HORIZON
NUCLEAR POWER

WYLFA NEWYDD

ENERGY WORKING FOR BRITAIN

Wylfa Newydd Project

6.4.33 ES Volume D - WNDA Development App D8-8 - Summary of preliminary design for construction surface water drainage

PINS Reference Number: EN010007

Application Reference Number: 6.4.33

June 2018

Revision 1.0

Regulation Number: 5(2)(a)

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Horizon Internal DCRM Number: WN0902-JAC-PAC-APP-00071

[This page is intentionally blank]

Wylfa Newydd Power Station

Bulk Earthworks & Drainage: Summary of Preliminary Design for Construction Surface Water Drainage

Horizon Nuclear Power

Reference: 5151821-301-005

06 February 2018

Table of contents

Chapter / Pages

Tables

Figures

1. Introduction

This report has been prepared as a technical summary which outlines the preliminary design for the proposed surface water drainage system and a concept drainage design for the management of surface water in the landscaped areas post construction for the Wylfa Newydd Development Area (WNDA). A description of the proposed drainage system and related mitigation measures (particularly focussed upon the Construction Phase) will be provided together with an overview of catchments on the WNDA and a summary of discharges proposed to the aquatic environment. This section of the report outlines the proposed drainage system, whilst Section 2 presents catchment analysis to refine the proposed sediment or total suspended solids (TSS)[1] limits for each catchment. Section 3 sets out recommendations for future work.

1.1. Wylfa Newydd Development Area

The WNDA is approximately 406 hectares (ha) in size and is located on the Wylfa peninsula, between the bays of Cemlyn and Cemaes on the northern coastline of the Isle of Anglesey, North Wales. The WNDA, in its current form, is predominantly greenfield agricultural land and is sited on an area of glacial till, described as comprising clays, silts, sands and gravels, with metamorphic bedrock. The most predominant land use within the catchments has been identified as pastoral farming.

There are five existing surface water catchments located within the WNDA, these are listed as follows:

- Tre'r Gof Catchment
- Afon Cafnan Catchment
- Cemlyn Catchment
- Cemaes Catchment, and,
- Power Station catchment.

Catchment areas and notable features such as Sites of Special Scientific Interest (SSSI) are provided in table 1-1; table 1-2 provides a comparison between the existing and proposed catchment areas within the WNDA. It should be noted that discharge references quoted in this report may be subject to future change or variation to suit project requirements.

[1] "Total suspended solids" is a measure of particles suspended in the water column and is used as an indicator of water quality. Changes to natural levels of TSS (i.e. large increases or large decreases) can impact the ecology of aquatic environments.

Table 1-1 Catchment Summary

Catchment	Area (km^2)	Watercourses and designated areas (within the WNDA)	Existing point of discharge
Tre'r Gof	1.0	Catchment drains into the Tre'r Gof SSSI	Irish Sea via culvert and outfall at Porth Wylfa
Afon Cafnan	9.9	Afon Cafnan Nant Caerdegog Isaf Cae Gwyn SSSI	Irish Sea at Porth-y-Felin
Cemlyn	2.3	Nant Cemlyn (Cemlyn Bay SSSI and SAC[1] and Anglesey Terns SPA[2])	Cemlyn Lagoon at Cemlyn Bay
Cemaes	3.0	Nant Cemaes Foel Fawr	Cemaes Bay via culvert
Power Station	0.3	Nant Porth-y-pistyll	Porth-y-pistyll

1 – Special Area of Conservation
2 – Special Protected Area

It should be noted that the Cemlyn Bay SSSI and Special Area of Conservation (SAC) and Anglesey Terns Special Protected Area (SPA) are not within the WNDA area. These catchments are included as E1 discharges into the Nant Cemlyn, which flows into Cemlyn Lagoon. All catchments discharge into North Anglesey Marine Candidate Special Area of Conservation (cSAC) and Anglesey Terns SPA, both of which encompass the entire coastline adjacent to the WNDA.

Table 1-2 Catchment Area Comparison

Mound	Outfall reference	Existing permeable area which is overlapped by new catchment area (ha)	Proposed catchment area (ha)	Difference in contributing area (ha)
A	A1	18.298	19.140	+0.842
A	A2	2.752	4.050	+1.298
A	A3	6.220	9.400	+3.180
B	B1	8.016	39.520	+31.504
C	C1	10.800	14.540	+3.740
D	D1	3.461	4.390	+0.929
D	D2	8.770	8.770	Nil
E	E1	13.418	14.580	+1.162
E	E2	14.675	14.675	Nil
Platform Area	PA PB PC	37.41	71.620	+34.210
	Totals	123.82	200.685	+76.865

1.2. Proposed Drainage System

1.2.1. Drainage Principles

The existing land use within the WNDA is predominantly agricultural. During storm events, rainfall can either infiltrate the ground and fill pore spaces in the soil / rock, or run across the surface (commonly referred to as runoff). The rate at which runoff will occur is typically influenced by the slope of the landform, or catchment, and/or the type of surface over which water will flow across. For example, the runoff rate from a steeply sloped catchment or an artificial (and impermeable) paved surface will be significantly greater than that generated from a shallow slope or a vegetated (and permeable) surface. The construction of the proposed landform within the WNDA will result in earthwork mounds that are both higher and steeper than they are currently and may also be formed using soils that have less space within them to allow for a flow of water through them. As a result, higher rates of runoff from the development are anticipated and these will need to be managed alongside potential changes to the water quality in receiving watercourses and/or water bodies as a result of construction activities.

Planning Policy Wales[2] and related supplementary technical advice[3] recommends how flood risk issues should be determined and action that should be taken through development plans to mitigate flood risk. The proposed drainage system that will serve the WNDA landscaped areas has been designed in line with current planning policy so as not to increase local flood risk and will be achieved through the adoption of industry good practice that promotes a natural approach to managing drainage in and around developments. Sustainable Drainage Systems (SuDS) work by slowing and holding back the water that runs off from a site whilst allowing natural processes to break down pollutants and/or remove sediment. The proposed drainage system will be sized so that it can manage increased flows from extreme storm events to ensure that flood risks are managed to an acceptable level throughout the lifetime of the development.

High concentrations of suspended solids can lower water quality. Any organic matter in the solid material (particulate or dissolved) may reduce dissolved oxygen through reduction reactions or microbial action. Monitoring data suggests that there is an existing occurrence within the WDNA of elevated suspended solids from both natural and artificial sources that will need to be managed. During the Construction Phase of the earthwork mounds it is likely that, under rainfall onto unvegetated slopes, fine soil particles will become suspended and flushed into the drainage system. The proposed SuDS system will be designed to remove the majority of suspended sediments that are generated because of construction activities to meet permitted limits stipulated by Natural Resources Wales (NRW). The system is both flexible and adaptable to ensure that flows can be routed, managed and treated to suit construction activity whilst also replicating baseline conditions as far as practicable. To ensure that there are sufficient safeguards in place to manage risks across a range of storm events additional measures have been incorporated into the drainage system. These will include soil management techniques, the use of artificial barriers to capture/trap sediments and only where considered necessary a system of dosing, i.e. using coagulants or flocculants to reduce suspended sediment concentrations. These artificial measures would be kept in place until vegetation on the mounds matures and the risk from suspended solids decreases to an acceptable level. The following section discusses and further develops these principles.

1.2.2. Drainage Design

As stated in Section 1.1 the proposed development will alter existing drainage catchment characteristics through the construction of platforms to accommodate the new Power Station, associated infrastructure and earthwork mounds (that will be formed using material excavated during construction of the platforms). A total of five earthwork mounds will be located on the WNDA.

The surface water management proposals to be implemented aim to maintain an overall surface water balance within existing drainage catchments with key focus on minimising impacts to the SSSIs and European designated sites located within, or close to, the development area. Flows and related volumes have been derived using hydraulic modelling software used to design the drainage system. Alongside maintaining the surface water balance within the WNDA, there is also the requirement to maintain water quality with consideration being given to TSS, nitrates and phosphates.

---

[2] Planning Policy Wales: Edition 9 November 2016: Welsh Assembly Government

[3] Technical Advice Note 15 (TAN15): Development & Flood Risk:2004: Welsh Assembly Government

Exposed topsoil during construction and later from the newly formed landscape mounds could potentially increase sediment levels in surface water runoff. Surface water runoff carrying sediment could also be a source of nutrients, i.e. nitrates and phosphates, and other substances that may potentially effect water quality (further discussion is provided in Sections 2.3 and 2.4).

A flexible multi-stage treatment solution has been designed using good practice soil management, SuDS and polyelectrolyte coagulant dosing. A high level summary of the proposed treatment train is presented in figure 1-1 and is discussed further in Sections 1.2.3, 1.2.4 and 3.2. Drainage drawings will include details of drainage features (ditches, swales, ponds, outfall details).

