Outline Drainage Strategy (Revision 1)

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OUTLINE DRAINAGE STRATEGY

ABERGELLI POWER LTD

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Abergelli Power Ltd.

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APPENDIX A GENERATING EQUIPMENT SITE – DRAINAGE CATCHMENT AREAS

1 EXECUTIVE SUMMARY

The following report presents an outline strategy for disposal of foul, oily and surface water from the proposed Abergelli Power Project to assist with planning and detailed drainage design phases. Indicative storm water attenuation requirements are defined to demonstrate design compliance with UK environmental regulations for new developments and assist with site spatial planning.

2 PROJECT BACKGROUND

2.1 SCOPE OF THIS REPORT

This conceptual Project Site drainage strategy outlines the proposal for managing the surface water, oily water and waste water drainage systems at the proposed Abergelli Power Project.

External flood risk to the Project Site is outside the scope of this report and will be addressed separately.

2.2 SITE DESCRIPTION

The Project Site (approximate UK National Grid Reference SN 65477 01290) is located on open land approximately 2 km north of Junction 46 on the M4, to the north of Swansea and approximately 1 km southeast of Felindre, 760 m west of Llwyncelyn and 1.4 km north of Llangyfelach. Refer to Figures 2.2-1 to 2.2-3 inclusive below.

Figure 2.2-1 Site location (1)

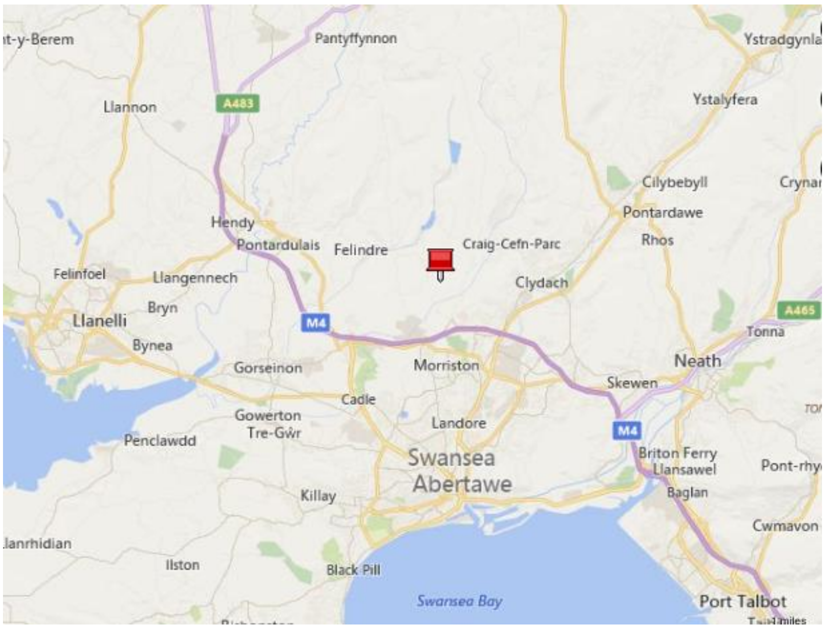


Figure 2.2-2 Site Location (2)

Figure 2.2-3 Site Location (3)

The current land use is predominantly agricultural, with sheep and horse grazing. The western extent of the Project Site encompasses parts of National Grid's 'Swansea North' electrical substation (comprising a 400kV and 132kV substation) and the existing access road leading to the substation and Felindre Gas Compressor Station from the B4489.

The Project Site is accessed from Junction 46 of the M4. From the M4 vehicles would travel north via the B4489, with the Project Site therefore accessed from the west utilising the existing

National Grid junction and access road from the B4489 (which is to be widened to accommodate abnormal loads and is part of the Access Road) and then via land following the southern boundary of the Felindre Gas Compressor Station before crossing over agricultural land immediately west of the Generating Equipment Site.

The Project Site is roughly 'L' shaped (in reverse). Ground levels at the Project Site vary from approximately 146 m above ordnance datum (AOD) at the highest point in the north-west corner at Rhyd-y-Pandy Road to approximately 80 m AOD along the southern perimeter, with ground levels generally falling in a southerly and south easterly direction. The land within the Generating Equipment Site is at approximately 90 m AOD.

There are no residential dwellings located within the boundary of the Project Site. Most of the Project Site is improved grassland but there are areas of marshy grassland in the south eastern part of the Generating Equipment Site. There are parts of a Site of Importance for Nature Conservation (SINC) within the Project Site (Lletty Morfil SINC). The woodland present within the Project Site is designated as Ancient Woodland (a mixture of restored and semi-natural woodland).

Within the Project Site there are springs, with their associated streams and drainage ditches which discharge into the Afon Llan (See Figures 2-4 to 2-7 inclusive). The Afon Llan links with the Afon Lliw and the River Loughor, which discharges into the Bristol Channel.

The Generating Equipment Site is located primarily within fields used for grazing, bounded by a mixture of drainage ditches, fencing and poor quality hedgerows with substantial gaps in them. The Generating Equipment Site and Laydown Area are both crossed by a soft surface horse training track known as 'the gallops', which runs diagonally north-west to south-east. A block of broadleaved woodland, classified as Ancient Woodland, and a Site of Importance for Nature Conservation (SINC) lie to the east. There are also further blocks of Ancient Woodland, also classified as SINCs, to the west surrounding Swansea North Substation, Felindre Gas Compressor Station and the existing access road leading to these facilities from the B4489.

The proposed gas supply pipeline will follow an approximate north-south route corridor, as shown in Figures 2-4 & 2-6, between the National Transmission System south of Rhyd-y-Pandy Road and the Generating Equipment Site. The Pipeline corridor varies between 50 m and 200 m in width, depending on the working area required during construction. The maximum area of the Gas Connection Site during construction is approximately 13 Ha. Once construction is completed, the route corridor will reduce to 10 m wide, reflecting the width of the easement surrounding the Pipeline required for maintenance and to ensure safety. The Pipeline crosses grazing fields bounded by a number of poor quality hedgerows (with gaps) and/or fence lines, one Public Right of Way, and two drainage ditches. The Pipeline avoids the small deciduous copse to the north of the Generating Equipment Site, part of which is classified as Ancient Woodland and a SINC.

