use during the Scheme's construction through the use of water efficient technologies and practices.

Table 11 Water efficiency opportunities

Activity	Options to reduce potable water demand on key sources
Site cabin related activities	Efficient showers, taps, toilets and urinal controls. Trigger control on catering taps and use of vessels for washing rather than under running taps. Rainwater capture for toilet flushing. Waterless urinals. Trigger control on boot washing equipment.
Drainage	Reuse water collected from activities e.g. dewatering. Watertight circulation tanks rather than pits. Use water from attenuation tanks or rainwater harvest tanks as outlined in the CEMP and Energy Man plan. Inspect water hose lines for leakage and repair or replace as required.
General cleaning	Fill containers rather than use running taps or open hoses. Trigger operated spray guns. Use of a closed water recycling system.
Dust suppression in relation to soil stripping	Use of control systems to allow damping activities to be altered for different applications and weather conditions. Use of water efficient road sweepers and dust suppression vehicles which recirculate water and/or have efficient spraying mechanisms such as a hydraulic spinning system. Use water collected elsewhere on site such as from SUDs, for dust suppression activities (may require on-site treatment).
Drilling	Inspect water hose lines for leakage and repair or replace as required. Watertight circulation tanks, rather than pits. Use of meters on supply lines / consumption monitoring for high demand activities.
Shaft construction	Use water from attenuation tanks or rainwater harvest tanks. Inspect water hose lines for leakage and repair or replace as required
Tunnelling (Slurry TBM)	Inspect water hose lies for leakage and repair or replace as required. Watertight circulation tanks, rather than pits. Use of meters on supply lines / consumption monitoring for high demand activities.
Building	Use of damp sheets as alternative to spray cooling
Concrete Blocks	Use of water butts and localised water cisterns for mortar mixing as alternative to live ring main and long hose pipe runs on site.
Screed	Apply in early morning, late evening or out of hours, for natural cooling (avoiding additional water demand for damping). Use ready mix (avoid onsite water demand/waste/pollution risk). Avoid screed through higher tolerance and finishing specification for concrete slabs.
Concrete Production	Alternative sources can be used provided the risk of contamination from non-cement based materials is minimal. Consider a storage facility on site where water for cleaning could be blended with potable water for use in production.
Sweeper Tip	Where feasible sweeper tip wash water will be taken from the sites outfall lagoon or other source of reclaimed water.
Wheel Wash	The wheel wash water will be re-circulated within the wheel wash and the solids periodically extracted.
Concrete wash out	Consider collecting waste water and reusing in the concrete batching process. CO2 neutralisation to permit reuse. Consider use of a concrete sock to cover concrete chutes on lorries. Use hose trigger guns.
Commissioning	Planned water use – sequential flushing, sub-valving and reuse where practicable. Isolate water flows as soon as water turns clear when commissioning pipes and systems. Use of tanks for storage / use in landscaping works or other. Inspect water hose lies for leakage and repair or replace as required. Use of meters on supply lines / consumption monitoring for high demand activities.

11.2 Site Welfare Facilities

As outlined in Table 11 there are opportunities to improve water efficiency. Where appropriate these will be developed in line with HUK's Energy Reduction Plan. This

will be submitted to National Grid for approval separately to the Water Management Plan

Site welfare facilities must use plumbed in water dispensers.

The most effective water efficiency methods for hand basins include:

- the use of motion sensors; and
- installing taps with efficient flow patterns e.g. spray taps or aerated taps.

All new toilets would have a flushing volume of 6 litres or less to comply with Water Supply (Water Fittings) Regulations 1999. However a number of more efficient options are now available including toilets that flush a maximum of 4.5 litres. Dual flush toilets are another sustainable water saving option.

Good practice in the water efficiency of urinals involves installing a device to control flushing based on how often the urinal is used. There are a number of options to achieve this but good practice in the construction sector would usually involved the use of a low maintenance hydraulic valve. This can be fitted in the inlet pipework of the urinal system and dos not required power to operate. Considerations should also be made for waterless urinals.

Multiple showers are to be installed as part of the welfare facilities and a flow rate of 6 to 8 litres per minute should be considered for water efficiency.

A trigger control to ensure auto-isolation of flow would be fitted to sink taps involved in food preparation or canteens. This will prevent taps being left running when not in use.

11.3 Plant and Equipment

The large majority of activities on site using water would inevitably involve plant or equipment. Water using activities have already been identified in Table 4.1 . The frequency of use would be taken into account in the procurement process of such plant and equipment by HUK.

11.4 Maintenance

Welfare facilities will have on-going maintenance to ensure low water use. Regular preventive maintenance checks will include:

- Checking that taps are not dripping;
- Checking that percussion taps do not run for longer than necessary;
- Ensuring the sensor driven taps an/or urinals ae working correctly; and
- Ensuring that toilets are not leaking through the overflows or valves;

Plant and equipment would each have individual maintenance requirements. The instructions provided with the equipment of from the hire company will be followed to ensure efficient water use.

12. Training and Awareness Plan

12.1 Water Resources

HUK will ensure that all staff working on site are aware and receive relevant training in the efficient and safe use of water in order to reduce wasted water during construction.

Site induction will include training to all staff in the usage of water with tool box talks and refresher training repeated in advance of high demand periods.

12.2 Water and Risk Management

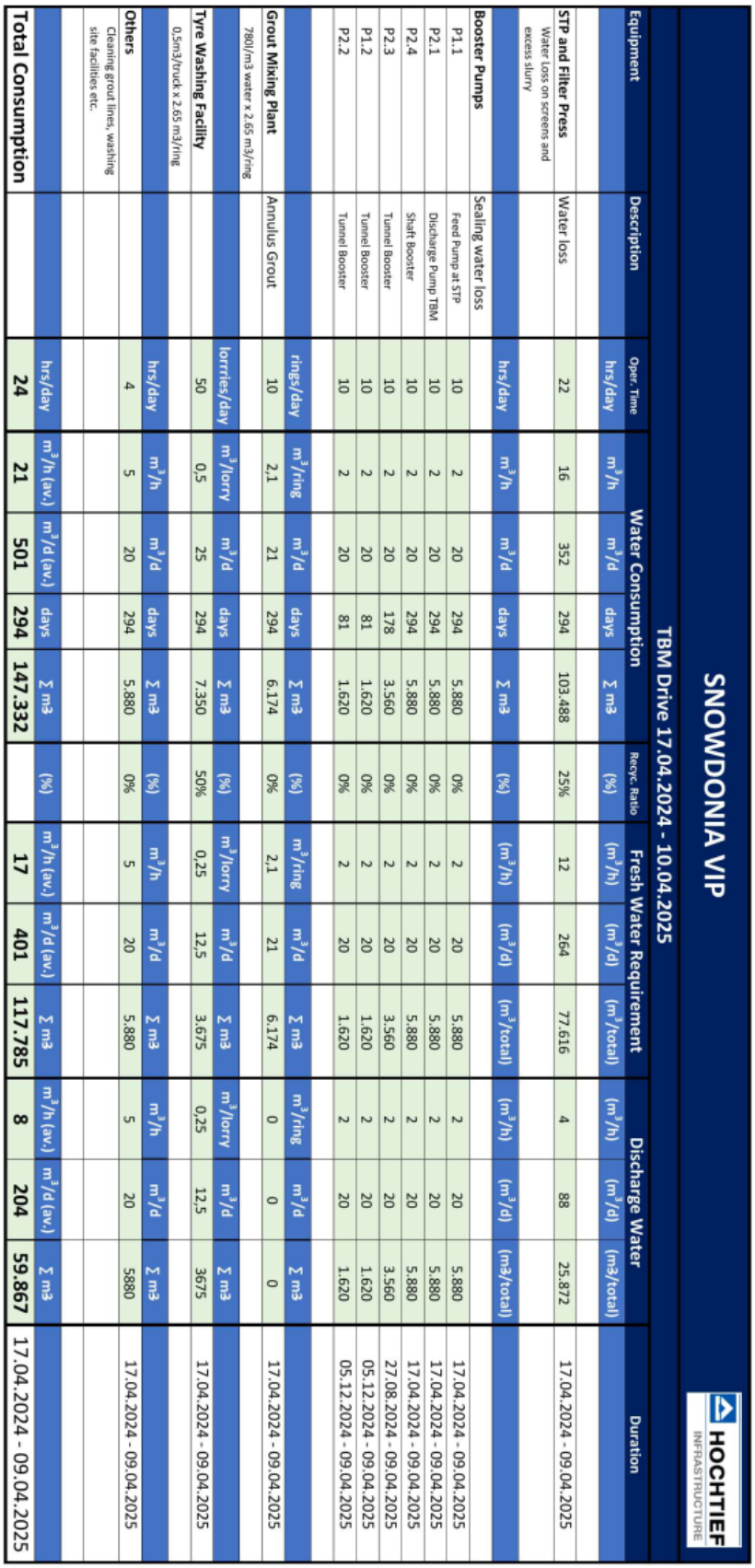
HUK will ensure that all staff working on site are aware and receive relevant training in the management of the risk of flooding. Further information regarding evacuation procedures are outlined in the Flood Consequences Assessment report (ref. 3).