This multi-stage approach:

- Uses surface water runoff as a resource
- Manages rainwater close to where it falls
- Manages runoff on the surface
- Promotes evapotranspiration
- Slows and stores runoff to mimic natural runoff characteristics
- Reduces contamination of runoff through pollution prevention and controlling runoff at source
- Treats runoff to reduce the risk of construction contaminants causing environmental pollution
- Provides a flexible and adaptable system capable of replicating, as far as, practicable baseline conditions within the existing drainage catchments

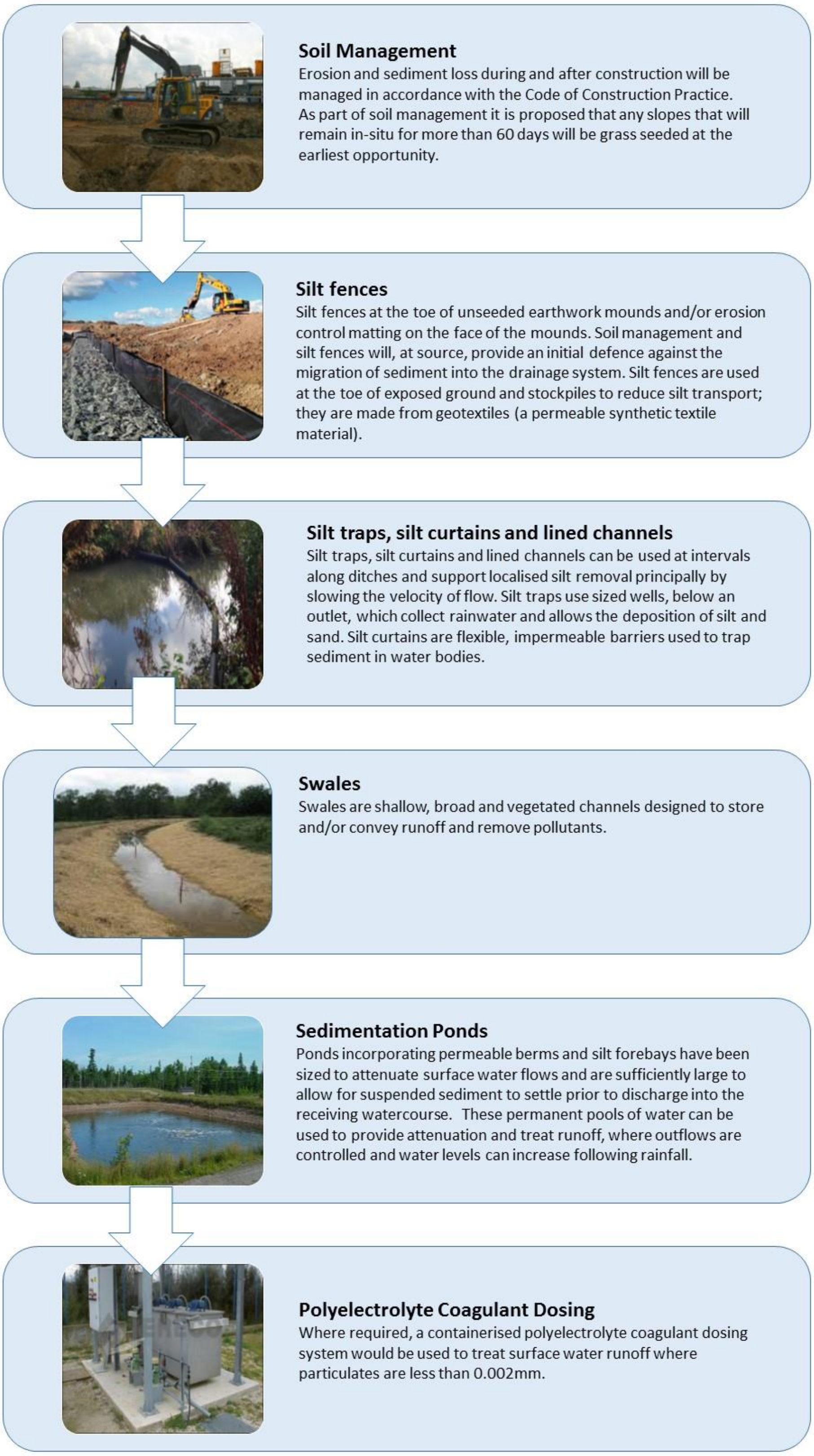

Figure 1-1 Multi-stage treatment summary

As shown in figure 1-1 above, the proposed drainage system (that includes a polyelectrolyte coagulant dosing system) will be both flexible and adaptable. This has been selected for the following key reasons.

1) To robustly protect against peaky and flashy TSS concentrations in the surface flow from the mounds.
2) To adequately treat and remove finer particles in the flow, such as clays and silts.
3) To robustly ensure that TSS limits are met whilst taking consideration of existing baseline conditions and the variability of the mound environment throughout its construction.

At this stage, a “family based” approach has been taken prior to permit issue. Further details on the polyelectrolytes will be available during the determination period as part of a developed design package. Final details will be provided during the detailed design phase.

During construction, the TSS concentration that will be generated within the surface flow from the mounds is, at this stage, largely unknown. For the majority of a mound’s life TSS concentrations in surface flow are expected to be low and this consequently supports the use of a natural SuDS design as mitigation. Notwithstanding this, there will be occurrences where TSS concentrations in the surface flow could peak considerably. Several factors will affect concentrations, such as storm intensities, mound surfacing make-up (the material used within it), mound surfacing finish (whether it is grassed or bare earth) and the construction activities taking place on the mound at any given time. Data for the baseline environment indicates that drainage catchments are characterised as flashy whilst also highlighting that TSS concentrations are typically low. This aspect is discussed in later sections but does highlight the need to consider and protect against high concentrations.

During or immediately following periods of rainfall the drainage system will operate in a natural way and often without the need for coagulant dosing. A SuDS system can be used to remove sediment from flows, however the effectiveness of the treatment process is reduced when fine soil particles are mobilised and raises the prospect of these particles passing through the system largely untreated. However, where TSS concentrations increase because of construction activity, there will be occurrences that would rely on a polyectrolyte dosing system to improve the level of treatment prior to discharge into the receiving watercourse. Whilst these occurrences are expected to be infrequent in nature, and of short duration, they cannot be ignored.

Where monitoring data indicates that TSS concentrations will be raised and have the potential to exceed consented limits then the dosing system will automatically be engaged. Dosing of coagulant will be undertaken proportional to flow to achieve the consented TSS limit; once sediment concentrations (only because of construction activity) have been shown to reduce to below the consented limit the dosing system would then cease to operate. It should also be noted that in the vast majority of storms, the ‘first flush’ contains the initial surface water of the rainstorm and transports the highest concentrations of the pollutants, including TSS. Once this ‘first flush’ has passed, it is likely that the natural SuDS system will suffice.

Existing watercourses within the WNDA will be fenced off to prevent the deterioration of riverbanks by livestock which in turn will result in lower sediment levels to the watercourses and could contribute to an overall improvement in the water quality of the existing environment.

1.2.3. Sustainable Drainage System Design

SuDS work by mimicking natural drainage systems and provides a method that can decrease the peak rate of surface water runoff, and hence reduce the risk of flooding. In addition, these features can help to control surface water runoff quality and provide biodiversity benefits. Biodiversity benefits can include provision of habitats and diversifying landscapes.

The associated ponds have been sized so that the permanent pool volume contains 4 times the design treatment volume to provide sufficient settling time for sediment. As an alternative option, for future design stages, the sedimentation pond sizes could be reduced if silt curtains are introduced within the ponds. The total pond volume shall be a combination of the permanent required treatment volume **plus** the attenuation volume requirements (noting that the attenuation sizes are relatively insignificant when compared with the required treatment volumes). Attenuation volumes have been calculated based on the 100 year + 20% climate change storm with a discharge rate limited to the 100 year greenfield runoff rate.

The design will capture the majority of sediments down to a particle size of approximately 0.002mm. Excavated material from the site will however include clay; clay particles are typically less than 0.002mm in size and as such a purely SuDS based system will not effectively remove these particles. Release of these fine particles in surface water runoff would typically be expected during construction activities and whilst mounds are not vegetated. Due to the nature of these particles, further treatment may be required using a polyelectrolyte coagulant dosing system which is discussed further in Section 1.2.4. Notwithstanding this the proposed SuDS system is considered both flexible and adaptable to be responsive to construction needs whilst continuing to offer protection to the downstream aquatic environment. The system is predominantly soft-engineered and as such means that it can be amended or adapted to respond to site conditions, for example the location and length of swales can be altered (to provide additional treatment volume) or the number of silt traps can be increased.

Each of the five mounds will have an associated drainage system and outfalls will discharge into the existing aquatic environment. Surface water runoff will be collected using a system of open ditches and swales. Where swales can be used, they will be constructed with a french drain[4] below to improve silt capture efficiency and capacity. The sedimentation ponds have been designed to receive runoff generated in a 1 in 100 year storm event with an additional 20% climate change factor.

Increased levels of sediment suspended within surface water runoff will be the main source of risk to watercourses during the Construction Phase and will remain so until vegetation becomes established and matures on earthwork mounds. The proposed drainage system will be of low maintenance, although sediment loads during the Construction Phase will influence the frequency of maintenance required. Regular inspection will be required to monitor sediment build-up that could have an adverse effect on the efficiency of the system. Notwithstanding this, the frequency of maintenance, including sediment removal requirements, will reduce over time as vegetation on the mounds becomes established and matures.

1.2.4. Polyelectrolyte Coagulant Dosing System

Additional mitigation, in the form of polyelectrolyte coagulant dosing is proposed alongside the SuDS system to provide further treatment of sediment within surface water run-off should this be required. At this stage, it is planned that dosing will only be used to respond to rapid increases in TSS concentrations from within the WNDA construction areas (the SuDS system will manage TSS at all other times). A containerised polyelectrolyte coagulant dosing system[5] will be established at each discharge location to treat surface water runoff particulates less than 0.002mm because of construction activity and based on the particular TSS limit imposed. Treatment by dosing can, if required, reduce TSS concentrations to 25mg/l, although it should be recognised that these lower limits are achieved through larger volumes of coagulant. A flow proportional system of dosing is proposed, i.e. dosing will be directly proportional to the incoming flow. This method of treatment is more efficient than other treatment methods that are available; an example of this is a “floc-block” system, which uses a solid block of a flocculant continually releasing small amounts into the water.

The dosing units would be installed between the SuDS sedimentation pond outfalls and the eventual discharge point. Intake to the unit would be controlled either using a weir or penstock gate and/ or by pumping. Flow enters a mixer tank where polyelectrolyte dosing takes place prior to discharge into the clarifier tank (where sediment is treated).

Each dosing unit will have a limiting capacity; a typical unit has a capacity of 200m^3/hr (55l/s). Multiple units are expected to be required at each discharge point with the estimated number of units required to treat flows generated during a 1 in 2 year storm event at each discharge point being stated in Section 2.2. The 1 in 2 year storm event has been selected because the lower return period storm events have the higher probability of occurrence but also recognises the practical limitations of providing further units to treat runoff (this is a reasonable balance between the provision of treatment to limit sediments against the number of dosing units required). Notwithstanding this the proposed sedimentation ponds have been sized to provide volume for storms up to and including the 1 in 100 year plus climate change storm event; the system therefore has capacity to treat runoff associated with the higher return period events.

[4] French drains temporarily store runoff below the surface in a shallow trench filled with stone/ gravel. They provide attenuation, conveyance and treatment (via filtration).
[5] The use of coagulant within contained mixing and settlement containers.