The Electrical Connection will follow a route corridor of approximately 30 m in width during construction. The Electrical Connection route coincides with the Access Road for approximately 500 m of the route length. The maximum site area for the Electrical Connection during construction is 3 ha. It will be located to the southwest of the Generating Equipment Site passing through grass fields and following the southern boundary of the Gas Compressor Station, passing through an area classified as Ancient Woodland and a SINC, before entering National Grid's Swansea North Substation.

The geology of the site is characterised by boulder clay and the underlying Grovesend Beds, Upper Carboniferous sandstones and thin coals; overlain by glacial sand and gravel, alluvium and peat. The geology is overlain by raw grey and brown soils.

The land within the power generation plant site is approximately 90 m Above Ordnance Datum (AOD), generally sloping at 1:25 downwards in a southerly direction.

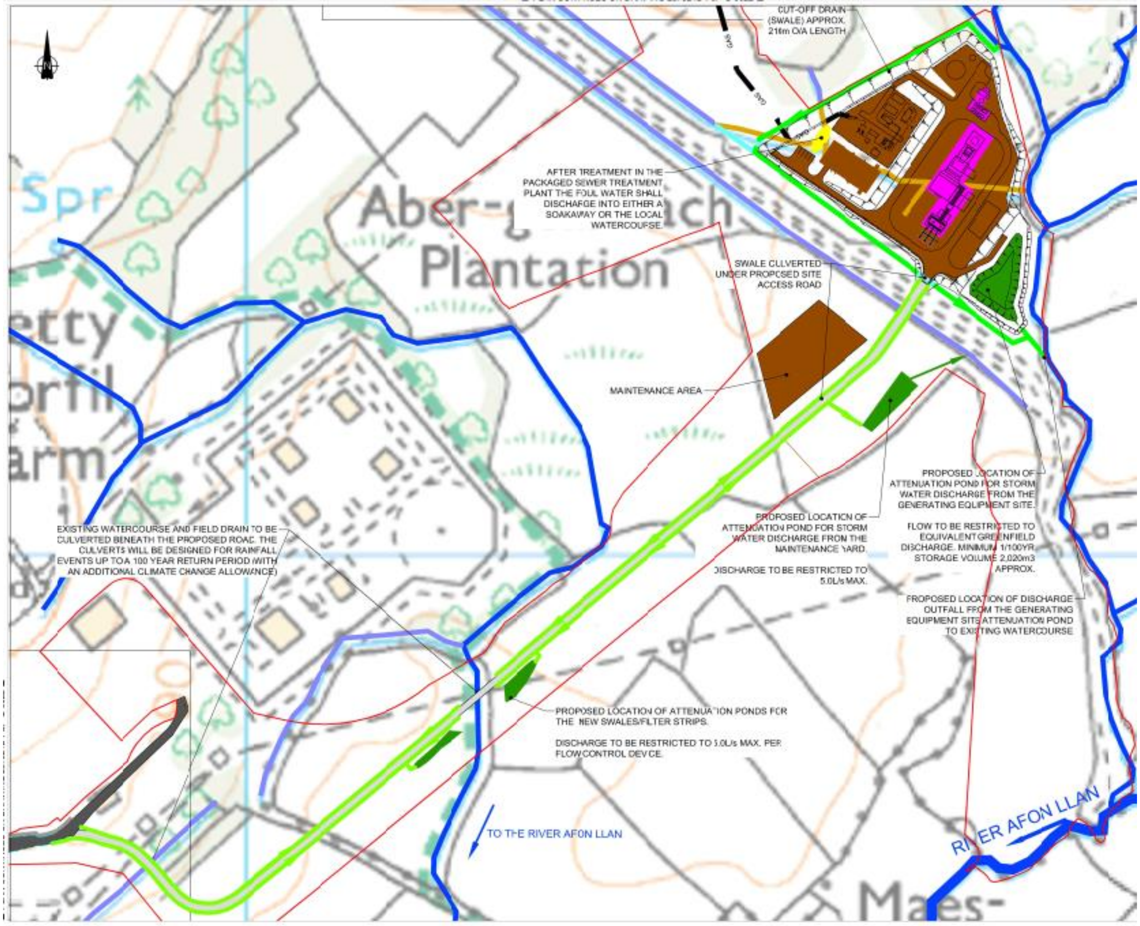


Figure 2-4 Plan showing nearby drains and watercourse to the site (Central section)

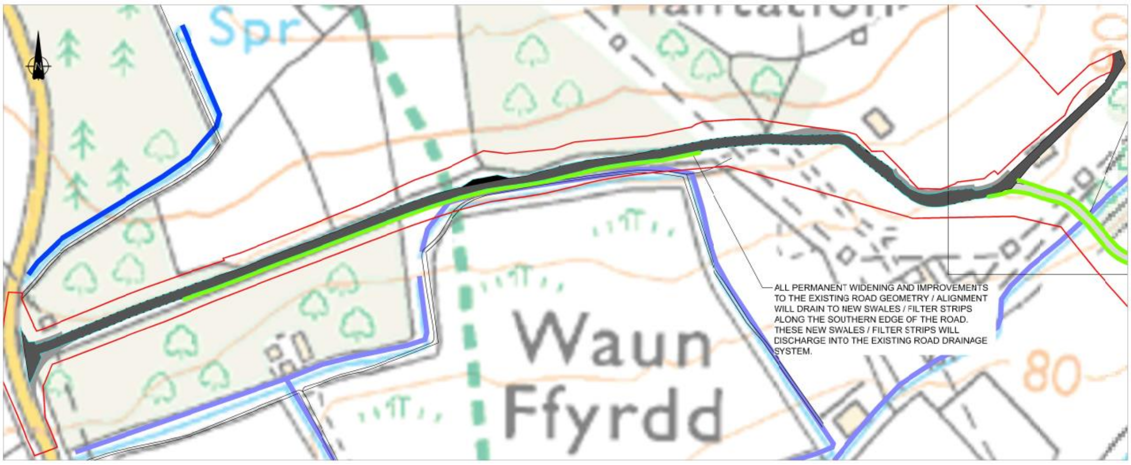


Figure 2-5 Plan showing nearby drains and watercourse to the site (West section)

