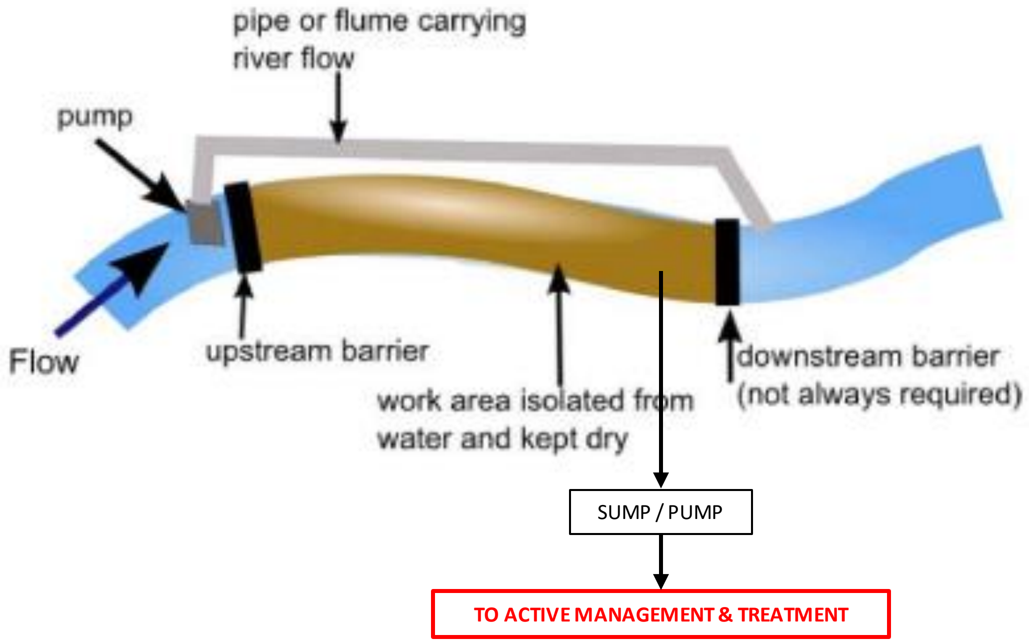
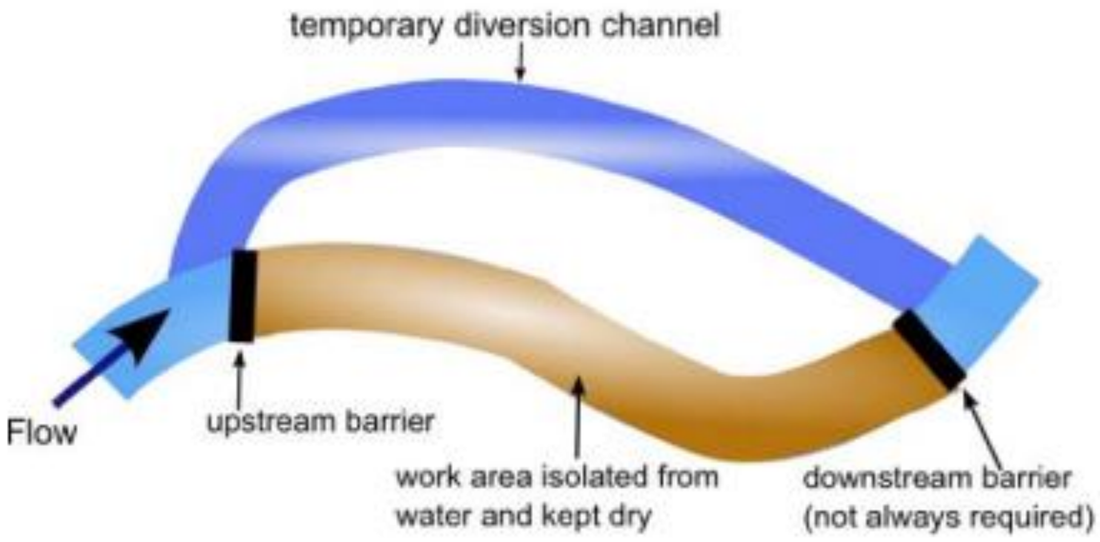
Full Isolation Over Pumping – Plan



Full Isolation by Diversion – Plan



NOTES:

- Full isolation over pumping / siphon. A whole section of the channel is isolated using barriers that span the full width of the river. This keeps a stretch of the river dry and the water is transferred downstream of the works area by mechanical assistance (pumping or siphon). The pump and associated pipework need not be located in the isolated area.
- This method is the preferred method for channel diversion during instream works , for example, during watercourse crossing / culvert construction. However, the pumping equipment deployed must be capable of the surface water feature discharge rate, including back up equipment and fail safe protocols.

NOTES:

- Full isolation temporary diversion channel. A whole section of the channel is isolated and kept dry, and the water is transferred downstream of the works area by excavating a temporary open channel.
- This is the less preferred method due to the destructive nature of constructing temporary diversion channels. However, in some instances where discharge rates are high, this method will negate the requirement for large volume pumping and associated inherent risks.

SEPA (2009) Engineering in the Water Environment Good Practice Guide – Temporary Construction Methods.

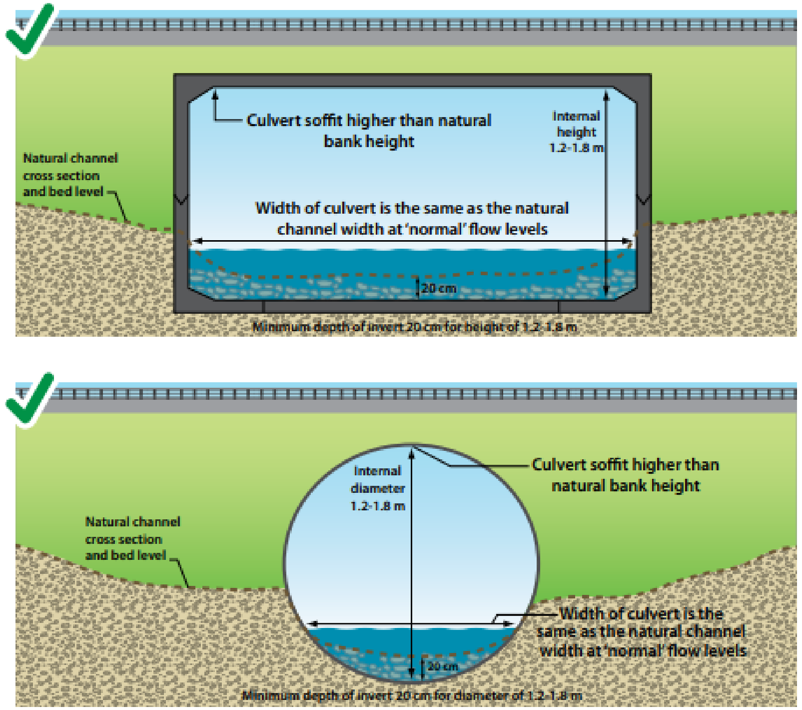
Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 1 Overpumping– General Considerations**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Closed Culvert Good Practice Design Considerations – Section

Figure 40: Good practice, culverts showing invert buried below bed level allowing the natural bed level, slope and material to be maintained. Culvert also maintains natural channel width.



SEPA (2010) Engineering in the Water Environment Good Practice Guide – River Crossings .

Closed Culvert Good & Bad Examples – Section

Figure 41: Good practice, use a single large culvert for crossings that maintains the natural channel width.

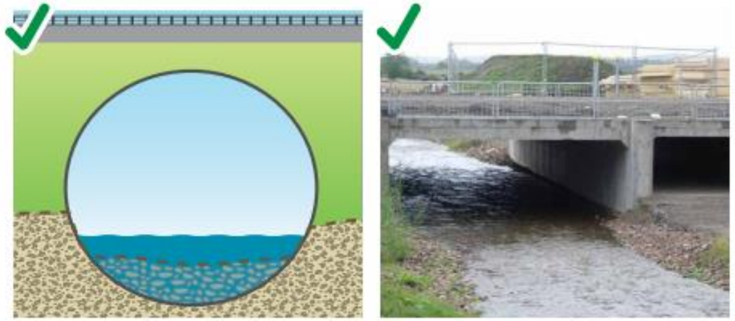


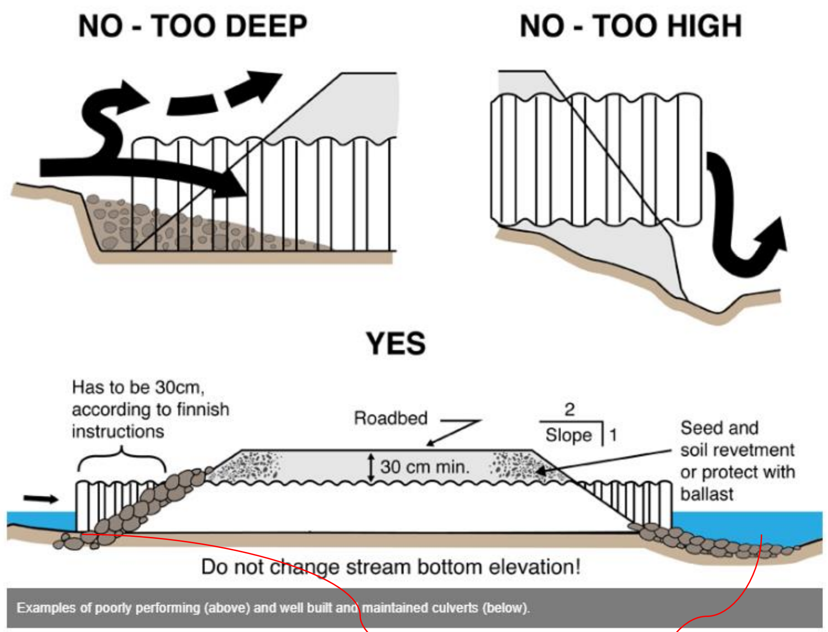
Figure 42: Poor practice, do not use smaller multiple pipes; they can create a barrier to fish passage.

SEPA (2010) Engineering in the Water Environment Good Practice Guide – River Crossings .

NOTE: Coarse aggregate has been used for erosion control. Silt fencing has been used to mitigate against the entrainment and mobilization of solids during the construction process

TrueNorth Steel (2021)

Closed Culvert Erosion Control Good & Bad Examples – Section



NOTE: Coarse aggregate will be used for erosion control. These areas at the openings of the culvert will also be designed to reduce velocity / discharge rate in turn further controlling erosion and providing additional beneficial impacts such increased attenuation time, increased recharge to ground etc.

Roadex Network (https://www.roadex.org/e-learning/lessons/drainage-of-low-volume-roads/components-of-road-drainage-system/)

Site Name:	Project No.	603676	Drawn By:	Sven Klinkenbergh Principal Environmental Consultant
Firlough Green Energy – Wind Farm	**Client:**	JOD / Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 2** **Culverts – General Considerations**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

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Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

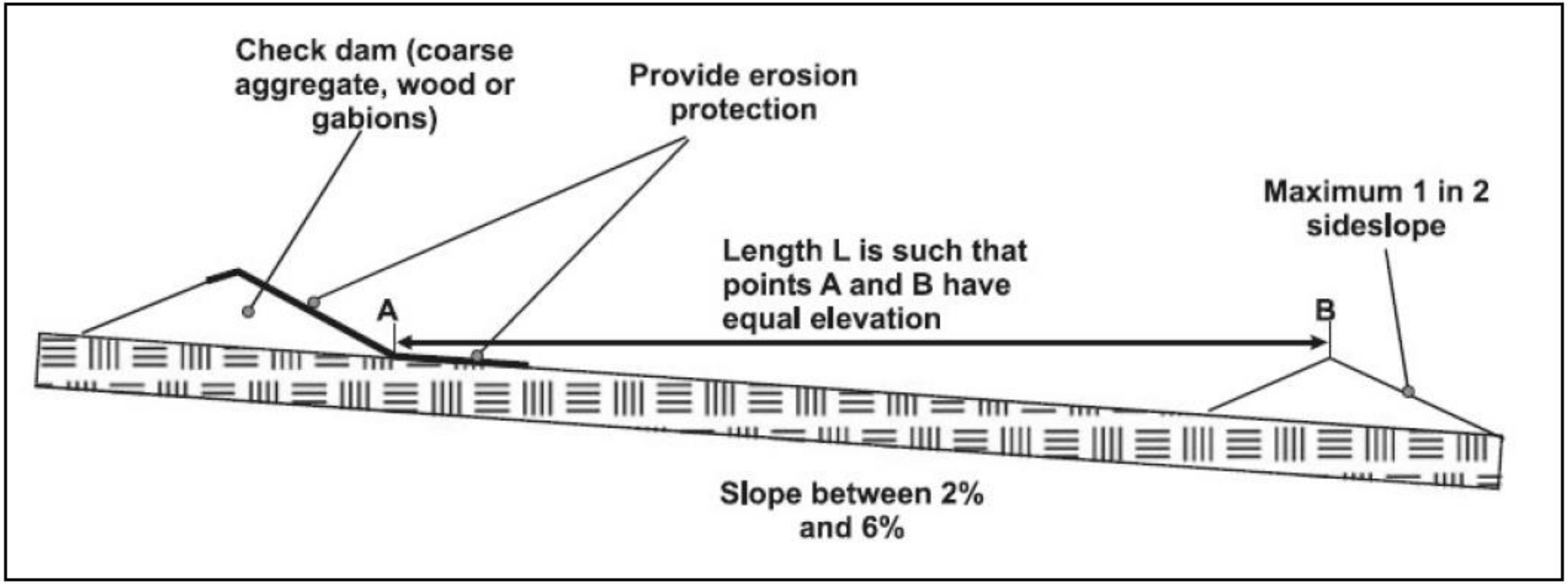
Example of a clear-span bridge, which retains the existing river channel and column set back from the river bank
(National Roads Authority, 2008)

Example of a clear-span bridge which retains the existing river channel, abutments are set back from the river bank
(AT&F, 2022)

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	JOD			
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 3** **Examples of Clear Span Bridge**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Constructed Drain and Check Dams – Section



Check Dam Design Consideration (CIRIA, 2004)

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 4** **Check Dams – General Considerations**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

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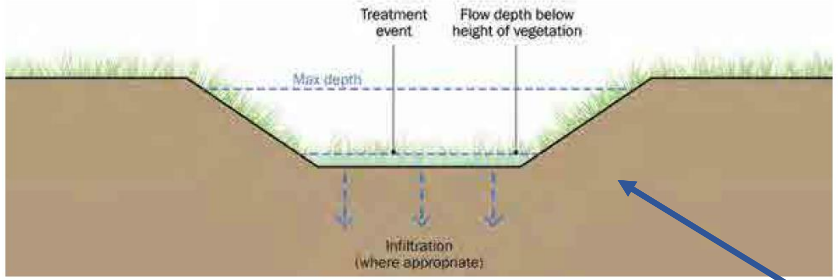
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



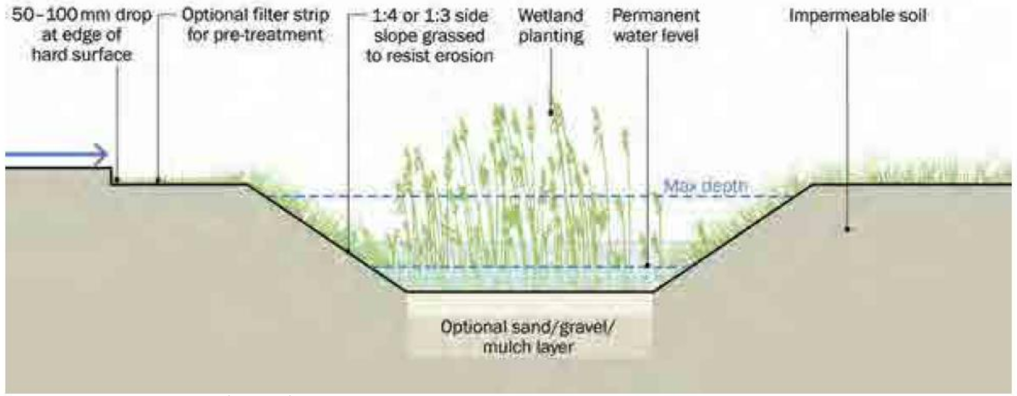
CIRIA SuDS Manual (2015)

A swale can have check dams installed at measured intervals across the flow path, that temporarily pond runoff to increase pollutant retention and infiltration and further decrease flow velocity.

Image Source: Massachusetts Department of Environmental Protection (2023) <https://megamanual.geosyntec.com/npsmanual/checkdams.aspx>

Swale channels are broad and shallow and covered by vegetation, which slows the flow of water and facilitates sedimentation as well as filtration through the roots and soil matrix, evapotranspiration and infiltration into the underlying soil.

Shallow, vegetated, open channel designed to direct, treat and attenuate surface water runoff with a potential for biodiversity benefits.



CIRIA SuDS Manual (2015)

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 5** **Check Dams – General Considerations**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

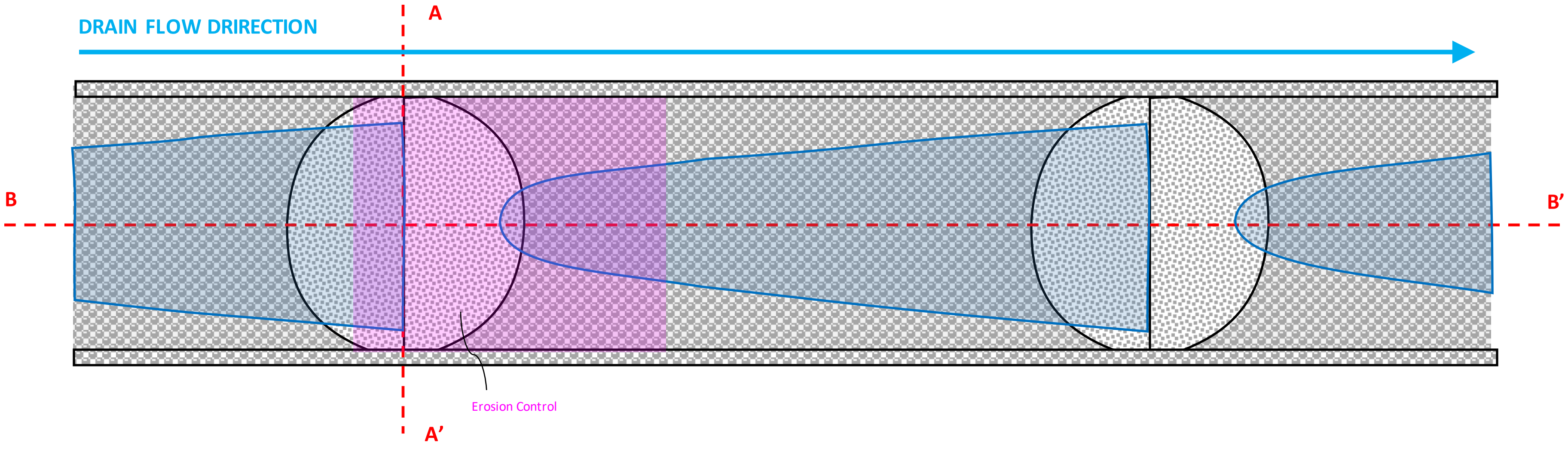
RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

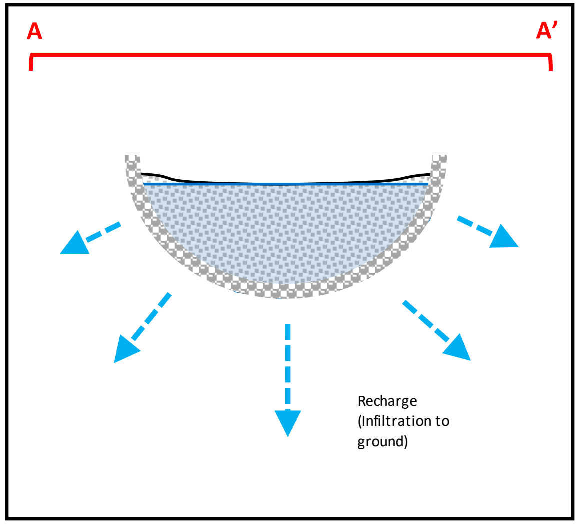
NOTES:

- The extensive use of check dams is recommended for the following reasons:
    - Management of runoff in terms of reducing flow velocity and minimising in channel erosion, or erosion at drainage outfalls.
    - Maximise attenuation of runoff with a view to enhancing runoff quality i.e. settlement of suspended solids.
    - Maximise attenuation of runoff with a view to reducing the hydrological response to rain fall at the site.
    - Maintain or improve the site hydrological/ hydrogeological regime with a view to maximising recharge to ground and increasing groundwater levels locally. This is particularly relevant for peatland areas.
- Check dams will be constructed with the following features and specifications:
    - A low flow pipe or small orifice to allow for low flows through the check dam.
    - Check dams will be permanent (life of development) and will be constructed with crushed rock with appropriate geo-chemistry (local) for example; coarse aggregate (100-600 mm). Wooden boards, gabions can also be used.
    - Erosion protection and energy dissipaters (cobbles / boulder 100-150mm diameter) which will extend approximately 1.2 – 1.8m downgradient of the dam and applied to both the base and side walls of the drain / swale.
    - Erosion control can be enhanced with the in-combination use of geotextile base layers (but consider low flow through).
    - It is recommended that the drainage channels / swales are entirely lined with coarse aggregate / erosion control. This will enhance mitigation in terms of attenuation, erosion control, and recharge to ground. Alternatively, allowing drains / swales to vegetate will achieve similar effects.