13.0 References

1. https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure/visual-impact-provision/snowdonia
2. NGET Project Specific Scope Snowdonia VIP, version 3.4, November 2021
3. Stantec, Visual Impact Provision, Flood Consequences Assessment dated 03-012-29
4. Stantec, Visual Impact Provision, SuDS Strategy dated 02/06/2020
5. Site investigation
6. Hydrological impact assessment
7. CEMP
8. Planning Docs
9. Pollution prevention and control plan
10. SVIP Tunnel Landowner Commitments Register rev. 12-10-21
11. C0233-HUK-GES-ZZ-PL-W-0001 TBM Plan of Advance
12. C0233-HUK-GES-AS-PL-W-0001 Garth Shaft
13. C0233-HUK-GES-IS-PL-W-0001 Cilfor Shaft
14. C0233-HUK-GES-XX-SH-W-0002 Materials Approval Schedule (NRW)
15. C0233-ATM-GES-XX-PL-X-0008 Pollution Incident Control Plan
16. 00000-HUK-GHS-XX-PC-Z-0048 Appointment of Key Personnel with SHE Responsibilities
17. 0000-HUK-GHS-XX-PC-Z-0021 Incident and Accident Reporting
18. https://www.herrenknecht-separations.com/en/contact

Appendices

A Estimated daily water consumption during the TBM drive



SNOWDONIA VIP

HOCHTIEF INFRASTRUCTURE

TBM Drive 17.04.2024 - 10.04.2025

Equipment	Description	Oper. Time	Water Consumption					Recyc. Ratio	Fresh Water Requirement			Discharge Water			Duration
		hrs/day	m³/h	m³/d	days	Σ m3	(%)	(m³/h)	(m³/d)	(m³/total)	(m³/h)	(m³/d)	(m3/total)	
STP and Filter Press	Water loss	22	16	352	294	103.488	25%	12	264	77.616	4	88	25.872	17.04.2024 - 09.04.2025
Water Loss on screens and excess slurry														
		hrs/day	m³/h	m³/d	days	Σ m3	(%)	(m³/h)	(m³/d)	(m³/total)	(m³/h)	(m³/d)	(m3/total)	
Booster Pumps	Sealing water loss													
P1.1	Feed Pump at STP	10	2	20	294	5.880	0%	2	20	5.880	2	20	5.880	17.04.2024 - 09.04.2025
P2.1	Discharge Pump TBM	10	2	20	294	5.880	0%	2	20	5.880	2	20	5.880	17.04.2024 - 09.04.2025
P2.4	Shaft Booster	10	2	20	294	5.880	0%	2	20	5.880	2	20	5.880	17.04.2024 - 09.04.2025
P2.3	Tunnel Booster	10	2	20	178	3.560	0%	2	20	3.560	2	20	3.560	27.08.2024 - 09.04.2025
P1.2	Tunnel Booster	10	2	20	81	1.620	0%	2	20	1.620	2	20	1.620	05.12.2024 - 09.04.2025
P2.2	Tunnel Booster	10	2	20	81	1.620	0%	2	20	1.620	2	20	1.620	05.12.2024 - 09.04.2025
		rings/day	m³/ring	m³/d	days	Σ m3	(%)	m³/ring	m³/d	Σ m3	m³/ring	m³/d	Σ m3	
Grout Mixing Plant	Annulus Grout	10	2,1	21	294	6.174	0%	2,1	21	6.174	0	0	0	17.04.2024 - 09.04.2025
780l/m3 water x 2.65 m3/ring														
		lorries/day	m³/lorry	m³/d	days	Σ m3	(%)	m³/lorry	m³/d	Σ m3	m³/lorry	m³/d	Σ m3	
Tyre Washing Facility		50	0,5	25	294	7.350	50%	0,25	12,5	3.675	0,25	12,5	3675	17.04.2024 - 09.04.2025
0,5m3/truck x 2.65 m3/ring														
		hrs/day	m³/h	m³/d	days	Σ m3	(%)	m³/h	m³/d	Σ m3	m³/h	m³/d	Σ m3	
Others		4	5	20	294	5.880	0%	5	20	5.880	5	20	5880	17.04.2024 - 09.04.2025
Cleaning grout lines, washing site facilities etc.														
		hrs/day	m³/h (av.)	m³/d (av.)	days	Σ m3		m³/h (av.)	m³/d (av.)	Σ m3	m³/h (av.)	m³/d (av.)	Σ m3	
Total Consumption		24	21	501	294	147.332		17	401	117.785	8	204	59.867	17.04.2024 - 09.04.2025

Appendix B Water discharge control measures and water treatment methods

B1 Agricultural Drainage

Land drainage is a system of piped or gravel drains to control the water table and reduce the frequency with which agricultural land becomes waterlogged.

The installation of shafts and other construction features will adversely impact existing agricultural drainage. The following measures will be used to manage agricultural drainage within the Scheme:

- Haul roads will be constructed through the site to minimise sub-soil compaction by traffic movements and the associated increased likelihood of surface water runoff;
- Where required cross drainage pipes will be laid beneath access tracks on the site to maintain existing overland drainage pathways;
- Where possible agricultural drainage will be retained by limiting excavation into the subsoil. Where retained agricultural drainage is obstructed by site infrastructure it will be intercepted with culverts that will aim to preserve existing drainage flow paths;
- The compound drainage design will aim to limit surface water runoff from the construction sites to the surrounding drainage ditches with the use of SUDs. The compounds' permeable hardcore layer will also provide attenuation storage for runoff from uncontaminated impermeable surfaces e.g. office and welfare cabins, haul roads, parking areas etc;

Action when existing land drains exposed
If land drains are exposed during the topsoil strip action needs to be taken immediately to prevent silt laden runoff from entering the exposed drains and risk causing a pollution event. The water management plan (Appendix B1 and B3) describes a range of measures that can be adopted to control silt laden runoff from agricultural drainage.

Remedial measures could also include controlling seepage into the exposed pipework with silt fencing / or silt matting or similar material" (ref SVIP Soil Management Plan).

The nature of the exposure will inform the most appropriate remedial measure. This could include:

- re-piping or diverting the exposed pipe section. The drainage installer will be required to provide drainage installation records so that these can be referred to during compound reinstatement works and handed over in the project's as-built records;
- cutting off and capping existing land drains to stop any potential silt run off into ditches or open excavations. During the demobilisation and reinstatement of the construction compound some land drains that had been temporarily blocked (e.g. to permit lagoon or shaft construction) will be reinstated. The drainage installer will be required to provide drainage installation records so that these can be handed over in the project's as-built records.

B2 Temporary Watercourse Crossings

Temporary access routes (comprising Trackway) will be required in order to construct the Scheme. Where these need to cross existing watercourses culverts will be installed.

There is a risk that Culverts could lead to a localised increases in flood risk if they are undersized, become blocked, or are otherwise inappropriately designed. To mitigate this potential risk, all temporary bridges or culverts will be appropriately designed from a hydraulic perspective to convey the range of peak flows likely to occur on each respective watercourse over the duration of the construction period.

Land Drainage Consent applications for all temporary crossings will be made to either Gwynedd Council or NRW and these would be constructed in accordance with their approval.

All watercourse/ditch crossing points will be visually inspected on a regular basis to ensure that construction (or otherwise) debris does not block the crossing point. Permanent surface water drains would be reinstated to their pre-construction condition.

B3 Rainfall runoff from grassland and disturbed ground

B3.1 Silt fencing

Silt fencing is a temporary sediment control barrier used to prevent discoloured water runoff entering water courses. Silt fences are widely used in construction due to their low cost and simple design. Silt fencing will be installed at locations where there is a risk of silt being washed into the ditches via surface water runoff which may change over the course of the construction programme.

The effectiveness of Silt fencing in controlling sediment can be limited due to poor installation, improper placement and inadequate maintenance. Therefore silt fencing will be installed as follows:

- Silt fences shall be installed in a position and shape that will impede the flow of run-off as it travels down / across a slope;
- They should be crescent / half in shape with the majority of flow being caught by the centre of the fence;
- The base of the silt fence shall be buried in accordance with the manufacturers recommendations;
- Wooden stakes should be used at regular intervals in order to maintain fence integrity under the weight of silt loading.

Silt fencing locations will be marked drawings included in appropriate RAMs such as Garth site establishment RAMs to be developed by the sub-contractor Jennings Ltd. Silt fencing will be monitored as described in Section 9 water monitoring. Appendix F contains Silt fence location drawings.

B3.2 Grips and Bunds

A grip is a channel or ditch cut into the ground on the uphill side of a receptor to channel run-off away from the receptor. Grips are useful for the control of run-off on site and typically carry run-off towards the fence line.

It is important that Grips are not installed at steep an angle as this can lead to erosion of the subsoil. Shallow angled Grips are preferrable. Grips can be modified to channels filled with aggregate that allow surface and sub-surface water to drain away i.e. French Drains.

A bund is a linear earth barrier placed on the uphill side of a receptor to channel runoff away from the receptor. Bunds are generally installed to prevent discharge to controlled waters and may be installed in combination with Grips.