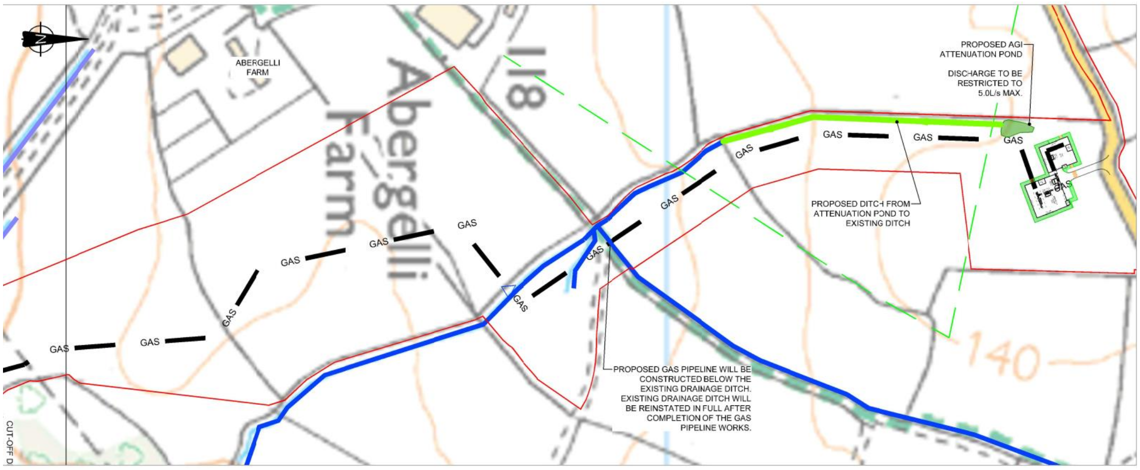


Figure 2-6 Plan showing nearby drains and watercourse to the site (North section)

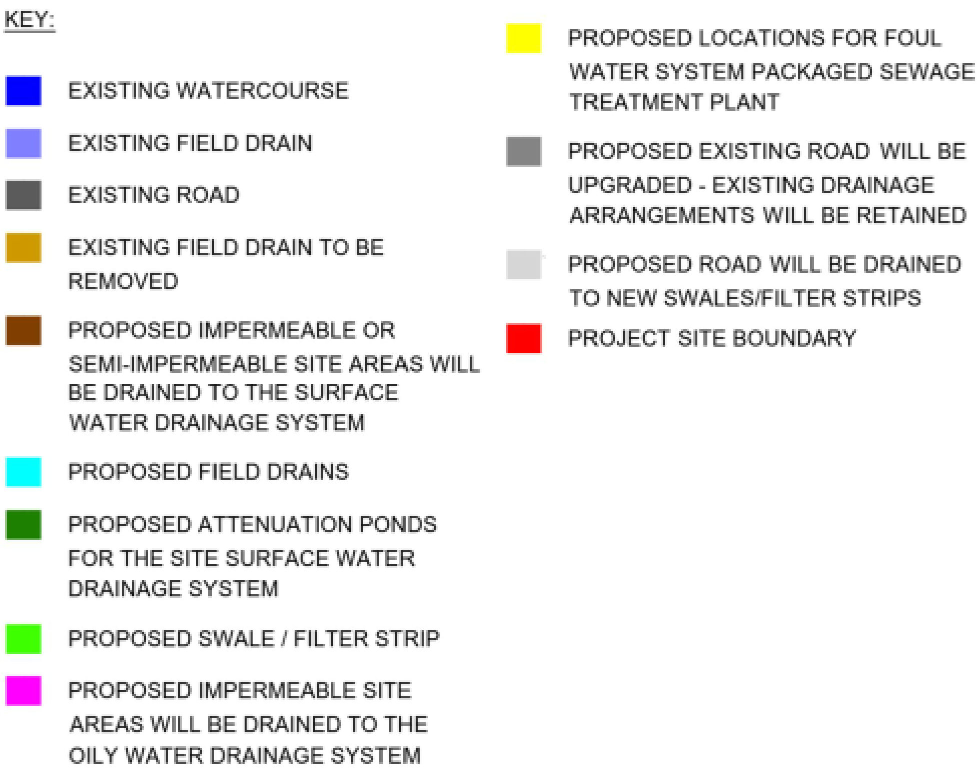


Figure 2-7 Key for Figures 1 to 3

3 DRAINAGE STRATEGY

3.1 FOUL WATER DRAINAGE PROPOSAL

The Generating Equipment Site incorporates welfare facilities which will require a site foul water drainage system. The site is remote and it is believed it will be unfeasible to connect to a public sewer. The provision of a cesspool, composting or chemical toilets has not been considered due to Natural Resources Wales preferences, maintenance requirements and staff comfort. As a result there are two options for the foul water drainage system:

1. A foul water drainage system that will drain to a septic tank within the site. The water from septic tank would then discharge into an onsite drainage field.
2. A foul water drainage system that will drain to a package sewage treatment plant within the site. The processed water from this treatment plant would then discharge into an onsite drainage field or nearby watercourse.

Option 2 is likely to be the preferred option for ease of maintenance and environmental criteria.

The selected foul water drainage system will be positioned away from any areas at risk of flooding.

Site foul water drainage systems shall be designed and constructed in accordance with Part H of the UK Building Regulations 2010. Any septic tank or package treatment plant shall be situated a minimum of 10 metres from habitable buildings. We suggest the most appropriate siting of the sewage treatment plant is in the area to the northwest of the accommodation building (immediately northeast of the car parking area) in order to satisfy the aforementioned separation requirement and allow ease of vehicular access for maintenance.

