

Technical Appendix 10.2:
Flood Risk and Drainage Assessment

Flood Risk & Drainage Assessment

Carnbuck Wind Farm

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1 INTRODUCTION

1.1 Terms of Reference

This Flood Risk and Drainage Assessment has been commissioned by RES, to support a planning application for the proposed development of a wind farm known as Carnbuck near Clogh Mills, Co. Antrim.

The purpose of this assessment is to address Revised Planning Policy Statement 15 (PPS15). The assessment will therefore determine potential sources of flooding at the site and their associated risk to life and property; and shall discuss the site suitability for development and outline proposed design and mitigation measures where appropriate.

1.2 Statement of Authority

This report and assessment have been prepared and reviewed by qualified professional civil engineers, specialising in the fields of hydrology, drainage and flood risk as required by DfI Rivers. The key staff members involved in this project are as follows:

- Iain Muir MSc CEnv MIEEnvSc – Senior Project Consultant and Chartered Environmentalist specialising in environmental assessment and applied hydrology, and particular experience in fluvial flood hydrology and modelling.
- Kyle Somerville BEng (Hons) CEng MIEI – Director and Chartered Engineer specialising in the fields of flood risk assessment; flood modelling, drainage and surface water management design.

1.3 Approach to the Assessment

Consideration has been given to the sources and extent of fluvial and tidal flooding at the site, as well as flooding of the site from pluvial sources, infrastructure failure, overland flow, and ponding of localised rainfall within the site. The assessment is intended to be proportionate to the scale and nature of the development and the perceived risk to it.

For the purposes of this study the following have been considered:

- Available information on historical flooding in the area.
- Site level information based on a high resolution digital terrain model;
- Detailed assessment of potential flooding from rivers, including fluvial flood modelling;
- Assessment of potential flooding to the site from overland sources;
- Assessment of potential flood risk to adjacent lands caused by development at the site; and
- Determination of the availability of safe discharge of surface water from the site.

Further guidance is also provided in the CIRIA Research Project 624 “Development and Flood Risk: Guidance for the Construction Industry” and Revised Planning Policy Statement 15 (PPS 15) – Planning and Flood Risk.

1.4 Application Site

The development and application site lies within a surveyed site comprising a wider landholding (lands under applicant control). The “site” referred to in this assessment is the land within a preliminary survey boundary.

The site is located on elevated land north-west of Clogh Mills.

Site context and location are shown on the drawings submitted in support of the application.

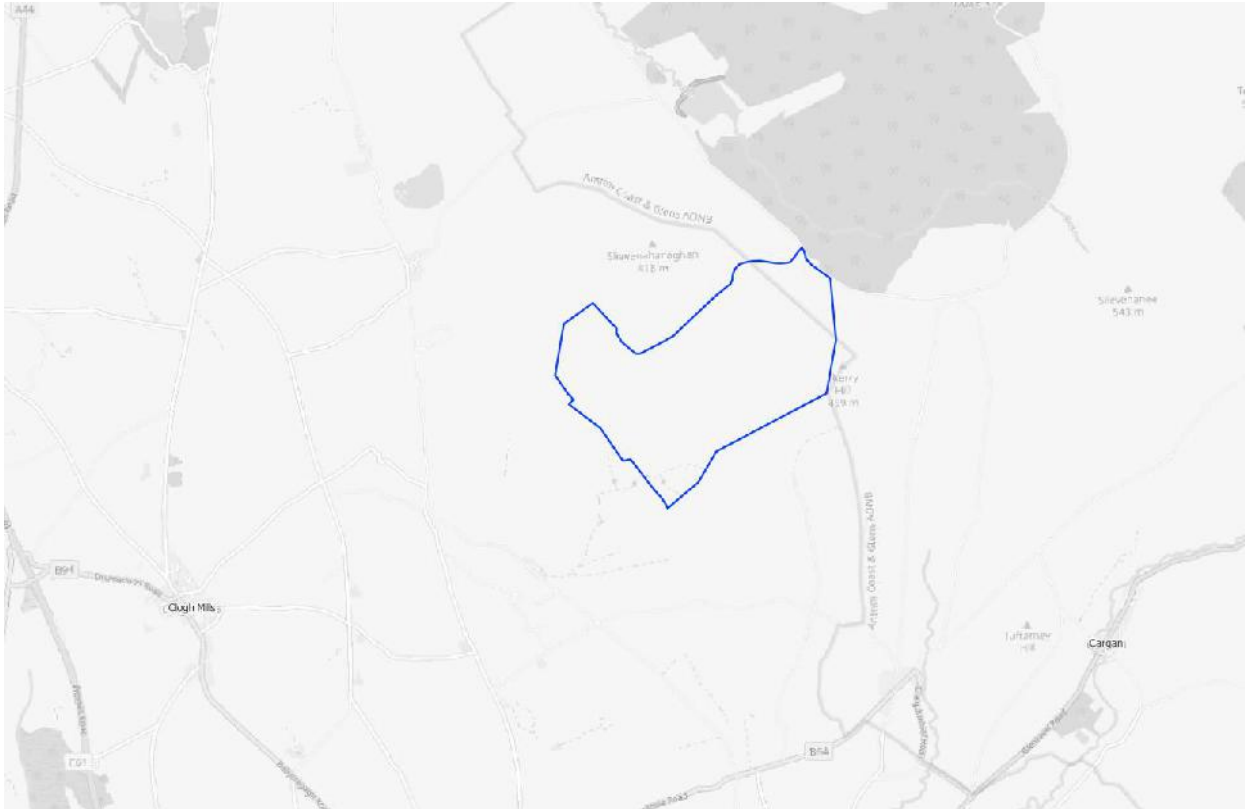


Figure 1-1 Site Location

1.4.1 Existing Land Use

The surveyed site comprises part of the existing Grug Wind Farm and adjacent undeveloped land used for agricultural grazing. The site is accessed from Altnahinch Road to the north.

1.4.2 Proposed Development

The proposed development involves the construction of 12 no. wind turbines with associated permanent unbound gravel track for access and egress, associated site infrastructure including a control building / substation, and permanent drainage features. The development includes the structural upgrade of an existing track at Grug Windfarm, however there is no effect to drainage or impermeable area.

The proposed development footprint within the site is shown on the following figure.

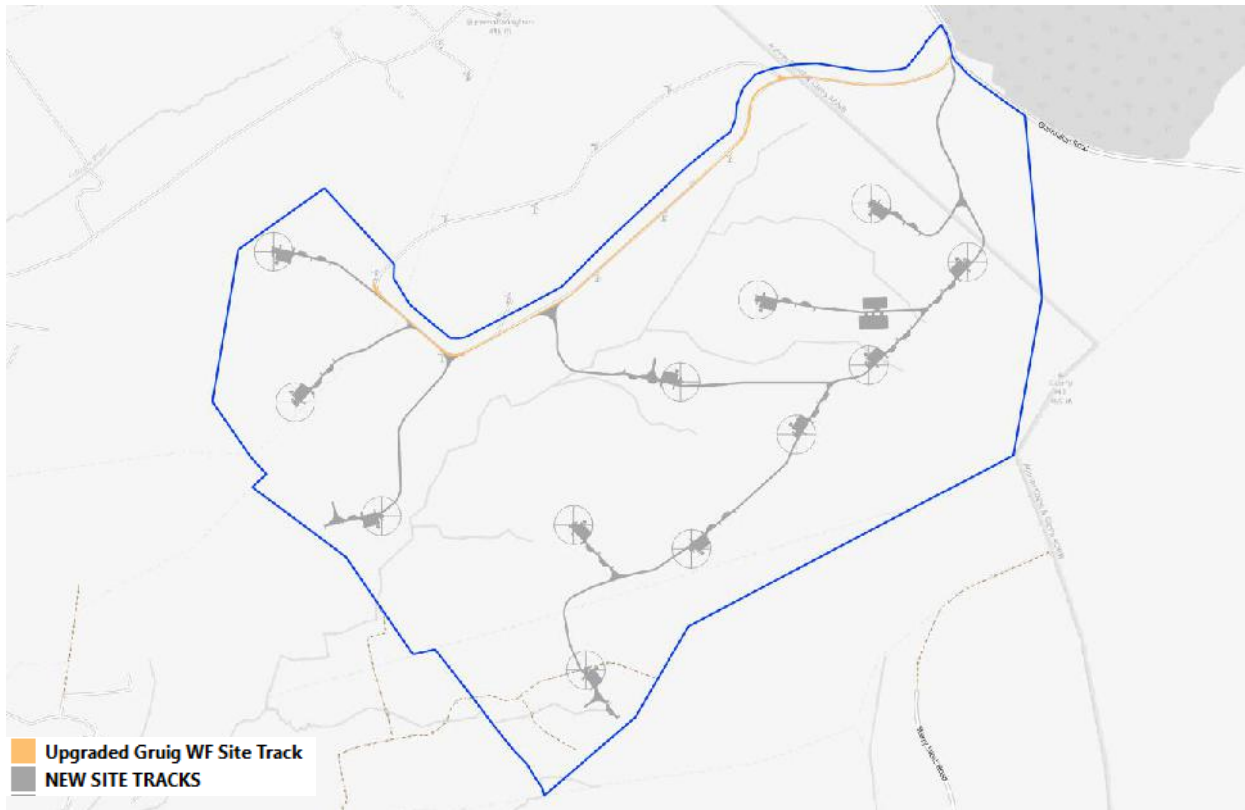


Figure 1-2 Proposed Site Layout

1.5 Site Characteristics

Site characteristics are more fully described within the Geology and Water Environment chapter within the Environmental Statement that this assessment is intended to support. Those aspects pertinent to flood risk and drainage are highlighted in the following sections.

1.5.1 [Topography](#)

Topography derived from the OSNI NI 10m DTM is shown on the following figure.

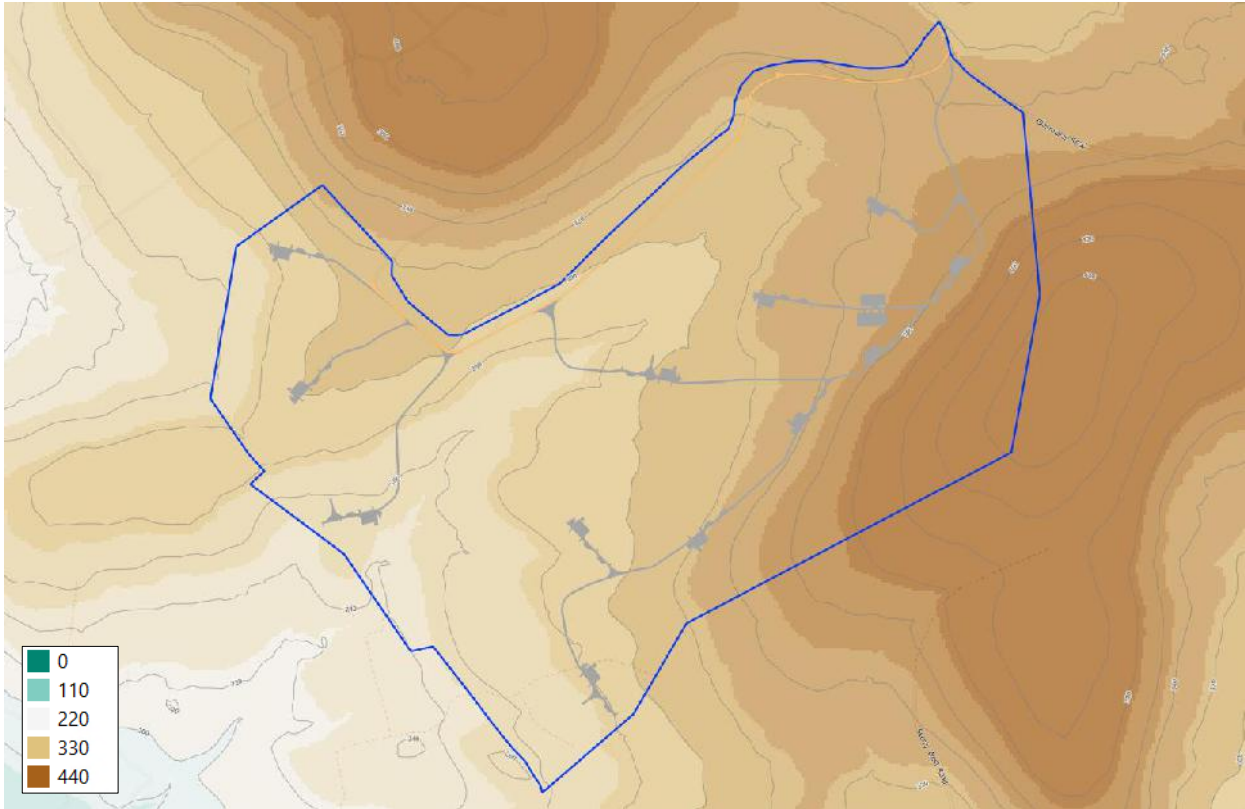


Figure 1-3 Site location and Topography

1.5.2 Hydrology and Watercourses

There are no watercourses designated under the Drainage Order on the site. Undesignated / minor drainage has been mapped to inform the Environmental Statement.