B3.3 Sumps

A sump is a hole or a pit that may be lined or unlined and is used to collect water to enable pumping out:

- Sumps are generally excavated at the termination of grips and bunds where the heavy silt will fail out of suspension;
- Sumps should be regularly maintained and re-excavated to remove to remove and build-up of silt;
- Sumps should be Heras fenced or similar in order to prevent unauthorised access.

B3.4 Swales

Swales will be installed to manage the flow of water to the outfalls. Swales are linear vegetated drainage features in the which surface water can be stored or conveyed. They have been designed to allow the suspended particulate load in the water to settle out providing pollutant removal. The swale channel will be broad and shallow and covered by dense vegetation (grass) to slow down flows and trap particulate pollutants. All swales will be monitored in accordance with Table 17 of CIRIA C793 SUDS Manual.

Silt fencing or similar barrier(s) will be introduced into a swale in the event of a pollution incident affecting the swale concerned. This will enable the polluted water to be trapped within the swale and enable it to be pumped from the swale and passed to suitable treatment.

B4 Concrete and grout wash out water treatment and disposal

A variety of concrete and grouts mixes will be used on site to construct the shaft and tunnel linings. Some of these materials will be delivered to site as a readymix material ready to be poured straight away and some will be mixed on site and pumped to where needed.

Figure B4 Concrete wash out skip at Garth site 10-05-23

Readymix delivery vehicles may need to be washed before leaving site. A concrete wash out skip will be used for this purpose. These will retain the solids and allow drained water to be collected and reintroduced back into water treatment systems.

An example of concrete wash skip in use at Garth site in May 2023 is shown in Figure B4 below.

Larger volumes of concrete and grout wash water generated from the washing of grout mixing and pumping equipment used by piling rigs and TBM equipment will be treated on site to neutralise the wash water and remove gross solids prior to reusing the water in later grout and concrete mixes. The STP and water discharge treatment plant will both have sedimentation and pH neutralisation equipment. Early works undertaken before the installation of the STP and water discharge treatment plant may require supplementary treatment equipment. Suppliers of suitable proprietary concrete and grout wash out equipment with pH neutralisation include:

- www.kellytanks.co.uk
- www.siltbuster.co.uk

B5 Rainfall runoff from site compound hardstanding areas

B5.1 Rainfall runoff from office roofs and pedestrian areas (Zone 1)

Rainfall runoff from office building roofs and adjacent pedestrian areas is expected to be uncontaminated and will be collected for use in WCs, boot wash, dust suppression, wheel wash.

B5.2 Rainfall runoff from access roads and parking areas (Zone 2)

Rainfall runoff from impermeable tarmac areas is expected to be uncontaminated and suitable for discharge via SUDs. Vehicle fuel/oil spill risk will however require discharge to SUDS via oil water separator(s).

B5.3 Rainfall runoff from material laydown area (Zone 3)

Rainfall runoff from the impermeable storage area is expected to be uncontaminated and suitable for discharge via SUDs. Vehicle fuel/oil spill risk will however require discharge to SUDS via oil water separator(s).

B5.4 Rainfall runoff from shaft and tunnel spoil treatment area (Zone 4)

The spoil treatment area will have an impermeable concrete hardstanding and an isolated drainage area. Runoff will be contaminated with excavated materials, grout residues, concrete residues and water treatment chemical spillages. The area will also be contaminated with runoff from general cleaning, concrete wash out, tool rinsing, boot washing, plant and equipment washing. Sludges from a vehicle wheel wash, sweeper tip, and water treatment plant will be handled in this area and some may be spilt.

The surface water runoff will be treated in a water treatment plant operated in accordance with an environmental permit (see B6 below). The treated water will be discharged to either an ordinary water course or a main river.

Pollution control chambers

Rainfall run off from potentially contaminated areas will flow to pollution control chambers that contain penstocks. Chambers will be inspected and cleaned as appropriate. The penstocks are operated in an open position to allow water to flow to discharge points via water treatment infrastructure. The penstocks will be closed in the event of the following:

- Watercourse monitoring checks (either formal or informal) identifies unusual or unidentified flow from the outfalls;
- A pollution incident on site that has entered the site drainage.

A member of the Environmental Team, Environmental Response Team, Supervisor or Works Manager must provide authorisation to use the penstock keys unless in the event of a pollution incident. The penstocks will be closed using a penstock key that will be available at all penstock locations. Simple instructions on how to use the keys will be made available at the key location. Whenever an individual opens or closes a penstock valve they must sign the penstock record sheet and record the date and time.

Muck bay drainage
Dedicated muck bays will be constructed to temporarily store the filter cake material prior to removal from site for reuse. Surface water from the muck bays will be pumped via a sump into the slurry tanks for processing in the Slurry Treatment Plant (STP). Alternatively this water will be pumped directly to the lagoons from the sump.

Water generated from the operation of the Filter Press
Water generated from the filter press will be recirculated back into the Slurry Treatment tanks for use in the slurry circuit i.e. it is a closed loop system. At the end of tunnelling the water will be pumped into the lagoons and passed through the three stage treatment process or tankered off site.

Wheel wash
Any waste water from the wheel wash will be pumped to the lagoon system and through the three stage treatment or tankered off site. Potential fuel / oil contamination can be treated within the proposed onsite treatment process.

B6 Dewatering flows

B6.1 Pumps

Pumps are used to remove water from excavations to aid in the construction process. They should be suitably sized in order that they are able to pump the required volume of water whilst not discharging water in an uncontrolled manner. Environmental requirements such as drip trays will be employed to minimise risk of fuel spillage. If pumps are integrally bunded then drip trays will only be used if the pump is sited for a considerable length of time. Spill kits will be readily available at each pump location entered onto the spill kit register tagged and checked weekly.

A noise assessment shall be undertaken on all pumps prior to use.

B6.2 Parallel Plate Separators (Siltbusters)

Parallel Plate Separators (PPS) use parallel plates to create ideal settlement conditions. They enable suspended solids to settle out and so reduce the turbidity of water. They can quickly accumulate silt and must be regularly emptied so as not to become ineffective. PPS are most effective when flow rates are uniform and relatively low. PPS will be used in conjunction with settlement lagoons and straw bale lagoons.

Siltbuster PPS units are typically designed to treat flow rates of up to 50 m3/hr. They are typically fed with a four inch pump to maintain optimum flow rates in to Siltbuster. If greater volumes need to be treated additional units can be connected in parallel to increase treatment capacity.

Any water in excavations that may be contaminated with concrete e.g. during the piling works for the TBM Launch Shaft it will be pumped into a Siltbuster or other treatment unit depending on the volume of water and treated to neutralise the pH using suitable pH adjustment equipment using Carbon Dioxide.

The specific dewatering configuration will be discussed and agreed as part of the permit to pump issued by a member of the Environmental Team.

B6.3 Settlement Lagoons

Settlement lagoons will be excavated and surrounded by earth bunds. The lagoons will have an impermeable liner. The bunds will be subject to temporary works design approval process. Once constructed these will be regularly inspected to ensure that they remain intact and are not damaged during construction See section 4.2)

A settlement lagoon is designed to enable suspended solids to settle out by holding water in relatively shallow quiescent conditions for several hours. This effect can be enhanced by introducing baffles across the full width of a lagoon. They can also be used to contain short periods of high flows and release water at a slower rate, balancing the flow. Water held in Lagoons can be pumped, piped or tankered to a final discharge location.

The lagoons will be periodically de-sludged. Care will be taken to prevent damaging the lagoons' impermeable layer. Desludging will include pumping fluid sludges to the Slurry Treatment Plant's Filter Press for dewatering. Denser fluids may require compressed air injection to fluidise the sludges to enable them to be pumped. Compacted or cemented solids in the base of lagoons may not be able to be pumped. These will instead be carefully scrapped from the lagoons using a mechanical excavator. Care will be taken to retain a solid sludge layer above the impermeable membrane to ensure the excavator bucket is kept away from the impermeable liner.

Settlement lagoons should be lined and be free of leaks. They should be Heras fenced (or similar) in order to prevent unauthorised access.

The top of Settlement Lagoon bunds will be above the expected flood levels. This is to prevent flooding of a site with potentially contaminated water from the lagoons.

B6.4 Straw Bale Lagoons / Silt Traps

Straw bale lagoons are four sided structures approximately 1.5m in height of varying length and width and constructed above ground. They are lined with geotextile and work of the same principle as settlement lagoons. A typical silt trap is shown in Photo 1 below for illustrative purposes.

Straw Bale Lagoons are an efficient and cost effective method of silt mitigation. They can be positioned off site (with landowners consent) or on an area of unstripped ground away from watercourses and drains. They are typically used in combination with pumps, PPS and settlement lagoons to achieve maximum silt reduction prior to discharge to either land or ditch.

They require regular inspection and maintenance to ensure that they do not collect excessive amounts of silt that would reduce its performance.

Fig. B6.4 Typical silt trap constructed of straw bales and geotextile membrane.

B6.5 Filtration Media

Filtration media are any materials that remove suspended solids from water whilst not impeding its flow. Grassland can be used as a natural filtration medium. Landowner permission should be sought for any discharges to off site grassland. Geotextile can be an excellent filtration medium however it can become readily clogged with silt. Sand, gravel and carbon filters can be used to remove suspended solids.