The proposed location of the sewage treatment plant is indicated in Figure 2-4. The most appropriate outfall location would seem to be to the proposed drainage swale running along the southwest boundary of the Generating Equipment Site.

3.2 OILY WATER DRAINAGE PROPOSAL

An oily water drainage system will be required to receive surface water from potentially contaminated oil retaining areas and prevent contaminated water being discharged from the site. The following areas and activities have been identified as potential sources of oil contamination:

- Oil filled transformers
- Lubrication systems for the Generating Equipment
- Oil/fuel storage
- Vehicle hard-standings used for the unloading of oil/fuel

In the event of a spillage all designated oil retaining areas (e.g. oil filled transformers and oil storage areas) will be designed to contain at least 110% of the stored oil plus an allowance for fire-fighting water/foam. Rainwater will be removed from oil retaining areas by an automatic pump to the oily water drainage system. The automatic pumps will be designed to automatically shut down in the event that a major oil spillage is detected in order to prevent large quantities of oil entering the oily water drainage system.

Rainwater drainage from oily water areas will pass through a Class 1 Full Retention Oil Separator (as defined in BS EN 858) to remove residual traces of oil before discharging into the site surface water drainage system. The Oil Separator shall be sized to suit the oily water catchment area and will be fitted with an alarm to indicate when the integral oil coalescer requires maintenance.

Oily water drainage shall be designed in accordance with National Grid Technical Specification 2.10.01 'Generic Electricity Substation Design Manual for Civil, Structural and Building Engineering: Section Nº 01: Oil Containment' or similar approved. Outline oily water drainage areas for the Generating Equipment Site are indicated in Figure 2-4.

3.3 SURFACE WATER DRAINAGE PROPOSAL

SURFACE WATER DRAINAGE PHILOSOPHY

The surface water drainage system will be required to adequately drain the Project Site and prevent any significant flooding for the maximum design rainfall event of 100 year return period. The surface water drainage system will adopt the principles of The SuDS Manual – CIRIA C753.

To prevent inundation of the Generating Equipment Site from surface runoff down the hillside, cut off drainage ditches will be placed around the uphill Generating Equipment Site perimeter. These new drainage ditches will be designed to divert surface runoff around the Generating Equipment Site and return downstream back to the original drainage ditches/watercourse.

Where possible the new platform (levels and surfacing) will be designed so they naturally drain by infiltration into the surrounding ground. Where this is not economically possible or presents an unsatisfactory risk of flooding to the site, infiltration drains will be installed into the new platforms. All infiltration drains will connect to the surface water drainage system.

It is not expected that it will be possible to connect the surface water drainage system to an infiltration basin due to the presumed predominantly clayey ground and high groundwater level in places. This will be confirmed when the Ground Investigation surveys are carried out. For the purposes of this drainage strategy, a worst case is assumed. Instead the discharged flow of water at the site boundary from the surface water drainage system will be attenuated in order to mimic the equivalent greenfield runoff flow for events up to the 100 year return period event (with climate change allowance). The flow will be attenuated using suitably sized attenuation pond(s) with downstream flow restriction. The resulting equivalent greenfield runoff will discharge to existing nearby watercourses. The attenuation pond(s) shall be sited to prevent flooding of operational areas in the event of an extreme rainfall event in excess of the 100 year return period.

The Gas Connection comprises a buried pipeline and Above Ground Installation (AGI). The Pipeline will not give rise to an increase in impermeable area within the Project Site and impact upon the surface water run-off regime.

The only permanent above ground structure associated with the gas connection is the AGI at the point of connection to the National Transmission System. The AGI consists of 2Nº 30m by 30m compounds and is proposed to drain to a soakaway.

Proposed new bituminous Power Generation Plant Site roads will generally have a constant crossfall with no longitudinal fall. Where possible, roadside swales and infiltration drains will be used to remove and convey any standing water into the surface water drainage system. Where there are space constraints, or there is an elevated risk of contamination, the new roads will be kerbed and drain via road gullies into the surface water drainage system.

Construction laydown areas and a maintenance yard are proposed to the west of the Generating Equipment Site on the opposite side of the water main easement. We understand both laydown and maintenance areas require granular finish (i.e. crushed rock pavement construction) at commencement of construction in the Generating Equipment Site. The maintenance yard will be retained on completion of construction, however the laydown areas will be returned to grassland As a result, the construction laydown area runoff is omitted from calculations for permanent construction runoff and it shall be considered in the CEMP only (refer to Section 3.5).

Culverts to route existing field drains under the proposed Access Road have been assumed in the outline design, however, other techniques such as bridges could also be used. These culverts or crossings will be designed for events up to the 100 year return period. It is expected that drainage of the new section of Access Road will be via roadside swales. Swales will discharge to existing watercourses via flow restriction device and piped outlets as necessary to approximate equivalent greenfield runoff flows from the proposed road area.

A section of access road crosses the water main easement. At the time of writing, the form of this crossing is unknown. The access road is likely to be raised due to restrictions on excavation within the easement zone. In this case this section of road is likely to be formed on an embankment above the easement (a causeway) or, if surcharge loading of the easement zone is unacceptable, on a suspended bridge deck. Surface water runoff from the grassland/pasture area to the north and upslope of the raised access road shall be allowed to passively drain through the causeway due to installation of open pipes / culverts at regular spacings for the former option. A suspended bridge structure would permit surface water runoff to flow unimpeded in the latter option. We would expect any temporary drainage requirements during construction of a raised access road to be addressed in the CEMP (refer to Section 3.5).

It is not proposed to connect existing road drainage systems into the new surface water drainage system. Existing road drainage systems along the existing section of Access Road will be maintained or modified to reflect any widening.

PROPOSED SUDS MANAGEMENT TRAIN

For purposes of this study it is assumed that the sensitivity of receiving watercourses is ‘Medium’. In accordance with the ‘SuDS Manual’ (CIRIA, 2015), three SUDS management train techniques for drainage of runoff from general site development areas shall be provided:

1. TRAPPED GULLIES / FILTER DRAINS

As described above, where possible all proposed new bituminous road drainage will be collected via roadside swales or infiltration drains. Where required the new platforms will be drained via a filter drain. The swales and filter drains will be designed to minimise the ingress of sediment into the drainage network. All new swales and drains on the Generating Equipment Site will discharge into the proposed attenuation ponds and then the existing watercourses.