The hydrology in the areas where development is proposed falls across 4 primary drainage basins defined by the Water Framework Directive. The majority of the site drains west and south to the Cloghmills Water, and the west of the site drains west to the Killagan Water; both rivers drain to the River Main. Site access infrastructure drains north to catchments of the River Bush.

Watercourses, peat / land drainage and field boundary drainage, have been mapped as part of the wider hydrological assessment. Main water features on and adjacent to the site are shown on Figure 1-4. A detailed hydrology map is included at Appendix A (which is a duplicate of EIAR Figure 10.1).

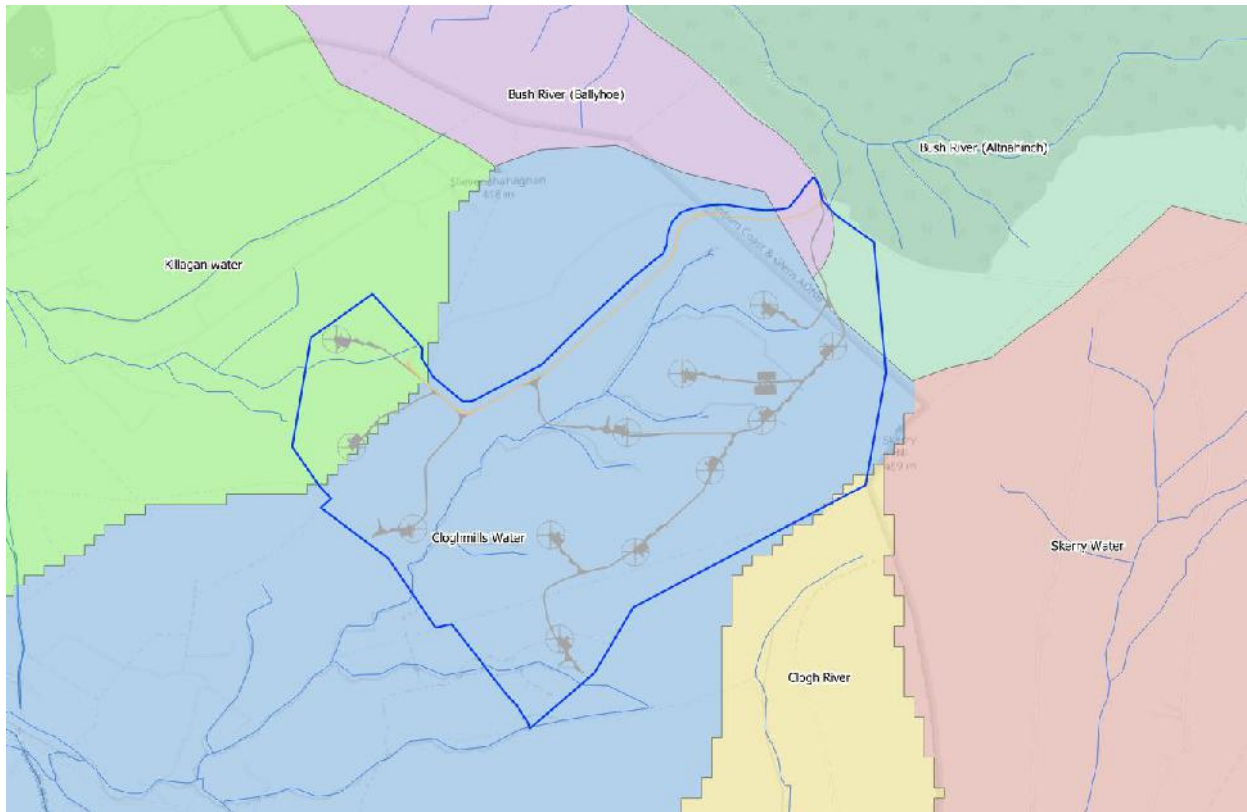


Figure 1-4 Site Hydrology

1.5.3 Geology

A review of GSNI geology data¹ has been undertaken to inform this assessment. Underlying superficial site geology based on GSNI 10k mapping is shown on the following figure. A refined description of ground cover is contained in the Environmental Statement.

¹ Department for the Economy. GSNI GeoIndex. Available from: https://mapapps2.bgs.ac.uk/GSNI_Geoindex/home.html. [Accessed: 28/1/2020].

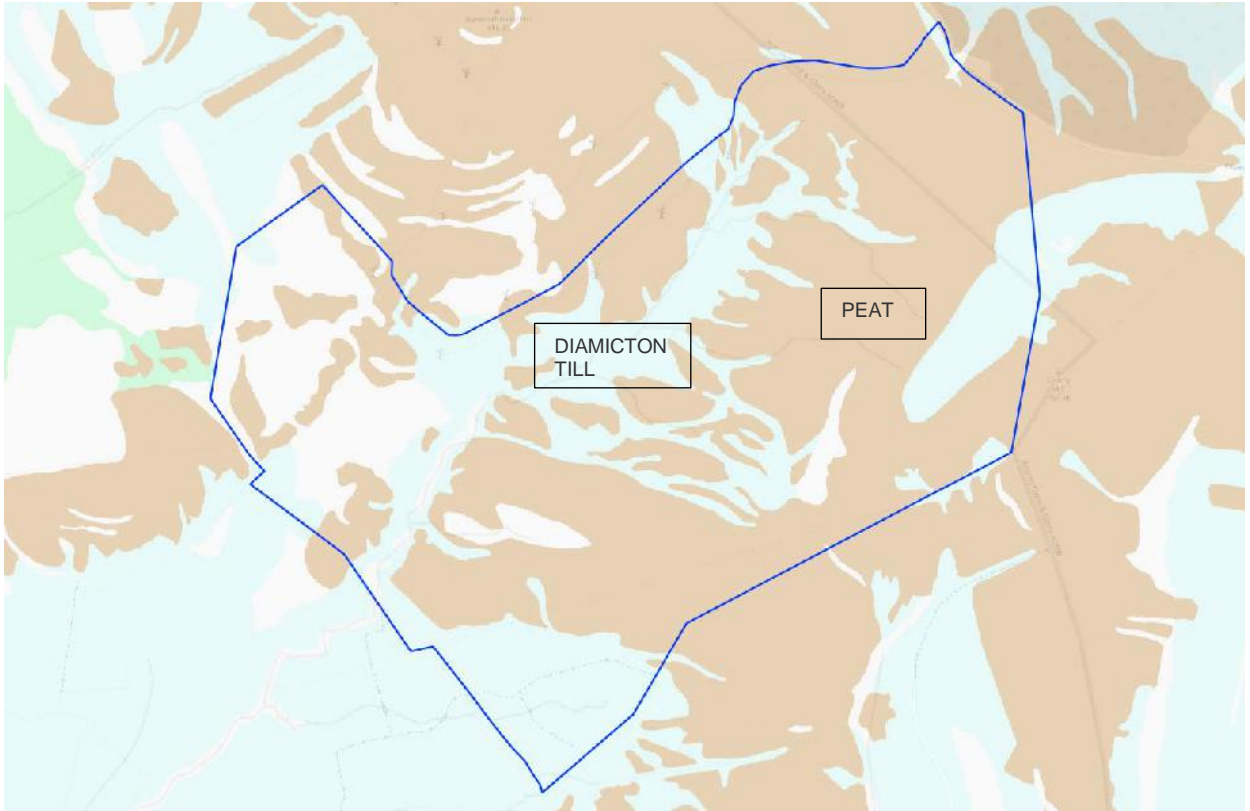


Figure 1-5 GSNI 1:10K Superficial Cover

2 BACKGROUND INFORMATION REVIEW

As part of the data collection phase, several sources of information were investigated to develop an understanding of the potential site flood risk. The following review highlights the findings of the anecdotal evidence collection exercise.

2.1 Internet/Media/Background Search

Preliminary consultation with online media sources indicates that there are no recorded flood incidents which have affected the site.

2.2 Northern Ireland Water

Review of asset information confirms that there are no NIW water supply or drainage assets within or proximal to the site and no further consideration has been given to flooding from such artificial sources.

2.3 DfI Rivers

2.3.1 [Flood Maps NI](#)

The extent of development was reviewed with reference to Flood Maps (NI). Information obtained from flood maps is summarised as follows:

- There is no record of historic flooding within or in proximity of the proposed development.
- DfI Rivers indicative fluvial flood maps – present day indicates that a reach coinciding with a headwater of the Cloghmills Water is affected by the indicatively modelled 1% AEP fluvial flood extents.
- DfI Rivers indicative surface water flood maps – present day indicates that parts of the site are affected by the indicatively modelled 0.5% AEP surface water flood extent. Flooding generally coincides with the routes of watercourse.
- The DfI Reservoir inundation maps confirms that the site is unaffected by the inundation zone of any controlled reservoir.