B6.6 Agricultural Irrigation Sprayer

Irrigation sprayers remove water from site through seepage an evaporation similar to that o natural rainfall. Water is supplied via a pump and sprayed into the air through sprinklers so that it breaks up into water drops which fall to the ground. The pump supply system, sprinklers and operating conditions must be considered prior to use.

Irrigation sprayers can disperse water over large areas thereby not saturating the ground that may otherwise lead to inefficient settlement of solids.

B6.7 Chemical Flocculation and Coagulation

Very fine particles (typically less than 0.001mm) will not settle out of solution without chemical addition. Although very effctive guidance will be sought from the Environment agency before the decision is made to use such chemicals. This solution is only recommended where no alternative treatment is available.

Coagulants are added to water to cause the fine particules to aggregate together into larger particles. Flocculants are chemicals that promote floccultion by causing colloids and other suspended particles in liquids to aggregate forming a floc. Flocculants are added to solution in order to cause fine suspended soilds to combine and therefore fall out of suspension quicker. Flocculants are used in water treatment processes to improve the sedimentation or filterability of small particles.

B6.8 Drainage Filter Socks

Filter socks / silt socks are pillow case type attachments (in terms of shape, dimension and material) that are fitted using zip ties or jubilee clips to the outfall of drainage pipes.

Filter socks trap sediments suspended solids whilst allowing the water to seep through the filter. Filter socks are effective in reducing sediment concentrations discharged by retaining sediment within the sock. However this can result in siltation of the upstream pipework. Filter socks can be modified by puncturing the top of the sock to increase outflow and prevent damage to the drainage system.

B6.9 Sediment Entrapment Mats (Sedimats)

Sediment entrapment mats are hessian and straw mats of approximately 1.5m x 3m which are fixed to the bed of water courses and do not impede flow. They are designed to allow sediment to settle through an upper layer of jute mesh into a layer of straw. A lower layer of hessian prevents the sediment from escaping.

Sedimats are designed to be removed following construction but this will release trapped silt into the water course. Sedimats are very heavy when saturated making removal potentially hazardous. They can be left in place as they are readily biodegradable.

Sedimats can be placed at the discharge point of a pump hose to assist in silt removal.

B6.10 Blue Barrier Fencing

Blue barrier fencing shall be installed adjacent to watercourses. The purpose of this measure is to highlight to project personnel potential impacts that construction operations may have on water courses. This measure is also relevant when controls are being implemented for a Permit to Pump.

B6.11 Straw Bales

Straw bales act as a filter for silty water. Straw bales can be positioned in a watercourse or where water is entering a watercourse.

Straw bales also slow the flow of silty water thus decreasing silt pick up from subsoil or increasing residence time in water courses to allow silt to drop out of suspension.

Straw Bales will be used in combination with pumps, silt busters and settlement lagoons to achieve maximum silt reduction prior to discharge to either land or ditch.

B6.12 Vacuum Tankers

Vacuum tankers can be used to remove silty water from the working area. The silty water can be disposed of by spraying on the land surface elsewhere within the site where the land surface is relatively dry. During dry weather silty water can be removed from holding lagoons and sprayed onto grassland on site as a means of disposal.

B6.13 Off-easment Pumping

Off-easement pumping transfers water from the designated working area (easement) to adjacent land. This mitigation requires landowner consent and is designed to reflect the discharge's water quality and quantity and the adjacent land's topography.

B6.14 Borehole Protection

A number of boreholes are required at various locations. In order to prevent pollution of the subsurface water or damage to the boreholes and associated equipment they will be protected with post and rail fencing to make them clearly visible to machine drivers. When no longer required the boreholes will be decommissioned in line with the Environment Agency guidelines for the Decommissioning Redundant Boreholes and Wells.

B7 TBM Slurry Treatment Plant

B7.1 TBM water circuits

Herrenknecht Separations (Ref. 18) produced a slurry treatment plant design (Herrenknecht proposal ref. SVIP Tunnel, Wales, UK). The average daily water consumption and discharge volumes for which are shown in Appendix A.

The STP design was informed by a TBM water mass balance that distinguished between two types of geology. A hard mudstone (rock) geology producing a slurry that can be readily dewatered and the water readily recycled for re-use. The second geology type comprises fluvioglacial deposits that require greater treatment capacity and greater volumes of fresh water top up water because the resulting slurry is expected to be less readily treated. The volumes concerned are shown in Table B7.1 below and the water circuits shown schematically on Fig B7.1 below.

Table 7.1 Herrenknecht Separations TBM STP design assumptions

Geology Type	Daily Volume of Water (m^3 / day)			
	Max additional volume of slurry needed	Max volume of slurry recirculated	Min water top up required	Range of discharge from STP
Mudstone Rock	90	51	39	39 – 90
Fluvioglacial deposits	758	332	426	426 - 758

The expected TBM track length of the mudstone rock is 3207m compared to 170m for the Fluvioglacial deposits. The high volume flow rates through the STP are expected to be required for less than 4 months.

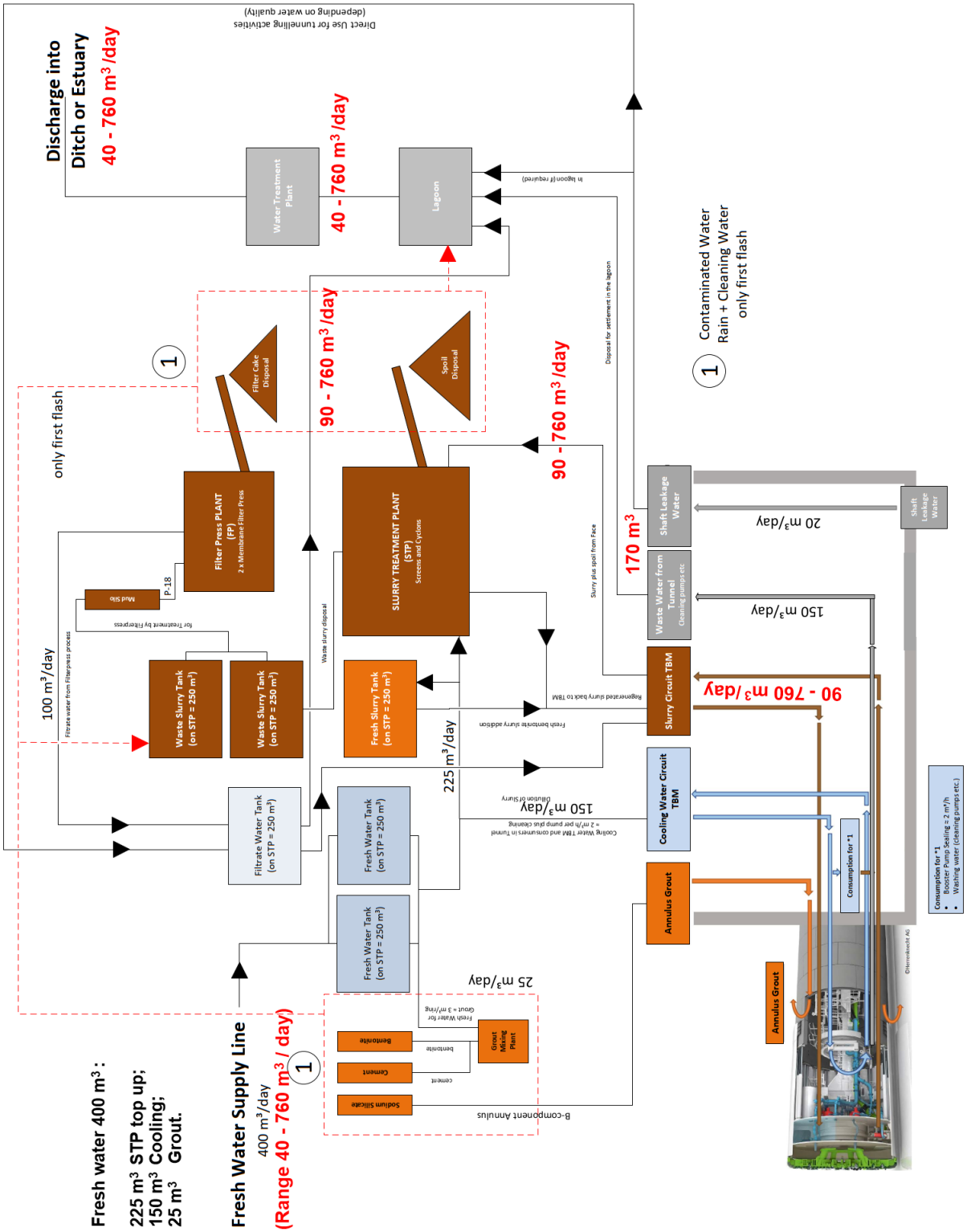
B7.2 TBM Slurry Treatment Plant

The spoil excavated by the TBM will be pumped from the tunnel as a water slurry and dewatered in a Slurry Treatment Plant (STP). The STP's capacity will at least 150% of the TBM capacity (Ref. 2 page 12)

The STP will remove the heavier solids, through screens and cyclones producing material that may be re-used as structural fill. The remaining fines will be extracted from the water through the filter-presses. This will produce filter cakes that cannot be re-used but will have to be disposed of. Water in the TBM slurry will largely be re-circulated back into the tunnel after suitable water treatment.