2. ATTENUATION

The primary purpose of the attenuation pond is storage and gradual release of storm water runoff, however it will have secondary benefits in terms of water treatment. The pond geometry will be selected to promote settlement of any remaining suspended sediment from inflow as the pond widens and flow velocity decreases towards its outfall. Furthermore, in the unlikely accidental event of entry of pollutants from site activities to the surface water drainage system, the attenuation pond provides access for water quality sampling and retention of pollutants via closure of a valve within the outfall manhole prior to remediation.

Periodic maintenance of the attenuation pond and its surrounding area will be required by the Generating Equipment Site operator in order to remove significant silt deposits and control vegetation. Suitable provision shall be made in the layout and levels of the pond area to permit access by off-road vehicles to allow this maintenance to take place.

3. **SWALE**

The final measure within the SUDS system will be a drainage swale between the attenuation pond and the un-named tributary of the Afon Llan (subject to agreement with City and Council of Swansea). The swale will be incorporated into the landscaping and be of a vegetated design to provide further filtering measures for any particles that have passed through the previous control techniques.

Drainage from roads only requires application of two treatment train components. Therefore, the proposed site access road will be drained via swales that shall provide storage attenuation with controlled discharge, approximating to pre-development greenfield runoff, to existing watercourses.

OUTLINE SIZING OF SITE ATTENUATION

Refer to Section 4 of this report for calculation of outline storage volume requirements.

3.4 SITE FLOOD RISK

The risk to the Project Site by flooding from external sources is outside the scope of this report and is therefore not evaluated further herein.

Buildings, plant and equipment within the site will be elevated above the surrounding platform level to avoid inundation by minor surface water flooding in the event of local drainage failure or extreme rainfall events in excess of the 100 year return design event.

As a minimum a raised pedestrian access route will be provided to and within the site to provide for safe access and egress during a flood.

3.5 SURFACE WATER DRAINAGE STRATEGY DURING CONSTRUCTION

Surface water drainage during construction will be developed by the contractor and detailed in the Construction Environmental Management Plan (CEMP). At this stage it is expected that the CEMP will include provisions such as:

→ New temporary and /or permanent drainage ditches to prevent uncontrolled surface runoff of contaminated water

→ Silt traps within drainage ditches to reduce the flow of suspended solids from site.

→ Settlement lagoons and / or proprietary settlement tanks as required to reduce the flow of suspended solids from site.

→ Suitable layout of the construction site and application of suitable management techniques to prevent runoff from stockpiles directly into watercourses.

4 OUTLINE ATTENUATION REQUIREMENTS – PERMANENT CONSTRUCTION

4.1 SCOPE

The following figures are based on permanent construction only. Runoff and attenuation from temporary construction hardstanding (e.g. construction laydown) and similar shall be considered by the Contractor in the CEMP (refer to Section 3.5).

4.2 RAINFALL & RUNOFF

Site-specific rainfall data has been obtained for purposes of attenuation design from the Natural Environmental Research Council's Centre for Ecology & Hydrology using the Flood Estimation Handbook Web Service. This data is presented in Table 4.2-1 below. Note that a Climate Change factor of 120% has been applied to the FEH2013 rainfall depths. This is in accordance with the upper bound figure stated in Table 2 of the UK Environment Agency's publication 'Flood risk assessments: climate change allowances' (February 2016) for the period 2040 to 2069. The design life of the Abergelli Power Project is 25 years.

	FEH2013 Basic Values		Climate Change Factor	Modified Design Values	
Storm Duration (hrs)	Total Rainfall (mm)	Rainfall Intensity (mm/hr)		Total Rainfall (mm)	Rainfall Intensity (mm/hr)
1	38.6	38.6	1.2	46.3	46.3
2	46.9	23.5	1.2	56.3	28.2
6	65.0	10.8	1.2	78.0	13.0
10	75.4	7.5	1.2	90.4	9.0
24	96.6	4.0	1.2	115.9	4.8
48	118.3	2.5	1.2	141.9	3.0

Table 4.2-1 Site-specific rainfall calculations

Permanent site construction areas have been subdivided by category for purposes of runoff calculation. Subdivision of the Equipment Generating Area is shown on drawing 70034053-SK-C-001 in Appendix A. A runoff coefficient has been allocated to each area type for determining the proportion of rainfall that is converted to runoff. The permanent site area and runoff coefficients are presented in Table 4.2-2. The chosen runoff coefficients represent the impermeability of the area categories within the limits of 0.0 (no runoff) to 1.0 (100% of rainfall is converted to runoff) and are benchmarked against equivalent values from industry publications. Note that the runoff coefficients contain implicit allowances for minor ponding to ground surface during high intensity rainfall events.

	Basic Area by Category (m^2)				Assumed Runoff Coefficient	Equivalent Impermeable Area (m^2)			
	Gen Equip Site	Access Rd Extn	Maintenance Yard	AGI		Gen Equip Site	Access Rd Extn	Maintenance Yard	AGI
Buildings	1825	0	0	0	1.00	1825	0	0	0
Roads & Car Parking	4478	4458	0	0	0.85	3806.3	3789.3	0	0
Oily Water Areas	985	0	0	0	0.95	935.75	0	0	0
General Site Areas	14239	0	3385	2660	0.8	11391.2	0	2708	2128
Total	21527	4458	3385	2660		17958.25	3789.3	2708	2128
					Equivalent Lumped Runoff Coefficient	0.834	0.850	0.800	0.800

Table 4.2-2 Permanent Site Areas and Associated Runoff Coefficients

*Note *** - Assumed gravelled / granular surface finish*

Runoff volumes are determined by multiplication of the rainfall depths by the equivalent impermeable areas (the ‘Rational Method’).