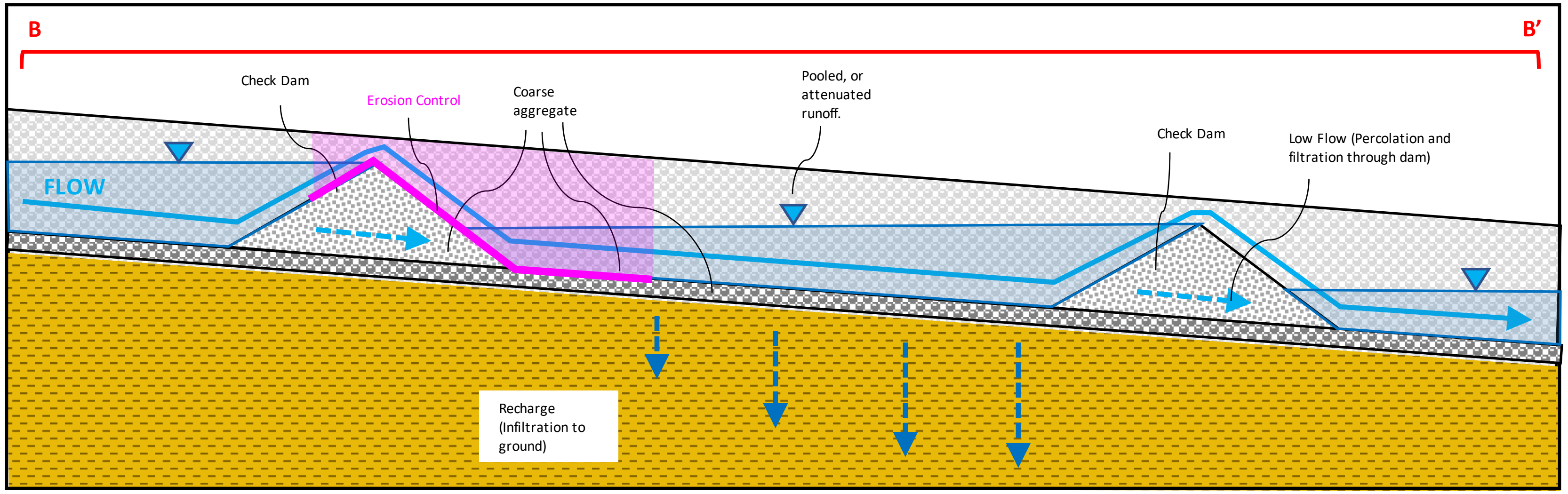
Constructed Drain and Check Dams – Plan View



Constructed Drain and Check Dams – Section A-A'



Constructed Drain and Check Dams – Section B-B'



Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 6** **Check Dams – General Considerations**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

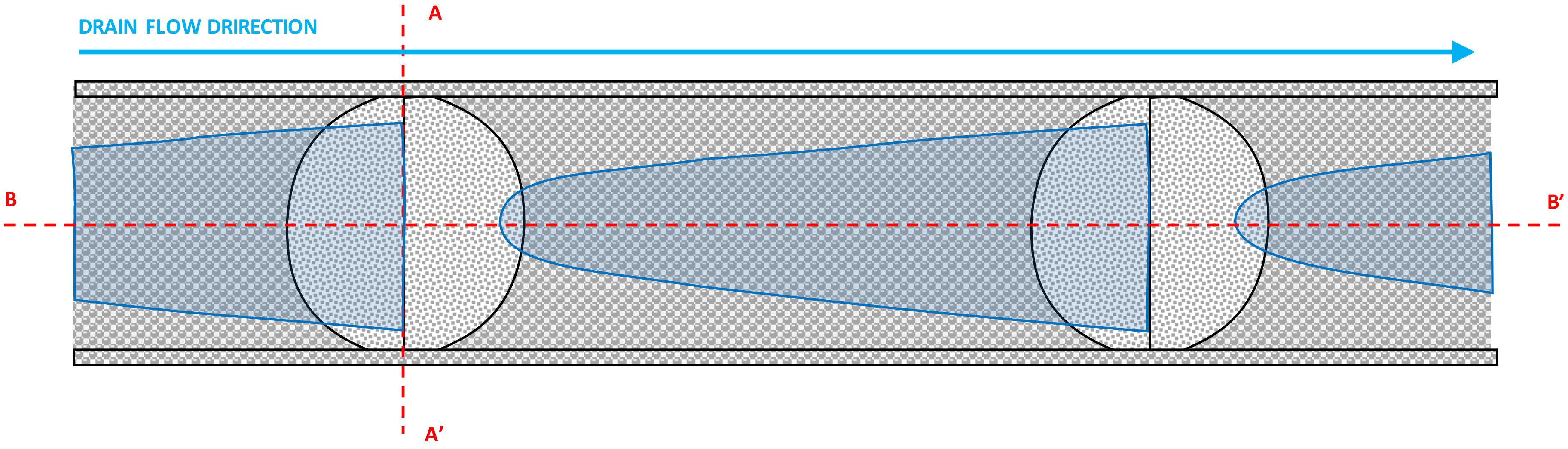
RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

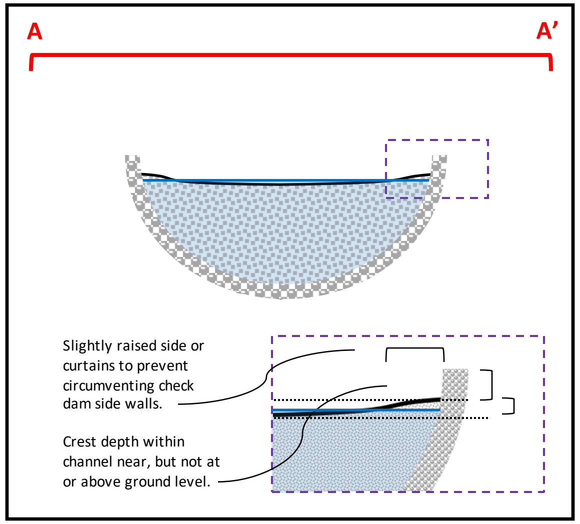
NOTES:

- It is recommended to align the elevation of the upgradient toe and downgradient crest. Therefore the spacing (L) of check dams will be dependent on the on the slope angle of a particular length (L) of drainage, whereby; on shallow slopes check dams will have larger spacing and on steeper slopes (up to 15 degrees *) spacing will be smaller.
- The purpose of aligning the toe and crest of respective check dams is recommended with a view to maximising pooling, or attenuation capacity of the drainage channel. The conceptual section presented here is designed with the downgradient crest (A) higher than the upgradient toe, as opposed to the crest (B) which is aligned with the toe. The purpose of this is to further enhance attenuation capacity at the dam, and to maximise hydraulic head ** and infiltration / percolation of runoff to ground water (recharge). However, this approach has limitations including for the potential to adversely impact undermine the integrity of the upgradient dam through erosion etc. or the downgradient dam through loading / excess weight. Mitigation measures including material selection, erosion control, and variable flow (V-notch) *** will be used where relevant to mitigate such impacts.
- (*) Check dams are recommended for drainage channels with slope angle up to 15 degrees. Drainage and runoff on steeper slopes (>15 degrees) will require different drainage velocity control features, for example; rock ripraps.
- (**) Attenuation of runoff in drainage channels is an opportunity to enhance recharge and reduce the hydrological response to rainfall at the site. However, detailed design will consider environmental and geological constraints, for example; enhanced recharge is not recommended in areas of elevated or high landslide susceptibility or risk.
- (***) V-Notch weirs discussed Conceptual Design – Drainage Infrastructure Check Dams – With Variable Flow Rate / V – Notch Weirs

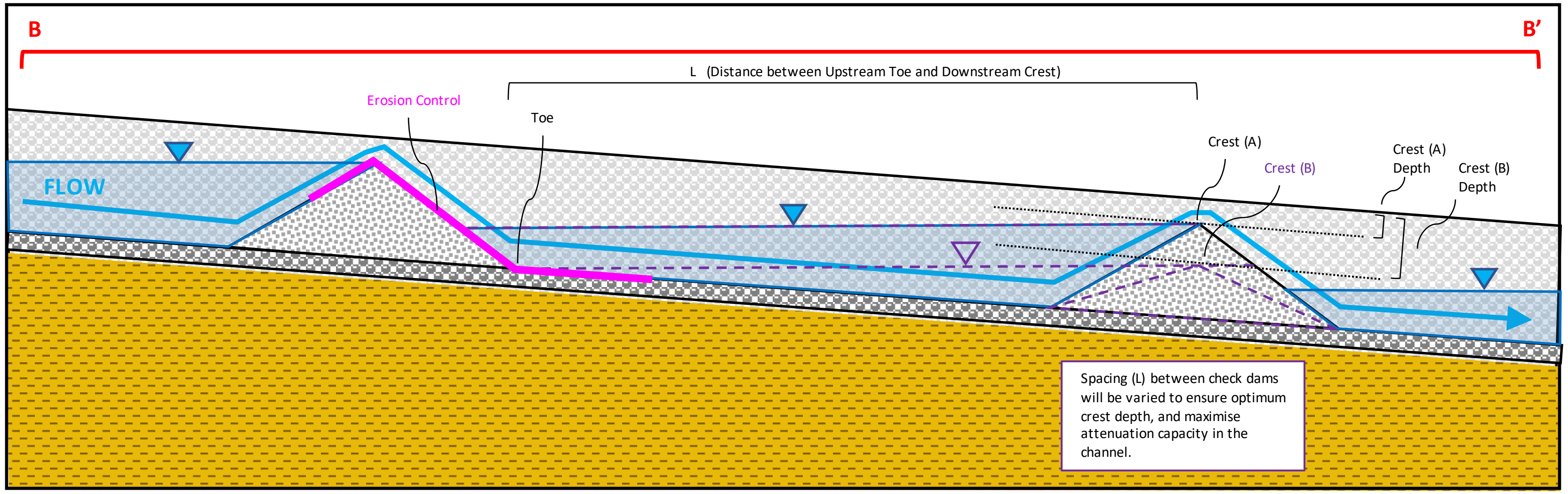
Constructed Drain and Check Dams – Plan View



Constructed Drain and Check Dams – Section A-A'



Constructed Drain and Check Dams – Section B-B'



Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 7** **Check Dams – Design Specifications and Considerations**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

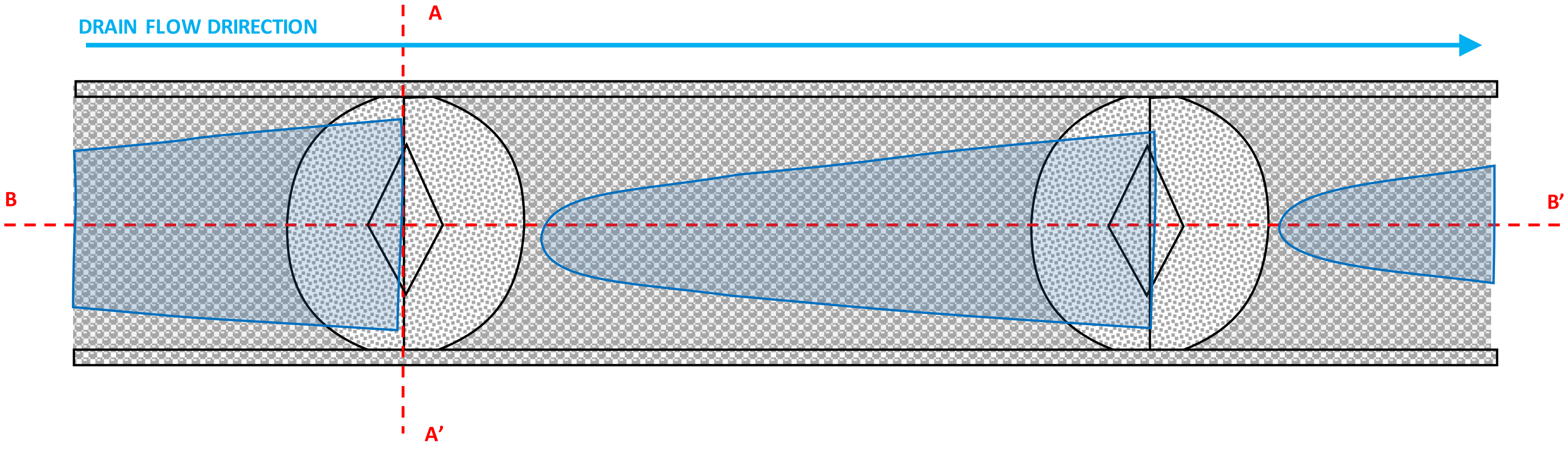
RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

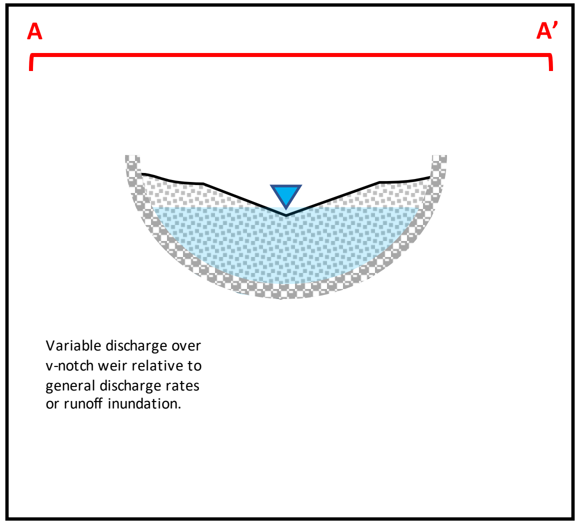
NOTES:

- V-Notch weirs can be included in designs as a control to mitigate against variable or peak flows / drainage discharge rates.
- V-Notch can also be employed to correct the elevation differential (between Toe and Crest) of respective in line check dams.

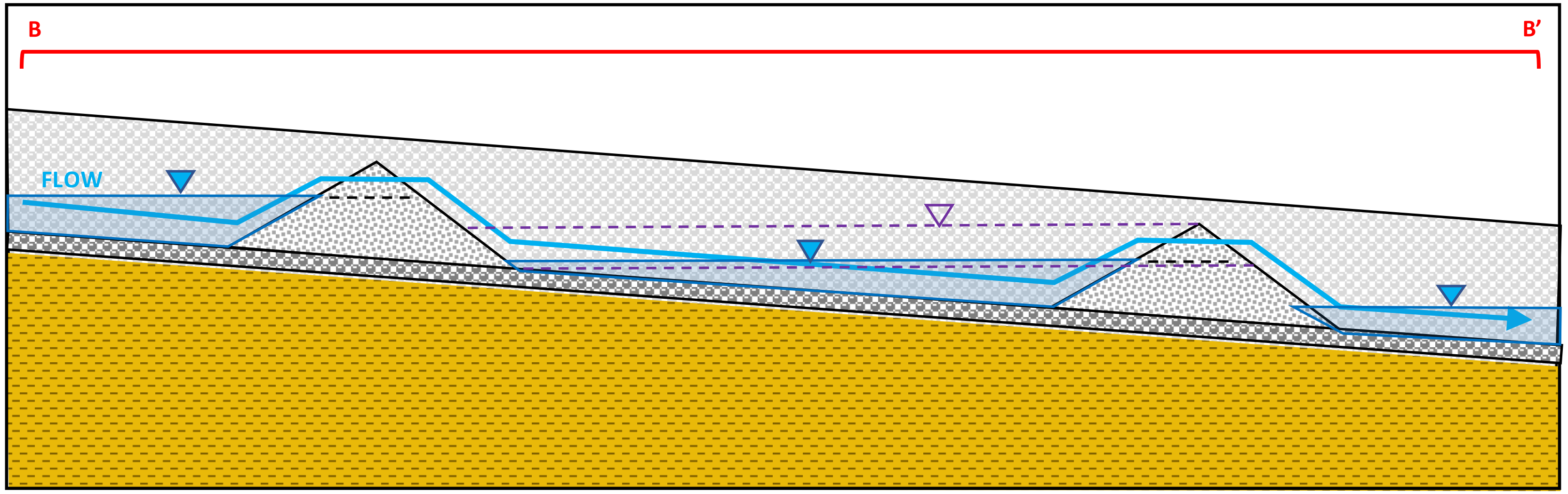
Constructed Drain and Check Dams – Plan View



Constructed Drain and Check Dams – Section A-A'



Constructed Drain and Check Dams – Section B-B'

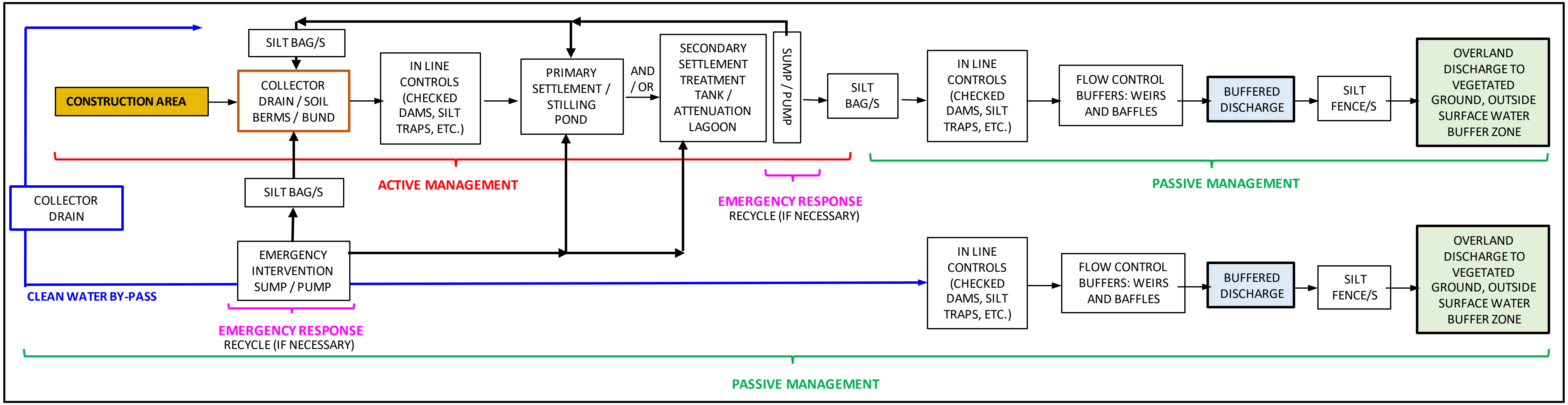


Site Name: Firlough Green Energy – Wind Farm	Project No.	603676	Drawn By:	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: Appendix 9.7 – Conceptual & Information Graphics – Tile 8 Check Dams – With Variable Flow Rate / V – Notch Weirs	Date:	03/05/23	Reviewed By:	SK
	Revision:	02		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

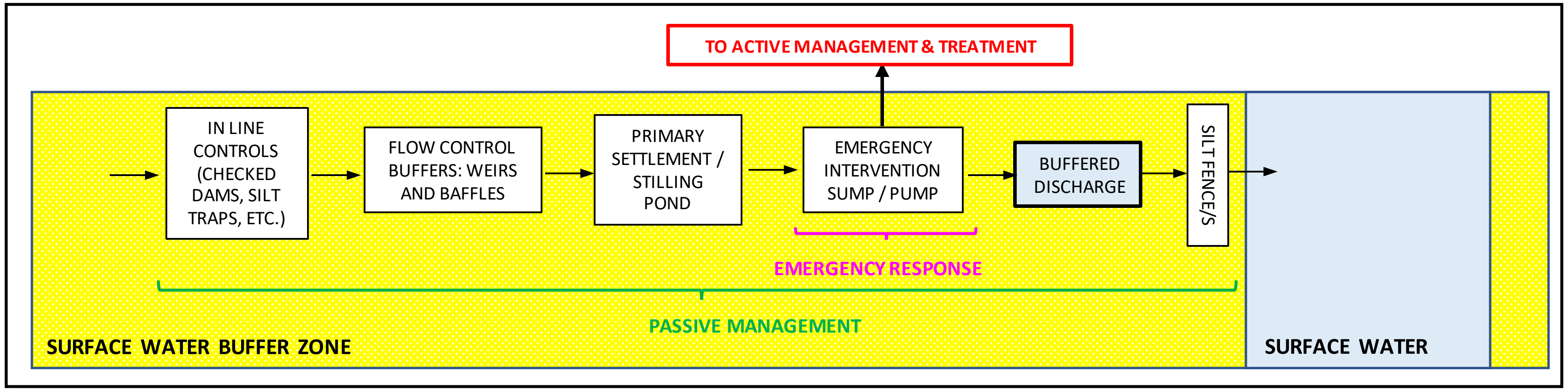
Conceptual Treatment Train Layout for Construction Areas (Access Tracks, Hardstand Areas, Turbine Base, etc.) & Clean Water By-Pass



NOTES:

- Wherever possible, outfalls will be positioned outside of Surface Water Buffer Zones.
- For areas of the development footprint within Surface Water Buffer Zones, in line measures such as silt screens will be over specified e.g. double / triple silt screens, and access to emergency intervention sump / pumps will be facilitated through design and/or emergency response.
- Quality of runoff entering buffer zones will be good i.e. suspended solids <25mg/l. Where runoff quality is poor, emergency response will be to use an intervention sump / pump and pump divert runoff to an area of the drainage network where it will be treated before redistribution and discharge.