The STP will be designed to removed suspended solids and correct the pH. This is expected to include chemical precipitation possibly using ferric chloride and pH adjustment using carbon dioxide gas.

Table 7.1 Herrenknecht Separations TBM water circuits



The heavier materials will be deposited in a "mucking out" area adjacent to the shaft. This will be a covered area with pre-cast dividing walls to segregate material types. The storage bays will be designed to accommodate seven days of TBM production. The material will be tested and loaded in road haulage vehicles for off site removal. It is expected that most of the tunnel excavated material will be able to be used in construction as good quality granular fill material.

Prior to loading into road haulage vehicles the spoil will be tested to identify its Pyrite content because any material with Pyrite greater than 2.6% may be unsuitable for reuse. If Pyrite contaminated material is identified it will diverted to separate storage for use in land restoration.

Grout mixing area

The STP will also be used to treat waste water from the Grout mixing area. Grouts will be mixed on site for use in shafts, tunnel and for ground stabilisation. The Grouts will be mixed in designated areas surrounded by a flood wall (see B7 below). The flood wall will contain the grout mixing area and the area used to wash out grouting lines and equipment. Grout washout and other extraneous liquids within the grout mixing area flood wall will drain via channel drains into a sump and be pumped back into the STP plant for reuse.

Muck bays containing excavated materials

A designated containment area for excavated material and tunnel arisings shall be established at the tunnel drive site. The containment area will be a fully bunded, impermeable storage area that will be large enough to contain at least 7 days-worth of excavated material from the tunnel or shafts.

The working areas will be designed so that any water present within excavated material and tunnel arisings, including water run-off from spoil heaps and spoil transfer areas will be pumped via a sump into the slurry tanks for processing in the Slurry Treatment Plant (STP).

B7.3 Treatment of Slurry Treatment Plant discharge (Siltbuster)

The water unsuitable for reuse in the TBM will be discharged into a series of four Settlement Lagoons. The lagoons will be lined with an impermeable membrane and all joints will be sealed.

From the lagoons the water will pumped to a three stage treatment process to remove oil, suspended solids and adjust the pH (see Section 6.3) prior to discharge off site.

The treated water will be discharged to either an ordinary water course or a main river.

The water treatment plant will be operated in accordance with an environmental permit.

B8 Foul water discharges

Foul water will be produced by site personnel using the site cabins. In particular the: toilet facilities; kitchens; canteen; and showers.

The permanent foul discharge from Cilfor is expected to be discharged to a Cess Pit. The permanent foul discharge from Garth has been removed from the HTUK scope of work.

The temporary foul discharge from Garth will be treated on site using a package sewage treatment plant and discharged to surface water under the terms of an NRW water discharge consent. Pre-treatment of some foul water streams may be feasible. The use of grease traps in canteen areas will reduce fat blockage risks. The separate collection of showering discharge water may enable is reuse for concrete wash water.

During construction small sewage volumes such as those generated at Cilfor site will be tankered off site for treatment at suitably permitted sites elsewhere.

B9 Pollution Prevention

Specific methods for preventing pollution from oil and other contaminants

The generator compound will include a bunded concrete pad containing bunded fuel tanks. A minimum distance of 10m will be maintained between the generator compound and the water receptors.

Pollution Prevention Guidelines (PPGs) produced by the Environment Agency in 2007 describe good practice water pollution prevention measures. Although the PPGs have since been withdrawn they are still a useful source of guidance. Table B7 summarises some PPGs relevant to the Scheme's construction.

Table B9 Key Pollution Prevention Guidance

PPG 1: Understanding your environmental responsibilities – good environmental practices	
Comment	**How could this be addressed on site?**
Drain rainwater from premises to reduce flood risk	Surface will be drained via attenuation lagoons to slow discharge flow rate and collect surface water for reuse of site.
Consider what materials have been delivered collected or stored on site.	Record materials on site. Control of Substances Hazardous to Health Regulations (COSHH) assessments carried out. Materials to be stored, handled and disposed of in accordance with COSHH. Provide suitable storage away from drains or water courses and protect against fluvial flooding. Keep materials secure on site to reduce the risk of accidental damage, vandalism, arson or theft. Inspect storage areas and containers regularly to make sure a good condition is maintained.
Plant washing can produce high volumes of silt. Reduce silt pollution.	As in PPG13 Vehicle washing and cleaning, locate such facilities as least 10m away from water course or drains n site. Designated area with either isolated drainage settlement tanks or sealed system.
Excavation can cause silt pollution and potential contamination of water receptors.	A contaminated land assessment has been conducted as part of the Ground Investigation Report to assess if any potential contaminants are present on site. Additional checks during excavation will identify any unexpected contamination. Silty water to be allowed to settle out before disposal through the use of lagoons. However the use of lagoons is dependent on the volume silt produced and where appropriate settling /inspection tanks will be utilised.

PPG6: Working at construction and demolition sites	
Control of vehicular traffic to reduce pollution risk	Vehicle to be limited to designated routes, wheel washes, bio-security.
Provide protection for vulnerable drains	Bunds and oil/diesel traps to be provided where applicable in order to mitigate against impacts on water quality of nearby water courses. 10m buffer to be used where practicable.
PPG22: Dealing with Spills	
Provide measures for dealing with spillages.	Standard procedure would be outline in a pollution prevention and control plan as a contractual requirement to ensure that all staff are aware in order to reduce the severity of spills should they occur. All incidences would be reported. Spill kits would be provided at relevant locations across the site. Staff would be mad aware of these.

Compound drainage will pass through oil water separators before discharging in the onsite treatment lagoons. The refuelling procedure requires that fuel transfers be only undertaken within designated fuel transfer areas. The principal fuelling area at Garth site will incorporate a bunded impermeable hardstanding draining via a fuel oil interceptor. The drainage from the fuel oil interceptor should incorporate an isolation valve to enable the refuelling area to be sealed off. This will prevent pollutants in the refuelling area reaching a sensitive receptors via the site's wider drainage system.

Concrete for the construction of the bases to the launch and reception shafts will only be laid following the suitable preparation of the ground surface and temporary shuttering will be use to contain potential leaks.

Designated areas for washing out concrete lorries will be constructed with impermeable liners to protect the soil and groundwater. Contaminated wash water will be tankered off site for disposal at a licenced facility to prevent adverse effects on the water quality of surface water receptor in the study area.

Visual inspections of key water resources within the application boundary would be undertaken by suitable staff members at suitable frequencies as co-ordinated by HUK to identify issues that may affect the water quality of surface water receptors and therefore require remediation.

Methods for preventing pollution from sediment during water abstraction

Abstraction of water from the estuary using centrifugal pumps in the estuary will risk loosening bed sediments. This has the potential to adversely affect water quality in the estuary and reduce the quality of the water abstracted.

To reduce this impact of the centrifugal pumps used for water abstraction the pumps will be mounted in cages to keep the pump off the sediment bed. This will avoid pulling sediment into the pumps and contaminating the water abstracted

Methods for preventing pollution from waste and spoil

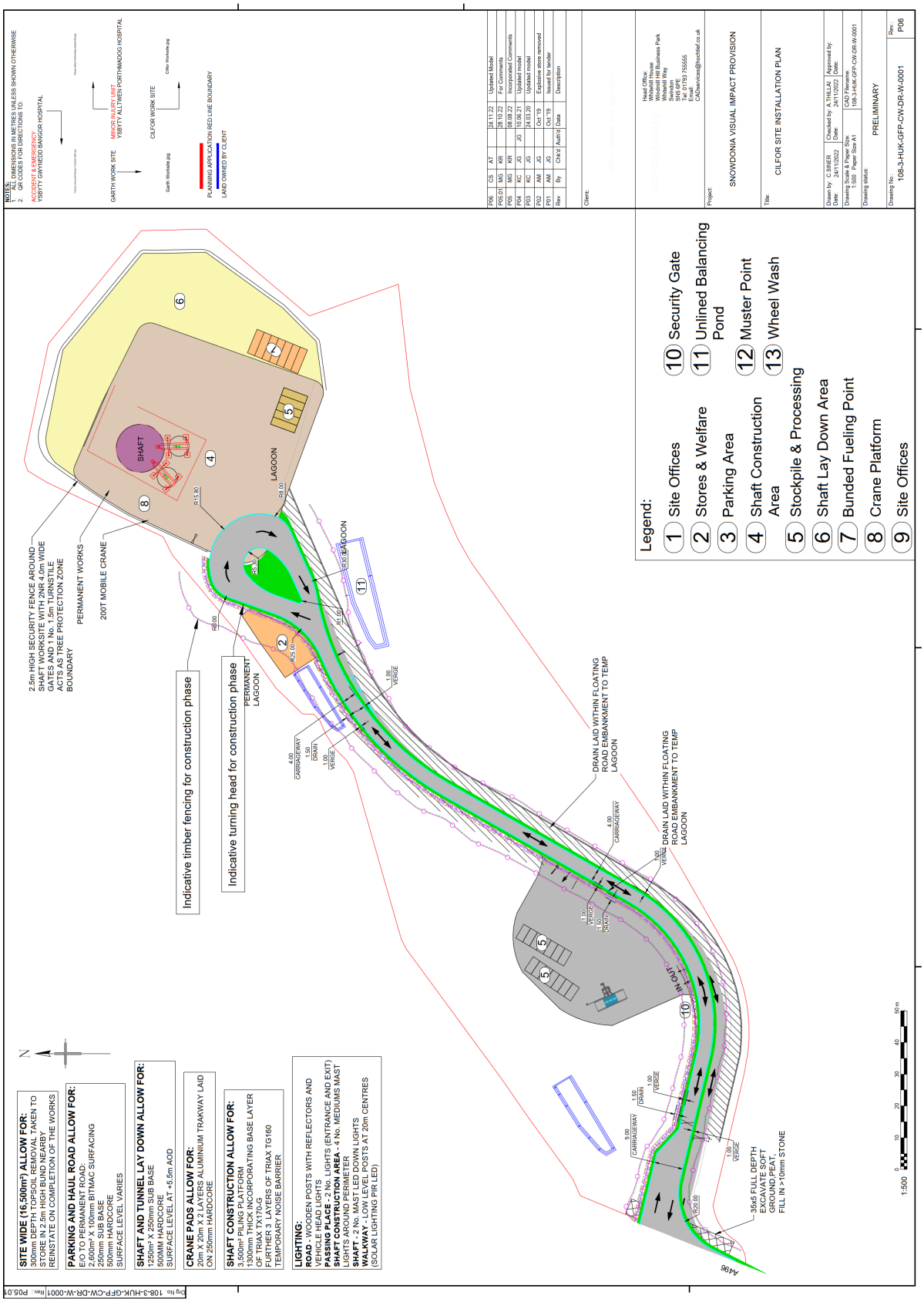
All materials stored on site would be recorded and safety requirements for the use and management of materials would been overseen by HUK and information with work staff. All storge would be in accordance with COSHH.