4.3 ATTENUATION VOLUMES

GREENFIELD RUNOFF

Greenfield equivalent runoff rates are calculated individually for the permanent site area using the procedure recommended in Institute of Hydrology report 124 ‘Flood Estimation for Small Catchments’ and ‘Rainfall Runoff Management for Developments’ (EA / DEFRA, 2013). See Table 4.3-1 below. Site soil type is derived from HR Wallingford’s Flood Studies Report. Annual average rainfall is the site-specific FEH2013 value. The maximum surface water drainage discharge rate which shall be used for the whole Abergelli Power Station development has been highlighted in bold in Table 4.3-1.

	Site Area				
	Gen Equip Site	Access Rd Extn	Maintenance Yard	AGI	Totals
Hydrological Region	9	9	9	9	
Soil Type	3	3	3	3	
SPR	0.37	0.37	0.37	0.37	
SOIL	0.40	0.40	0.40	0.40	
SAAR (mm/year)	1435	1435	1435	1435	
Total Site Area (Ha)	2.153	0.446	0.339	0.266	3.204
Impermeable Area (Ha)	1.796	0.379	0.271	0.213	2.659
IH 124 Reference Area (Ha)	50.0	50.0	50.0	50.0	
Reference Area Greenfield Runoff (L/s)	332.7	332.7	332.7	332.7	
Site Area Greenfield Runoff (L/s)	11.9	2.52	1.80	1.42	**17.64**

Table 4.3-1 Greenfield Runoff Equivalent

Runoff volumes are determined by multiplication of the rainfall depths by the equivalent impermeable areas (the 'Rational Method').

STORAGE REQUIREMENTS

Outline attenuation requirements for the Generating Equipment Site, Access Road Extension, Maintenance Yard and AGI areas are shown below in Tables 4.3-2, 4.3-3, 4.3-4 and 4.3-5 respectively. Storage volumes include a 25% increase to account for effects of varying pressure head – discharge relationship upon initial filling of attenuation pond until the constant target discharge rate is achieved.

Time from Storm Commencement (mins)	**Storm Event**					
	M100- 1 hour	**M100- 2 hour**	**M100- 6 hour**	**M100- 10 hour**	**M100- 24 hour**	**M100- 48 hour**
0	0.0	0.0	0.0	0.0	0.0	0.0
5	84.8	50.8	22.4	15.0	7.2	3.7
10	169.6	101.6	44.9	30.1	14.3	7.3
15	254.5	152.4	67.3	45.1	21.5	11.0
30	508.9	304.7	134.6	90.2	43.0	21.9
60	1017.8	609.5	269.3	180.5	85.9	43.9
120	995.3	1218.9	538.6	360.9	171.8	87.7
240	950.3	1173.9	1077.1	721.9	343.7	175.4
360	905.3	1128.9	1615.7	1082.8	515.5	263.2
600	815.3	1038.9	1525.7	1804.7	859.2	438.6
1440	500.3	723.9	1210.7	1489.7	2062.2	1052.7
2880	0.0	183.9	670.7	949.7	1522.2	2105.3
Maximum	1017.8	1218.9	1615.7	1804.7	2062.2	**2105.3**

Table 4.3-2 Generating Equipment Site Attenuation Requirements

Time from Storm Commencement (mins)	Storm Event					
	M100-1 hour	**M100-2 hour**	**M100-6 hour**	**M100-10 hour**	**M100-24 hour**	**M100-48 hour**
0	0.0	0.0	0.0	0.0	0.0	0.0
5	16.0	9.2	3.3	1.7	0.0	0.0
10	31.9	18.5	6.5	3.4	0.1	0.0
15	47.9	27.7	9.8	5.1	0.1	0.0
30	95.8	55.4	19.5	10.2	0.2	0.0
60	191.5	110.8	39.1	20.3	0.4	0.0
120	169.0	221.7	78.1	40.7	0.8	0.0
240	124.0	176.7	156.3	81.3	1.5	0.0
360	79.0	131.7	234.4	122.0	2.3	0.0
600	0.0	41.7	144.4	203.3	3.8	0.0
1440	0.0	0.0	0.0	0.0	9.1	0.0
2880	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	191.5	221.7	**234.4**	203.3	9.1	0.0

Table 4.3-3 Access Road Extension Attenuation Requirements

Time from Storm Commencement (mins)	Storm Event					
	M100-1 hour	**M100-2 hour**	**M100-6 hour**	**M100-10 hour**	**M100-24 hour**	**M100-48 hour**
0	0.0	0.0	0.0	0.0	0.0	0.0
5	10.9	6.1	1.8	0.7	0.0	0.0
10	21.7	12.1	3.6	1.4	0.0	0.0
15	32.6	18.2	5.4	2.0	0.0	0.0
30	65.2	36.4	10.7	4.1	0.0	0.0
60	130.5	72.8	21.5	8.1	0.0	0.0
120	108.0	145.6	43.0	16.2	0.0	0.0
240	63.0	100.6	86.0	32.4	0.0	0.0
360	18.0	55.6	129.0	48.6	0.0	0.0
600	0.0	0.0	39.0	81.1	0.0	0.0
1440	0.0	0.0	0.0	0.0	0.0	0.0
2880	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	130.5	**145.6**	129.0	81.1	0.0	0.0

Table 4.3-4 Maintenance Yard Attenuation Requirements

Time from Storm Commencement (mins)	Storm Event					
	M100-1 hour	**M100-2 hour**	**M100-6 hour**	**M100-10 hour**	**M100-24 hour**	**M100-48 hour**
0	0.0	0.0	0.0	0.0	0.0	0.0
5	8.4	4.4	1.0	0.1	0.0	0.0
10	16.8	8.7	2.0	0.3	0.0	0.0
15	25.2	13.1	3.0	0.4	0.0	0.0
30	50.4	26.2	6.0	0.8	0.0	0.0
60	100.8	52.4	12.1	1.6	0.0	0.0
120	78.3	104.8	24.1	3.1	0.0	0.0
240	33.3	59.8	48.3	6.2	0.0	0.0
360	0.0	14.8	72.4	9.3	0.0	0.0
600	0.0	0.0	0.0	15.5	0.0	0.0
1440	0.0	0.0	0.0	0.0	0.0	0.0
2880	0.0	0.0	0.0	0.0	0.0	0.0
Maximum	100.8	**104.8**	72.4	15.5	0.0	0.0

Table 4.3-5 AGI Attenuation Requirements

5 WATERCOURSE CROSSINGS

5.1 ELECTRICAL CONNECTION

The underground cable connecting the power plant to the National Grid substation crosses a watercourse at the point indicated in Figure 5.1.