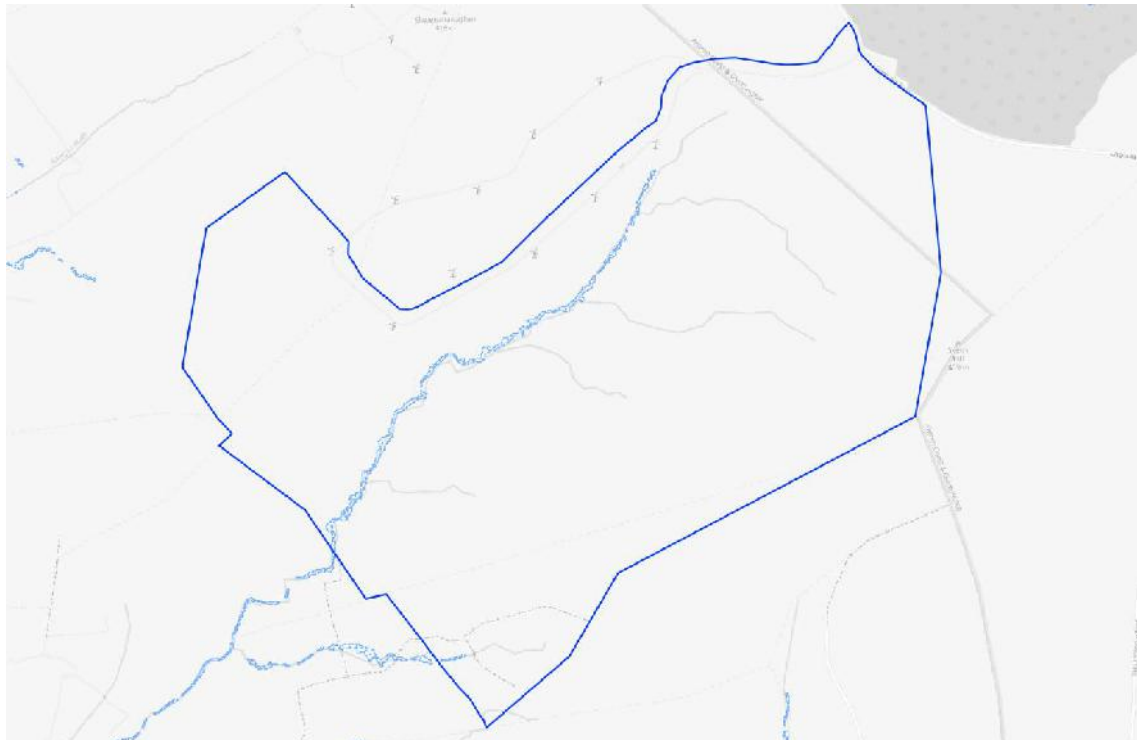


Figure 2-1 Extract from Flood Maps NI – Indicative 1% AEP Fluvial Flood Extent

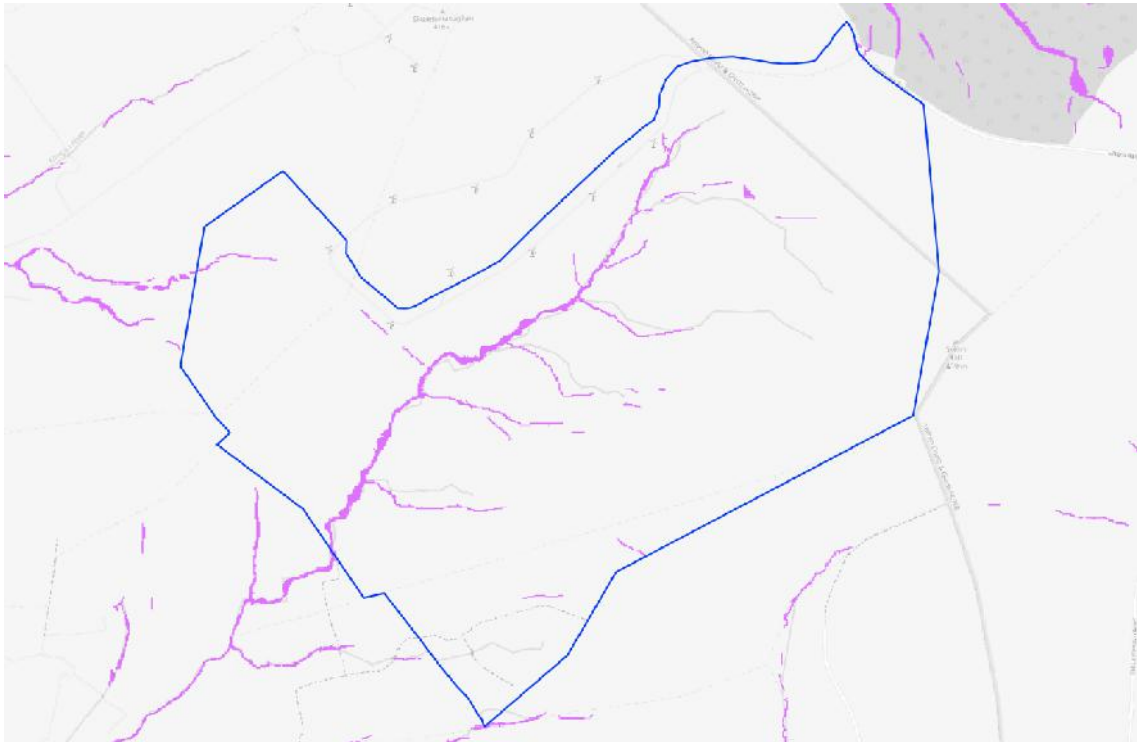


Figure 2-2 Extract from Flood Maps NI - Indicative 0.5% AEP Surface Water Flood Extent

3 FLOOD RISK ASSESSMENT

3.1 Initial Assessment

The following flood mechanism and policy screening is undertaken based on the initial information obtained and in the absence of any pre-application DfI Rivers Planning Advisory consultation response.

Table 3-1 Potential Flood Mechanism and Policy Screening

Policy	Flood Mechanism	Initial Assessment	Policy Applies?	Assess further?
FLD 1 - Development in Fluvial & Coastal Flood Plains	Fluvial Flooding	The site is affected by fluvial flooding shown on FMNI. Locations where development is proposed coincide with proposed watercourse crossing at access tracks.	Yes	Yes
	Coastal Flooding	The site is unaffected by coastal flooding shown on FMNI.	No	
	Flood Defence / Failure	The site does not lie in a defended area.	No	
FLD 2 - Protection of Flood Defence & Drainage Infrastructure	Development near drainage or flood defence assets	The proposed development is located adjacent to and crosses several watercourses and minor drains.	Yes	Yes
FLD 3 - Development and Pluvial Flood Risk Outside Flood Plains	Surface water flooding	Predicted surface water flooding shown on FMNI coincides with watercourses and is more appropriately assessed as fluvial.	No	Yes
	Surface water discharge	The development would potentially modify surface water run-off characteristics onsite/offsite. The scale and nature of the proposal triggers the need for a drainage assessment; development is required to demonstrate that safe discharge of surface water is feasible.	Yes	
	Culvert Blockage	No existing culverted watercourses have potential to affect the site in areas that would be of concern in relation to flood damage to the proposal.	No	
	Urban Drainage / Local Drainage Failure	No record of local drainage failures.	No	
	Groundwater	Not for consideration due to underlying geology and soil types.	No	
FLD 4 - Artificial Modification of Watercourses	Development affecting watercourses	The development shall involve several crossings of undesignated watercourses and field drains to permit access.	Yes	Yes
FLD 5 - Development in Proximity to Reservoirs	Reservoir Flooding	The site is not located within a reservoir inundation zone.	No	No

3.2 Fluvial Flooding

3.2.1 Background – Indicative Floodplains

Review of Flood Maps (NI) indicates that the undesignated Cloghmills Water has been indicatively modelled within and proximal to the Application Site. The flooding affects areas where access tracks are proposed to cross the watercourses and floodplains. No development is planned in affected areas other than watercourse crossings where tracks are required for access.

A more robust site-specific river model, suitable to the scale and nature of the proposed development, has been prepared using high resolution DTM to allow design and evaluation of crossing options given spate upland rivers can characteristically spread over a broad valley floor from a small base channel. Flood mapping produced is intended to supersede the indicative model predictions within the application site.

3.2.2 Existing 1% AEP Flood Extent

Site-specific hydraulic modelling of the undesignated watercourses undertaken (See Appendix D for methodology and detail) indicates) 1% AEP flooding broadly consistent with that shown on Flood Maps NI.

Due to expected climate change impacts, the application of the precautionary approach requires any assessment of flood risk to incorporate the necessary allowances for increased rainfall, storminess and sea level rise (where appropriate) specified in current UK research and guidance. As per DfI guidance², an climate change has been derived through modelling an increase of current design flows by 20%.

In this instance (given primary driver is sizing of culvert openings), flooding for Present Day hydrology has not been assessed and the effect of climate change is included in the flood levels and flood mapping shown on the preceding figure and all subsequent figures. The 1% AEP flood extents applicable to policy FLD 1 is shown in Figure 3-1.

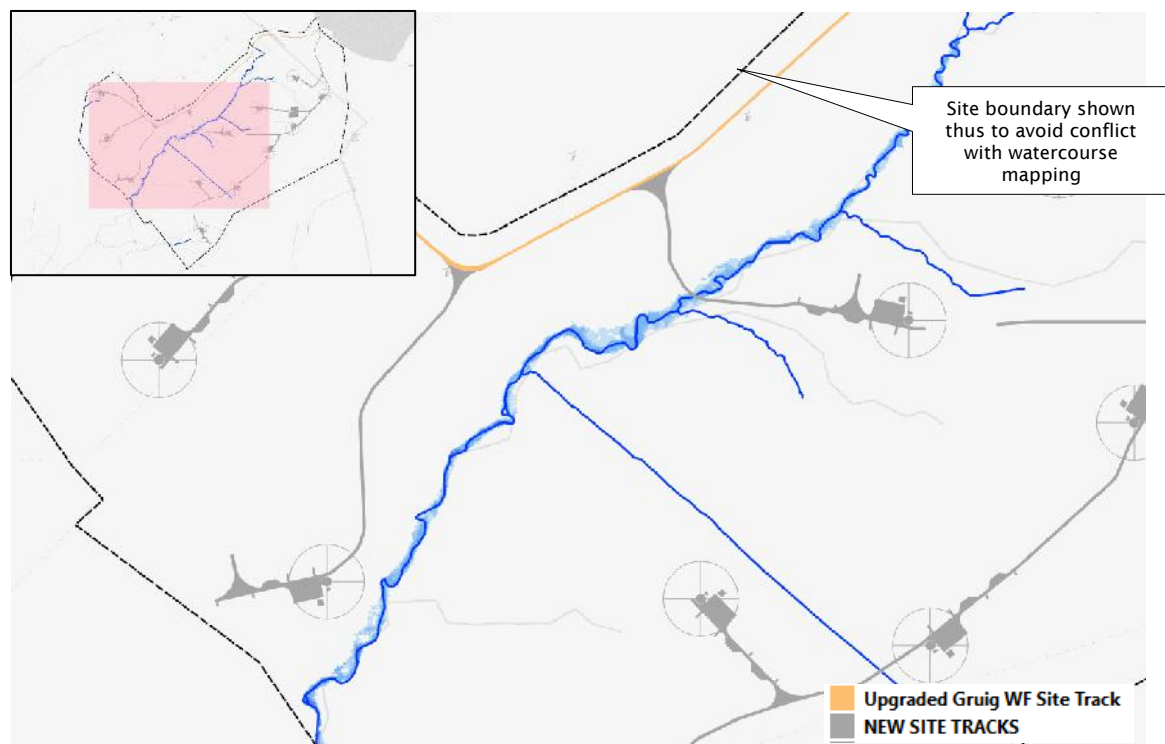


Figure 3-1 1% AEP Flood Extent – Existing Scenario

² DfI. (2019). Technical Flood Risk Guidance in relation to Allowances for Climate Change in Northern Ireland. Available from: [link](#).

Detailed flood extents mapping is provided in Appendix G. Mitigation of risk to the development adjacent to or crossing the floodplain is stated in Section 4.2.

3.2.3 Effect of the Development

The proposed access tracks must cross the undesignated watercourse to permit access throughout the site area. The number of crossings have been minimised and have sought to avoid complex meandering reaches which would cause a complex extended culvert or need for a diversion / realignment of the watercourse.

There are thirteen culverts of which one is a significant crossing on the Cloghmills Water where fluvial flood mapping is shown on Flood Maps NI. Other watercourse crossings are not significant in flood risk and planning terms and cannot have a significant effect on flood risk, and their design is deferred post-planning consent subject to normal requirements for DfI Rivers authorisation.

Due to the larger scale of the significant Cloghmills Water crossing, the effect of the proposed development (track geometry and proposed culvert opening) has been assessed by incorporating the track alignment as raised embankments within the model geometry and testing river culvert dimensions until a satisfactory outcome was resolved that complies with normal culvert design and flood protection standards.

The proposal has targeted the following standard:

- Main channel culvert / bridge sized to accommodate the in-channel 1% AEP + Climate Change flow with min. 0.3m freeboard between inlet top water level to culvert soffit, per CIRIA C689 Culvert Design and Evaluation Guide. The culvert span is informed primarily by environmental protection standards which seek to maintain the stream banks and bed intact.
- While causing no change to upstream water levels is not viable without bridging the whole floodplain, then the proposal has sought to cause an upstream effect not greater than approximately +0.3m, the effect of which is contained entirely within lands under control of the applicant.