The following sets out the requirements for a typical single unit:

- Typical footprint for an installation with a 55l/s capacity unit is 15m x15m, to be sited on a compacted unbound surface.
- Power requirement (per unit): minimum 30kVA 415V three-phase supply
- Noise emissions:
    - Treatment unit: 70dB (excluding power generation)
    - Power generator (silenced and diesel operated): 70dB

Regular maintenance/ management of the dosing system will be required and activities would typically include checking of coagulant levels, desludging of sumps together with checks to pumps and pipelines, it is expected that this would be undertaken on a daily basis. As the dosing system is a proprietary asset the supplier will recommend their own maintenance requirements and as such the exact maintenance requirements cannot be confirmed at this stage. The frequency of maintenance will be sufficient to ensure an operable system but can only be confirmed once detailed design for it has been completed.

Polyelectrolytes are commonly used in water treatment to control and enhance the coagulation and flocculation of suspended particulate matter. Polyelectrolytes have been proposed in preference to a metal-based flocculant such as aluminium. The principal reason for this being that polyelectrolytes produce a lower quantity of waste than the metal-based flocculants.

A review of polyelectrolytes undertaken for the Environment Agency (WRc, 1996) found that the impact of polyelectrolytes on the aquatic environment is low due to the strong and irreversible sorption (or binding) to suspended and dissolved organic matter, losses due to hydrolysis and biodegradation (processes to breakdown substances) and a low potential to bioaccumulate (accumulation of substances within an organism). The study mainly focussed on impacts to a freshwater environment. The majority of proposed discharge locations within the WNDA outflow into a freshwater environment.

Impacts to brackish environments are not as widely studied as those to freshwater environments. However, in assessing the reasons given in the WRc report it is considered that any potential impact in a brackish environment would not greatly differ from those found in a freshwater body. For example, if additional binding in the brackish environment were to occur due to residue of polyelectrolytes, this would lead to some additional settlement of suspended solids in the immediate vicinity of the outfall and as such may be managed as part of the wider monitoring and mitigation of the system.

Under the proposed operational conditions with flow proportional polyelectrolyte dosing, it is very unlikely that there will be any notable concentrations of residual polyelectrolytes present in the effluents. Dosing is expected to be in the range of 0.1-1mg/l, thus any accidental releases or over-dosing of the polyelectrolyte would be in concentrations of less than 1mg/l. In addition, it is anticipated that the effects of any residual polyelectrolytes will be significantly reduced by losses due to sorption and degradation within the aquatic environment. Dilution would also reduce the concentration of any residual polyelectrolytes.

A well-maintained system will prevent unintentional discharges of polyelectrolytes to the aquatic environment. Accidental releases or over-dosing could be caused by inappropriate storage of coagulant or inadequate maintenance of the dosing units. As regular maintenance and best practice for material storage is proposed there is a low likelihood of occurrence. Furthermore, the risks on the aquatic environment, should releases occur, are expected to be minimal as the coagulant will bind with suspended solids in the receiving watercourse and become inert. It should also be noted that there are no proposals to store polyelectrolyte less than 10m from a watercourse.

Jar testing of various ionic strength polyelectrolytes has been undertaken. The results of the test indicated that there were no clear effects on the following parameters /substances (in comparison to tests where no polyelectrolyte had been added): alkalinity, biological oxygen demand, chloride, nitrate, potassium, sulphate, electrical conductivity and pH. Slight effects were observed on the following: calcium, magnesium, dissolved organic carbon and total organic carbon. The results of this test suggest a limited impact to the aquatic environment from polyelectrolyte dosing on site.

1.2.5. Post Construction Design

In terms of post-construction design, it is proposed that all completed mound slopes will be grassed / vegetated with the overall SuDS principle remaining unchanged, whereby ditches will remain connected to sedimentation ponds. Temporary measures such as silt fences, curtains etc. and dosing installations will be removed as vegetation becomes established and monitoring confirms its effectiveness.

2. Water quality

Available monitoring data had been used to inform a baseline assessment of a WNDA catchment wide TSS limit. Existing water quality data has been analysed for each catchment, which are expected to receive discharges from the drainage system and this is detailed in the Jacobs (2017) Assessment of Appropriate Suspended Sediment Concentrations for Water Discharge Location (60PO8083/HYD/REP/002 V1.2).

Long term water quality monitoring has included the following:

- Spot sampling at five sites since 2012 and expanded to 27 sites by 2014 across WNDA. This consists of monthly in-situ monitoring and quarterly laboratory analysis.
- One round of monitoring at eight locations around Tre'r Gof in February 2015, which was extended to monthly sampling between November 2015 and May 2016, and further extended to quarterly monitoring since May 2016.
- Monthly monitoring at accessible hydrological features around Cae Gwyn between November 2015 and May 2016, which was extended to quarterly monitoring since May 2016.
- Continuous water quality monitoring on Nant Cemlyn and Nant Caerdegog Isaf installed in May and July 2015 respectively.

The existing monitoring and proposed discharge locations are show in in figure 2-1 below whilst an overview of the drainage network is shown in figure 2-2 below. For more detailed drawings of the drainage network please refer to drawings 5151821-ATK-ZZ-XX-DR-D-0001 to 0012.