Suitable storage away from drains or water courses would be provided on site. All materials including spoil would be kept secure.

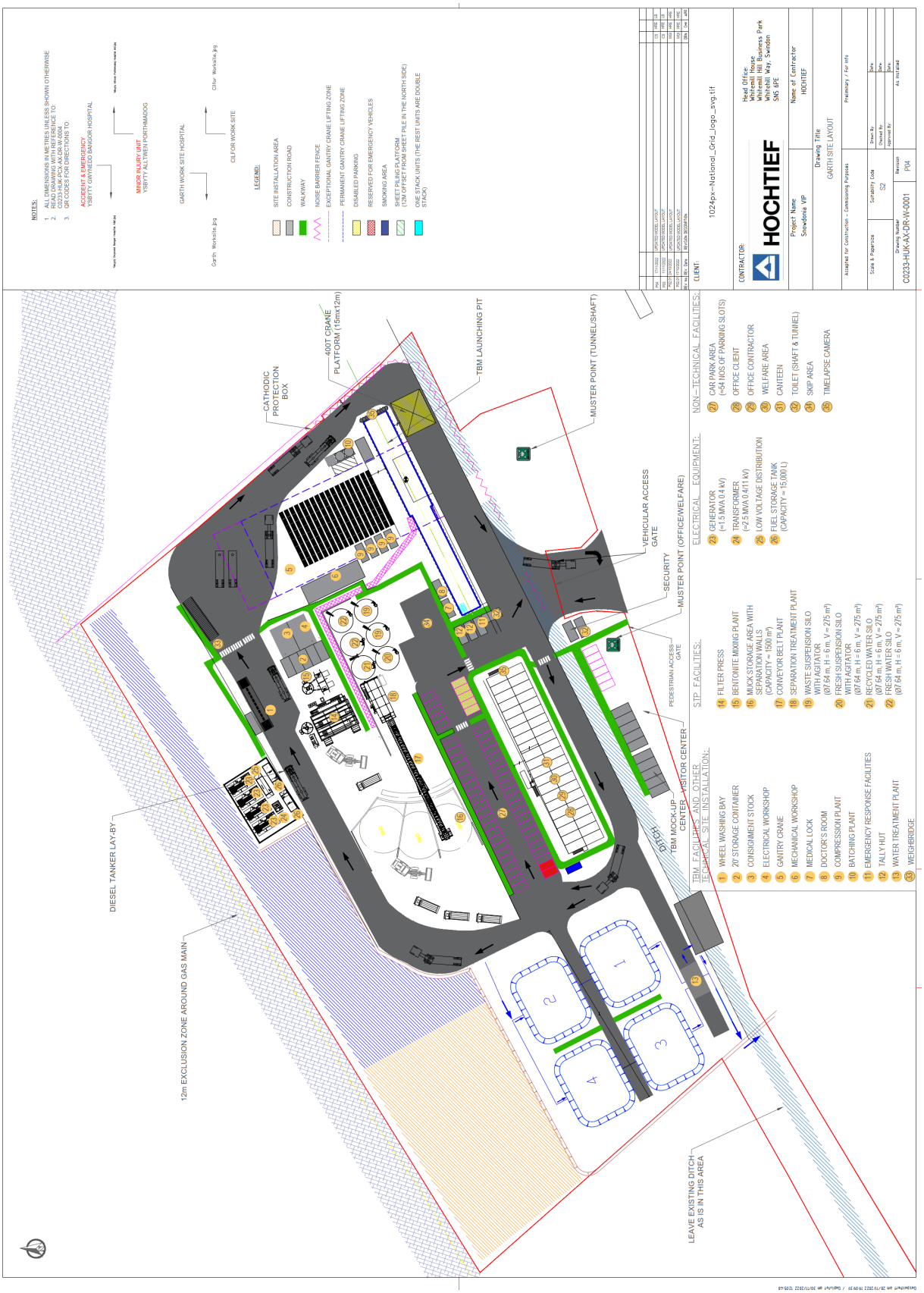
All waste containers are required to be maintained in good condition to prevent the escape of waste and the ingress of water which could cause contamination of nearby receptors of the water environment. HUK will undertake routine checks to evaluate the integrity of the storage containers.

The construction of the tunnel drive and reception pits will generate large volumes of spoil arisings in addition to spoil slurry. Settlement lagoons will be used to control surface water run-off and the construction of low level bunds around the boundary of the scheme spoil sediments would be prevented from reaching the nearby water receptors.