The outcome of the analysis and design is scheduled in the following table. Pre-/Post-development flood extent mapping is included at Appendix G.

WX	Upstream 1% AEP + CC Flood Level		Effect (m)	Proposed Solution
	Pre-Development	Post Development		
01	271.87	272.14	0.27	Bottomless culvert with span 3.0m, height 1.5m and soffit not less than 272.44 m OD.

Modelling confirms no significant effect on flooding elsewhere, with any localised effect contained immediately proximal to the proposed infrastructure and within lands under control of the applicant. No further mitigation (in the form of floodplain reprofiling) is necessary to mitigate any effect elsewhere.

3.2.4 Risk to the Development

All development other than unavoidable watercourse crossings is sited outside of floodplains and away from watercourses.

All development adjacent to floodplains and proposed track crest levels and any other proposed infrastructure adjacent to watercourse crossings shall be sited at a level greater than the adjacent 1% AEP Climate Change flood level (per mapping shown at Appendix G, ideally including 0.6m freeboard, and as such will have an appropriate standard of flood protection.

3.3 Surface Water

3.3.1 Effect of the Development

The proposed development shall lead to an increase in the impermeable area of the site. Therefore, the risk of flooding from surface water run-off from the site shall be greater relative to the existing scenario without appropriate mitigation.

An estimate of the unmitigated post-development run-off for the footprint of the proposed development has been made as part of this assessment. A comparison of existing and proposed run-off rates in litres per second (lps) are provided in Table 3-2.

Table 3-2 Comparison of surface water run-off rates (Peak [1hr] Runoff rates)

Return Period	Existing Site (l/s)	Proposed Site (l/s)	Increase (l/s)
1 in 2 year	116	175	59
1 in 30 year	201	499	298
1 in 100 year	239	677	438

3.3.1.1 Potential for Overland Flooding

The site setting is rural, and the proposal is unlikely to cause any significant direct risk of surface water flooding to any receptor downgradient.

Routing of overland flooding from the site has been determined based on a “rolling ball” hydrological analysis, the outcome of which (showing key overland flow routes) is shown on Figure 3-2. That analysis tends to confirm that all runoff from the site will be intercepted by the watercourse network prior to causing any effect of adjacent land.

Mitigation of surface water flood risk to adjacent lands shall be by provision of an adequate drainage system, see Section 4.2.3.

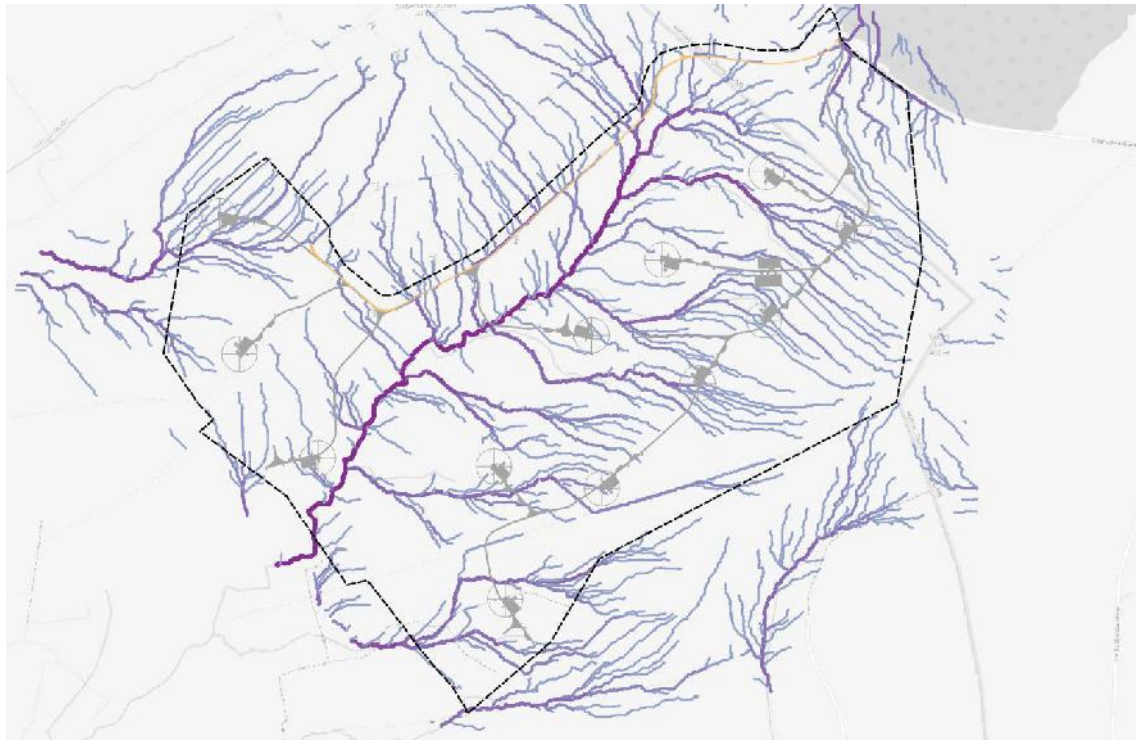


Figure 3-2 Indicative Overland Flow Path

3.3.1.2 Effect on Downstream Watercourses

All runoff from the site will drain to downstream watercourses lands under control of the applicant.

The effect of the development has been assessed as causing an increased rate and volume of run-off. To mitigate this effect, it is proposed to use a rural SuDS approach to encourage dispersal of runoff over the site and discourage point discharges to watercourses; and to limit run-off from direct discharges to watercourses to a greenfield equivalent pre-development run-off rate.

Point discharges to watercourses will be attenuated to the DfI Rivers greenfield rate up to the 1% AEP + Climate Change. DfI Rivers consent for point discharges has been determined in parallel with submission of the planning application – refer to Rivers consent ref IN1-22-6412 (copy in Appendix C).

Requirements for the attenuation and discharge of surface water based on the proposals at the site are discussed in Section 4.2.

4 SUMMARY OF FINDINGS AND RECOMMENDATIONS

4.1 Summary of Findings

Parts of the site are affected by the 1% AEP fluvial flood extents which are associated with out of bank flooding from undesignated watercourses comprising the upper reaches of Cloghmills Water.

An assessment of fluvial flooding undertaken. No development is sited within the fluvial floodplain other than a proposed track watercourse crossing required to permit access. The proposed development has been assessed and determined to cause no adverse effect outside lands under control of the applicant. No other significant flood risk has been identified.

The proposed development causes an increase in peak rate and volume of runoff from the site. Mitigation of surface water flood risk to the development, by providing an adequate drainage system, is discussed below.

4.2 Design Measures

This section details measures which have been incorporated into the proposal submitted in support of the planning application, and to be further developed in any detailed design or variation post-determination of the planning application.

4.2.1 Track Levels

Finished track levels adjacent to watercourse crossings where fluvial flooding has been assessed in detail shall be sited at a minimum level of the adjacent 1% AEP Climate Change flood level + 0.6m freeboard, to comply with DfI Rivers standard recommendations. Adjacent flood levels are shown on maps at Appendix G.

All other infrastructure is sited sufficiently remotely from watercourses that no minimum design levels apply.

4.2.2 Watercourse Crossings

The development shall involve the installation of piped crossings for thirteen features locations across the site to permit access, comprising of 2 no. significant watercourses (i.e. catchment areas >0.25 km²) and 11 no. minor watercourses. Watercourses vary from headwater channels to substantial upland streams with bed widths >2m.

The nature of the crossing proposed (i.e. closed culvert or clear span) is dictated by other overriding environmental factors (fisheries and habitats requirements) and the need to avoid in-stream works where applicable.

A detailed schedule of culvert crossings and the watercourses affected is included at Appendix H.

4.2.2.1 Culvert Crossings

Where no requirement for fish passage has been identified within the site-specific fisheries assessment included in the Environmental Statement, piped crossings on these 12 no. watercourses shall be designed as to mitigate potential for flooding of infrastructure. Culverts shall be designed to have free inlet conditions for an appropriate flood design standard, nominally 1% AEP / 1-in 100 years with climate change allowance or as may otherwise be required by DfI Rivers in consultation.

Any crossings required shall be designed to accommodate track crossings whilst limiting the length of the channel affected.

Hydraulic design of crossings shall be undertaken as per the guidance and requirements provided in CIRIA C689 "Culvert Design and Operation Guide" (or other standard as may be required by DfI Rivers in post-consent consultation), with primary parameters likely to include:

- Width of the crossing will be greater than the width of the active drainage channel.

- Alignment of the crossing will suit the alignment of the drainage channel i.e. preserve the existing direction of flow.
- The slope of the crossing will not exceed the slope of the bed of the existing channel.

Proposed culverts shall be subject to future approval from DfI Rivers through a Schedule 6 application, under the Drainage Order (NI) 1973. The locations affected are not located in any floodplain and are of a conventional nature and there is no significant potential for the culverts in themselves to cause a new flood risk requiring consideration as part of this flood risk assessment. As such detailed design and consent for those crossings is not material to determination of an associated planning application and can satisfactorily be deferred post-consent of the application.

4.2.2.2 Clear Span Crossing

The crossing over the Cloghmills Water is sited on a floodplain and as such its effects are of material consideration in terms of this flood risk assessment, and so have been considered and assessed in further detail.

The proposed structure, which complies with and exceed the minimum standards stated in Section 4.2.2.1 for minor watercourse crossings, is shown on drawings included in Appendix B. There is sufficient information in this FRA to allow the conclusion that the proposed structure is satisfactory from a flood risk point of view and that the planning application can be determined without DfI Rivers Schedule 6 consent in place.

The culvert shall be formed from precast portal frame sections or similar. The section heights shall be dictated by the structural and foundation / formation design and the minimum soffit height determined by this assessment.

4.2.3 Drainage Design

Drainage is to meet or exceed the hydraulic standards stated as follows:

- | | |
|--|--|
| <ul style="list-style-type: none"> • The drainage network / site layout ensures containment and control of the 100-year (1% AEP) return period storm within the site to ensure no offsite effect elsewhere. • The drainage network allows for a 20% allowance for climate change for the flood protection standard. | To suit DfI Rivers flood protection standards. |
|--|--|

Due to the nature of the development, a formalised conventional drainage system is not considered feasible or practical at the site. The design principles in summary are as follows:

- Runoff from the access track shall be collected via open swales. Run-off shall be attenuated with the use of check dams to reduce the peak rate of run-off and to encourage infiltration of surface water.
- Settlement/attenuation basins will be provided where drainage from significant areas of hardstanding discharge directly to streams and watercourses.
- If feasible at detailed design, run-off should be encouraged to discharge overland, rather than accumulate concentrated peak flows to discharge to watercourses.

The drainage networks should also allow for a 20% allowance for climate change at all the above listed return periods. SuDS features shall be designed in accordance with best practice guidance in The SuDS Manual (Document ref: C753; CIRIA).

4.2.3.1 Discharge Rate and Location

To demonstrate that the safe discharge of surface water from the proposed wind farm site is feasible, a preliminary drainage design has been prepared and is included in Appendix B. The proposal involves surface water from the proposed development discharging directly to the existing on-site watercourses and field drains, at the 9 no. locations indicated on the drainage design.

Point discharges to watercourses will be attenuated to the Dfl Rivers greenfield rate up to the 1% AEP + Climate Change. Dfl Rivers consent for point discharges has been determined in parallel with submission of the planning application – refer to Rivers consent ref IN1-22-6412 (copy in Appendix C).

Surface water run-off shall be limited as closely as feasible to the greenfield run-off rate of 10l/s/ha for the developed site area.