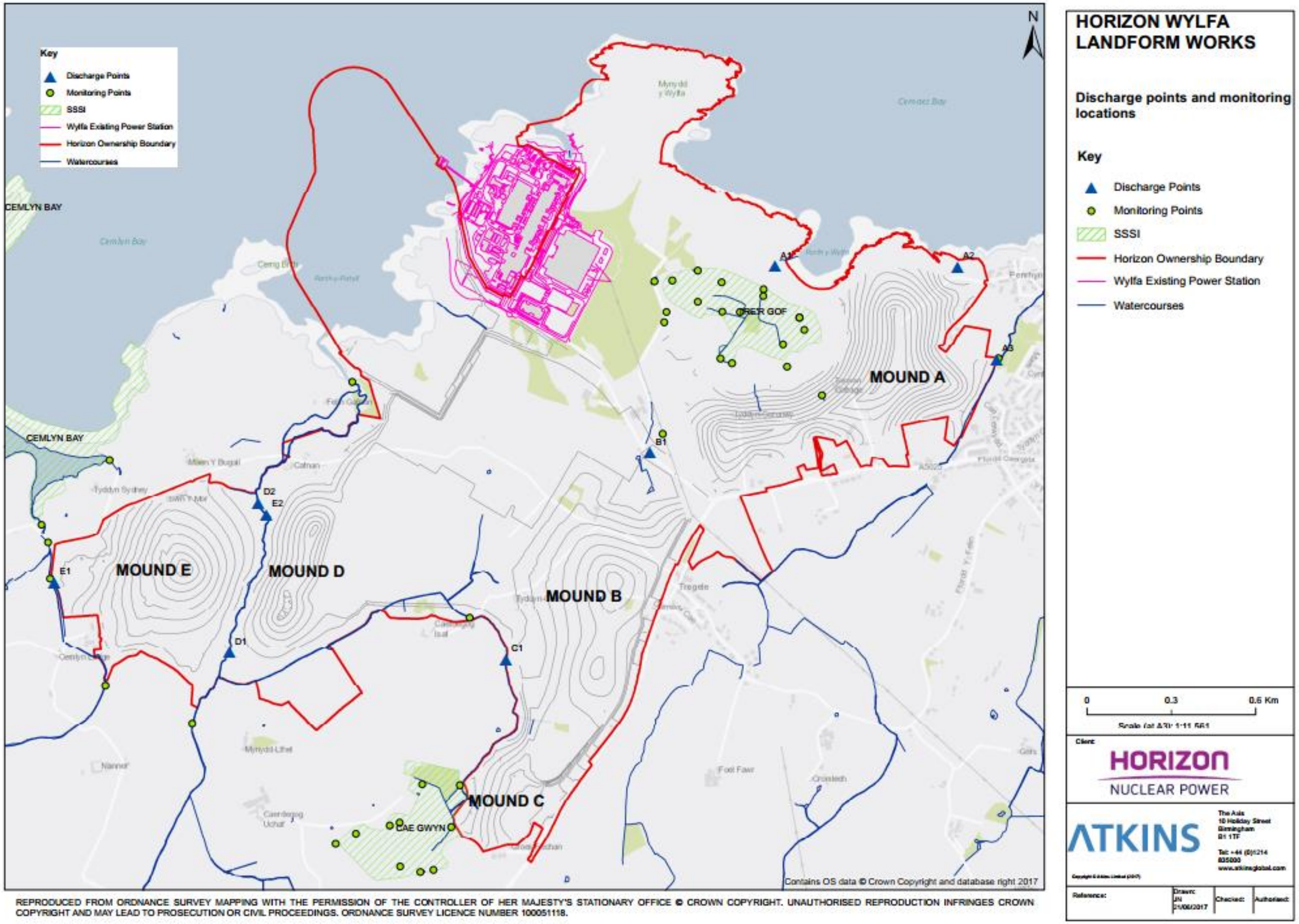

Figure 2-1 Existing monitoring and proposed discharge locations

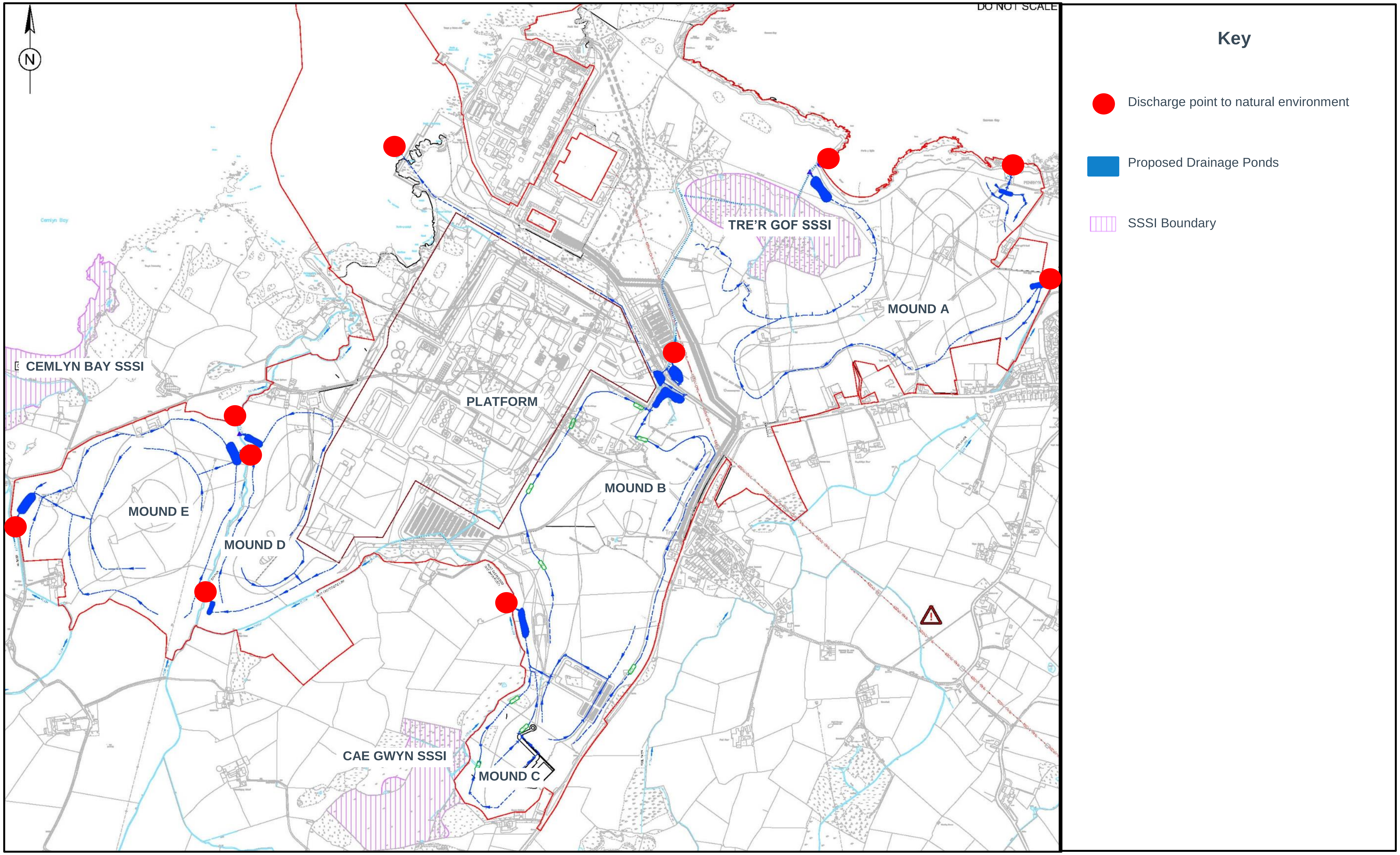

Figure 2-2 Surface Water Drainage Overview

In addition to water quality monitoring, flow and meteorological monitoring is also undertaken on site at regular intervals. Results from the flow data indicate flows in the surface waters are influenced by groundwater. The data also highlights the flashy nature of catchments within the WNDA, which results in natural exposure to high peaks of TSS and nutrients within watercourses. The monitoring of these parameters will continue to support detailed design and management of the drainage system during the Construction Phase. Relevant data has been used to understand catchment concentrations and loadings, in terms of TSS as part of this report only.

It should be noted that although the drainage design focusses on mitigating risks of elevated TSS in surface water runoff, there are further benefits to water quality in terms of nutrient management. As noted in Section 1.2, sediment can also be a source of nutrients and other determinands to surface waters. The treatment train can facilitate the retention of nutrients in vegetation and thus reduce the potential load discharged to receiving waters. Natural calcium and carbonate concentrations entering Tre'r Gof are also maintained through this drainage design.

The following sections provide a summary of the current proposed high-level limit for TSS and any required adjustments for individual catchments.

2.1. Total Suspended Solids Limit

When proposing a Total Suspended Solids (TSS) limit it is important to understand the varying conditions that the drainage system will experience. For example, some watercourses within the WNDA have been found to exhibit lower mean TSS concentrations whilst others exhibit higher levels, or fluctuate considerably within the TSS concentration ranges monitored.

A passive and natural SuDS system will provide a treatment reduction of TSS but cannot be relied upon to do so without supplementation by active systems. This is because the TSS input to the drainage system will vary based on the rainfall intensity, rainfall volume, the current condition of the mounds (seeded or unseeded) and/or any construction activities that may or may not be ongoing during, or before, any given storm event. The effectiveness of a natural SuDS system against finer clay and silt particles is also a consideration that needs to be made, as stated in Section 1.2.3. Notwithstanding this, once each of the mounds have been seeded, and construction activities completed, the TSS input to the drainage system will lower considerably. The TSS limits proposed herein relate to the Construction Phase of the project only and in particular the Construction Phase of each of the mounds.

An assessment of each mound and catchment, using baseline data, has been undertaken to derive and propose a catchment-based limit for each discharge location. The findings of the assessment initially proposed a single, overarching, and upper TSS limit of 70 mg/l for all discharges across the WNDA, as a first pass that that could be reached by passive treatment. An upper limit of 70mg/l is enveloped and conservative, and can be seen to be within the same bounds as the existing catchment characteristics. It should be noted that the TSS concentrations that will be discharged from the proposed drainage systems, during lower return period events, which will be the predominant rainfall, are expected to be less than the 70mg/l proposed limit but greater than or equal to 25mg/l. The actual range of discharge concentrations will be determined during the detailed design stage.

An assessment of appropriate suspended solids concentrations for water discharge locations has been undertaken, taking further consideration of catchment monitoring has been undertaken by Jacobs (2017), these are discussed in the following section. The system will be designed and managed to meet the conditions of these limits which have been set for the discharge permit application.

2.2. Catchment Based Water Quality Limits

A total of nine discharges from the five mounds are currently planned within the WNDA, the following sections provide a summary of each of the discharges. For details of catchment water quality conditions refer to Table 6 in the Jacobs (2017) Assessment of Appropriate Suspended Sediment Concentrations for Water Discharge Location (60PO8083/HYD/REP/002 V1.2).

2.2.1. Mound A

Mound A drainage will discharge at three locations as shown in figure 2-2.

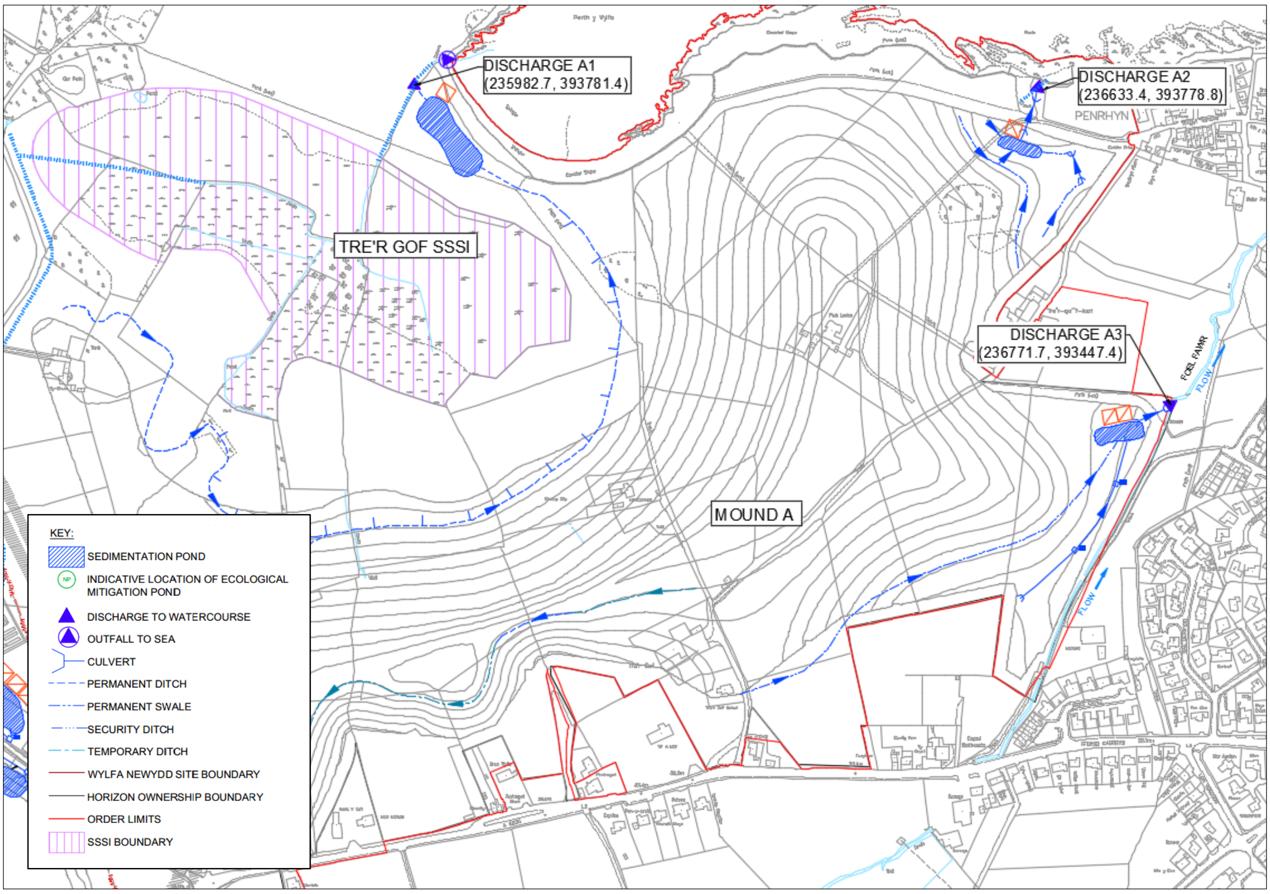

Figure 2-3 Mound A Site Location

2.2.1.1. Discharge A1

Mound A is in close vicinity to the Tre'r Gof SSSI, see figure 2-3. All associated earthworks on the northern and western side of Mound A are planned to be completed within the first earthworks season of the construction programme or full year. It is likely that would cover a period of around three months. This timescale is proposed in order to mitigate against potential impacts to the SSSI by working within the drier months and assumes favourable weather conditions. The proposals include reinstatement of topsoil and re-establishment of vegetation.