Conceptual Treatment Train Layout for Construction Areas & Associated Infrastructure within Surface Water Buffer Zones



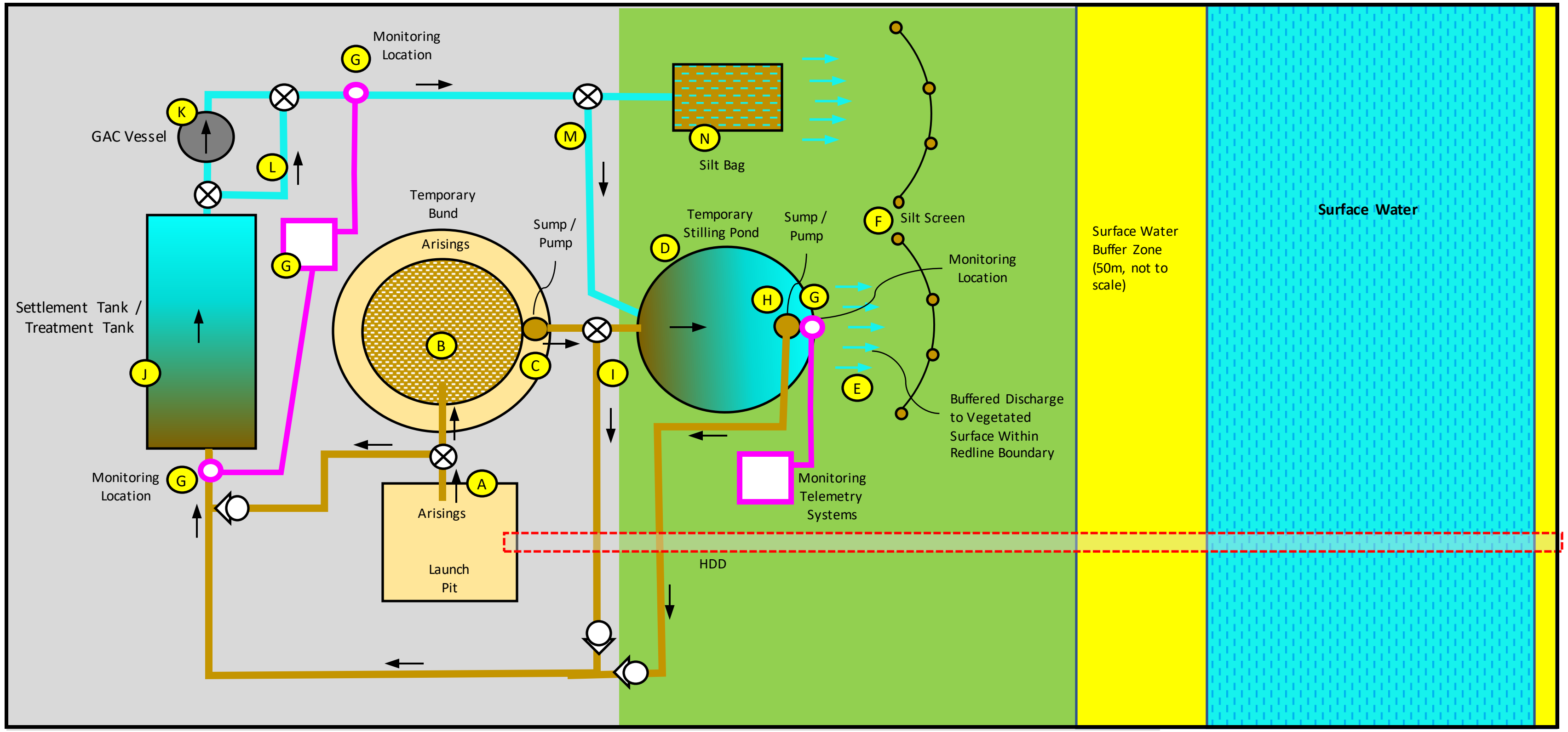
Site Name: Firlough Green Energy – Wind Farm	Project No.	603676	Drawn By:	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: Appendix 9.7 – Conceptual & Information Graphics – Tile 9 Water Treatment Train Layouts	Date:	03/05/23	Reviewed By:	SK
	Revision:	02		

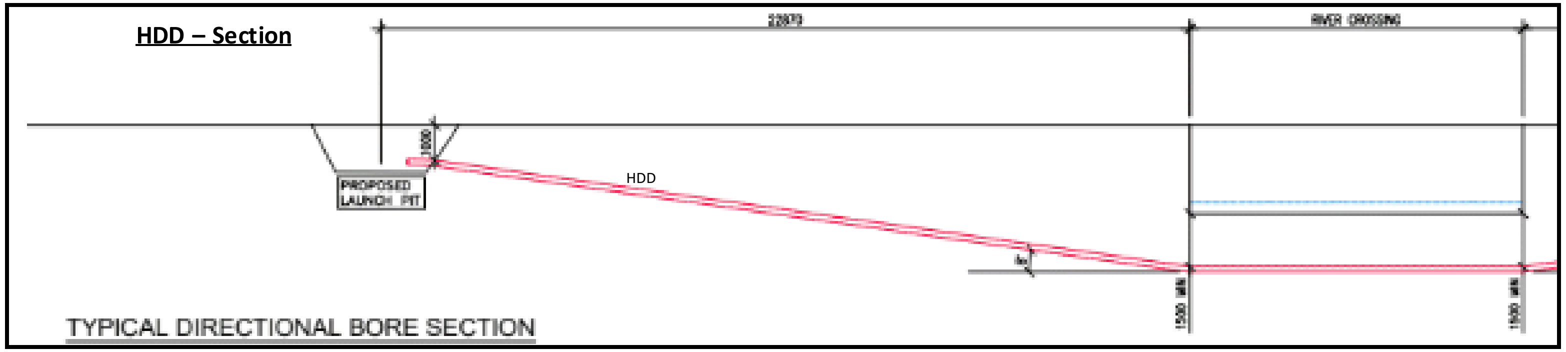
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

NOTES:

- This methodology and example scenario is designed with a view to managing Horizontal Drilling arisings, but can be applied to all scenarios whereby active dewatering, treatment, or management of construction waters is required.
- Contaminated water arising from construction works, namely; excavations, drilling and temporary stockpiling, will be contained and treated prior to release or discharge. The schematic presented here is a conceptual model of measures implemented to manage arisings and runoff;
  A. Arisings from the launch / reception pit, or any other significant excavation (e.g., cable joint bays), will be directed the treatment train.
  B. Arising control area i.e., a temporary bund. Gross solids will be temporarily deposited here. Water arsing with the material will be allowed to drain to sump.
  C. Sump / Pump. Sump will discharge by gravity / pumped to stilling pond.
  D. Temporary stilling pond. This can be constructed using soils for bunding in combination with an impermeable liner.
  E. The outfall from the stilling pond will be buffered (coarse aggregate) to dissipate energy and diffuse discharging water.
  F. Silt Screen. A silt screen will be in place down gradient of the Stilling Pond outfall. This is a precautionary measure to mitigate peak loads or surcharges in the system.
  G. Monitoring Location/s. Discharge quality will be monitored in real time using telemetry systems. Monitoring of discharge quality will be carried out at the outfall of the stilling pond i.e., before being actually discharged to surface vegetation or surface water (licenced).
  H. Sump / Pump. Discharge By-Pass. If water discharging from the stilling pond exceeds quality reference limits water will be diverted (pumped) from the stilling pond to the settlement / treatment tank.
  I. Stilling Pond By-Pass. Similar to Discharge By-Pass, if conditions dictate water can be diverted directly to Settlement / Treatment Tank.
  J. Settlement / Treatment Tank. A settlement tank will in line and ready to use if required i.e., water quality at stilling pond outfall fails to meet quality reference limits. The tank will be equipped with treatment systems which will be activated as the need arises, for example; very fine particles which are very slow to settle can be treated with a flocculant agent to promote settlement of particles.
  K. GAC Vessel/s. As a precautionary measure, GAC (Granulated Activated Carbon) vessel/s will be in line and ready to use if required. GAC vessels are used to filter out low concentrations of hydrocarbons. Significant hydrocarbon contamination is only envisaged under accidental circumstances. If a hydrocarbon spill does occur, normal operations will pause and the treatment train will be utilised to remediate captured contaminated runoff.
  L. GAC Vessel By-Pass. If the quality of the water is acceptable in terms of hydrocarbon contamination.
  M. Treated water will be discharge by gravity / pump to the stilling pond for additional clarification, monitoring and buffered discharge to vegetated area.
  N. Silt Bag. A silt bag can be used as alternative to stilling ponds. However, silt bags must only be used as primary method in lower risk areas i.e., outside of buffer zones, etc. Stilling ponds will be the primary method (D, N) is circumstances where risk is elevated, however a gate vale and silt bag can be included in the treatment train and used as an emergency discharge route in the event that the stilling pond needs remediation or maintenance.
- In all instances, stilling ponds (D), Silt Bags (N) and outfalls (E) will be situated outside of surface water buffer zones. At many locations, particularly at HDD locations works will be within buffer zones. In these instances, the treatment train can be positioned upgradient along the road where discharge to vegetated areas / roadside drains can be managed.

Conceptual Treatment Train Layout for HDD – Plan View





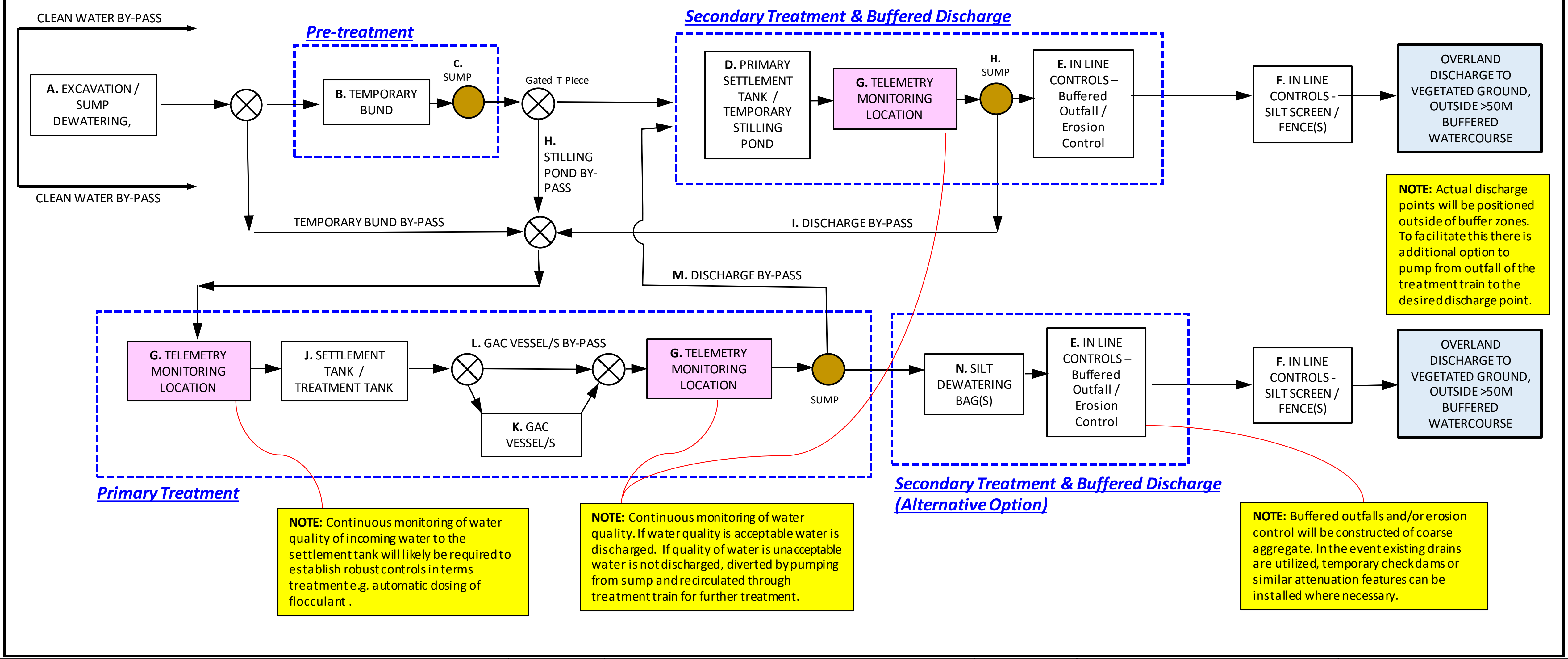
Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 10 Treatment Train Layout for Active Runoff Management (e.g. HDD)**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Conceptual Dewatering and Treatment Train Flow Diagram

Contaminated water arising from construction works, namely; excavations and temporary stockpiling, will be contained and treated prior to release or discharge.
The schematic presented here is a conceptual model of measures implemented to manage arisings and runoff.



Site Name: Firlough Green Energy – Wind Farm	Project No.	603676	Drawn By:	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: Appendix 9.7 – Conceptual & Information Graphics – Tile 11 Conceptual Dewatering and Treatment Train Flow Diagram	Date:	03/05/23	Reviewed By:	SK
	Revision:	02		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

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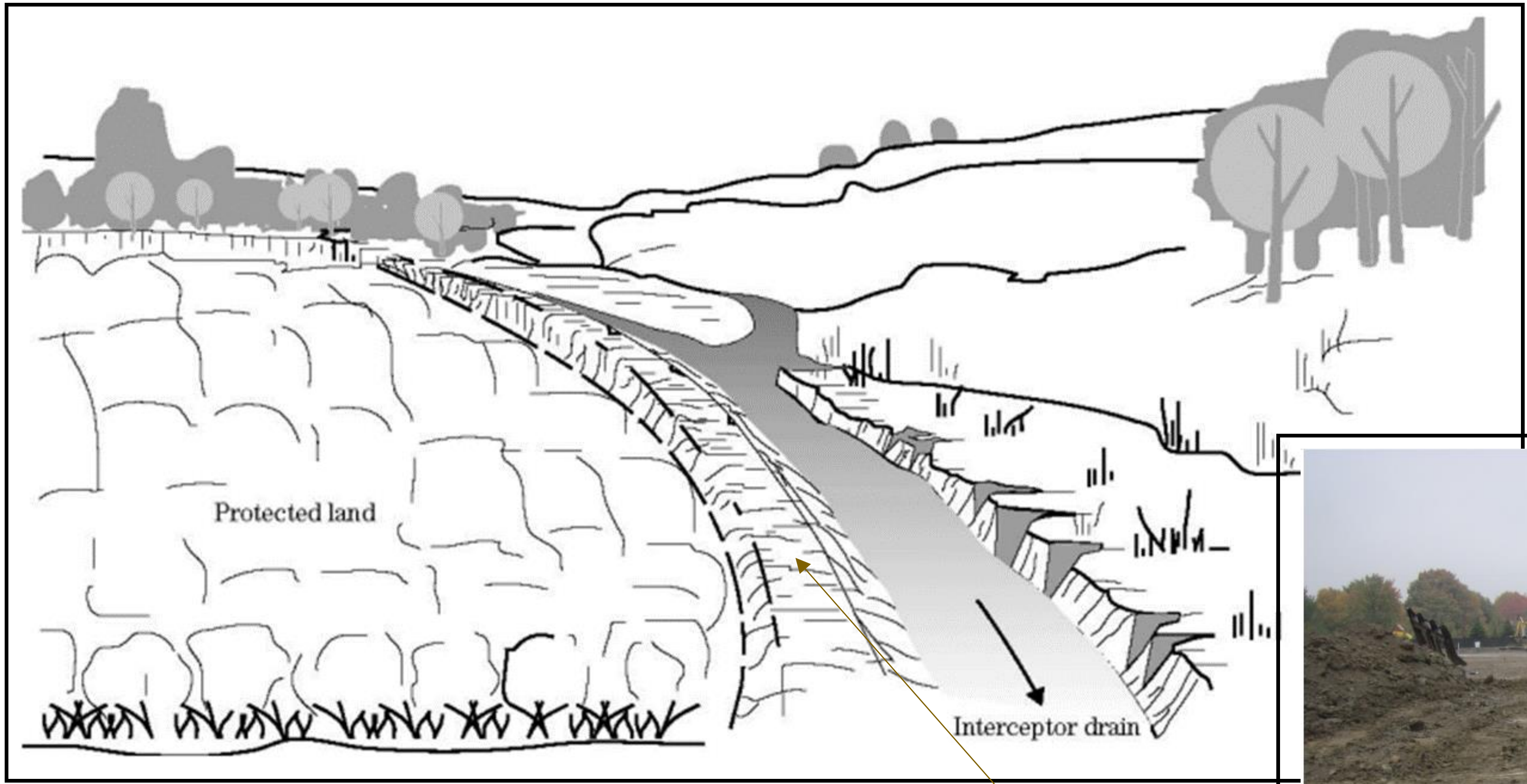
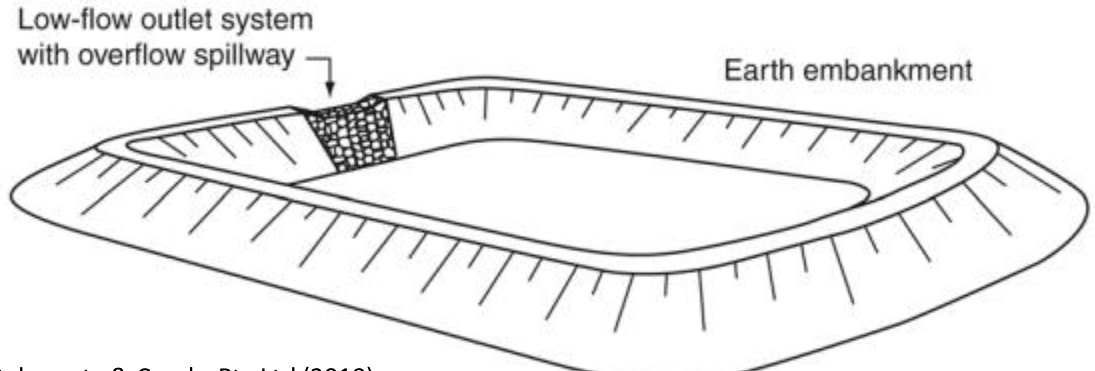


Conceptual graphic of an interceptor drain
(NRCS/USDA.gov, 2007) Available at: https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_017651.pdf

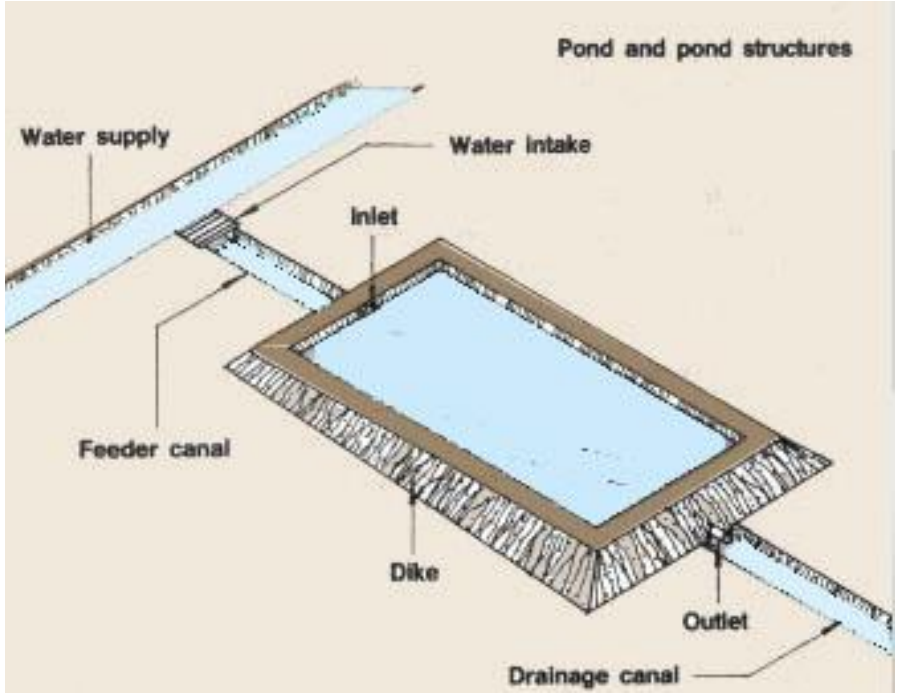
Example of a temporary berm
(Green Infrastructure Ontario, 2012) Available at:
https://greeninfrastructureontario.org/infiltration-trench-swale-construction/