4.2.3.2 *Attenuation Requirement*

The indicative drainage design shown intends surface water from the site to discharge into 16 no. attenuation basins at locations adjacent watercourses and field drains. Flows controls shall be installed at the pond outflow points to ensure that flows are discharging to watercourses as per Table 4-1.

The storage calculation has not included the storage provided within the drainage conveyance system i.e. by checkdams in swales, and loss of water by overland dispersal. The attenuation sizes required are therefore considered highly conservative. Attenuation calculations demonstrate that the following is required:

Table 4-1 Attenuation Requirements

Catchment	Comment	Drainage area (m ²)	Attenuation storage required (m ³)	Allowable run-off rate (l/s)
1	Discharge to drain / watercourse	4333	128	4.3
2	Discharge to drain / watercourse	9157	270	9.2
3	Discharge overland over heath	4690	138	4.7
4	Discharge to drain / watercourse	4477	132	4.5
5	Discharge overland over heath	5905	174	5.9
6	Discharge to drain / watercourse	5697	168	5.7
7	Discharge to drain / watercourse	9518	281	9.5
8	Discharge to drain / watercourse	2535	75	2.5
9	Discharge to drain / watercourse	5824	172	5.8
10	Discharge overland over heath	4300	127	4.3
11	Discharge to drain / watercourse	2620	77	2.6
12	Discharge overland over heath	8541	252	8.5
13	Discharge overland over heath	5631	166	5.6
14	Discharge overland over heath	5129	151	5.1
15	Discharge to drain / watercourse	3325	98	3.3
16	Temporary basin - discharge overland over heath	4790	141	4.8
TOTAL		8462 sq m	2550 cu.m	86.5 lps (equivalent to 10 lp/Ha)

The attenuation volume stated is based on preliminary information; drainage catchments are subject to change dependent on the finalised layout of any drainage layout and finished ground levels. Volumes stated are dependent on the type and efficiency of the flow control method used. Ultimately the final design (to be completed and agreed post-consent) must comply with the limiting discharge rate (per hectare) applied to the drained development area.

The location of attenuation basins / configuration can be viewed in drawings included in Appendix B.

4.2.3.3 Exceedance

In the event of an unprecedented flood, any attenuation pond is expected to overtop and drain overland.

It has been demonstrated that flows from the site up to the flood protection design standard (1 in 100 year/1% AEP) can be safely contained within the system without flooding. Runoff in the event of other exceedance (i.e. blockage or other failure) will tend to follow flow routes tending towards the south/south west of the site as per the present day scenario (refer to Figure 3-2.)

Mitigation of such exceedance shall be by robust maintenance of the drainage network described subsequently.

4.2.4 Protection of Watercourses

The proposal includes measures that prevent development within 10m of minor watercourses and 50m of hydrologically significant water features, which ensure that the requirements of policy FLD2 are met. The nature of the proposal causes no built development of a type that would impede riparian maintenance of watercourses, and as such meets the normal requirements stated in policy FLD2 in relation to watercourse maintenance.

4.3 Maintenance Requirements

4.3.1 Drainage System Maintenance

The developer/site operator is to ensure that the maintenance of the drainage system is included within the overall management plan for the site. Detailed drainage layouts for the site shall ensure that key features requiring maintenance (e.g. flow control devices) are in accessible locations.

Maintenance plans for SuDS are to include (where applicable):

- Cyclical (min. annual, or after significant storm event) check of any flow control device for damage, debris, or blockage.
- Seasonal maintenance of any surface water feature e.g. swales/ponds – nominally to include management of vegetation, clearing of obstructions, etc.

4.3.2 Drainage Feature Maintenance

The operator is reminded of their statutory obligations set out in the Drainage (Northern Ireland) Order 1973 in relation to their role as a riparian landowner to the watercourses and field drains located on site.

4.4 Flood Risk & Planning Policy Summary

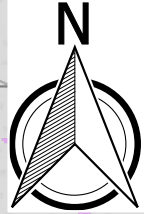
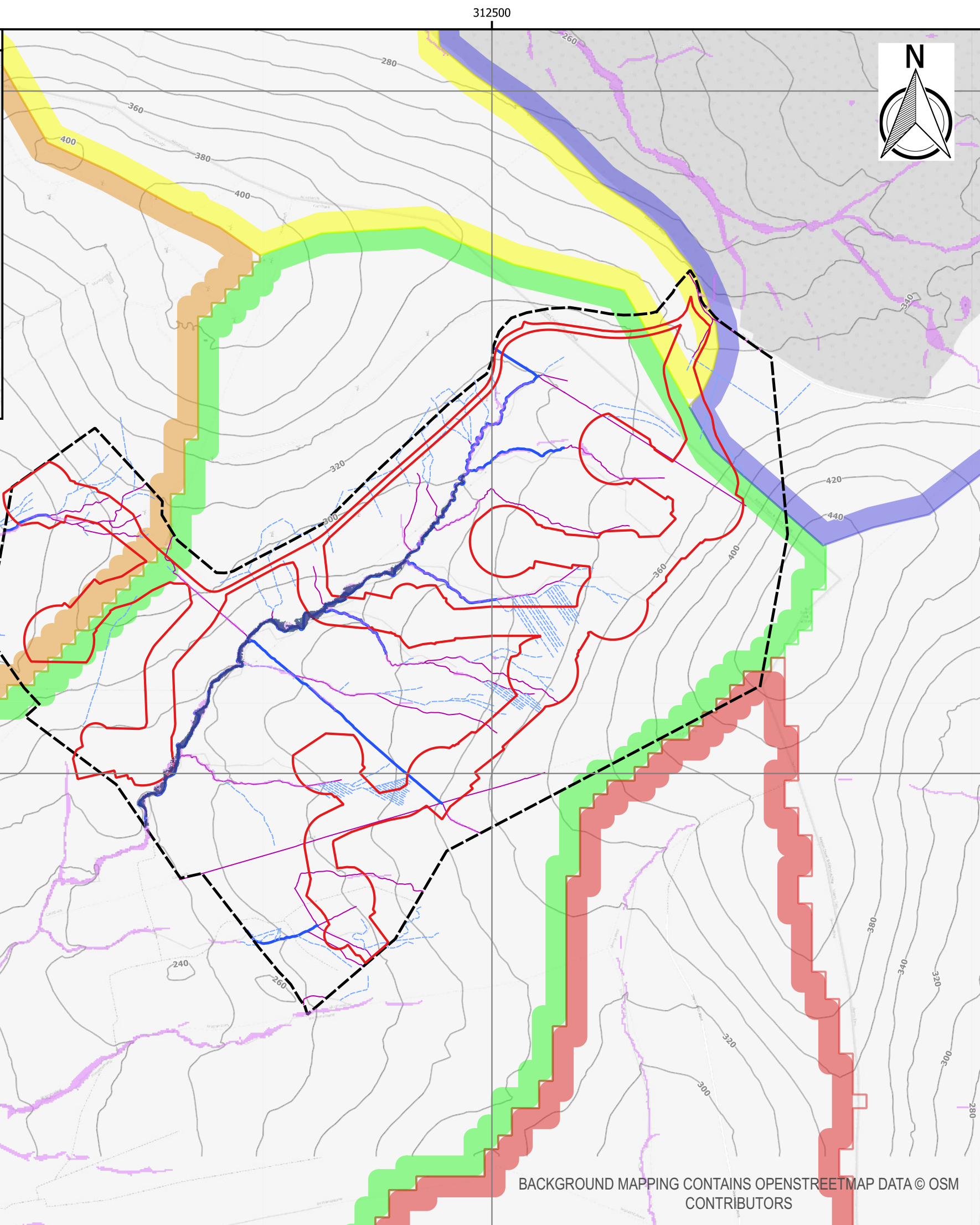
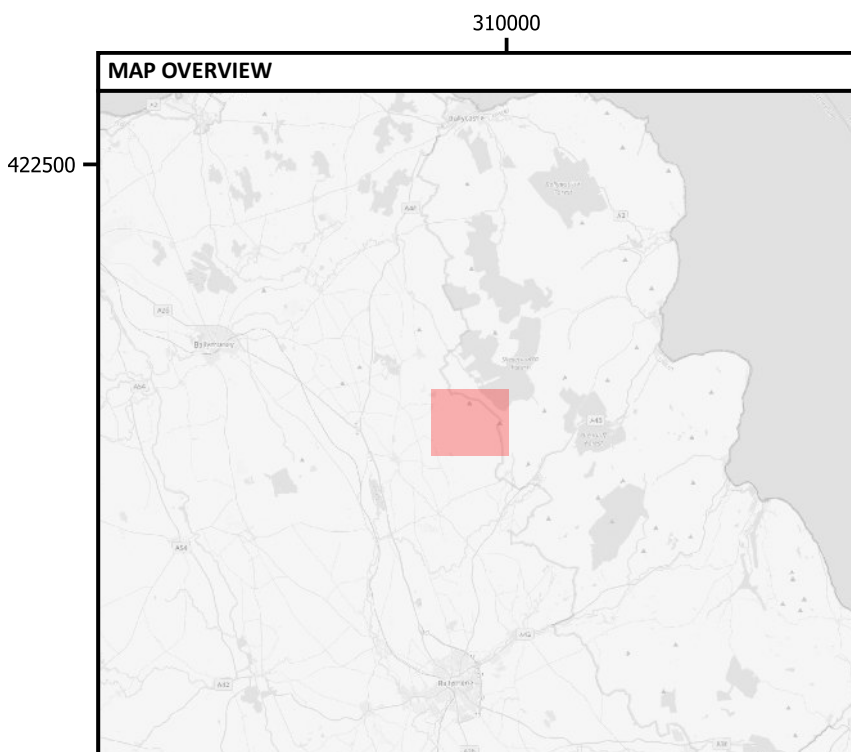
The following table summarises the findings, mitigation, and policy context of those flood mechanisms and policies deemed to be required to be investigated further by the initial assessment.

Table 4-2 PPS15 Policy Summary

Policy	Assessment / Mitigation
FLD 1 - Development in Fluvial & Coastal Flood Plains	<p>No development in floodplains is proposed other than where a proposed access track crosses a watercourse with a floodplain.</p> <p>Development adjacent to floodplains is resilient to flooding including freeboard to climate change flood levels.</p> <p>Proposed watercourse crossings have been assessed to have no effect elsewhere and no additional mitigation is required.</p>
FLD 2 - Protection of Flood Defence & Drainage Infrastructure	<p>The proposals shall not impede riparian maintenance of watercourses. The proposal therefore complies with FLD2.</p>
FLD 3 - Development and Pluvial Flood Risk Outside Flood Plains	<p>Site drainage shall ensure that the site is adequately drained and flood resilient.</p> <p>Drainage design shall adopt suitable hydraulic standards in relation to standards of flood protection to the site and downstream watercourses.</p> <p>Surface water can be safely disposed of to existing field drains and watercourses and has the benefit of DfI Rivers consent.</p> <p>The proposal will comply with FLD3.</p>
FLD 4 - Artificial Modification of Watercourses	<p>The proposed development shall involve the construction of crossings to existing watercourses and field drains.</p> <p>The crossings shall be constructed to facilitate access only and are a permissible exception to policy FLD4.</p> <p>Crossing designs ensure flood risk outside the site / outside lands under control of the applicant is unaffected.</p>
FLD 5 - Development in Proximity to Reservoirs	<p>Does not apply (see Section 3.1)</p>