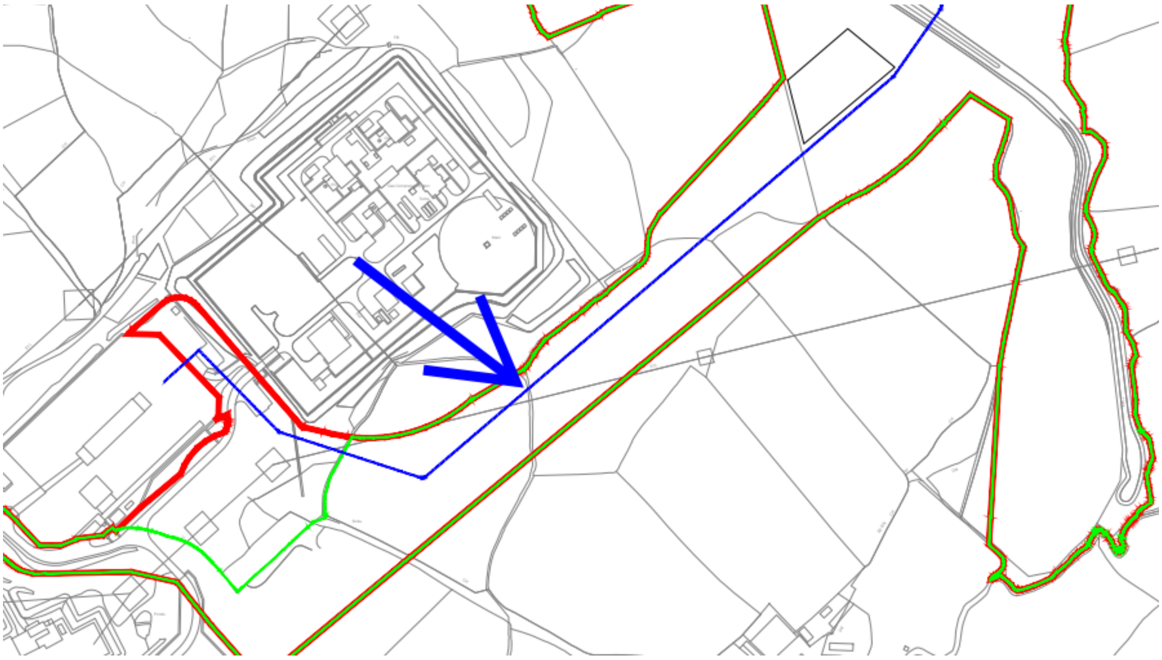


Figure 5.1. Location of crossing between the underground cable and a watercourse

Depending upon the size of the watercourse there are two methods that could be used to cross it with cables.

- Small watercourse crossing: The cables would cross under the watercourse using a concrete duct bank. The minimum depth of burial for the cables under the watercourse (in agricultural land this is normally 1050 mm to the top of the cables) would have to be maintained. To maintain the burial depth under the watercourse, the cable sections on either side of the water would have an increased burial depth and therefore the cable spacings would have to be increased to maintain the cable rating. The exact spacing required at the increased burial depth would be confirmed by calculation at detailed design stage.

  Whilst installing the duct bank it may be necessary to dam the watercourse on either side of the cable crossing and provide sufficient pumping to bridge this dammed section.

- Larger watercourse: The cables could cross under the watercourse using pipes installed by HDD (horizontal directional drills). Again, the minimum burial depth under the watercourse would be at least maintained, though it is likely that due to the operational requirements of installing the HDD the burial depth would increase (i.e. to a few metres). Therefore, the cable spacings would have to be increased to maintain the cable rating. The exact spacing required at the increased burial depth would be confirmed by calculation at detailed design stage.

5.2 GAS CONNECTION

The gas pipeline crosses a watercourse as indicated in Figure 5.2.

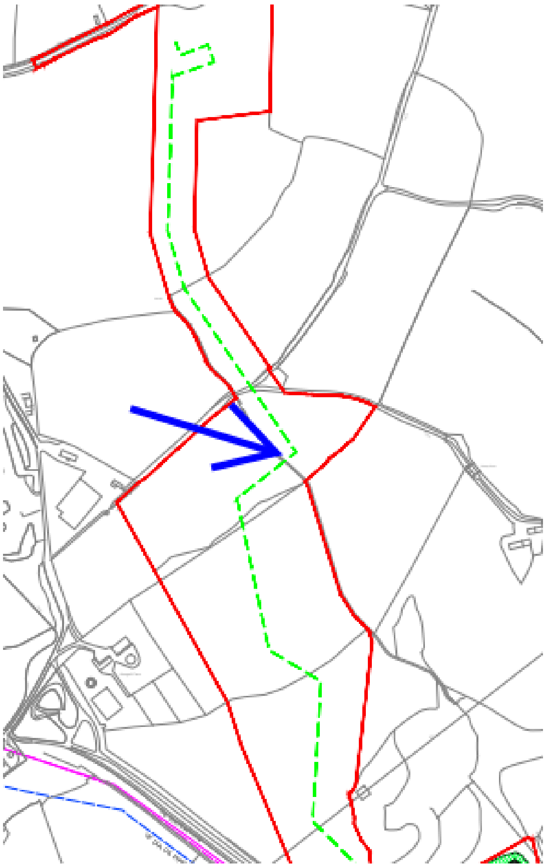


Figure 5.2. Location of crossing between the gas pipeline and a watercourse

This crossing is of a field drain and was identified by WSP during the Conceptual Design Study commissioned in 2014 for the gas connection. WSP would note that when the Route Walkover survey was conducted as part of the Conceptual Design Study it was found that this drain was dry. This crossing was originally flagged as requiring an open cut approach to installation, however due to its proximity to the nearby crossing of the gas National Transmission System pipelines, a trenchless approach may be preferred by the Main Works Contractor.