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientists	RSK
	Client:	JOD			
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 12 Interceptor Drain & Spoil berms**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant	
	Revision:	02			

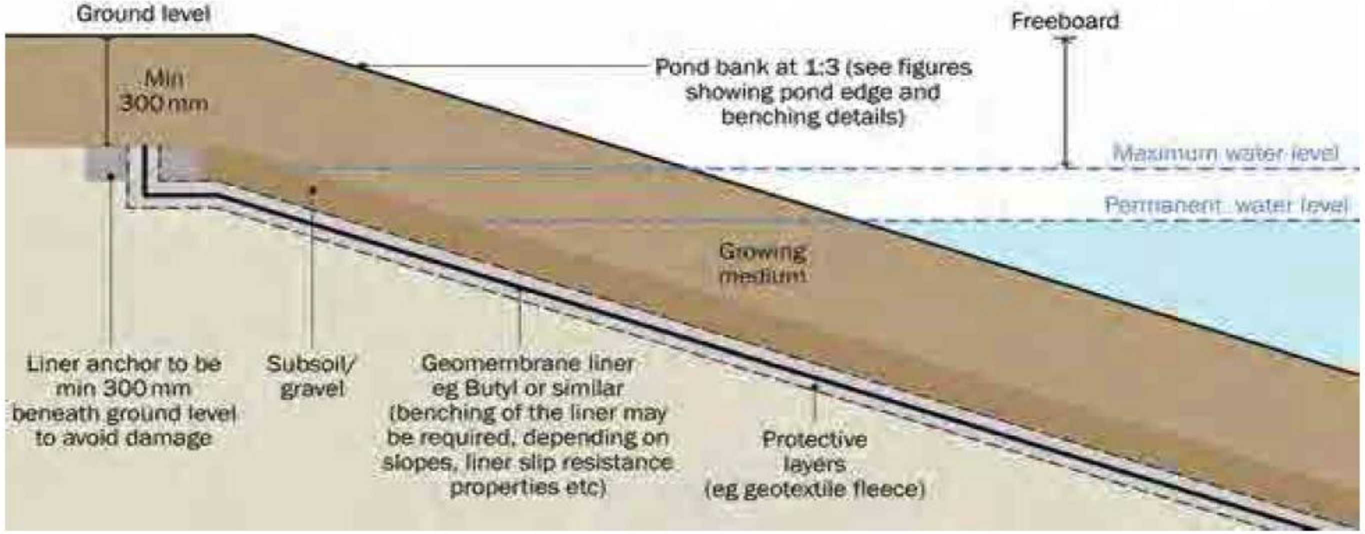
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



Catchments & Creeks Pty Ltd (2010)
<https://www.catchmentsandcreeks.com.au/docs/SEP-1.pdf>



United Nations Food and Agriculture Organization
<https://www.fao.org/fishery/docs/CDrom/FAO_Training/FAO_Training/General/x6708e/x6708e01.htm>

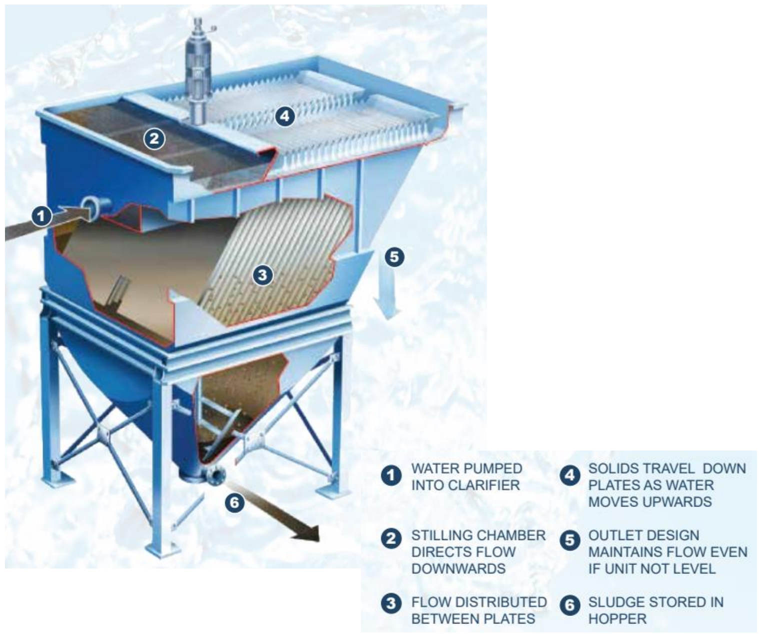


CIRIA SuDS Manual (2015)

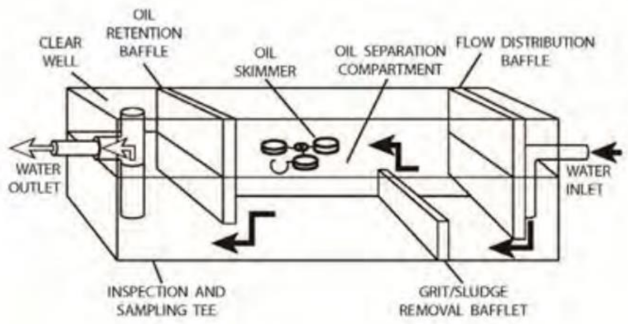
Ponds should be designed to mimic natural forms and have varying depths which can provide a range of different habitats.

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist	RSK
	Client:	JOD			
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 13 Settlement Ponds General Considerations**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



Example of an oil-water separator
Minerex Environmental Limited, an RSK Group company



Siltbuster ® (2017) "Solutions for Suspended Solids Removal: Hire, Sales & Technical Support" Siltbuster Ltd. Available at: https://www.siltbuster.co.uk/wp-content/uploads/2020/10/Solutions-for-Suspended-Solids-Removal.pdf.

Cross-section of oil-water separator
Mohr, Kirby S. (2014)

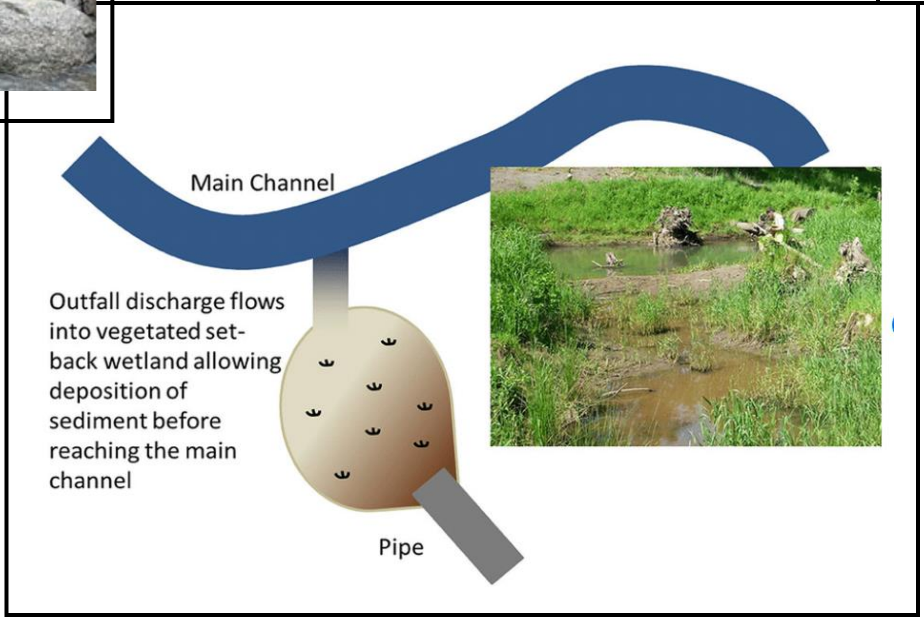
Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientists
	Client:	JOD		
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 14** **Example of Settlement Tank**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Example of buffered outfall with coarse aggregate
(Catchments and Creeks Pty Ltd., 2020)

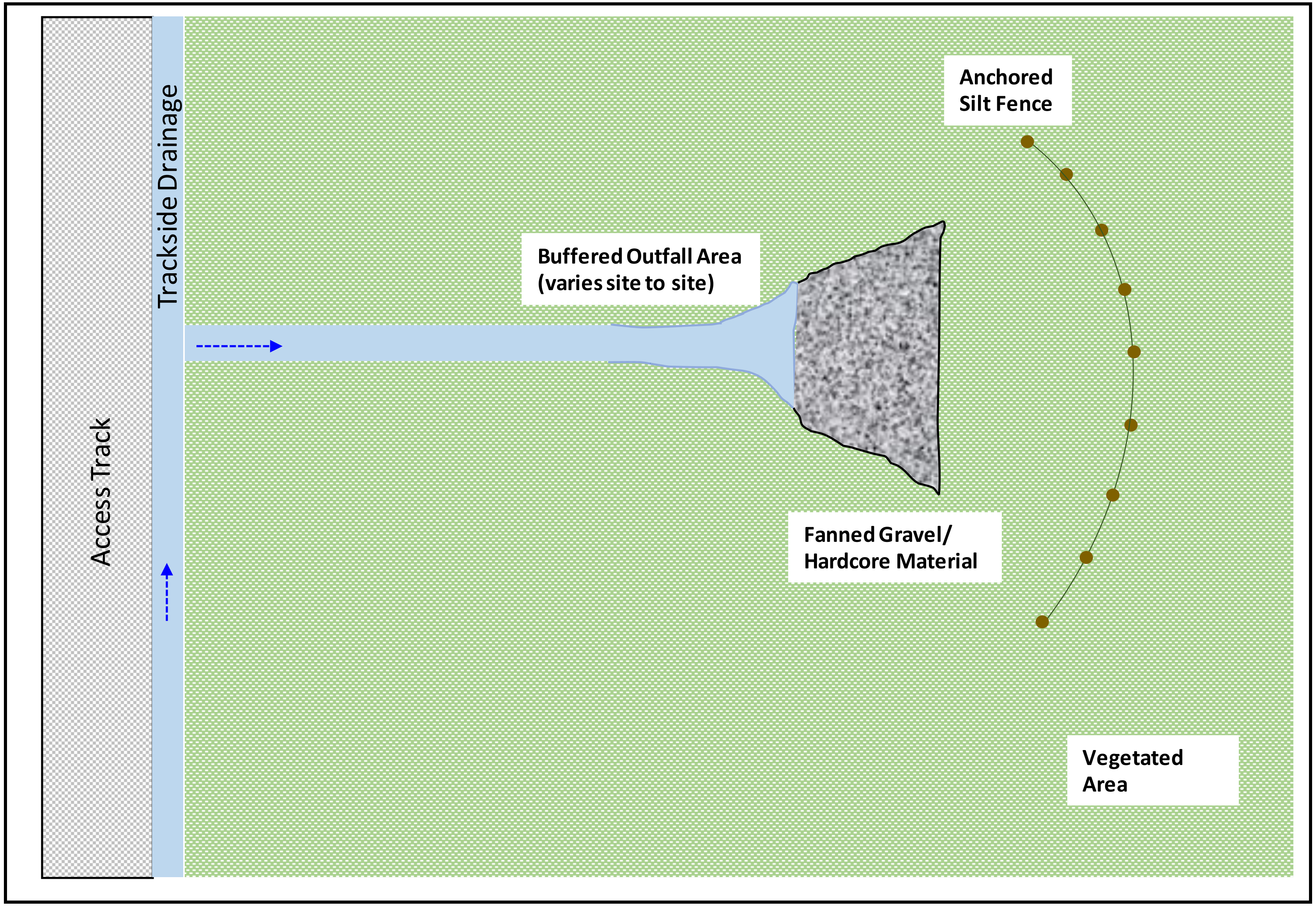
Example of a silt bag
(Cascade Geotechnical Inc., 2022)



Conceptual graphic of a discharge to vegetated outfall
(Janes-Bassett *et al.,* 2016)

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	60676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	JOD			
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 15 Examples of Mitigation Measures to Reduce Sediment Transport**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

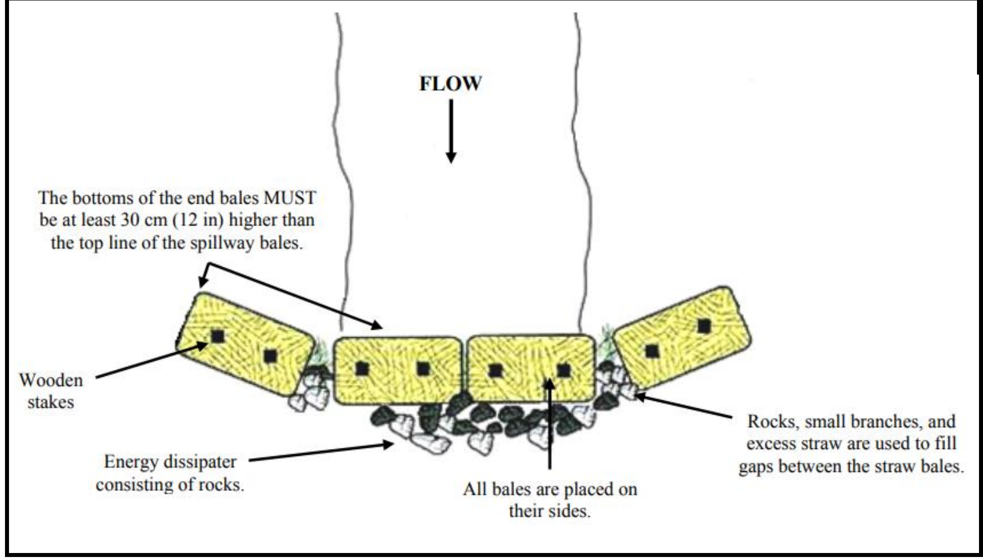
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 16** **Collector Drains and Buffered Outfalls**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Example of a Strawbale Checked Dam Robichaud, et al. (2019)



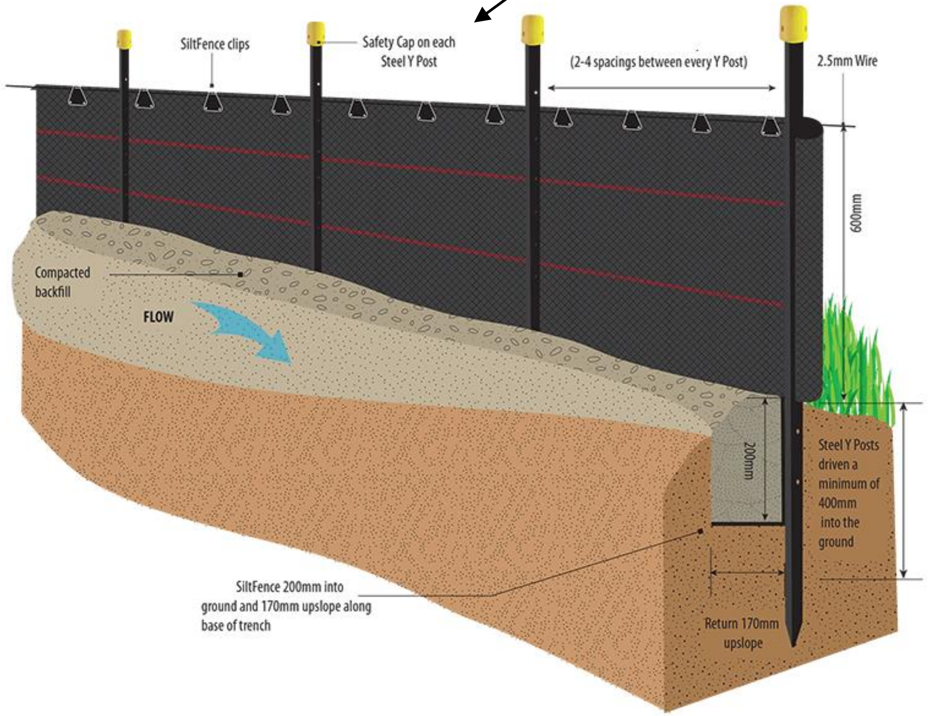
Conceptual graphic of a straw bale checked dam
(Storrar, 2013)

Example of a Strawbale Checked Dam
(Kawartha Conservation, 2020)

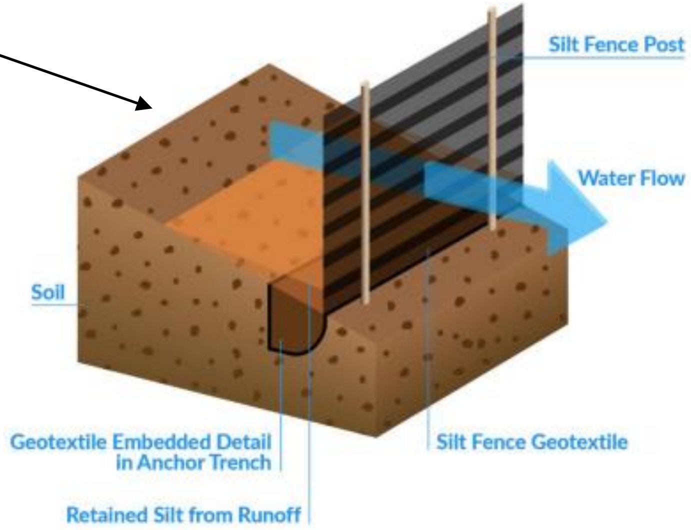
Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 17** **Examples of Mitigation Measures to Reduce Sediment Transport – Straw Bales**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Temporary barrier fabric used to retain erosion of sand, silt, and clay. Geotextile silt fencing acts as a vertical, permeable, interceptor to sediment-laden waters from construction.



Conceptual graphic of a silt fence
Tech Weave (2020) Available at:<https://techweave.com/silt-fences/>



Conceptual graphic of a silt fence
Available at: https://www.pub.gov.sg/Documents/SiltFences.pdf

Example of Silt fencing in use
Bowman Construction Supply (2023) Available at:<https://www.bowmanconstructionsupply.com/products/silt-fence/>

Silt fences control runoff by allowing water to pass through the fabric while collecting leftover sediment.