There are known existing springs and seeps that feed the Tre'r Gof SSSI; the basis of the drainage design at Mound A is to ensure that the springs and seeps continue to contribute to the existing flow regime. A new ditch is proposed at the toe of Mound A for drainage and to support the removal of sediment. It is recognised that this proposal would intercept runoff that in the existing situation would normally be directed into the SSSI. To ensure that the existing runoff regime is, as far as practicable, maintained the design of the ditch will incorporate a series of suitable connections at 50m intervals, set just above or at ditch bed level. The upstream end of each connection would be designed to incorporate stop logs to manage flows (and sediment) into the pipe; the number of stop logs could be adjusted during operation, as required, to suit site conditions and/or TSS related risks. At the downstream end of each connection, flows would be passed through a silt trap prior to dispersal across the vegetated buffer strip (existing vegetation would also support sediment removal prior to discharging into the SSSI).

A crushed rock drainage blanket would be constructed below Mound A using either imported fill or material generated from the deep excavation operations. It is expected that this drainage blanket will be the primary contributor of water into the SSSI. Material used to form the blanket would be inert and is not expected to have any impact on surface water quality. The function of the drainage blanket is to enable flows from springs and seeps to make their way into the Tre'r Gof SSSI catchment. The schematic diagram presented in figure 2-4 illustrates how, as far as practicable, the existing flow regime will be maintained.

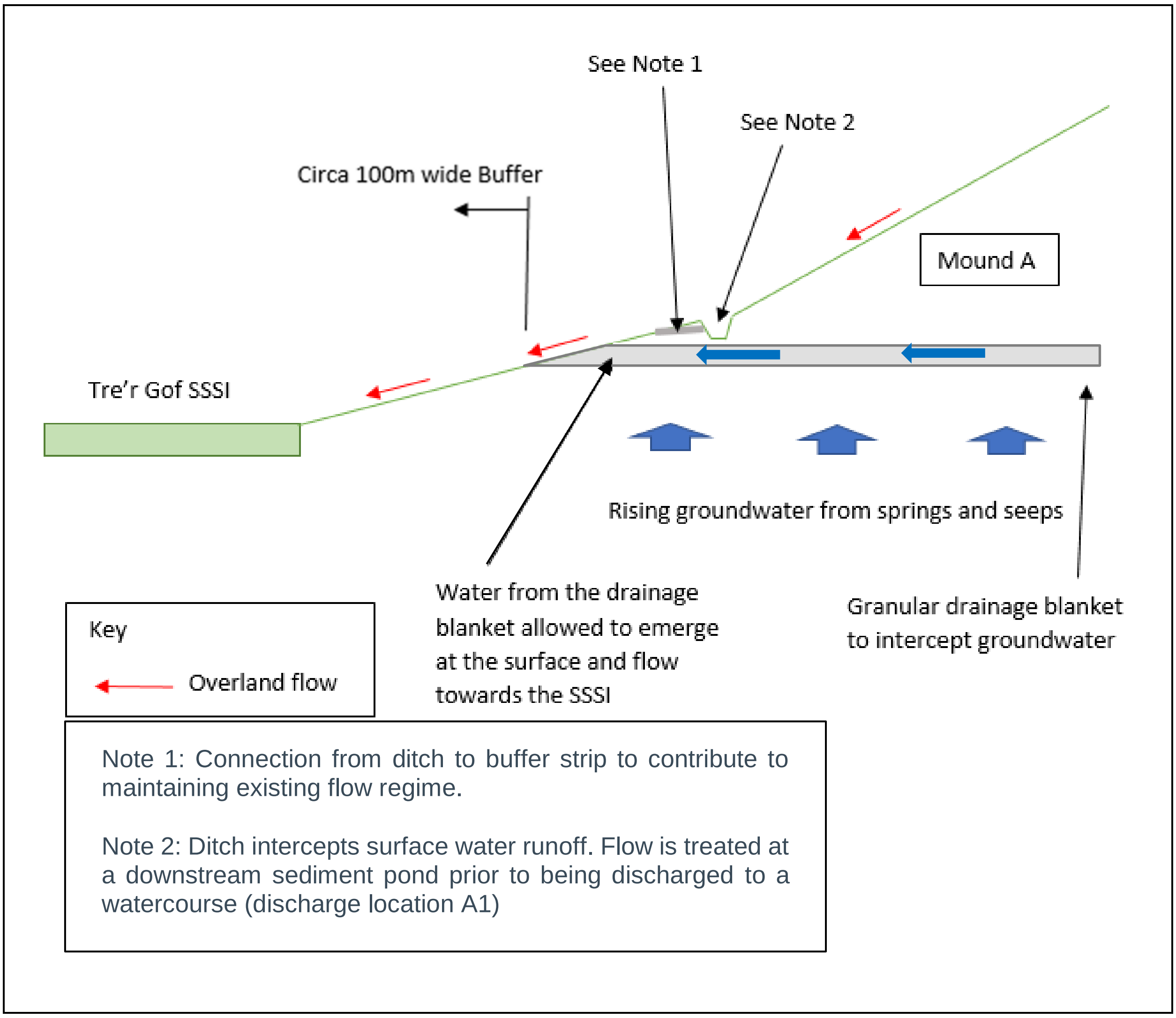

Figure 2-4 Mound A (Western Side): Drainage Schematic Diagram

Furthermore, vegetation on the western side of Mound A will be accelerated through the implementation of appropriate surface binding techniques, such as hydroseeding[6], or impregnated matting, thereby reducing the likelihood of elevated and/or uncontrolled sediment runoff from unvegetated surfaces. As discussed in Section 1.2.5, the requirement for dosing will cease when vegetation is fully established on the mound. A circa 100m buffer strip[7] will be established between the western toe of the mound and the SSSI prior to the commencement of earthworks operations and will be maintained until completion.

There is an aspiration that, post construction, the drainage systems associated with Discharge A1 will be removed and returned to its original and natural form. However, to enable this it is imperative that the existing flow regime is matched and this can only be confirmed during the detailed design stage. The drainage system proposed at Mound A is deemed to be flexible to enable alterations to be made as necessary throughout the Construction and Operational phases. The Tre'r Gof SSSI is a highly variable environment and the drainage system proposed, that interfaces closely with it, has been made flexible and low maintenance to manage the water flow into and around the SSSI as far as is reasonably practicable.

[6] Hydroseeding is a planting process that uses a slurry of seed and mulch. It is often used as an alternative to traditional sowing of dry seed because it offers a shorter and more successful germination period.
[7] Buffer strips is land that will remain vegetated and where construction work/activity will be prohibited.

A summary of discharge A1 is provided in table 2-1.

Table 2-1 Discharge A1

Catchment	Tre'r Gof
Receiving watercourse (Freshwater/ Coastal)	Existing drainage ditch (north of Tre'r Gof) that drains into Porth Wylfa **Freshwater discharge**
Grid Reference	235983, 393781
Catchment area (ha)	19.14
Combined inlet rate (30yr return period) (l/s)	126.6
Outlet rate (30yr return period) (l/s)	121.8
Cumulative volume (m^3/ day) (30yr return period)	389.2
Estimated no. of dosing units required	1

Catchment based TSS limit: A derived limit of 30mg/l from baseline data was noted to be overly stringent and therefore a limit of **40mg/l** has been proposed (Jacobs, 2017), further monitoring is required to justify this limit.

2.2.1.2. Discharge A2

A summary of discharge A2 is provided table 2-2.

Table 2-2 Discharge A2

Catchment	N/A
Receiving watercourse (Freshwater/ Coastal)	Drainage channel from an existing well installation. Existing channel ultimately discharges directly to Cemaes Bay **Freshwater Discharge**
Grid Reference	236633, 393779
Catchment area (ha)	4.05
Combined inlet rate (30yr return period) (l/s)	322.5
Outlet rate (30yr return period) (l/s)	145.6
Cumulative volume (m^3/ day) (30yr return period)	960.4
Estimated no. of dosing units required	1

Catchment based TSS limit: As the outfall will effectively be discharged to the marine environment at Cemaes Bay, a **70mg/l** limit for TSS is proposed (Jacobs, 2017).

2.2.1.3. Discharge A3

A summary of discharge A3 is provided in table 2-3.

Table 2-3 Discharge A3

Catchment	Cemaes
Receiving watercourse (Freshwater/ Coastal)	Nant Camaes **Freshwater Discharge**
Grid Reference	236772, 393447
Catchment area (ha)	6.22
Combined inlet rate (30yr return period) (l/s)	516.4
Outlet rate (30yr return period) (l/s)	273.5
Cumulative volume (m^3/ day) (30yr return period)	1475.9
Estimated no. of dosing units required	2

Catchment based TSS limit: A derived limit of 20mg/l from baseline data was noted to be overly stringent and therefore a limit of **40mg/l** has been proposed (Jacobs, 2017), further monitoring is required to justify this limit.

2.2.2. Mound B

Surface water drainage to Mound B will be provided principally by means of ditches that will drain in a northerly direction, see figure 2-5. As Mound B will be used as a laydown area the drainage ditches positioned for the Construction Phase will be temporary and will need to be repositioned prior to forming the final mound profile at the end of the Construction Phase; it should be noted that the laydown area has been omitted from figure 2-4 for clarity.