Appendix A

Site Hydrology Map



CARNBUCK WIND FARM

**M01616-08 CHAPTER 10
EIAR_FIG_10.1**

SITE HYDROLOGY

- The Site**
- Lands Under Applicant Control
- as Preliminary Site Boundary
- Planning Application Boundary
- Hydrology**
- Significant Watercourse (>0.25 km²)
- Minor Watercourse (<0.25 km²)
- Other Watercourses
- Flooding**
- Site Specific Model
1% AEP Flood Extent
- Flood Maps NI**
- FMNI Indicative 1% AEP Fluvial
Flooding
(Beyond Site-Specific Model Extents)
- FMNI Indicative 0.5% AEP Surface
Water
- Height Data [OSNI 10m DTM]**
- 20m Major Contour
- River Basin Context Map**
- Bush River (Altnahinch)
- Bush River (Ballyhoe)
- Clogh River
- Cloghmills Water
- Killagan water

M01616-08_FIG_10.1

SCALE - AS SHOWN

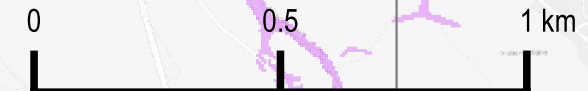
ENVIRONMENTAL STATEMENT

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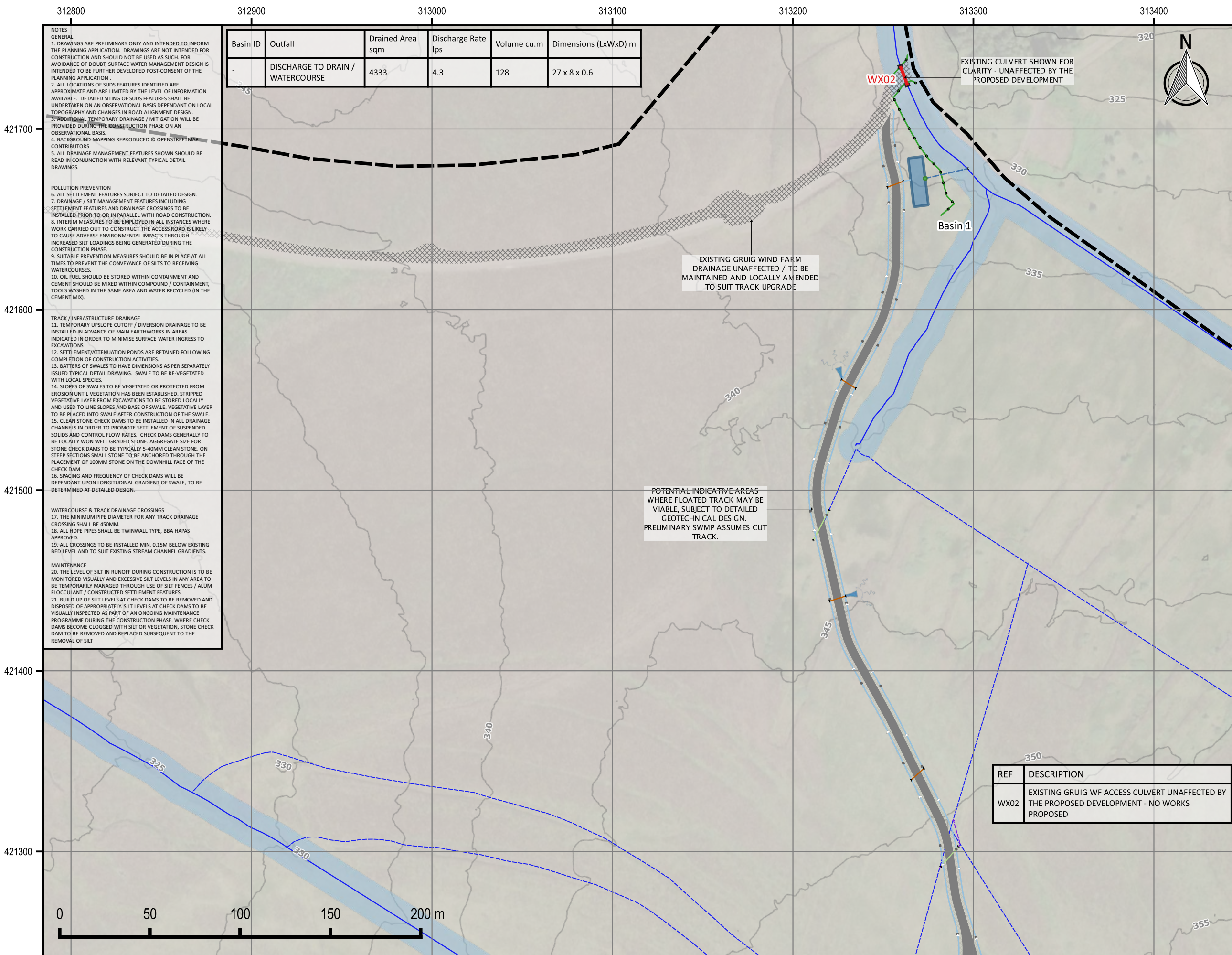
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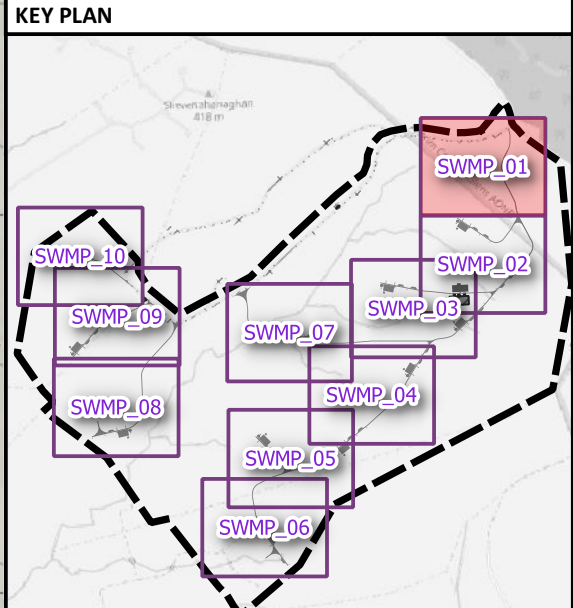
Appendix B

Drainage Layouts



Basin ID	Outfall	Drained Area sqm	Discharge Rate lps	Volume cu.m	Dimensions (LxWxD) m
1	DISCHARGE TO DRAIN / WATERCOURSE	4333	4.3	128	27 x 8 x 0.6

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POLLUTION PREVENTION
 6. ALL SETTLEMENT FEATURES SUBJECT TO DETAILED DESIGN.
 7. DRAINAGE / SILT MANAGEMENT FEATURES INCLUDING SETTLEMENT FEATURES AND DRAINAGE CROSSINGS TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH ROAD CONSTRUCTION.
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TRACK / INFRASTRUCTURE DRAINAGE
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 16. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DEPENDANT UPON LONGITUDINAL GRADIENT OF SWALE, TO BE DETERMINED AT DETAILED DESIGN.
WATERCOURSE & TRACK DRAINAGE CROSSINGS
 17. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 450MM.
 18. ALL HDPE PIPES SHALL BE TWINWALL TYPE, BBA HAPAS APPROVED.
 19. ALL CROSSINGS TO BE INSTALLED MIN. 0.15M BELOW EXISTING BED LEVEL AND TO SUIT EXISTING STREAM CHANNEL GRADIENTS.
MAINTENANCE
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LEGEND

Preliminary Site Boundary	Hydrological buffers (10m/50m)
Wind Farm Infrastructure	Track Drainage Features
COMPOUND, SUBSTATION	Trackside Drain & Checkdam
TRACKS, CRANEPADS	Clean Cutoff Drain
EXISTING GRUIG WIND FARM	Clean Drainage Pipe
INDICATIVE AREAS FOR FLOATED TRACK - SUBJECT TO DESIGN	Dirty Track Drainage Pipe
SPOIL STORAGE AREAS	Outfall, Flow Control
Existing Hydrology	Track Drainage Breakout
Water Features	Attenuation Basin
Significant Watercourse	Settlement Basin
Minor Watercourse	Indicative pumped dewatering
Other Ephemeral / Minor drainage	Temporary Silt Fence
	Watercourse Crossings

PRELIMINARY

REF	DESCRIPTION
WX02	EXISTING GRUIG WF ACCESS CULVERT UNAFFECTED BY THE PROPOSED DEVELOPMENT - NO WORKS PROPOSED

POLLUTION PREVENTION GUIDANCE NOTES:

- Suitable SUDS prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.
- Temporary or permanent SuDS features should be installed BEFORE or adjacent to construction of new access road and hardstanding.
- Clean water cutoff ditch and crossing should be planned and installed BEFORE construction. Clean water management must consider spoil deposition on the site.
- Direct discharge of road drainage to watercourses shall not be permitted.
- Buffer zones are to be maintained around all relevant watercourses as indicated on this drawing. No excavated material is to be stored within the buffer zone.
- DO NOT pump water direct to watercourses.
- DO NOT strip vegetation from existing ditches unless absolutely necessary.
- If water pollution is identified the following steps should be adhered to:
 STOP - Work in the immediate area should be stopped and the source of the pollution identified
 CONTAIN - The source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.
 NOTIFY - The relevant authorities (Site Manager / NIEA) and Client/Developer should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas.



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DESCRIPTION				
CARNBUCK WIND FARM - DRAINAGE LAYOUT SHEET 1				
PROJECT / FIGURE NO.				
M01616-08_SWMP_01				
DRAWN BY	SCALE	REVISION	DATE	
DKS	1:2000	1	08/07/2022	

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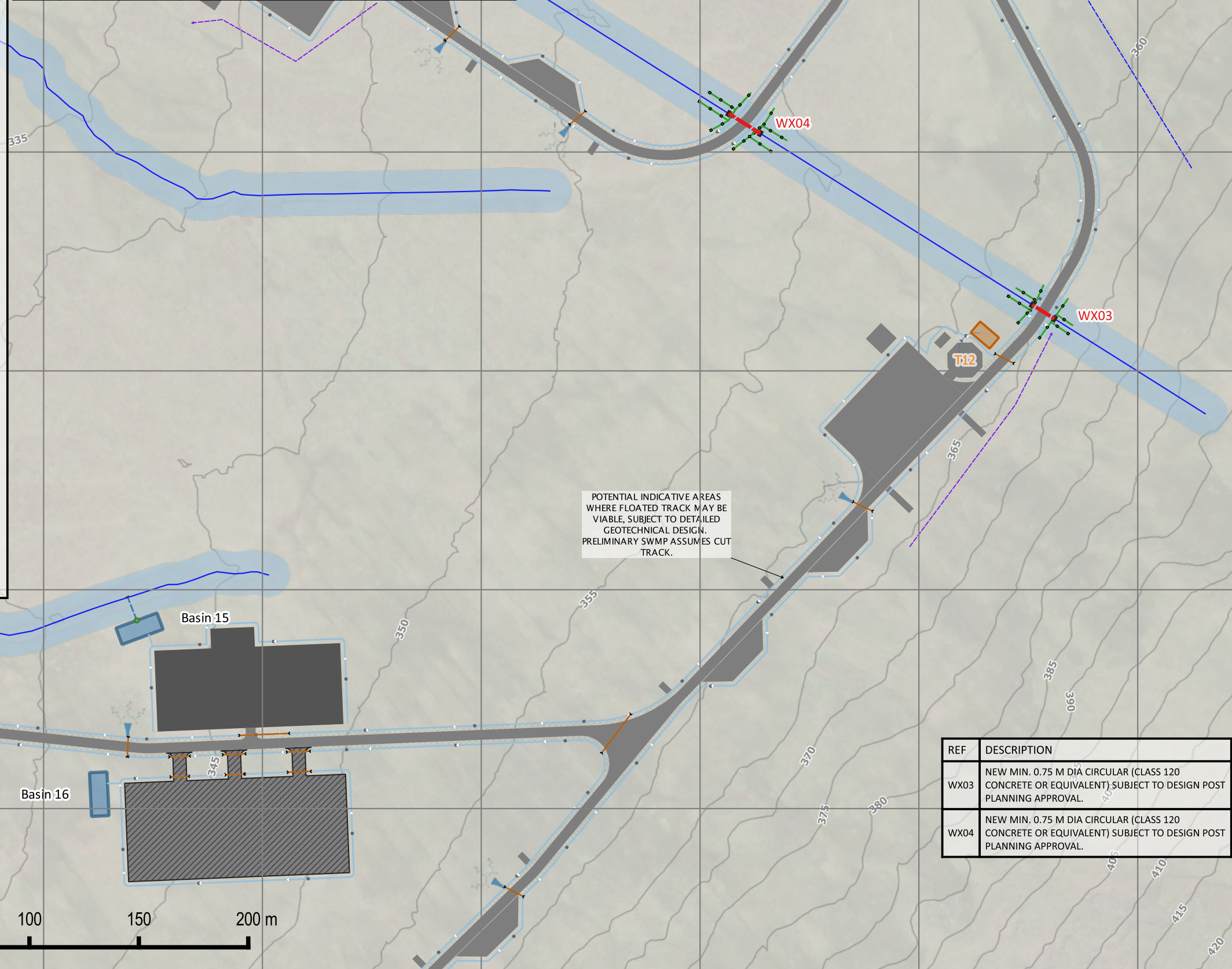
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MAINTENANCE