Example of Silt fencing in use
(EnviroPro, 2022) Available at:
<https://www.enviropro.co.uk/entry/153977/Siltbuster/Terrastop-silt-fences-for-erosion-and-runoff-control/>

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile no. 18 Silt Fencing**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

RSK

Example of a temporary spill pallet bund (Road Ware, 2023)
Available at: <https://www.roadware.co.uk/ibc-storage-tank-pallet-spill-containment-bund-stand/?sku=IBCSP&gclid=Cj0KCQiA8aOeBhCWARIsANRFrQFTsDlSEUrk4rdov4TcTBQOwNZguishep9-yj6_qx9NexUXnAv6ONkaAq8ZEALw_wcB>

Example of a temporary spill pallet bund (Road Ware, 2023)
Available at: <https://www.roadware.co.uk/bp4c-covered-4-drum-spill-pallet-bund-sump/?gclid=Cj0KCQiA8aOeBhCWARIsANRFrQFNE1gbC8i9OUP2HLpHeKcFDNjrurp_ui5Nz6rmRa1WblNXRH17di8aAn-kEALw_wcB>

Example of a temporary spill pallet bund (Road Ware, 2023)
Available at: <https://www.roadware.co.uk/gsp2ibc-galvanised-steel-double-ibc-spill-pallet-bund/?gclid=Cj0KCQiA8aOeBhCWARIsANRFrQGfh5e3lUi9TcfRiXMAcEnilLo5gFmKlb0_dHBi7MRklwiM0cU7F2oaAkDSEALw_wcB>

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 19 Examples of Mitigation Measures During Construction Phase- Environmental 'Good Practice' of Bunded Materials**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

RSK

Polymer Spill Kit
(Yellow Shield Ltd., 2023) Available at:
https://www.yellowshield.co.uk/polymer-spill-kit

Maintenance Spill Kit
(Hyde Park Environmental, 2023) Available at: https://hydepark-environmental.com/1100-litre-maintenance-emergency-spill-kit?utm_source=email&utm_medium=email&utm_campaign=HMK234%2F03.23

Example of a spill kit deployed in surface water
(Oracle Environmental Experts Ltd., 2022)
Available at: https://www.oracle-environmental.com/spill-kits

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientists
	Client:	JOD		
Figure Name: **Appendix 9.4 – Conceptual & Information Graphics – Tile 20 Emergency Spill Kits**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

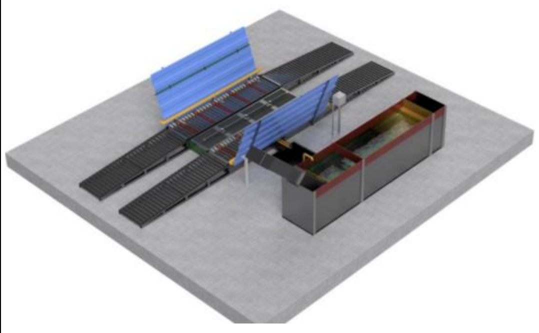
RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Meeds Environmental, LLC, 2012
<http://www.meedsenvironmental.com/wheel.php>

Construction.co.uk, 2023
<https://www.construction.co.uk/c/217313/wheelwash-ltd>

Neptune Wash Solutions, 2023
<https://www.neptunewash.com/automated-wheel-wash-systems/>

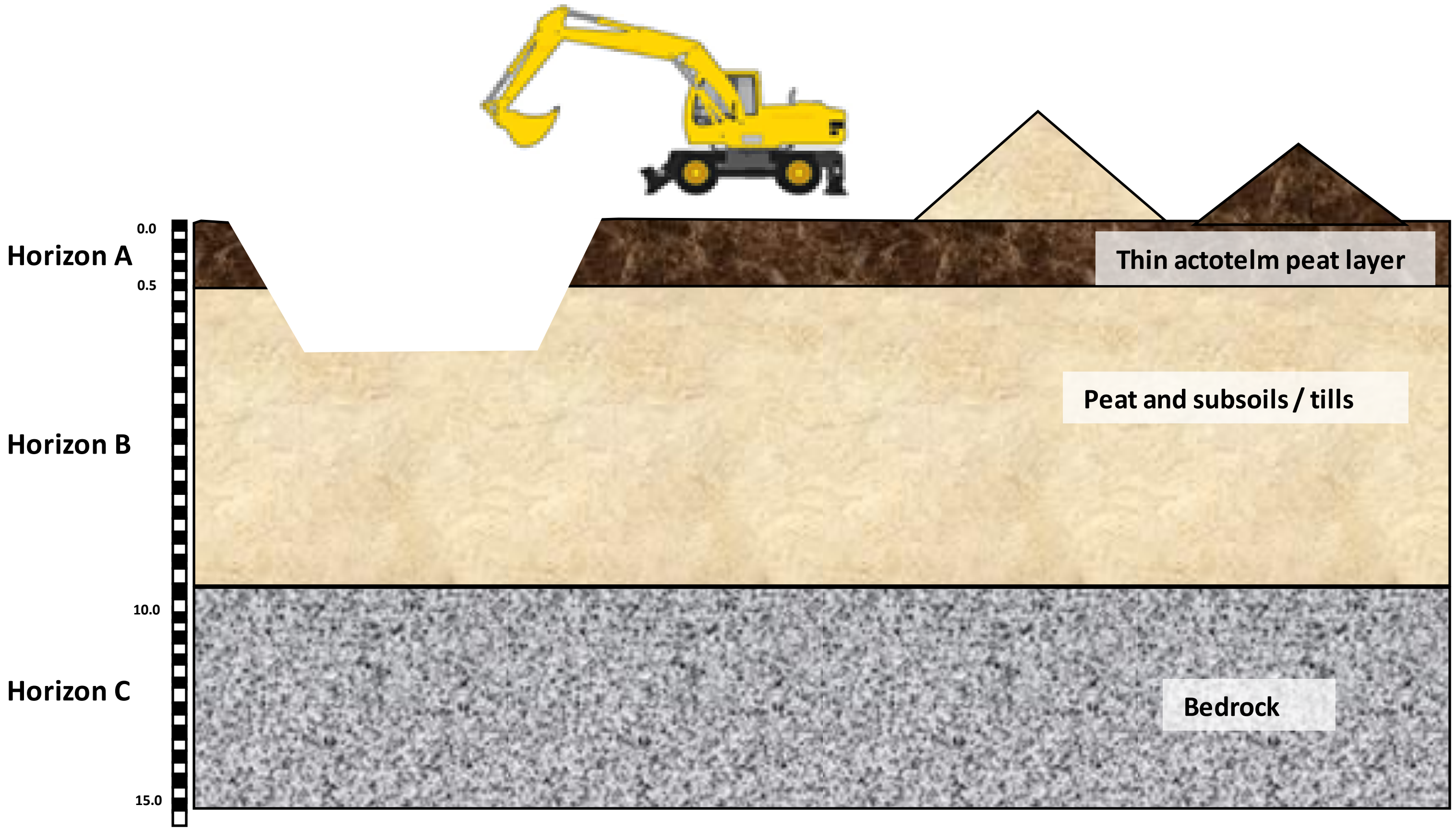


KKE Corporation, 2023
<https://kkewash.com/en-gb/8-4-agc-portable-tire-wash/>

Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 - Conceptuel & Information Graphics – Tile 21** **Wheel Washout Station**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

- The three principal materials excavated in order of depth will include topsoil at the surface, subsoils, and weathered and broken bedrock (Horizons A-C, respectfully).
- A suitably qualified geotechnical / soil scientist will supervise all excavation and the principal material types (topsoil, subsoil and bedrock) will be segregated as they arise.
- Temporary storage locations and stockpiled arisings will be managed in such a way that as to not mix induvial soils types which will, in turn will facilitate reuse on Site. Some measures which will be taken include;
    - Designated areas for each type of material which will be adequately sized based on Material Balance Assessment calculations and planned storage height.
    - Incorporating the planned movement of materials for example; actotelm peat will be the first material to be excavated and the last to be used in reinstatement.
    - Adequate space between stockpiles to reduce the potential of mixing when material is being deposited or removed, or if localized stability issues arise for example; stockpile collapse.
    - It is also important to mitigate against the entrainment of solids in runoff (EIAR Chapter 9 – Hydrology & hydrogeology).
- In order to reduce the amount of arisings to be managed or stored at any one time during the construction phase, a Materials Balance Assessment and Materials Management Plan will be developed with a view to identifying suitable locations for permanent reinstatement as early as possible, for example; as the construction phase progresses, opportunities to move arisings to a permanent reinstatement area in one movement will be taken as often as possible.
- Backfilling in layers will be carried out at the designated reinstatement locations, this will include; use of material as fill under infrastructure, backfill around newly installed infrastructure e.g. foundations, and potentially in improvement areas.
- Infilling with material in identified soil horizons to revert these areas to baseline levels.

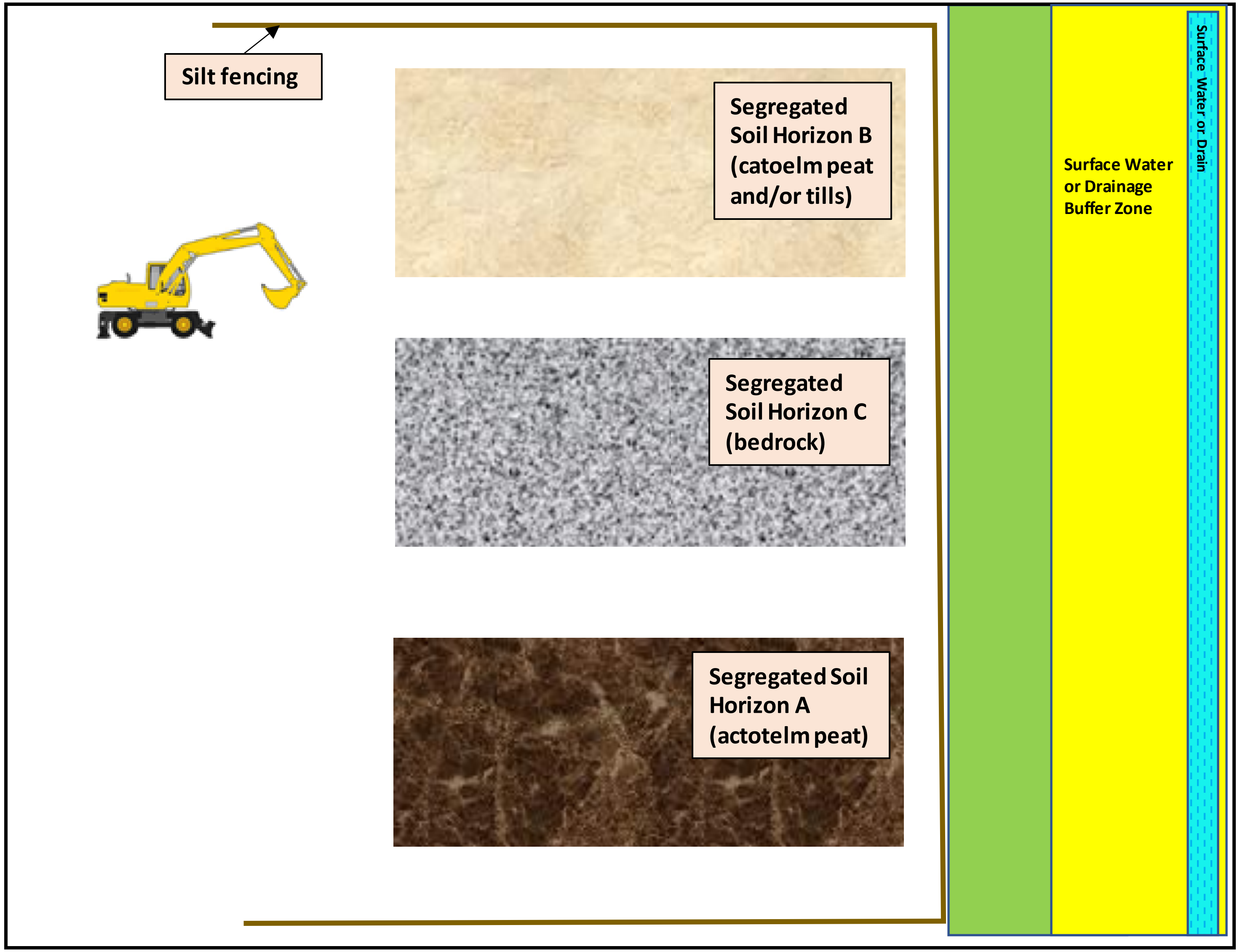


Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 - Conceptuel & Information Graphics – Tile 22 Conceptual Soil Horizon Graphic**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

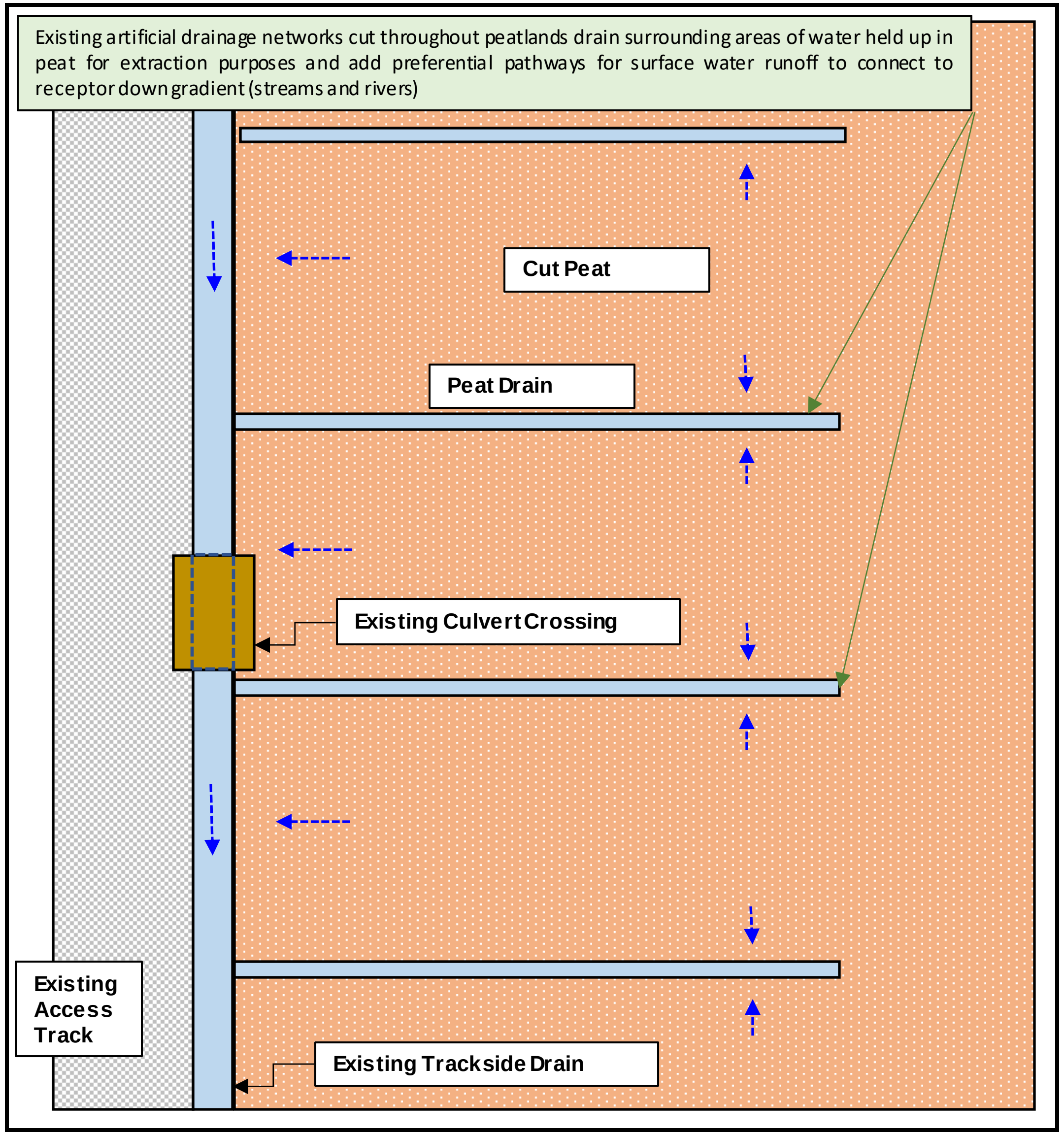
- All stockpiles will be covered with high-grade polythene sheeting to prevent run-off of rainwater and leaching of potential contaminants from the stockpiled material generation and/or the generation of dust.
- Recovered material destined for reuse off site will comply with Article 27 or Article 28 of the EPA to be classified as a by-product or as end-of-life waste, or Certificate of Registration for soils.
- Excess soils which cannot be reused will be tested and classified as a waste and disposed of appropriately.
- Temporary stockpiles will avoid areas on Site near artificial drainage channels (outside designated surface water buffer zones and will adhere to mitigation measures outline in **EIAR Chapter 9 Hydrology and Hydrogeology,** in dealing with entrainment of soils in surface water runoff.



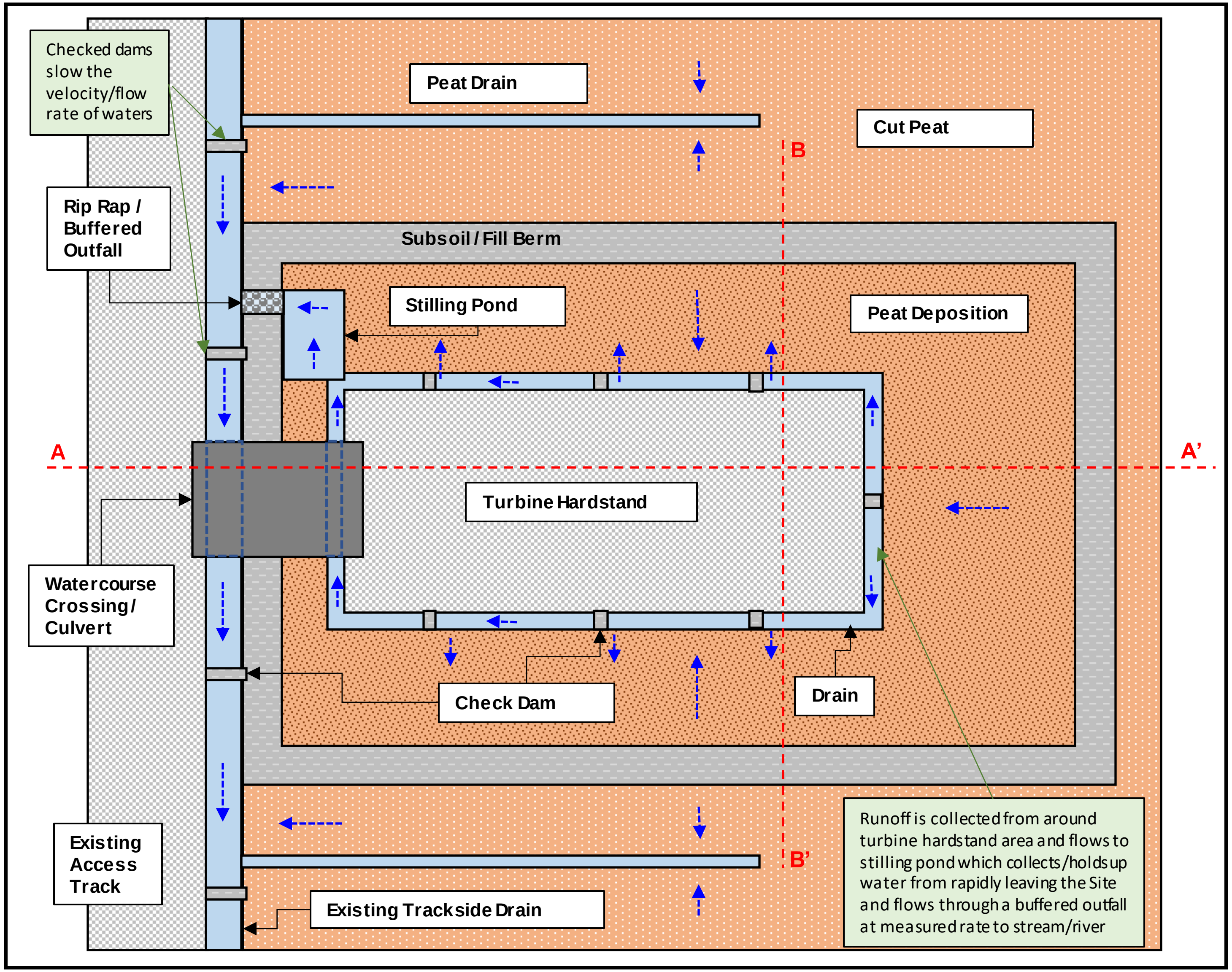
Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Colleen McClung Graduate Project Scientist
	Client:	JOD		
Figure Name: **Appendix 9.4 - Conceptuel & Information Graphics – Tile 23** **Conceptual Management of Stockpiles Graphic**	**Date:**	03/05/23	**Reviewed By:**	Sven Klinkenbergh Principal Environmental Consultant
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Existing Drainage Scenario