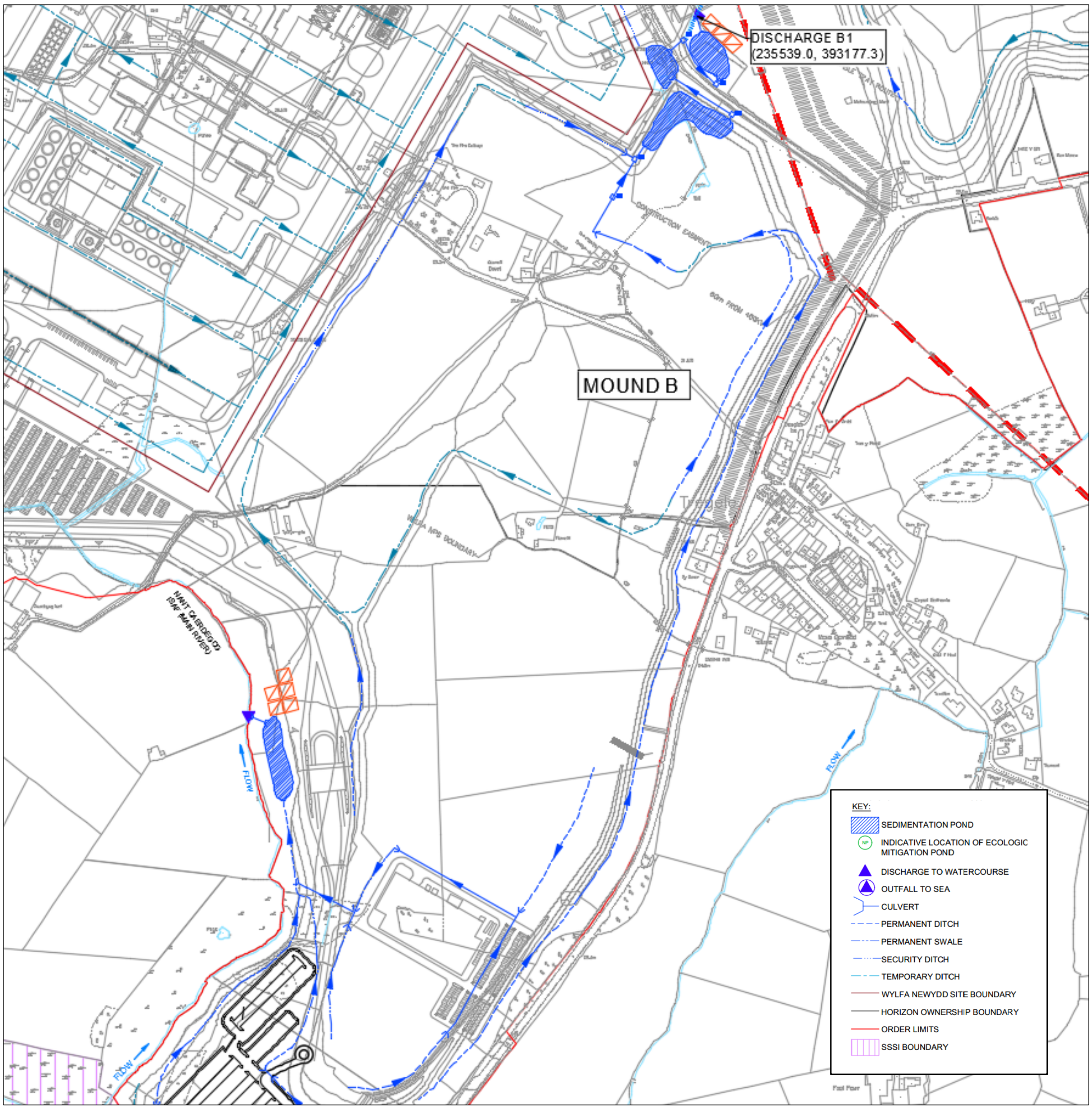

Figure 2-5 Mound B Site Location

2.2.2.1. Discharge B1

A summary of discharge B1 is provided in table 2-4.

Table 2-4 Discharge B1

Catchment	Tre'r Gof
Receiving watercourse (Freshwater/ Coastal)	Existing drainage ditch (West of Tre'r Gof) **Freshwater Discharge**
Grid Reference	235539, 393117
Catchment area (ha)	39.94
Combined inlet rate (30yr return period) (l/s)	1275.4
Outlet rate (30yr return period) (l/s)	527.3
Cumulative volume (m^3/ day) (30yr return period)	9,969.3
Estimated no. of dosing units required	3

Catchment based TSS limit: A **70mg/l** limit for TSS is proposed and will be achieved, as required, with dosing during construction activities (Jacobs, 2017).

2.2.3. Mound C

Mound C has been located to the northeast of the Cae Gwyn SSSI, see figure 2.6. Mound C will be characterised by an 1100 space temporary car park during construction that is significantly reduced to a smaller and permanent Visitor Centre car park on completion. This introduces additional impermeable surfaces into the catchment that will require mitigation to avoid impacts of higher rates of runoff. The majority of surface water runoff from the temporary car park will be drained northwards and will be discharged into the Nant Caerdegog Isaf, located to the west of the mound. The drainage system will also incorporate an overflow arrangement, or localised permeable surfacing with a dispersion ditch that will allow a controlled volume of runoff, equivalent to the existing greenfield runoff that will be removed from the Cae Gwyn catchment, to be discharged as sheet flow onto land adjacent to the car park.

The construction of a car park will introduce a risk of pollution from hydrocarbons entering the drainage system. Overall the risk of a significant polluting incident is considered low, however the design of each car park will need to incorporate appropriate mitigation to downstream pollution of the aquatic environment. This could preferentially include the use of SuDS features such as bio-retention strips, ponds incorporating reed beds or permeable paving. Oil separators would also be an acceptable form of mitigation. All related features would require ongoing maintenance to ensure that they remain effective.

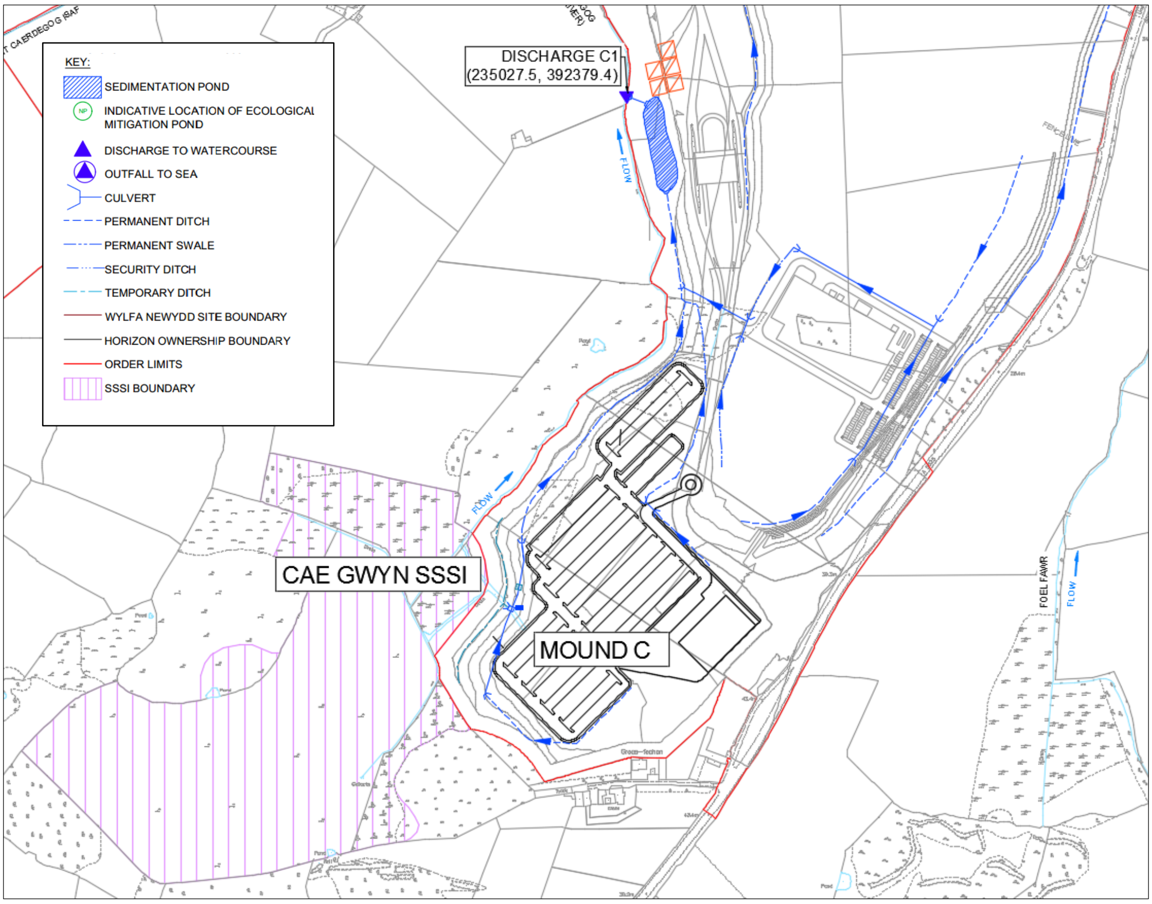

Figure 2-6 Mound C location

2.2.3.1. Discharge C1

A summary of discharge C1 is provided in table 2-5.

Table 2-5 Discharge C1

Catchment	Afon Cafnan
Receiving watercourse (Freshwater/ Coastal)	Caerdegog Isaf **Freshwater Discharge**
Grid Reference	235026, 392379
Catchment area (ha)	12.55
Combined inlet rate (30yr return period) (l/s)	1355.2
Outlet rate (30yr return period) (l/s)	924.3
Cumulative volume (m^3/ day) (30yr return period)	5,894.3
Estimated no. of dosing units required	5

Catchment based TSS limit: A **70mg/l** limit for TSS is proposed and will be achieved, as required, with dosing during construction activities (Jacobs, 2017).

2.2.4. Mound D

The Mound D area, see figure 2-7 will be used as a laydown area and most of the drainage ditches positioned for the Construction Phase will be permanent and will also provide the drainage for the final stage. However, there are areas where the drainage ditch will need to be relocated for the final Stage 5 proposal. Surface water runoff from Mound D will be discharged to the Afon Cafnan to the west. A minimum 15 metres construction buffer zone will be established and maintained immediately adjacent to the river edge to reduce the risk of uncontrolled sediment migration into the channel.