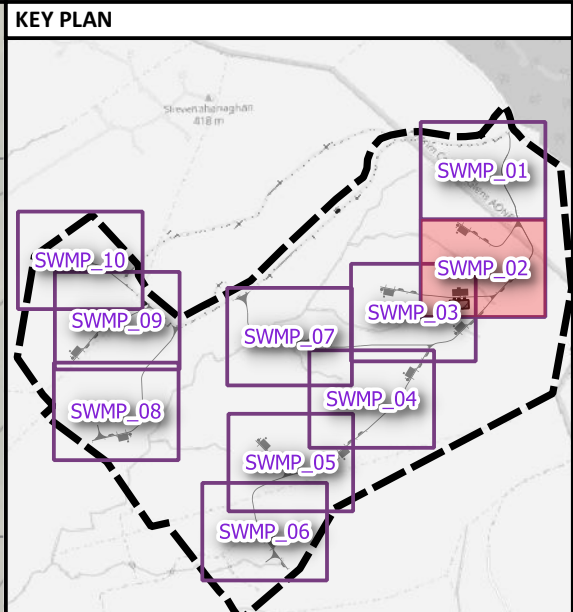
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Basin ID	Outfall	Drained Area sqm	Discharge Rate lps	Volume cu.m	Dimensions (LxWxD) m
3	DISCHARGE OVERLAND OVER HEATH	4690	4.7	138	29 x 8 x 0.6
15	DISCHARGE TO DRAIN / WATERCOURSE	3325	3.3	98	20 x 8 x 0.6
16	TEMPORARY BASIN - DISCHARGE OVERLAND OVER HEATH	4790	4.8	141	29 x 8 x 0.6



POTENTIAL INDICATIVE AREAS WHERE FLOATED TRACK MAY BE VIABLE, SUBJECT TO DETAILED GEOTECHNICAL DESIGN. PRELIMINARY SWMP ASSUMES CUT TRACK.

REF	DESCRIPTION
WX03	NEW MIN. 0.75 M DIA CIRCULAR (CLASS 120 CONCRETE OR EQUIVALENT) SUBJECT TO DESIGN POST PLANNING APPROVAL.
WX04	NEW MIN. 0.75 M DIA CIRCULAR (CLASS 120 CONCRETE OR EQUIVALENT) SUBJECT TO DESIGN POST PLANNING APPROVAL.



LEGEND

The Development

- Preliminary Site Boundary
- COMPUND, SUBSTATION
- TRACKS, CRANEPADS
- EXISTING GRUIG WIND FARM
- INDICATIVE AREAS FOR FLOATED TRACK - SUBJECT TO DESIGN
- SPOIL STORAGE AREAS

Track Drainage Features

- Trackside Drain & Checkdam
- Clean Cutoff Drain
- Clean Drainage Pipe
- Dirty Track Drainage Pipe
- Outfall, Flow Control
- Track Drainage Breakout

Existing Hydrology

- Significant Watercourse
- Minor Watercourse
- Other Ephemeral / Minor drainage

Water Features

- Attenuation Basin
- Settlement Basin
- Indicative pumped dewatering
- Temporary Silt Fence
- Watercourse Crossings

Hydrological buffers (10m/50m)

PRELIMINARY

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DESCRIPTION				
CARNBUCK WIND FARM - DRAINAGE LAYOUT SHEET 2				
PROJECT / FIGURE NO.				
M01616-08_SWMP_02				
DRAWN BY	SCALE	REVISION	DATE	
DKS	1:2000	1	08/07/2022	

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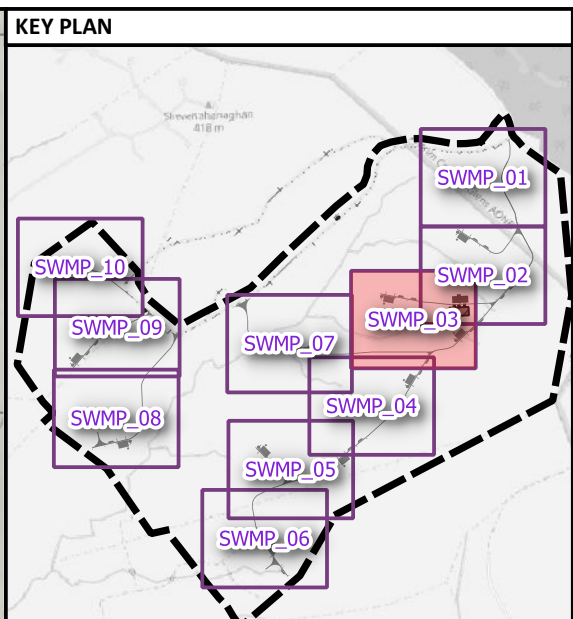
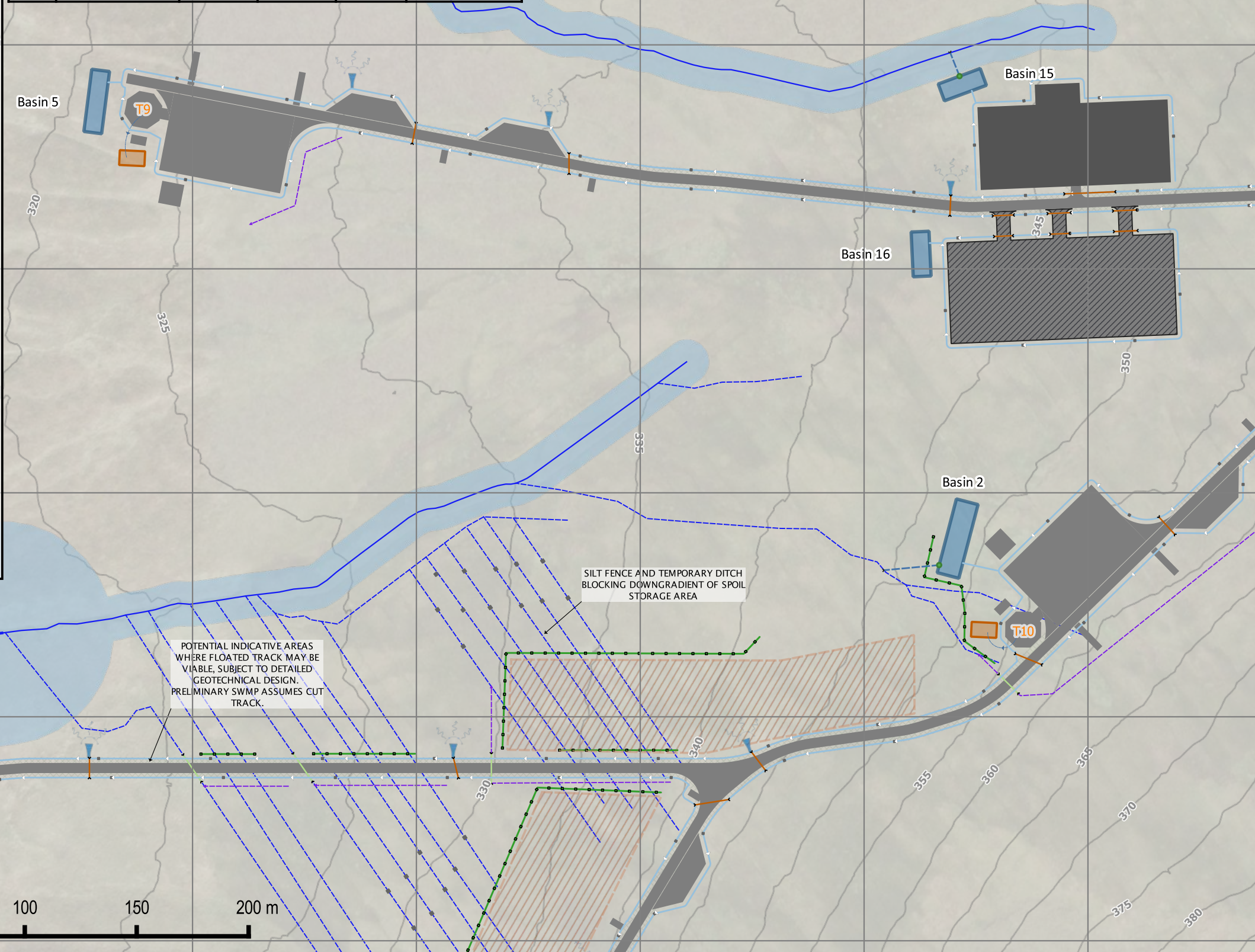
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19. ALL CROSSINGS TO BE INSTALLED MIN. 0.15M BELOW EXISTING BED LEVEL AND TO SUIT EXISTING STREAM CHANNEL GRADIENTS.

MAINTENANCE

20. THE LEVEL OF SILT IN RUNOFF DURING CONSTRUCTION IS TO BE MONITORED VISUALLY AND EXCESSIVE SILT LEVELS IN ANY AREA TO BE TEMPORARILY MANAGED THROUGH USE OF SILT FENCES / ALUM FLOCCULANT / CONSTRUCTED SETTLEMENT FEATURES.
21. BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DISPOSED OF APPROPRIATELY. SILT LEVELS AT CHECK DAMS TO BE VISUALLY INSPECTED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT

Basin ID	Outfall	Drained Area sqm	Discharge Rate lps	Volume cu.m	Dimensions (LxWxD) m
2	DISCHARGE TO DRAIN / WATERCOURSE	9157	9.2	270	34 x 10 x 0.8
5	DISCHARGE OVERLAND OVER HEATH	5905	5.9	174	27 x 8 x 0.8
15	DISCHARGE TO DRAIN / WATERCOURSE	3325	3.3	98	20 x 8 x 0.6
16	TEMPORARY BASIN - DISCHARGE OVERLAND OVER HEATH	4790	4.8	141	29 x 8 x 0.6



LEGEND

The Development

- Preliminary Site Boundary

Wind Farm Infrastructure

- COMPOUND, SUBSTATION
- TRACKS, CRANEPADS
- EXISTING GRUIG WIND FARM
- INDICATIVE AREAS FOR FLOATED TRACK - SUBJECT TO DESIGN
- SPOIL STORAGE AREAS

Existing Hydrology

Water Features

- Significant Watercourse
- Minor Watercourse
- Other Ephemeral / Minor drainage

Track Drainage Features

- Trackside Drain & Checkdam
- Clean Cutoff Drain
- Clean Drainage Pipe
- Dirty Track Drainage Pipe
- Outfall, Flow Control
- Track Drainage Breakout
- Attenuation Basin
- Settlement Basin
- Indicative pumped dewatering
- Temporary Silt Fence
- Watercourse Crossings

Hydrological buffers (10m/50m)

PRELIMINARY

POLLUTION PREVENTION GUIDANCE NOTES:

1. Suitable SUDS prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.
2. Temporary or permanent SUDS features should be installed BEFORE or adjacent to construction of new access road and hardstanding.
3. Clean water cutoff ditch and crossing should be planned and installed BEFORE construction. Clean water management must consider spoil deposition on the site.
4. Direct discharge of road drainage to watercourses shall not be permitted.
5. Buffer zones are to be maintained around all relevant watercourses as indicated on this drawing. No excavated material is to be stored within the buffer zone.
6. DO NOT pump water direct to watercourses.
7. DO NOT strip vegetation from existing ditches unless absolutely necessary.
8. If water pollution is identified the following steps should be adhered to:

STOP - Work in the immediate area should be stopped and the source of the pollution identified

CONTAIN - The source of the pollution should be bunded using a suitable method. Natural watercourses should be temporarily diverted around the source of pollution.