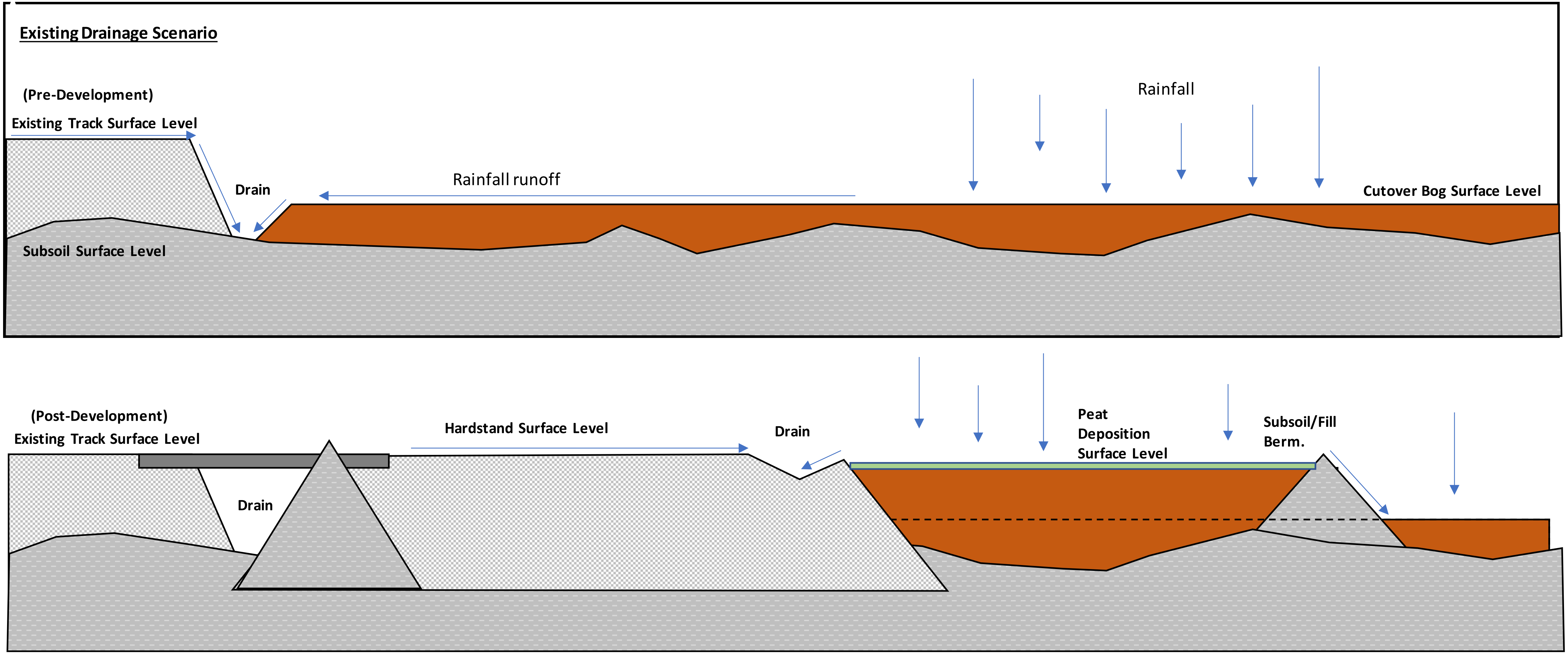


Proposed Drainage Scenario



Site Name: **Firlough Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 24 Examples of Conceptual Hardstand – Plan**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

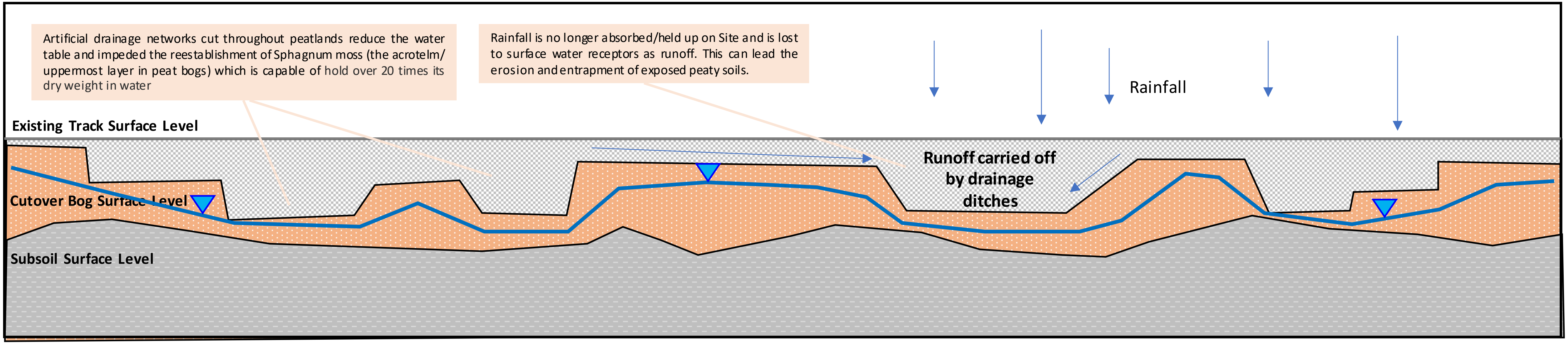
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



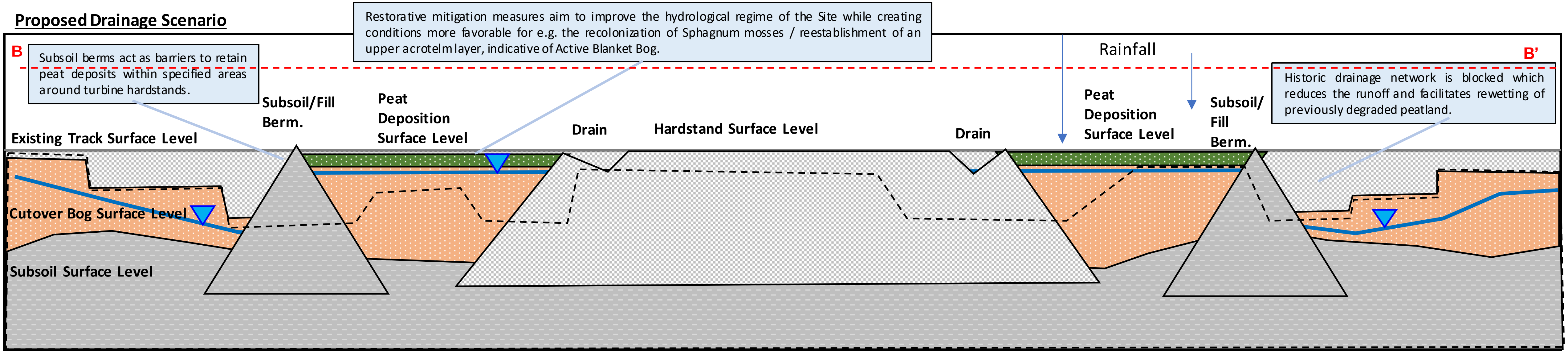
Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	JOD / Mercury Renewables			
Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 25** **Peat Deposition Areas – Side Profile view**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Existing Drainage Scenario



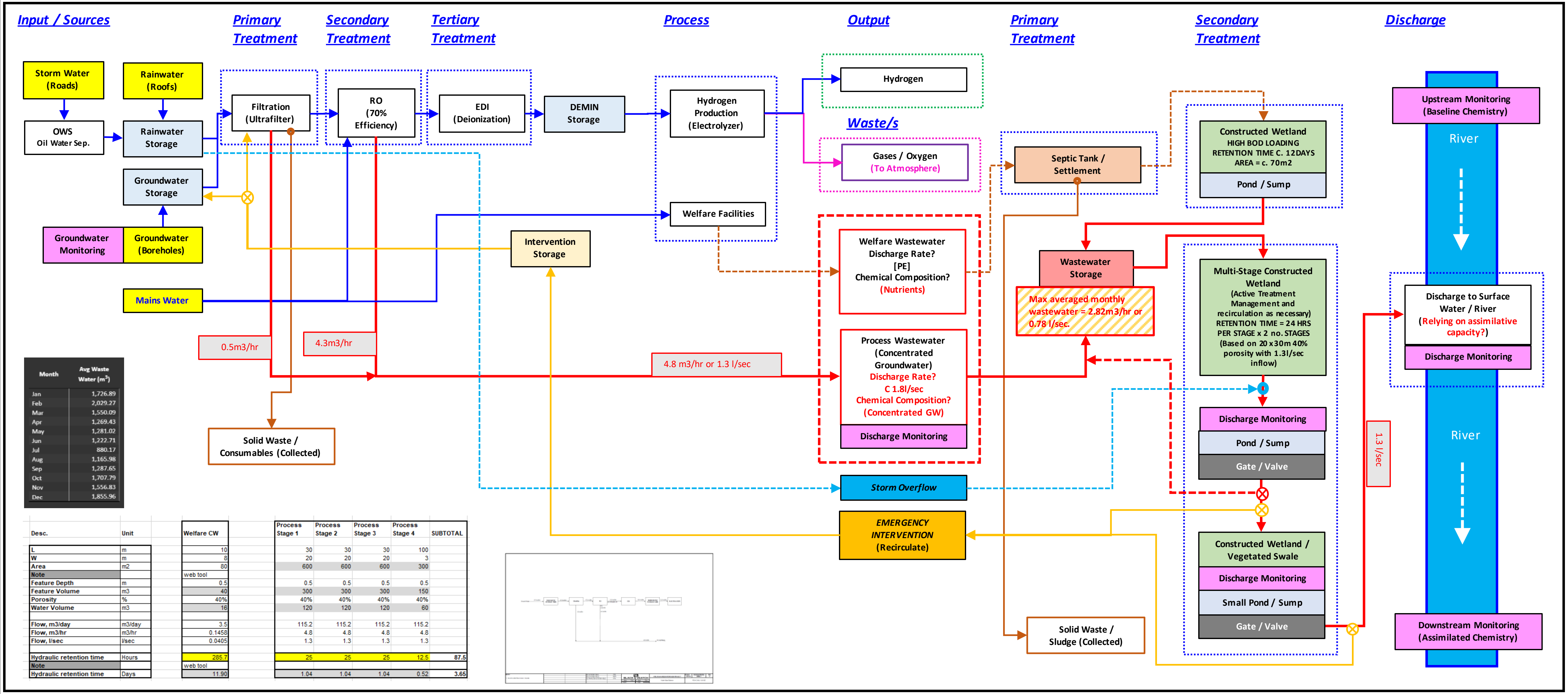
Proposed Drainage Scenario



Site Name: **Firlough Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	Mercury Renewables			
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 26** **Peat Deposition Areas – Linear view**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Conceptual Treatment Train Flow Diagram



Month	Avg Waste Water (m^3)
Jan	1,726.89
Feb	2,029.27
Mar	1,550.09
Apr	1,269.43
May	1,281.02
Jun	1,222.71
Jul	880.17
Aug	1,165.98
Sep	1,287.65
Oct	1,707.79
Nov	1,556.83
Dec	1,855.96

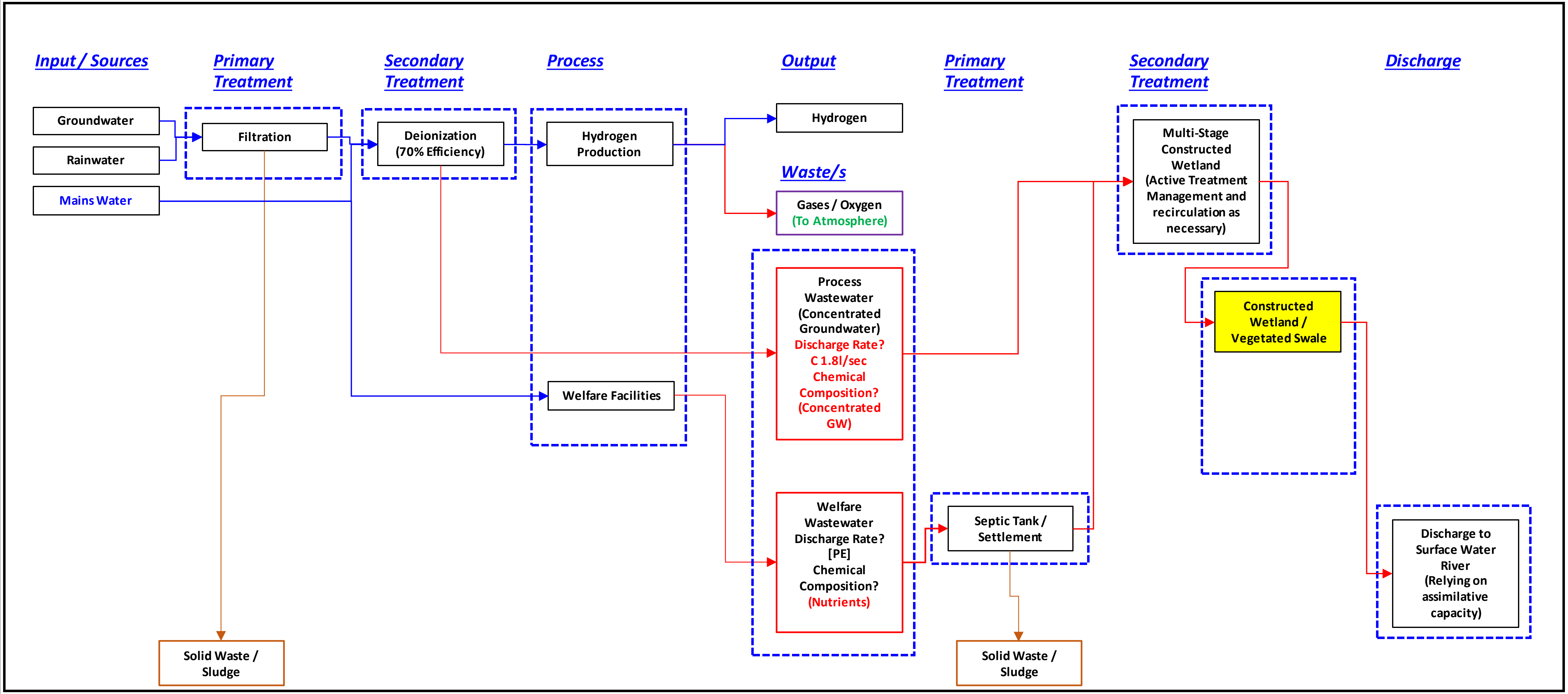
Desc.	Unit	Welfare CW	Process Stage 1	Process Stage 2	Process Stage 3	Process Stage 4	SUBTOTAL
L	m	10	30	30	30	100	
W	m	8	20	20	20	3	
Area	m2	80	600	600	600	300	
Note		web tool					
Feature Depth	m	0.5	0.5	0.5	0.5	0.5	
Feature Volume	m3	40	300	300	300	150	
Porosity	%	40%	40%	40%	40%	40%	
Water Volume	m3	16	120	120	120	60	
Flow, m3/day	m3/day	3.5	115.2	115.2	115.2	115.2	
Flow, m3/hr	m3/hr	0.1458	4.8	4.8	4.8	4.8	
Flow, l/sec	l/sec	0.0405	1.3	1.3	1.3	1.3	
Hydraulic retention time	Hours	285.7	25	25	25	12.5	87.5
Note		web tool					
Hydraulic retention time	Days	11.90	1.04	1.04	1.04	0.52	3.65

Site Name: **Firloiugh Green Hydrogen**	**Project No.** 603676	**Drawn By:**	Sven Klinkenbergh, Principal Environmental Consultant
	Client: Mercury Renewables		
Figure Name: **Tile 27** **Hydrogen Site – Conceptual Process & Treatment Train Flow Diagram**	**Date:** 03/05/23	**Reviewed By:**	SK
	Revision: 02		

DSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Conceptual Treatment Train Flow Diagram

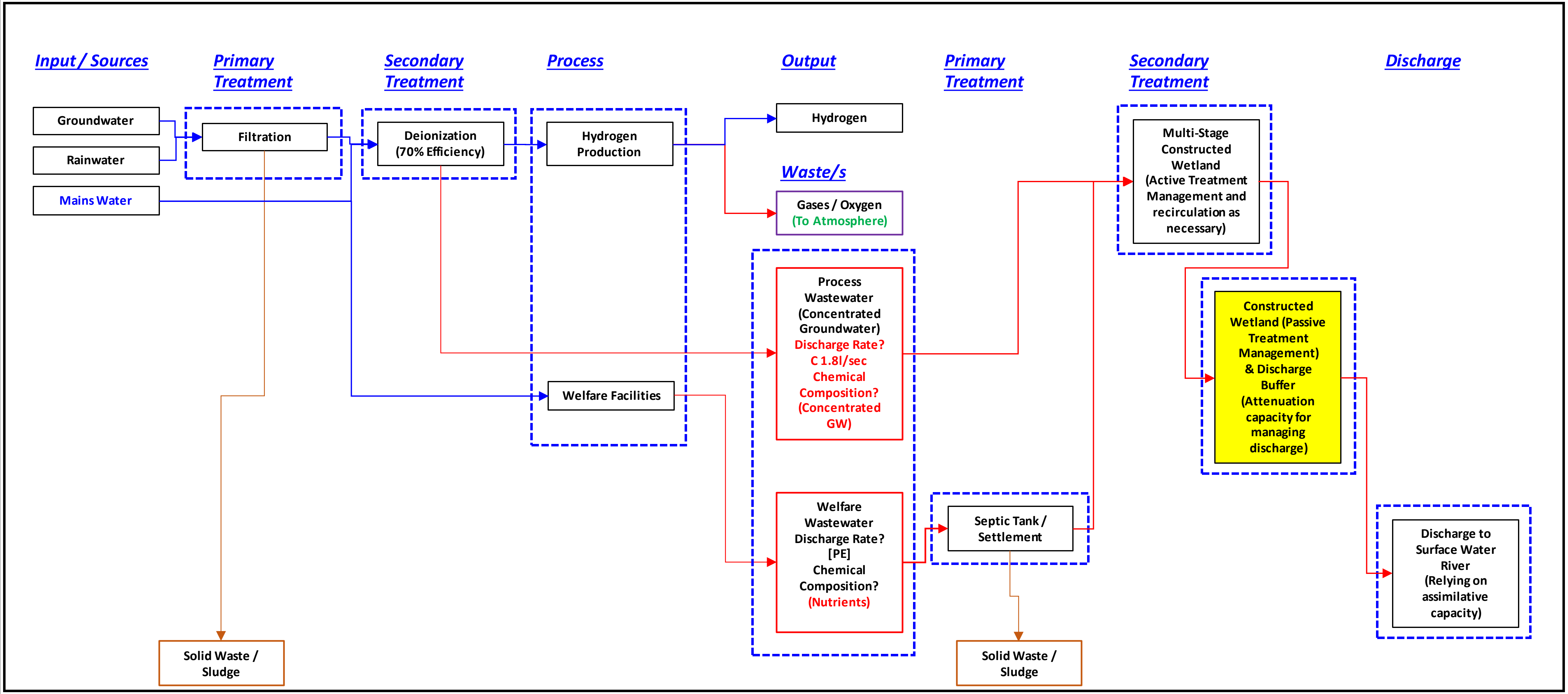


Site Name: **Firloiugh Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **DRAFT Conceptual Graphics Tile 28 Hydrogen Site WWT & SuDS – Configuration A**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

RSK

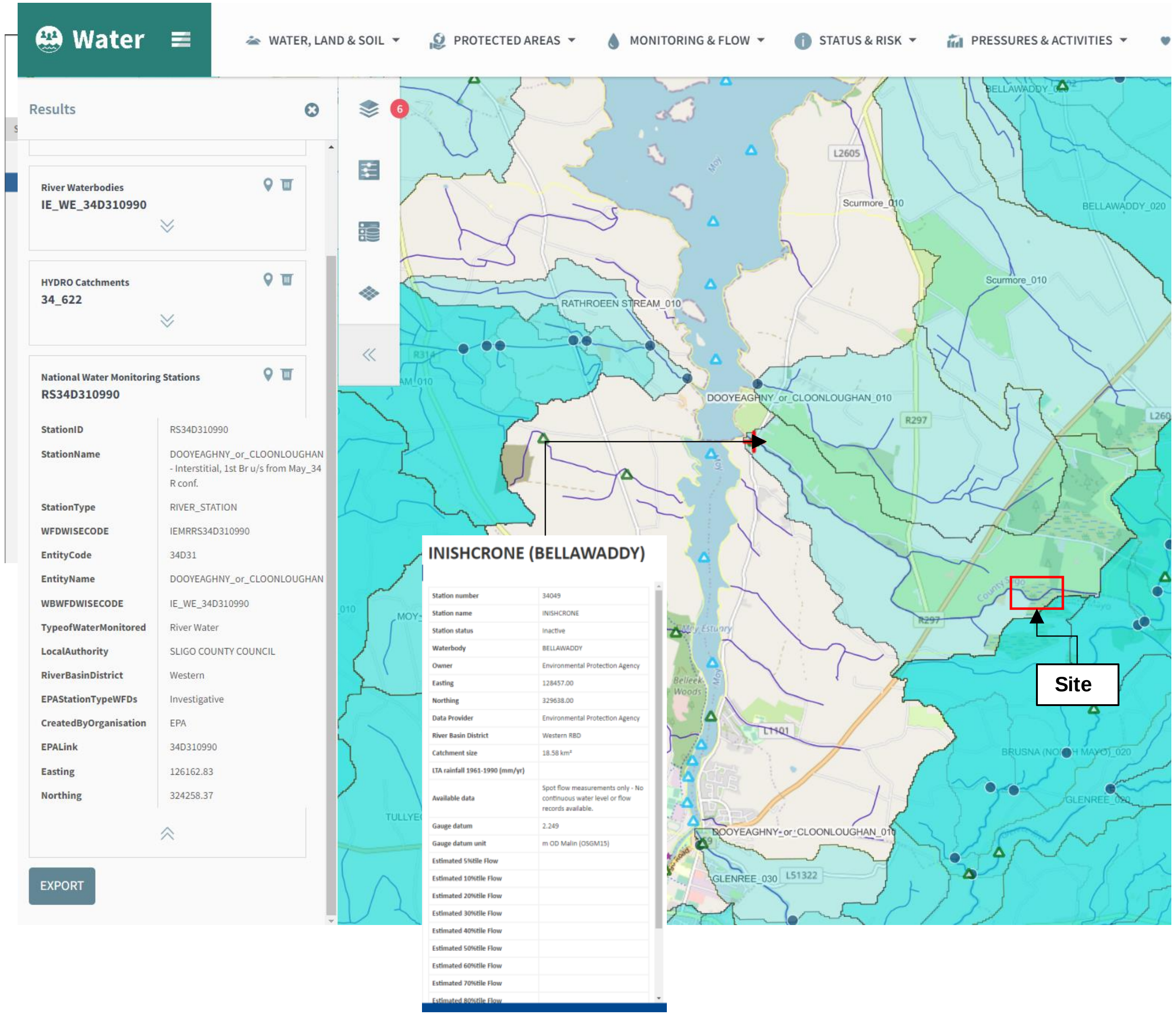
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