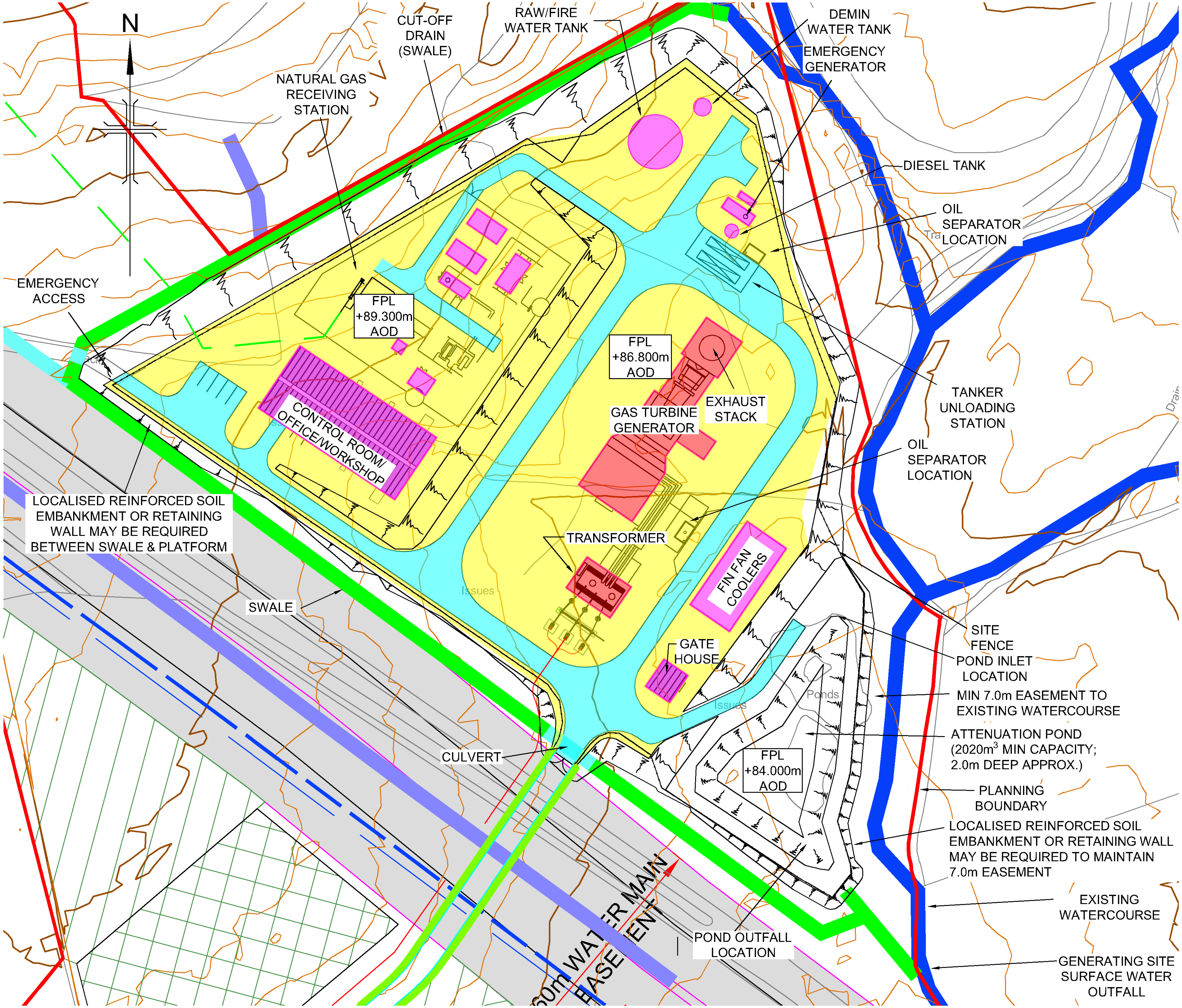
The crossing of the field drain will most likely be merged with the crossing of 3 National Transmission System (NTS) feeders just to the south-west of the drain. As part of the trenchless crossing of the 3 NTS feeders, the APL pipeline will need to be installed at sufficient depth to achieve at least a 300 mm separation between the APL pipeline and the existing feeders. Therefore, a similar separation should be anticipated for the separation between the drain and the APL pipeline.

If the drainage asset owner requires a specific separation to be maintained between the true clean bottom of the drain and the APL pipeline (which is beyond the expectations of the primary design code, of no less than 300 mm), then this can be considered and included in the tender documents for the Main Works Contractor. This separation will be achieved by a trenchless technique which is yet to be determined. The most likely approach will be either an Auger Bore or a Horizontal Directional Drill (HDD), either approach can reach depths well in excess of 1 metre and therefore achieving a sensible depth under the drain is feasible.

6 CONCLUSION & RECOMMENDATIONS

The guidance within this report should be used as a basic methodology for development of the detailed Abergelli site foul, oily water and storm water drainage design in accordance with the appropriate design codes and standards.

Appendix A



KEY TO COLOURED HATCH

- BUILDINGS ($1,825m^2$)
- ROADS & CAR PARKING ($4,478m^2$)
- OILY WATER AREAS ($985m^2$)
- GENERAL SITE AREAS ($14,239m^2$)
- WATER MAIN EASEMENT ZONE

wsp

TITLE: ABERGELLI POWER GENERATING EQUIPMENT SITE RUNOFF CATCHMENT AREAS

FIGURE No: 70034053-SK-C-001

File name C:\USERS\CHRISTOPHER.MOORE\DOCUMENTS\WSP-PB\ABERGELLI POWER LTD\DRAINAGE AREAS 20180227 WIP5.DWG, printed on 07 March 2018 11:01:02, by Moore, Chris