Appendix C Proposed Site Layout Drawings

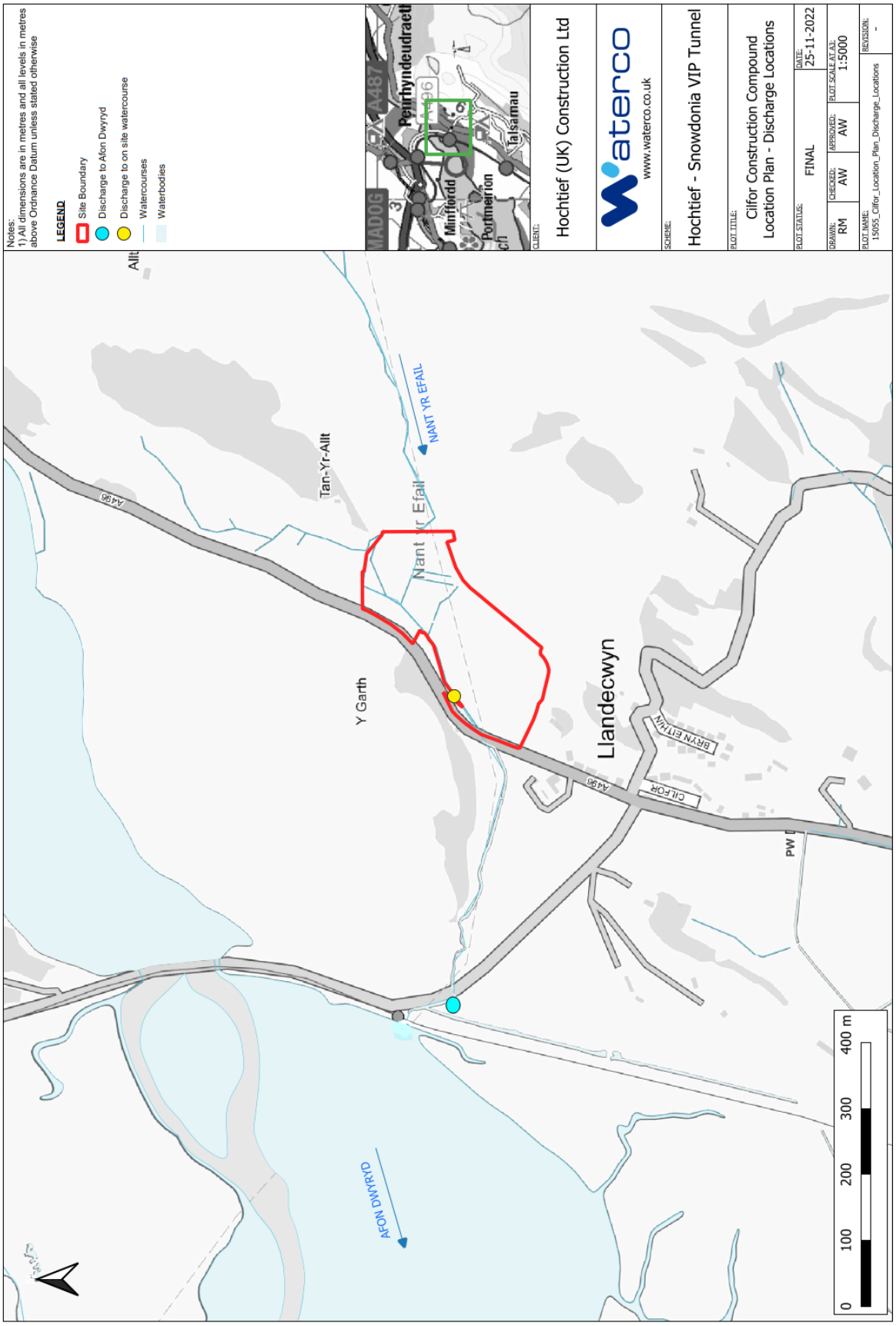


Proposed Cilfor Site Layout



Proposed Garth Site Layout

Appendix D Location of monitoring points and designated access routes


Notes:
1) All dimensions are in metres and all levels in metres above Ordnance Datum unless stated otherwise
LEGEND
Site Boundary
Discharge to Afon Dwyryd
Discharge to on site watercourse
Watercourses
Waterbodies
Penrhyndeudraeth
Minffordd
Portmeirion
Talsarnau
A487
A496
MAD06
CLIENT: Hochtief (UK) Construction Ltd
waterco
www.waterco.co.uk
SCHEME: Hochtief - Snowdonia VIP Tunnel
PLOT TITLE: Cilfor Construction Compound Location Plan - Discharge Locations
PLOT STATUS: FINAL
DATE: 25-11-2022
DRAWN: RM
CHECKED: AW
APPROVED: AW
PLOT SCALE AT A3: 1:5000
REVISION: -
PLOT NAME: 15055_Cilfor_Location_Plan_Discharge_Locations
Tan-Yr-Allt
NANT YR EFAIL
Nant Yr Efail
Y Garth
Llandecwyn
BRYN EITHIN
CILFOR
AFON DWYRYD
0 100 200 300 400 m
CONTAINS OS DATA © CROWN COPYRIGHT (2022)
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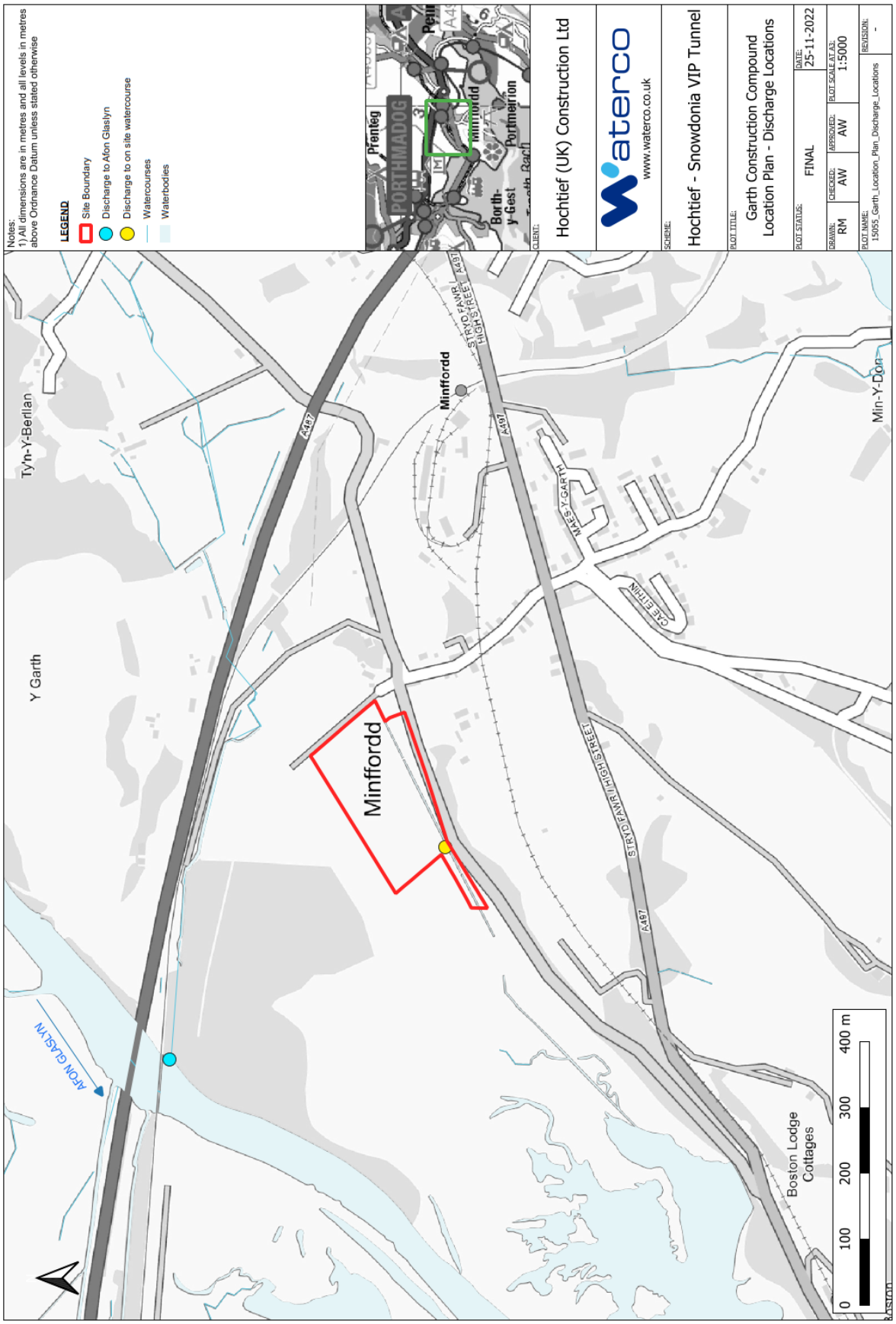
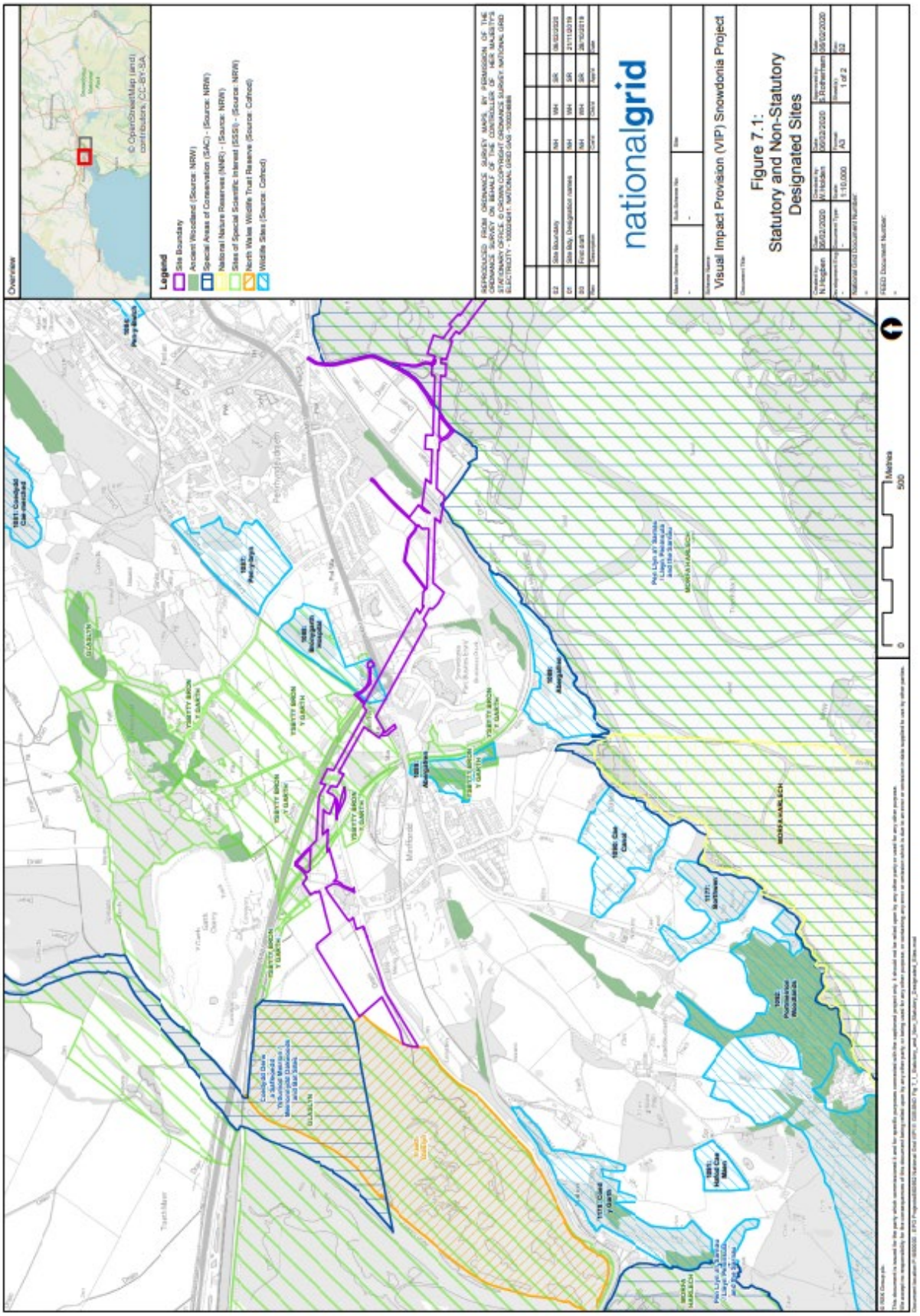
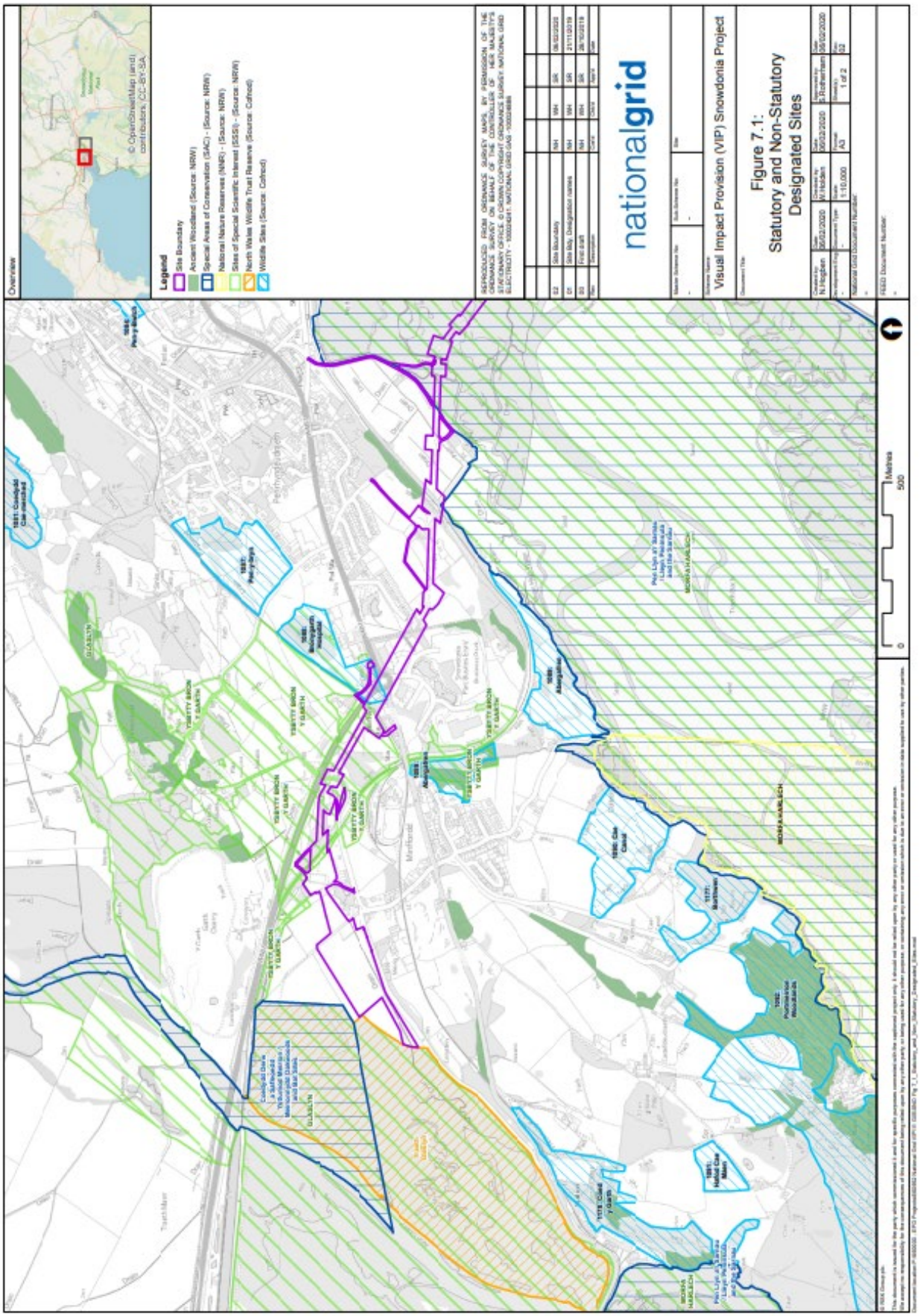