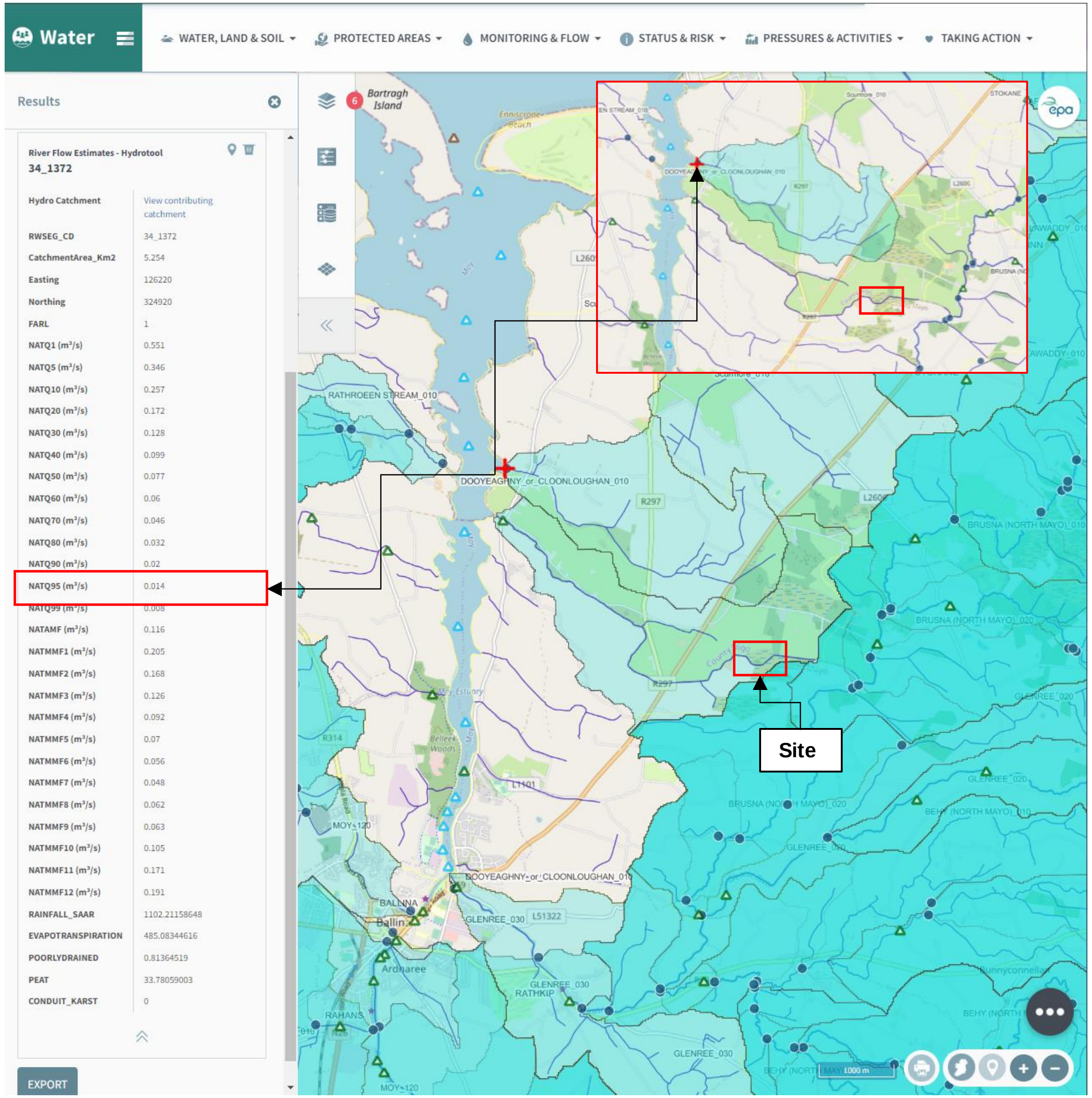
Conceptual Treatment Train Flow Diagram



Site Name: **Firloiugh Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **DRAFT Conceptual Graphics – Tile 31** **Hydrogen Site WWT & SuDS – Configuration B**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

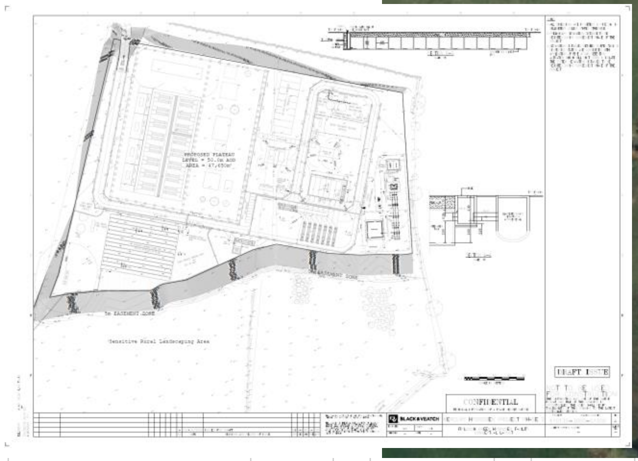
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

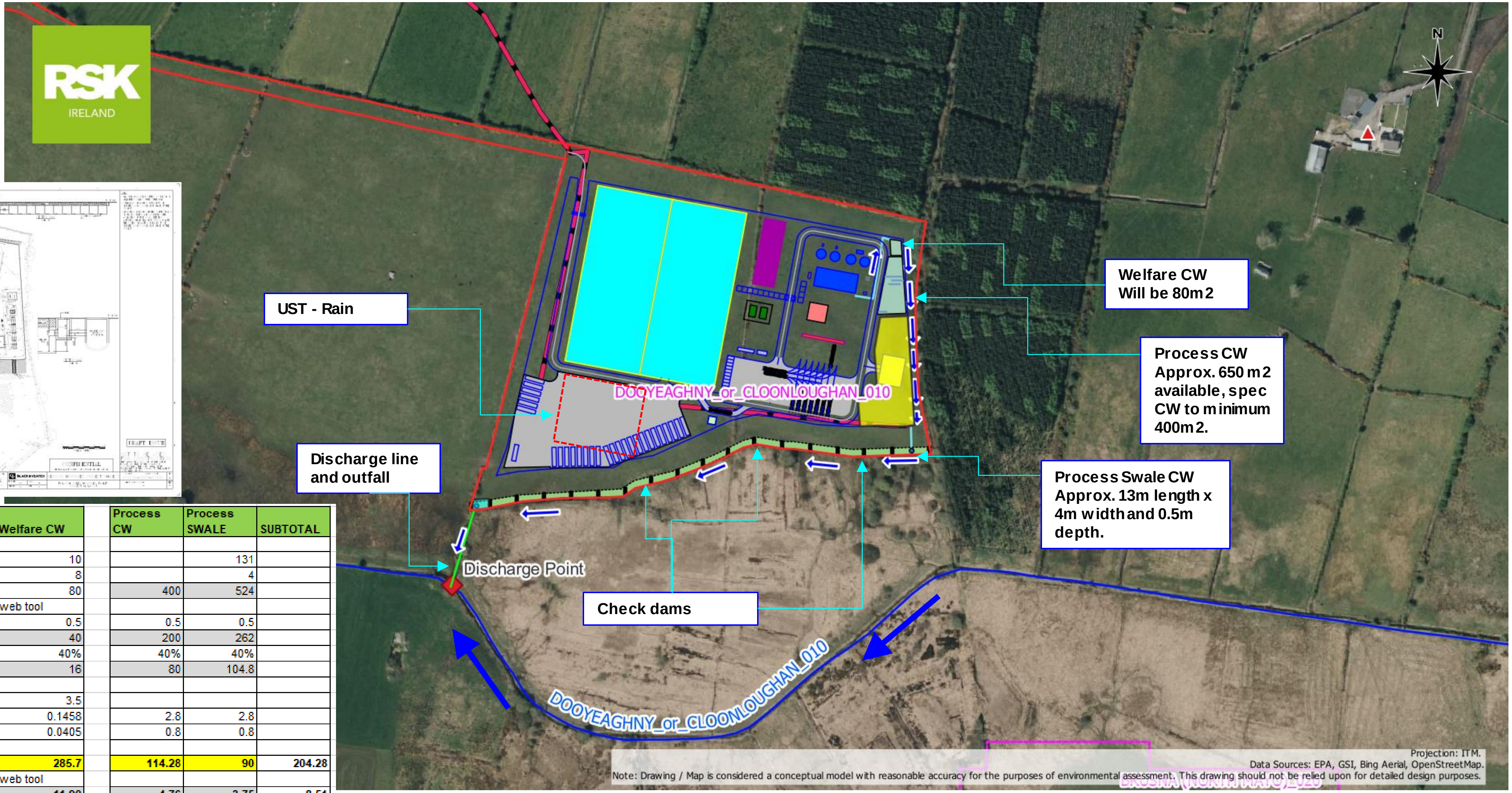




Site Name: **Firlough Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 1 – Tile 29** **Site Location & SW Discharge Data**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



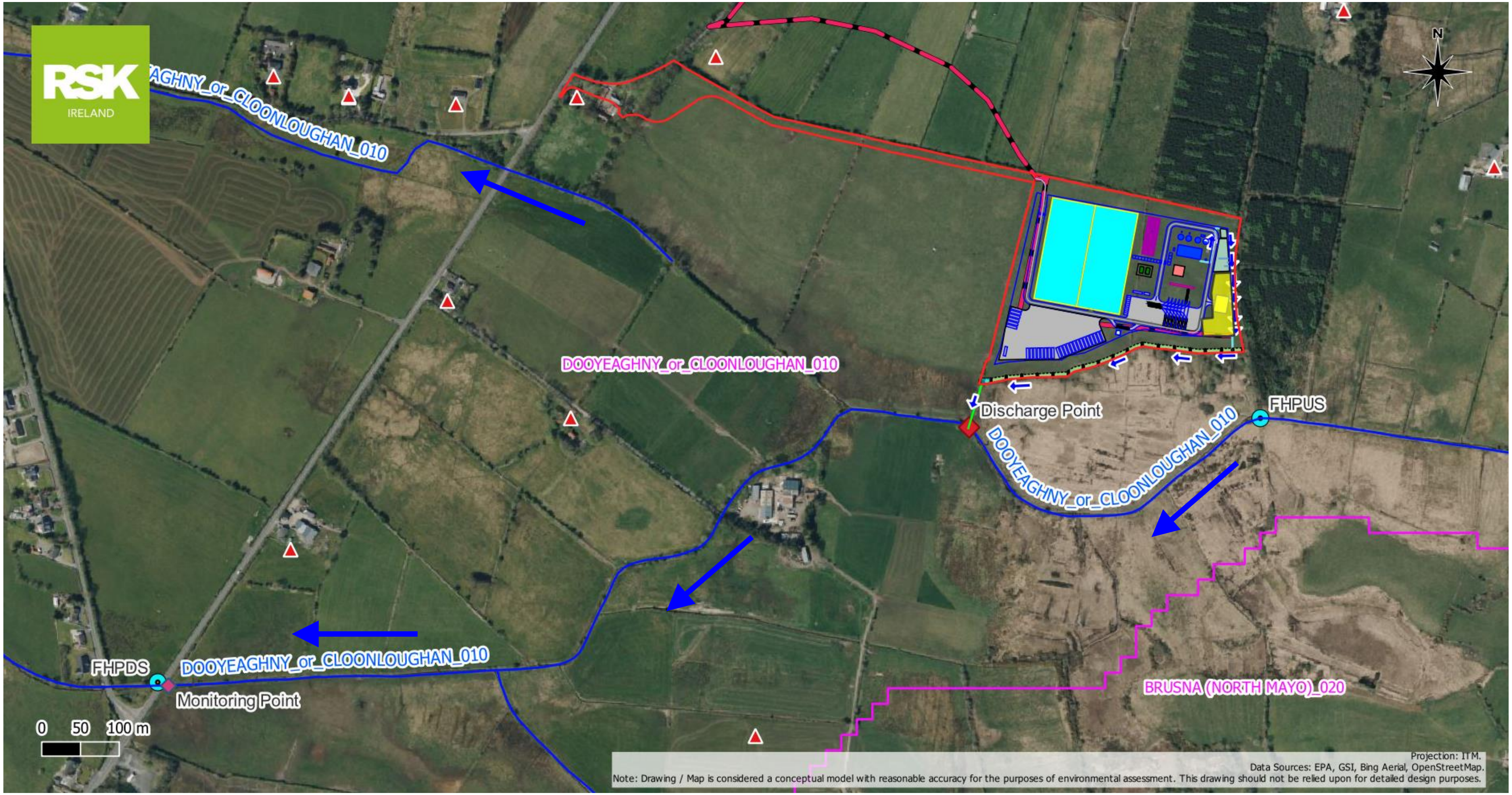


Desc.	Unit	Welfare CW	Process CW	Process SWALE	SUBTOTAL
L	m	10		131	
W	m	8		4	
Area	m2	80	400	524	
Note		web tool			
Feature Depth	m	0.5	0.5	0.5	
Feature Volume	m3	40	200	262	
Porosity	%	40%	40%	40%	
Water Volume	m3	16	80	104.8	
Flow, m3/day	m3/day	3.5			
Flow, m3/hr	m3/hr	0.1458	2.8	2.8	
Flow, l/sec	l/sec	0.0405	0.8	0.8	
Hydraulic retention time	Hours	285.7	114.28	90	204.28
Note		web tool			
Hydraulic retention time	Days	11.90	4.76	3.75	8.51

https://www.omnicalculator.com/chemistry/hydraulic-retention-time

Site Name: **Firlough Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh, Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 2 – Tile 30 Proposed Development**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

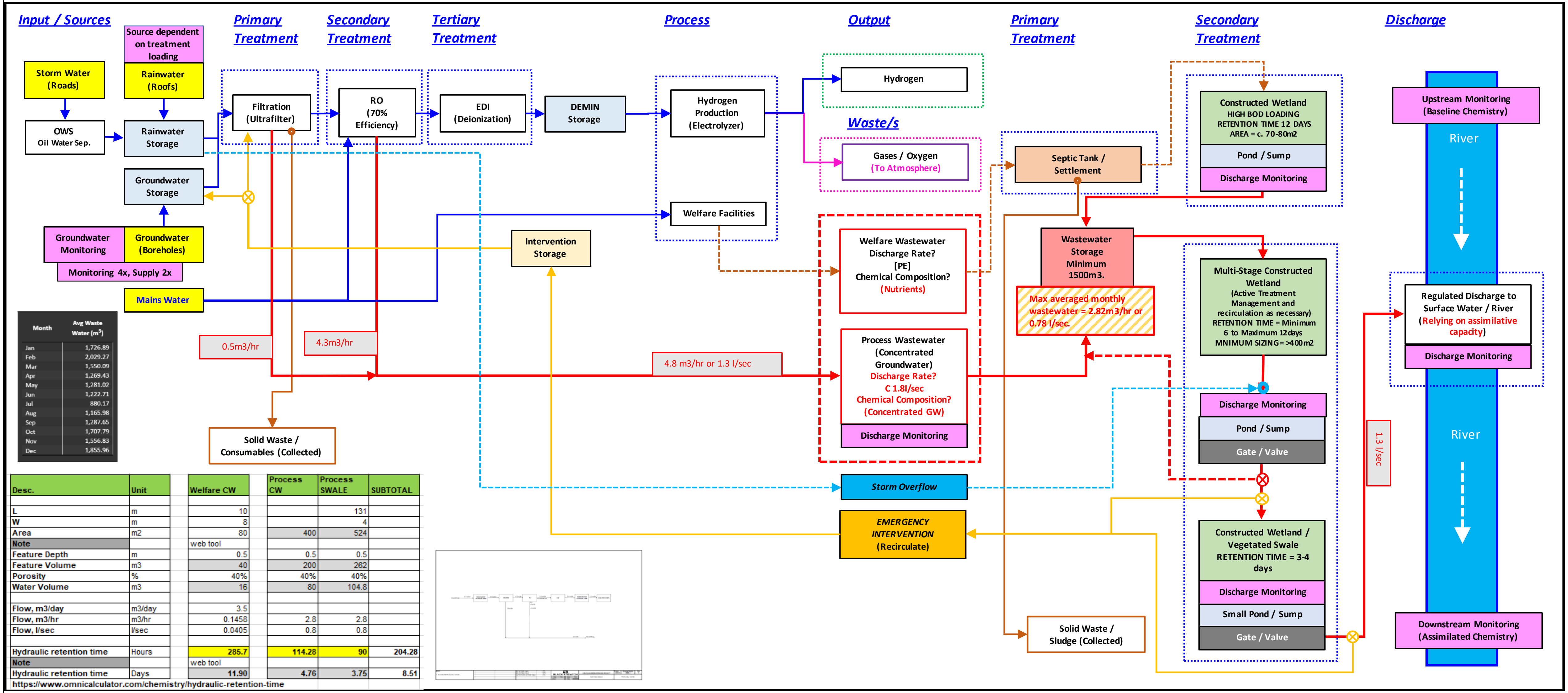


Site Name: **Firlough Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 3 – Tile 31 Site Location & SW Baseline Locations**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Conceptual Treatment Train Flow Diagram

Flow / Discharge rates based on Peak Flow.