NOTIFY - The relevant authorities (Site Manager / NIEA) and Client/Developer should be notified immediately to ensure that measures can be implemented downstream to protect fisheries and other sensitive areas.

McCloy Consulting

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DESCRIPTION				
CARNBUCK WIND FARM - DRAINAGE LAYOUT SHEET 3				
PROJECT / FIGURE NO.				
M01616-08_SWMP_03				
DRAWN BY	SCALE	REVISION	DATE	
DKS	1:2000	1	08/07/2022	

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NOTES

GENERAL

1. DRAWINGS ARE PRELIMINARY ONLY AND INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS INTENDED TO BE FURTHER DEVELOPED POST-CONSENT OF THE PLANNING APPLICATION.
2. ALL LOCATIONS OF SUDS FEATURES IDENTIFIED ARE APPROXIMATE AND ARE LIMITED BY THE LEVEL OF INFORMATION AVAILABLE. DETAILED SITING OF SUDS FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS DEPENDANT ON LOCAL TOPOGRAPHY AND CHANGES IN ROAD ALIGNMENT DESIGN.
3. ADDITIONAL TEMPORARY DRAINAGE / MITIGATION WILL BE PROVIDED DURING THE CONSTRUCTION PHASE ON AN OBSERVATIONAL BASIS.
4. BACKGROUND MAPPING REPRODUCED © OPENSTREETMAP CONTRIBUTORS
5. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT TYPICAL DETAIL DRAWINGS.

POLLUTION PREVENTION

6. ALL SETTLEMENT FEATURES SUBJECT TO DETAILED DESIGN.
7. DRAINAGE / SILT MANAGEMENT FEATURES INCLUDING SETTLEMENT FEATURES AND DRAINAGE CROSSINGS TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH ROAD CONSTRUCTION.
8. INTERIM MEASURES TO BE EMPLOYED IN ALL INSTANCES WHERE WORK CARRIED OUT TO CONSTRUCT THE ACCESS ROAD IS LIKELY TO CAUSE ADVERSE ENVIRONMENTAL IMPACTS THROUGH INCREASED SILT LOADINGS BEING GENERATED DURING THE CONSTRUCTION PHASE.
9. SUITABLE PREVENTION MEASURES SHOULD BE IN PLACE AT ALL TIMES TO PREVENT THE CONVEYANCE OF SILTS TO RECEIVING WATERCOURSES.
10. OIL FUEL SHOULD BE STORED WITHIN CONTAINMENT AND CEMENT SHOULD BE MIXED WITHIN COMPOUND / CONTAINMENT. TOOLS WASHED IN THE SAME AREA AND WATER RECYCLED (IN THE CEMENT MIX).

TRACK / INFRASTRUCTURE DRAINAGE

11. TEMPORARY UPSLOPE CUTOFF / DIVERSION DRAINAGE TO BE INSTALLED IN ADVANCE OF MAIN EARTHWORKS IN AREAS INDICATED IN ORDER TO MINIMISE SURFACE WATER INGRESS TO EXCAVATIONS
12. SETTLEMENT/ATTENUATION PONDS ARE RETAINED FOLLOWING COMPLETION OF CONSTRUCTION ACTIVITIES.
13. BATTERS OF SWALES TO HAVE DIMENSIONS AS PER SEPARATELY ISSUED TYPICAL DETAIL DRAWING. SWALE TO BE RE-VEGETATED WITH LOCAL SPECIES.
14. SLOPES OF SWALES TO BE VEGETATED OR PROTECTED FROM EROSION UNTIL VEGETATION HAS BEEN ESTABLISHED. STRIPPED VEGETATIVE LAYER FROM EXCAVATIONS TO BE STORED LOCALLY AND USED TO LINE SLOPES AND BASE OF SWALE. VEGETATIVE LAYER TO BE PLACED INTO SWALE AFTER CONSTRUCTION OF THE SWALE.
15. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS GENERALLY TO BE LOCALLY WON WELL GRADED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE TYPICALLY 5-40MM CLEAN STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 100MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM
16. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DEPENDANT UPON LONGITUDINAL GRADIENT OF SWALE, TO BE DETERMINED AT DETAILED DESIGN.

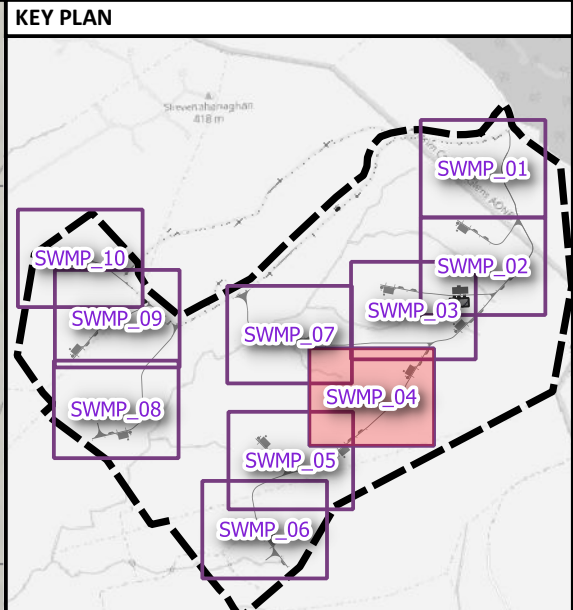
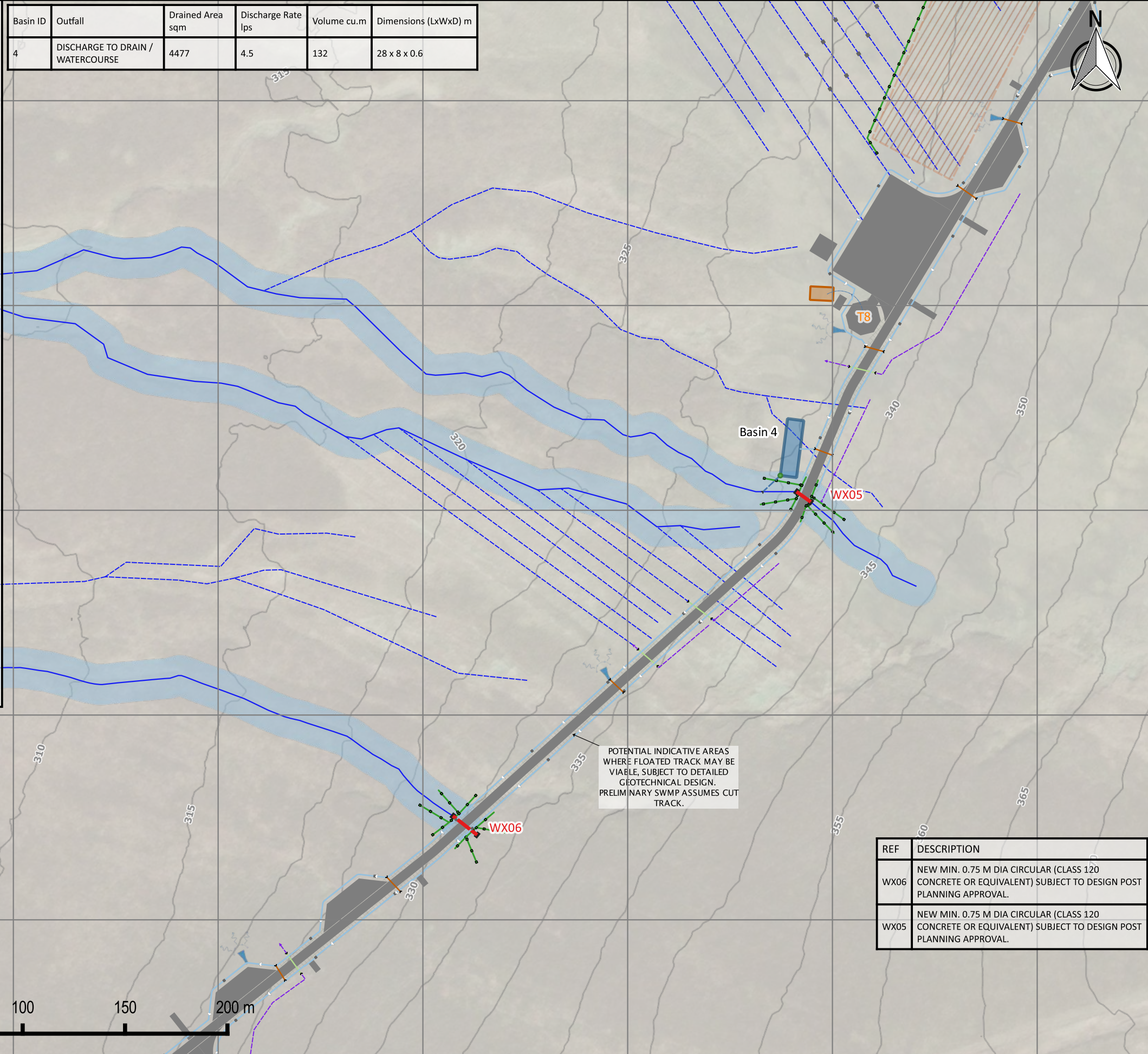
WATERCOURSE & TRACK DRAINAGE CROSSINGS

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Basin ID	Outfall	Drained Area sqm	Discharge Rate lps	Volume cu.m	Dimensions (LxWxD) m
4	DISCHARGE TO DRAIN / WATERCOURSE	4477	4.5	132	28 x 8 x 0.6



LEGEND

The Development	Hydrological buffers (10m/50m)
Preliminary Site Boundary	Track Drainage Features
Wind Farm Infrastructure	Trackside Drain & Checkdam
COMPOUND, SUBSTATION	Clean Cutoff Drain
TRACKS, CRANEPADS	Clean Drainage Pipe
EXISTING GRUIG WIND FARM	Dirty Track Drainage Pipe
INDICATIVE AREAS FOR FLOATED TRACK - SUBJECT TO DESIGN	Outfall, Flow Control
SPOIL STORAGE AREAS	Track Drainage Breakout
Existing Hydrology	Attenuation Basin
Water Features	Settlement Basin
Significant Watercourse	Indicative pumped dewatering
Minor Watercourse	Temporary Silt Fence
Other Ephemeral / Minor drainage	Watercourse Crossings

PRELIMINARY

REF	DESCRIPTION
WX06	NEW MIN. 0.75 M DIA CIRCULAR (CLASS 120 CONCRETE OR EQUIVALENT) SUBJECT TO DESIGN POST PLANNING APPROVAL.
WX05	NEW MIN. 0.75 M DIA CIRCULAR (CLASS 120 CONCRETE OR EQUIVALENT) SUBJECT TO DESIGN POST PLANNING APPROVAL.

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PROJECT / FIGURE NO.				
M01616-08_SWMP_04				
DRAWN BY	SCALE	REVISION	DATE	
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