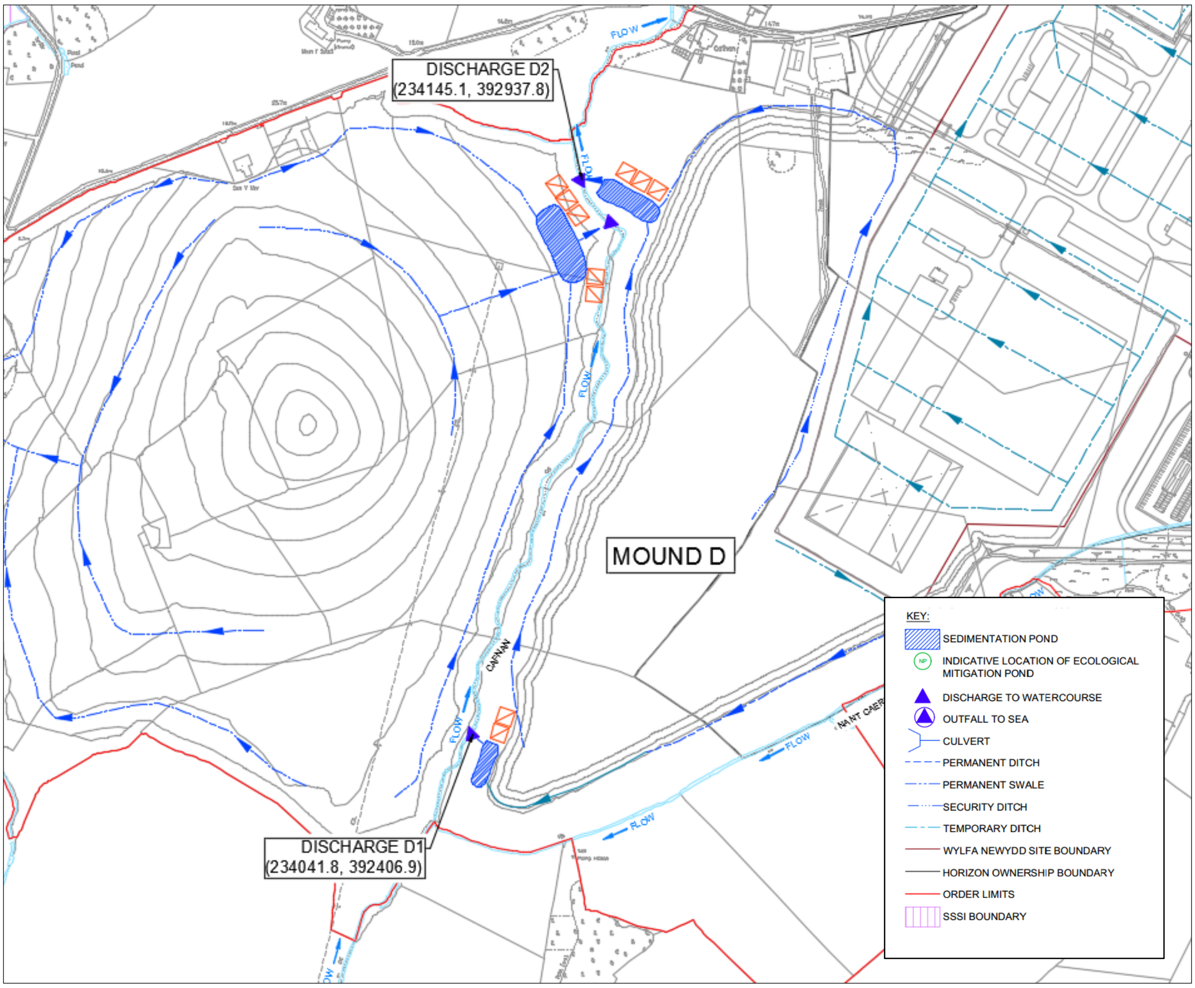

Figure 2-7 Mound D Site Location

2.2.4.1. Discharge D1

A summary of discharge D1 is provided in table 2-6.

Table 2-6 Discharge D1

Catchment	Afon Cafnan
Receiving watercourse (Freshwater/ Coastal)	Afon Cafnan **Freshwater Discharge**
Grid Reference	234042, 392407
Catchment area (ha)	4.39
Combined inlet rate (30yr return period) (l/s)	491.6
Outlet rate (30yr return period) (l/s)	178.4
Cumulative volume (m^3/ day) (30yr return period)	2361.6
Estimated no. of dosing units required	2

Catchment based TSS limit: A **40mg/l** limit for TSS is proposed and will be achieved, as required, with dosing during construction activities (Jacobs, 2017).

2.2.4.2. Discharge D2

A summary of discharge D2 is provided in table 2-7.

Table 2-7 Discharge D2

Catchment	Afon Cafnan
Receiving watercourse (Freshwater/ Coastal)	Afon Cafnan **Freshwater Discharge**
Grid Reference	234145, 392938
Catchment area (ha)	8.77
Combined inlet rate (30yr return period) (l/s)	192.7
Outlet rate (30yr return period) (l/s)	419.2
Cumulative volume (m^3/ day) (30yr return period)	1,047.8
Estimated no. of dosing units required	3

Catchment based TSS limit: A **40mg/l** limit for TSS is proposed and will be achieved, as required, with dosing during construction activities (Jacobs, 2017).

2.2.5. Mound E

Surface water runoff from Mound E, see figure 2-8, will discharge into the Nant Cemlyn and Afon Cafnan.

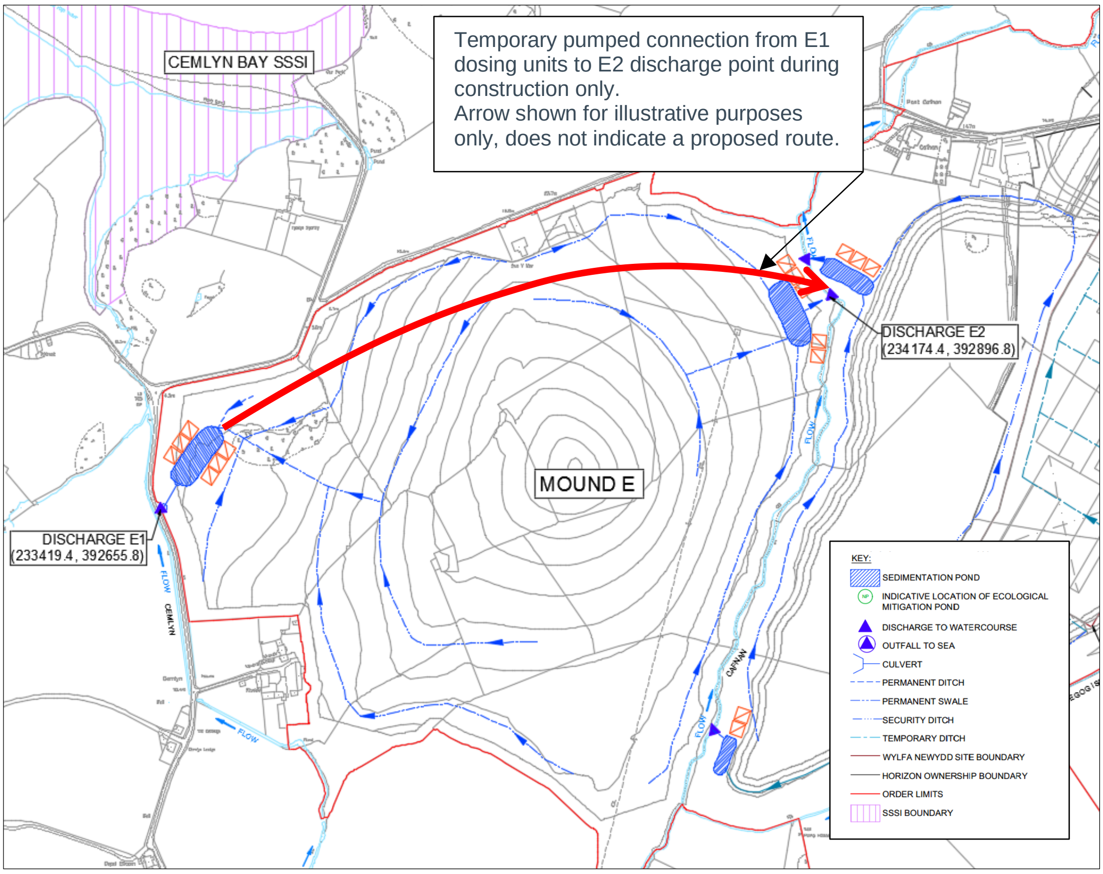

Figure 2-8 Mound E Site Location

2.2.5.1. Discharge E1

To maximise the control of surface water quality and in addition to the treatment pond and swales, reeds and natural habitat will be planted within the pond and swales. This approach increases the likelihood of maintaining current water quality conditions of Cemlyn Bay on SSSI/ SAC.

Following HNP discussions with NRW, it has been agreed that during construction of the western face of Mound E there will be no use of Discharge E1. The drainage system from catchment E1 will discharge to Pond E1 (with associated dosing units) but the discharge will be pumped to outfall E2 (downstream of the E2 dosing units). This arrangement only applies during the construction of the western face of Mound E; once vegetation has become established then Discharge E will be utilised. Any related impacts from the catchment transfer from the temporary pumping arrangements discussed above have not been assessed and will need to be reviewed prior to detailed design.

Following on from the construction period, drainage from the western side of Mound E will discharge to Cemlyn Bay lagoon, via Nant Cemlyn. To mitigate against potential impacts of the scheme on the SSSI, it is planned to complete all associated earthworks on the western side of Mound E within the first earthworks season of the construction programme (assuming favourable weather conditions), or a full year working within the drier months only. The works would include the reinstatement of topsoil and re-establishment of vegetation.

Furthermore, vegetation on the western side of Mound E will be accelerated through the implementation of appropriate surface binding techniques, such as hydroseeding, or impregnated matting, thereby reducing the likelihood of elevated and uncontrolled sediment runoff from unvegetated surfaces.

There is an aspiration, post construction, to remove the drainage systems associated with discharge E1, with land being returned to its original and natural form. However, to enable this it is important that the existing flow regime is matched as far as reasonably practicable and this can only be confirmed during the detailed design stage.

A summary of discharge E1 is provided in table 2-8.

Table 2-8 Discharge E1

Catchment	Cemlyn
Receiving watercourse (Freshwater/ Coastal)	Nant Cemlyn **Freshwater Discharge**
Grid Reference	233419.4, 392655.8
Catchment area (ha)	14.58
Combined inlet rate (30yr return period) (l/s)	976.9
Outlet rate (30yr return period) (l/s)	960.6
Cumulative volume (m^3/ day) (30yr return period)	3928.2
Estimated no. of dosing units required	6

Catchment based TSS limit: No net increase in downstream sediment concentration (Jacobs, 2017).

2.2.5.2. Discharge E2

A summary of discharge E2 is provided in table 2-9.

Table 2-9 Discharge E2

Catchment	Afon Cafnan
Receiving watercourse (Freshwater/ Coastal)	Afon Cafnan **Freshwater Discharge**
Grid Reference	234174, 392897
Catchment area (ha)	14.68
Combined inlet rate (30yr return period) (l/s)	860.4
Outlet rate (30yr return period) (l/s)	769.5
Cumulative volume (m^3/ day) (30yr return period)	3022.1
Estimated no. of dosing units required	5

Catchment based TSS limit: A **40mg/l** limit for TSS is proposed and will be achieved, as required, with dosing during construction activities (Jacobs, 2017).