Appendix E Location of Statutory and Non-Statutory Designated Sites


Overview
Legend
Site Boundary
Ancient Woodland (Source: NRW)
Special Areas of Conservation (SAC) - (Source: NRW)
National Nature Reserves (NNR) - (Source: NRW)
Sites of Special Scientific Interest (SSSI) - (Source: NRW)
North Wales Wildlife Trust Reserve (Source: Cofnod)
Wildlife Sites (Source: Cofnod)
nationalgrid
Visual Impact Provision (VIP) Snowdonia Project
Figure 7.1:
Statutory and Non-Statutory Designated Sites
Metres
500
0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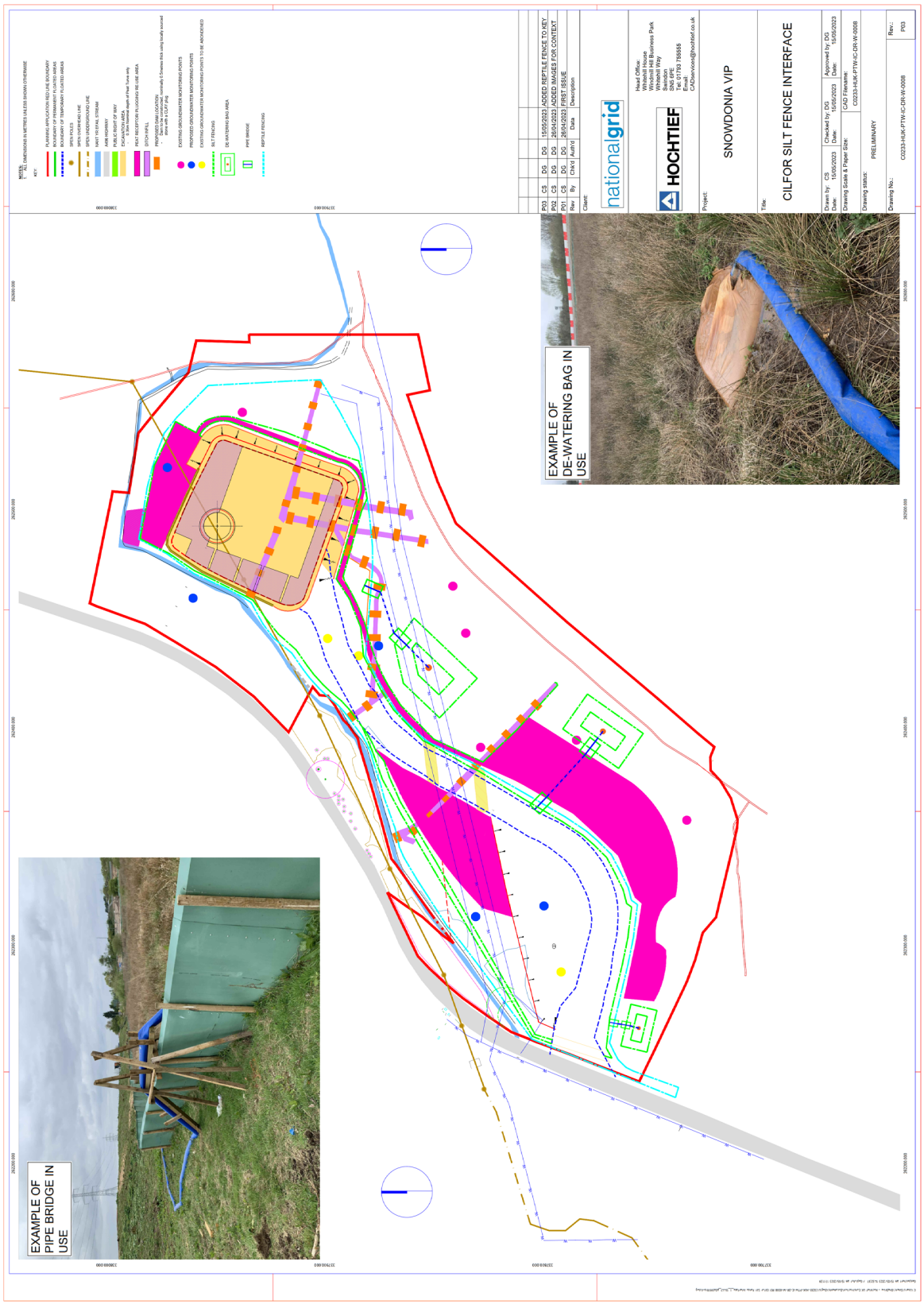
Wildlife Sites (Source: Cofnod)
nationalgrid
Visual Impact Provision (VIP) Snowdonia Project
Figure 7.1:
Statutory and Non-Statutory Designated Sites
Metres
500
0

Appendix F Silt fence location drawing



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