2.2.6. Platform Area

A summary of the platform area, located within the Power Station catchment is shown in figure 2-9 and table 2-10.

During the Construction Phase earthwork plateaus will be drained by a system of transverse and perimeter ditches that discharge into two sedimentation ponds. Further treatment will be provided by a polyelectrolyte coagulant dosing system when required. The manner in which dosing will be used will be in accordance with the strategy outlined in Section 1.2.2. Three discharge points (referred to as PA, PB and PC) will be used to drain the platform area. The use of these discharge points will vary dependant on the sequence of construction and therefore may be subject to change. However, at this stage it is anticipated that discharge PA would be used initially with PB developed to allow marine works (dependent on the deep excavation sequence); PC would be the final discharge brought into use for the remainder of construction and would be retained as a permanent discharge point.

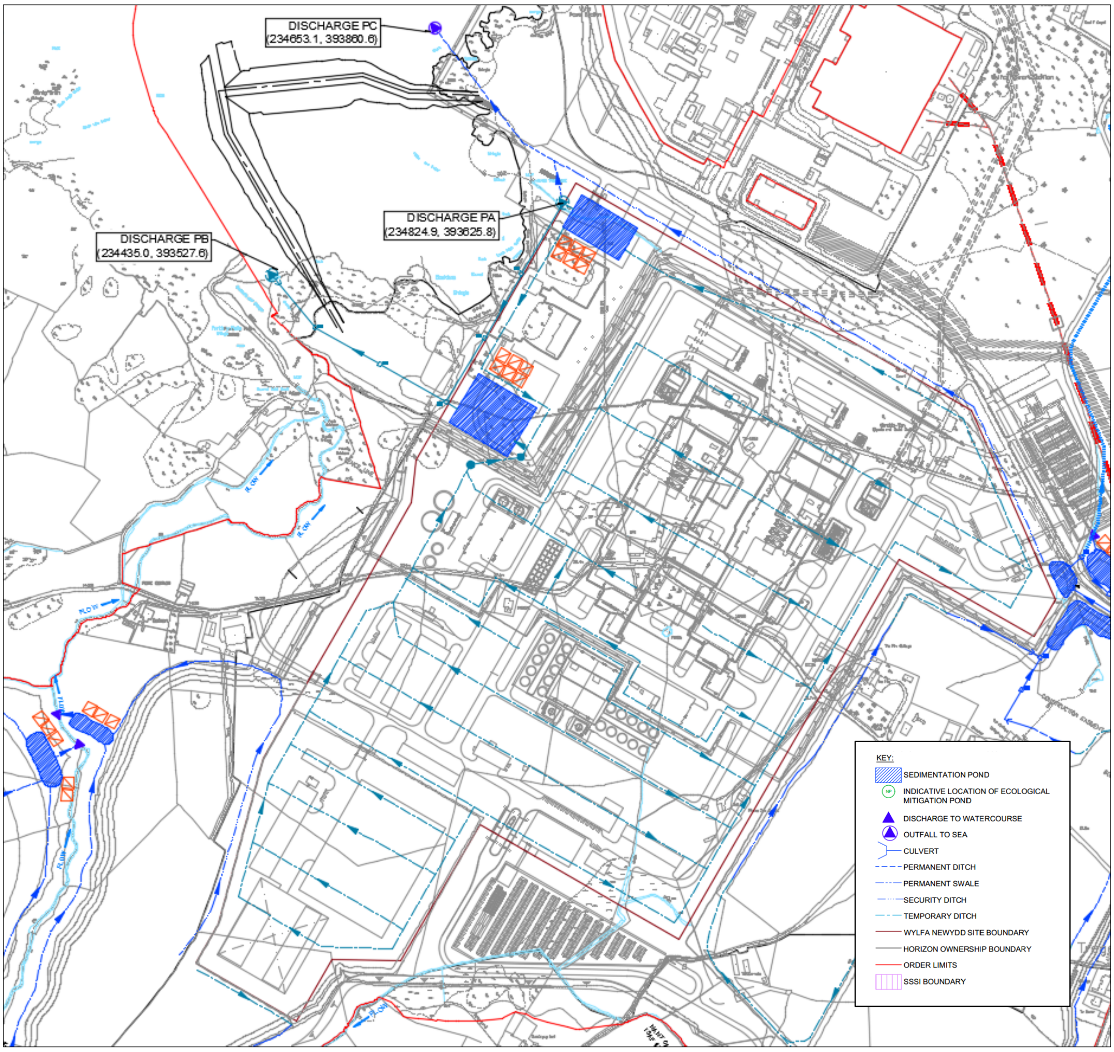

Figure 2-9 Platform Area Location

A summary of discharges from the platform area is provided in table 2-10.

Table 2-10 Platform Area Discharge

Catchment	Power Station
Receiving watercourse (Freshwater/ Coastal)	PA – Existing drainage (Freshwater) PB and PC – Porth-y-pistyll (Coastal)
Grid Reference	PA – 234824.9, 393625.8 PB – 234435.0, 393527.6 PC - 234653.1, 393860.6
Catchment area (ha)	70
Combined inlet rate (30yr return period) (l/s)	N/A
Outlet rate (30yr return period) (l/s)	1174.6
Cumulative volume (m^3/ day) (30yr return period)	16.623.7
Estimated no. of dosing units required	12

Catchment based TSS limit: A preliminary **70mg/l** limit is proposed for this catchment pending output of modelling (Jacobs, 2017).

2.3. Nitrates

Nitrate is a naturally occurring form of nitrogen in soil; the levels of nitrate can be changed through the addition of organic matter. The Construction Phase of the scheme will require existing topsoil from the site to be stripped and temporarily stockpiled and this operation has the potential to release nitrates into the aquatic environment. Aside from any areas treated by hydroseeding, the scheme will not be adding nitrates into the WNDA.

Existing nitrate data from long term water quality monitoring is limited and further ongoing monitoring will be required. Mitigation measures will be confirmed by the detailed design stage however measures to completely restrict livestock from the WNDA during the Construction Phase, localised stockpiling of topsoil (including re-use within the same catchment) and management of runoff will have positive effects on the release of nitrates into the environment.

2.4. Phosphates

Phosphorus is one of the three nutrients generally added to soils in fertilisers. As with nitrates, proposed bulk earthwork operations have the potential to increase the levels of phosphorous within the aquatic environment. Aside from any areas treated by hydroseeding, the scheme will not be adding phosphates into the WNDA.

Existing phosphate data from long term water quality monitoring is limited and further ongoing monitoring will be required. Notwithstanding this the following measures are expected to substantially control the release of phosphates into the environment:

- Control of surface water runoff as outlined in Section 1 of this report.
- Restrictions on livestock within the WNDA during the Construction Phase (preventing them from entering watercourses), however it is noted that there may be some areas where grazing occurs during the Construction Phase (e.g. Wylfa Head, Tre'r Gof SSSI and areas where landscaping is completed early on in the development).

- No application of fertilisers within the WNDA during the Construction Phase.

2.5. Exceedance Events

As discussed, the treatment of TSS will be undertaken using a number of features incorporated into the drainage system to achieve permit limits up to and including the 1 in 2 year return period storm event. The use of features such as silt fences, silt traps and sedimentation ponds will serve to remove the majority of suspended sediments from flow; polyelectrolyte chemical dosing will be undertaken to ensure that fine soil particles are removed to the required level.

A 1 in 2 year return period has been selected for the design event of the dosing units for the following reasons:

1. Risk based: It is anticipated that dosing units will only be required during bulk earthwork operations until vegetation on mounds has become established. As such, the annual probability of a large return period storm (e.g. 1 in 30 year event) being experienced is considered low; the 1 in 2 year event is therefore considered representative of the rainfall event that is likely to be experienced prior to the establishment of the mound vegetation.
2. Available Space: Multiple dosing units will be provided to treat surface water runoff at every proposed outfall from the drainage system. The number of units required has been estimated based on the design event considered. Notwithstanding this there will be limited space within the construction area, adjacent to drainage outfalls and ponds, within which to site a large number of dosing units to treat runoff from higher frequency storm events.
3. Availability and Cost: There are practical limits to the number of units that can be provided. Dosing units are specialised items of equipment and there are expected to be a finite number that are available nationally to serve the project; employing larger numbers treat higher frequency storm events is therefore likely to be impractical and cost prohibitive.
4. Exceedance: On the occasions when the 1 in 2 year return period event is exceeded, the dosing units will continue to operate at their maximum capacity (having been sized to treat the peak 1 in 2 year return period discharge rate) thus limiting the impact on the environment. The drainage system and pond treatments will continue to operate as designed during these periods of exceedance; due to the larger volumes of surface water the dosing units will provide a reduced level of treatment to the flow being discharged at outfalls.

3. Forward Actions

3.1. Water Quality Monitoring

To ensure the drainage design system is functioning as designed it is necessary to undertake regular sampling and monitoring within the identified catchments. It is envisaged that this will be an automated system that retains and adapts, where feasible, the current monitoring regime to suit the detailed design. The following are necessary features of any future monitoring system:

- Continuous water level and turbidity monitoring at all outfall locations as a minimum, upstream monitoring is also recommended, with additional storm event triggered auto-samplers. It is recommended that the system is set up to provide live access to the data.
  - Monthly spot-sampling at the outfall, with corresponding upstream and downstream sampling for a period of one year or up to the start of construction. Data should be reviewed monthly.
  - Monitored water quality parameters should correspond to those currently undertaken, i.e. physio-chemical parameters, nutrients, major ions, and suspended solids.
  - Flow monitoring at the outlet by a V-notch weir, or similar, at all discharge outfalls, at the same frequency as spot sampling water quality monitoring.

3.2. Soil Management

To support the management of surface water runoff, and levels of nitrate and phosphate in the aquatic environment a soil management plan will be developed prior to the commencement of bulk earthwork operations.

4. References

Jacobs, 2017, Wylfa Newydd – Horizon Nuclear Power: Assessment of Appropriate Suspended Sediment Concentrations for Water Discharge Locations, 60PO8083/HYD/REP/002, 19 December 2017, V1.2

CIRIA, 2015, SuDS Manual (C753), www.ciria.org

WRc, 1996, A review of polyelectrolytes to identify priorities for EQS development, R&D Technical report P21, Foundation for Water Research, Marlow, Environment Agency, Bristol