Month	Avg Waste Water (m^3)
Jan	1,726.89
Feb	2,029.27
Mar	1,550.09
Apr	1,269.43
May	1,281.02
Jun	1,222.71
Jul	880.17
Aug	1,165.98
Sep	1,287.65
Oct	1,707.79
Nov	1,556.83
Dec	1,855.96

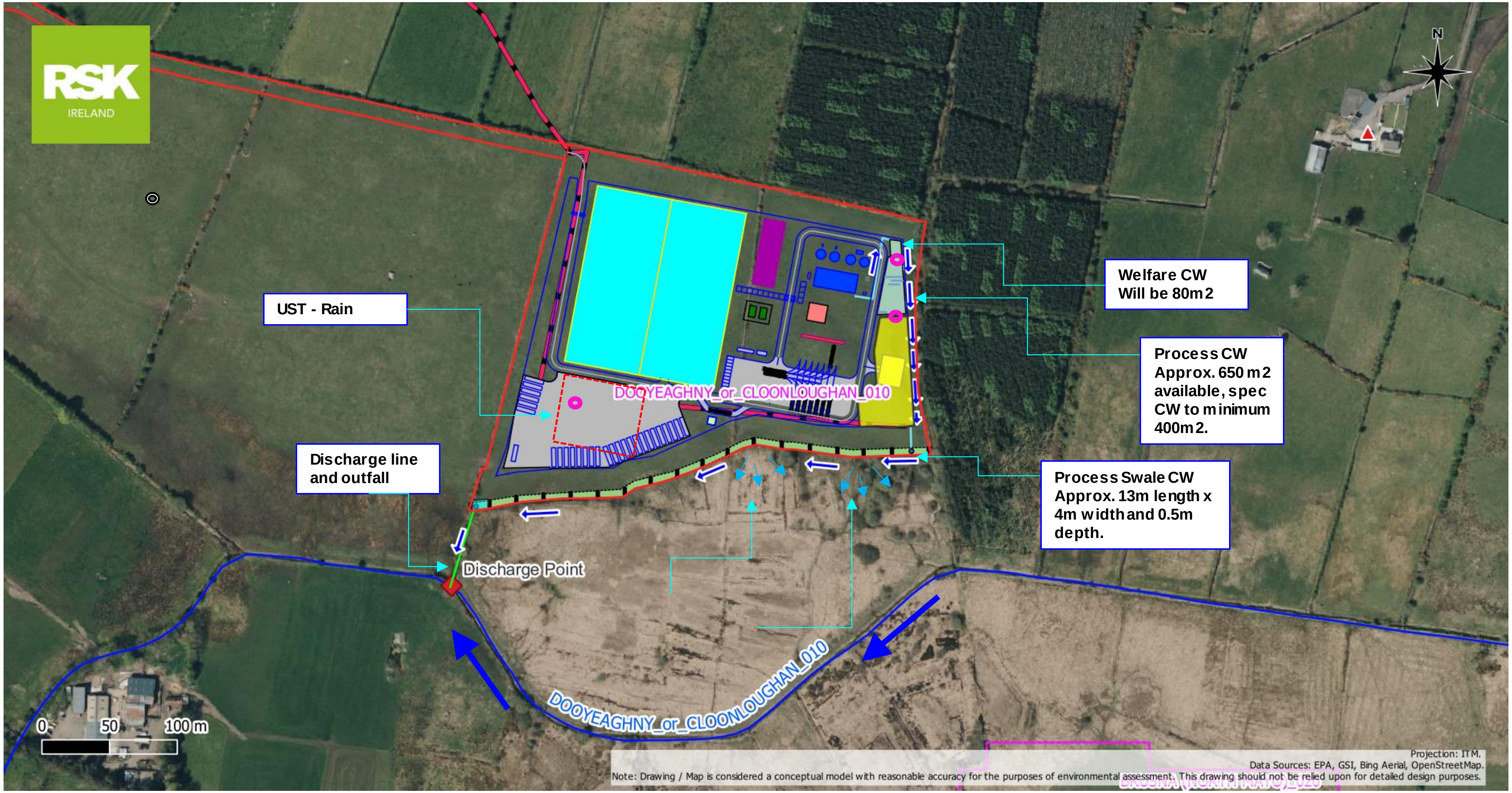
Desc.	Unit	Welfare CW	Process CW	Process SWALE	SUBTOTAL
L	m	10		131	
W	m	8		4	
Area	m2	80	400	524	
Note		web tool			
Feature Depth	m	0.5	0.5	0.5	
Feature Volume	m3	40	200	262	
Porosity	%	40%	40%	40%	
Water Volume	m3	16	80	104.8	
Flow, m3/day	m3/day	3.5			
Flow, m3/hr	m3/hr	0.1458	2.8	2.8	
Flow, l/sec	l/sec	0.0405	0.8	0.8	
Hydraulic retention time	Hours	285.7	114.28	90	204.28
Note		web tool			
Hydraulic retention time	Days	11.90	4.76	3.75	8.51

https://www.omnicalculator.com/chemistry/hydraulic-retention-time

Site Name: **Firlough Green Hydrogen**	**Project No.** 603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client: Mercury Renewables		
Figure Name: **Figure 4 – Tile 35** **Hydrogen Site – Conceptual Process & Treatment Train Flow Diagram**	**Date:** 03/05/23	**Reviewed By:**	SK
	Revision: 02		

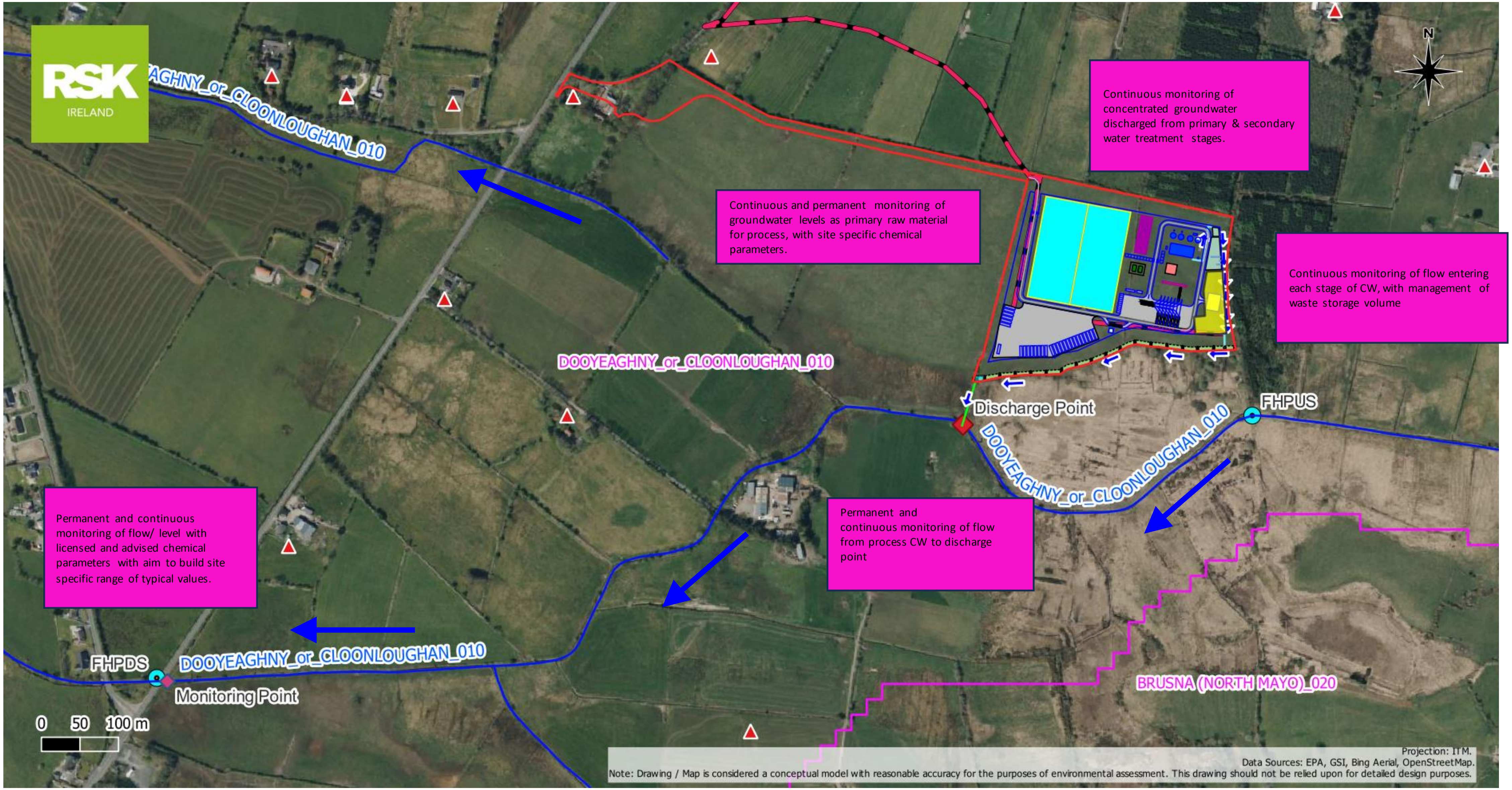
RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



Site Name: **Firlough Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 2 – Tile 32** **Proposed Development**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

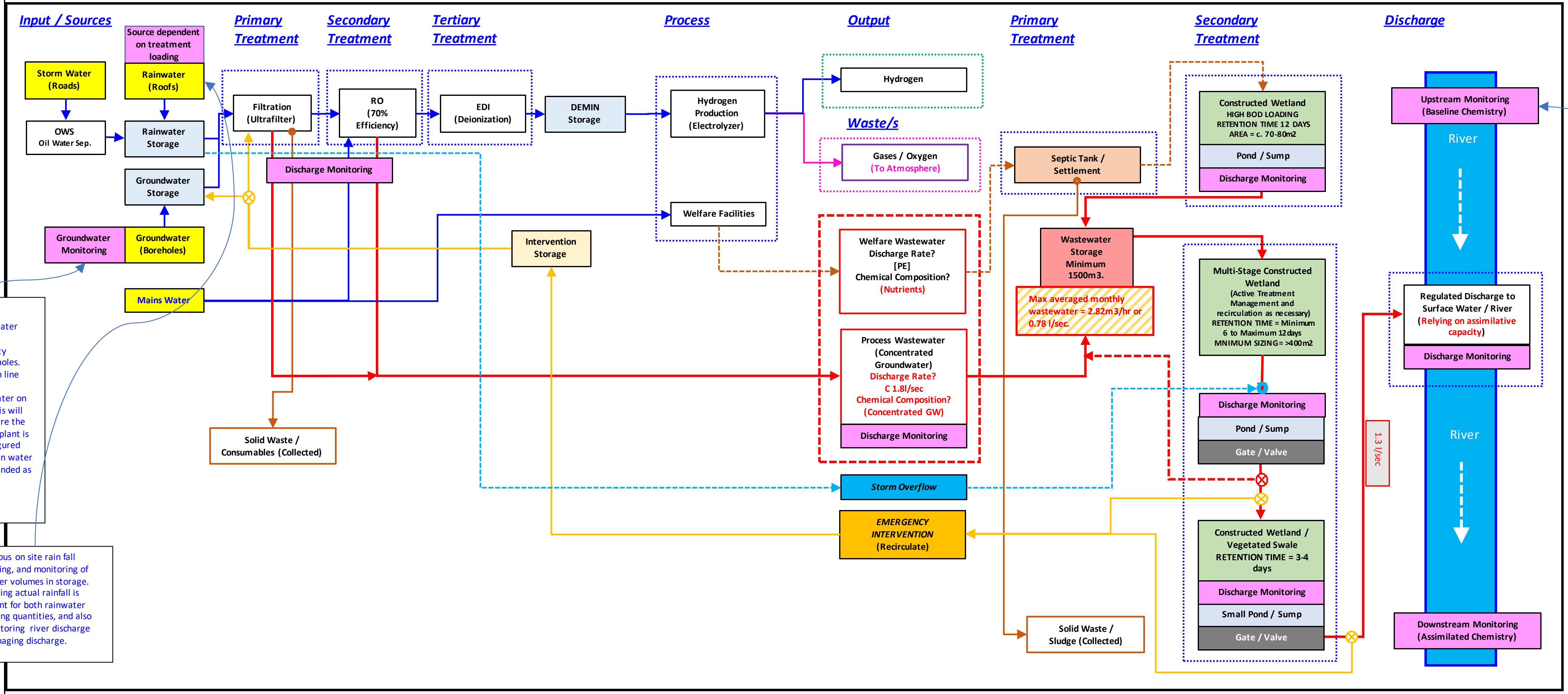


Site Name: **Firlough Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	
	Client:	Mercury Renewables			
Figure Name: **Figure 3 – Tile 33 Site Location & SW Baseline Locations**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Conceptual Treatment Train Flow Diagram

Flow / Discharge rates based on Peak Flow.



Site Name: **Firlough Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	Mercury Renewables			
Figure Name: **Figure 4 – Tile 34** **Hydrogen Site – Conceptual Process & Treatment Train Flow Diagram**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

CONSTRUCTED WETLAND ASSOCIATION | Guidelines

Design

The top surface of the treatment area should be at least 3m² per person equivalent (PE). The minimum total area is 15m² regardless of the population served, and the minimum width or length of the top surface is 2m*. The aspect ratio of the top surface is not important.

To ensure sufficiently low area loading rate for effective treatment, and to ensure "edge effects" are not significant.

NB the British Water Code of Practice for Flows and Loads #4 (current at the time of writing these guidelines) requires that domestic properties be designed for a minimum of 5 people (PE) i.e. 15m².

The total bed area should be undivided, or else divided into two equal beds to facilitate maintenance. If two beds are used, these should be loaded simultaneously (except when undergoing maintenance).

To ensure correct sewage loading rate to wetland surface.

*NB the sizing (and this standard generally) relate to wetlands treating small volumes of effluent from septic tanks. Smaller unit areas may be appropriate for other scenarios, e.g. tertiary treatment (receiving effluent that has already been treated in a package treatment plant).

**The measurement Vp is a value relating to the infiltration rate of the soil, defined in relation to a test described in the UK Building Regulations 2010 approved Document H2.

The wetland sides and base should be lined with a suitably protected waterproof membrane, or constructed in inert ground of Vp** > 100 s/mm.

To ensure treated effluent is directed to outlet. The Environment Agency allow septic tank effluent to infiltrate into soakaway between 15-100 s/mm, therefore infiltration at smaller rates where Vp >100 s/mm is acceptable.

If a waterproof liner is needed, a puncture-resistant synthetic membrane would be suitable, protected with geotextile membrane above and below according to the manufacturer's recommendation.

The wetland should be drained from the base using one or more "Base Drainage Pipes" connecting to a single pipe discharge of at least 70mm minimum bore.

To ensure the treatment layer is free draining.

A single, rigid base pipe 70mm in diameter is adequate for bed width <3m. For larger bed widths, parallel base pipes with 2m or less between centres would provide adequate drainage.

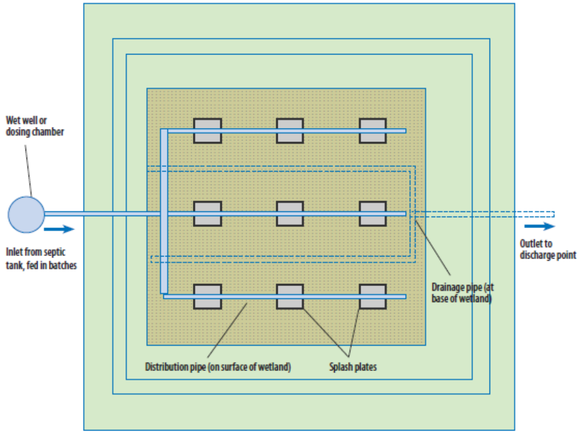


Figure 2. *Typical plan view of a vertical flow constructed wetland prior to planting*

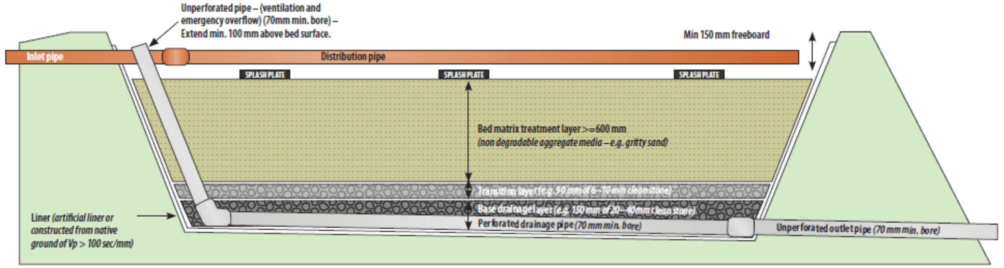
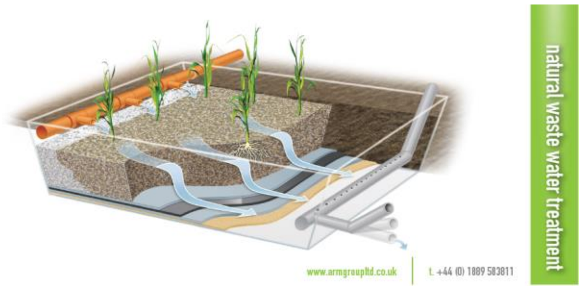


Figure 1. *Typical longitudinal section through a vertical flow constructed wetland prior to planting*



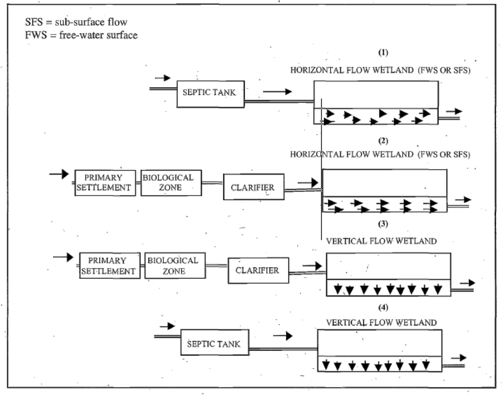


Figure 4: Various Arrangements of Constructed Wetlands

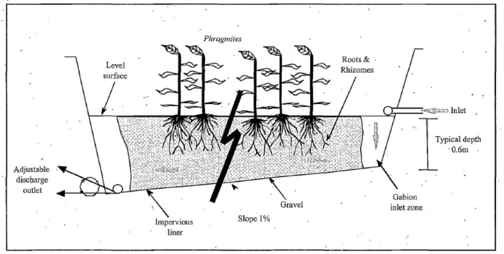


Figure 5: Sub-Surface Horizontal Flow Wetland

Table 3. Background concentrations of water quality constituents of concern in free water surface FWS constructed wetlands (EPA, 1999)

Parameter	Range (mg L⁻¹)	Typical (mg L⁻¹)	Factors governing
TSS	2-5	3	Plant types, plant coverage, climate, wildlife activity.
BOD[1]	2-8	5	Plant types, plant coverage, plant density, climate, wildlife activity.
BOD[2]	5-12	10	Plant types, plant coverage, plant density, climate.
TN	1-3	2	Plant types, plant coverage, climate, oxic/anoxic conditions.
NH_4-N	0.2-1.5	1	Plant types, plant coverage, climate, oxic/anoxic conditions.
TP	0.1-0.5	0.3	Plant types, plant coverage, climate, soil type.
FC[3]	50-5,000	200	Plant types, plant coverage, climate, wildlife activity.

[1] FWS with open water and submergent and floating aquatic macrophytes. [2] Fully vegetated with emergent macrophytes and with a minimum of open water. [3] Fecal coliform (FC) is used as an indicator of pathogens, measured in colony forming units (cfu) per 100 mL.

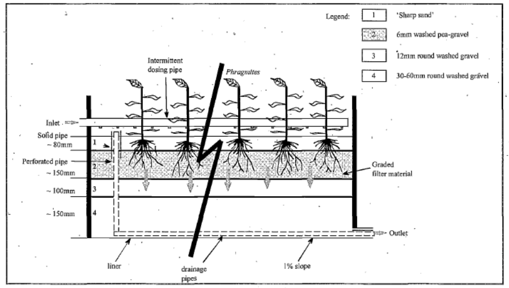
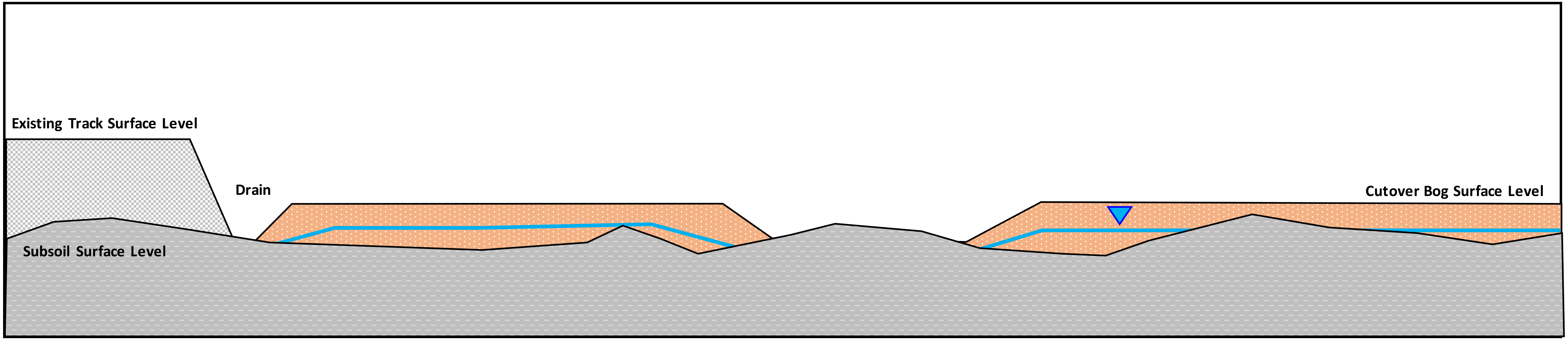


Figure 6: Vertical Flow Constructed Wetland

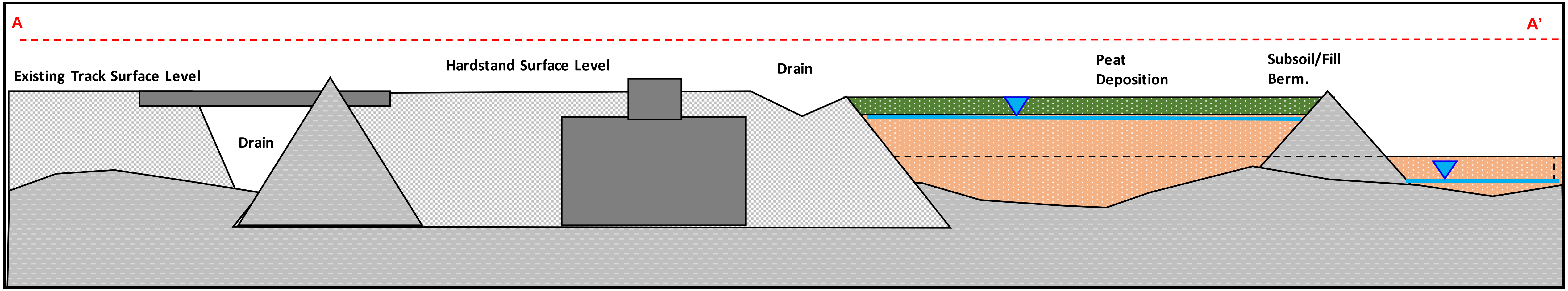
Site Name: **Firlough Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 5 – Tile 39** **Conceptual Information Graphics on Constructed Wetland Design**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Existing Drainage Scenario



Proposed Drainage Scenario



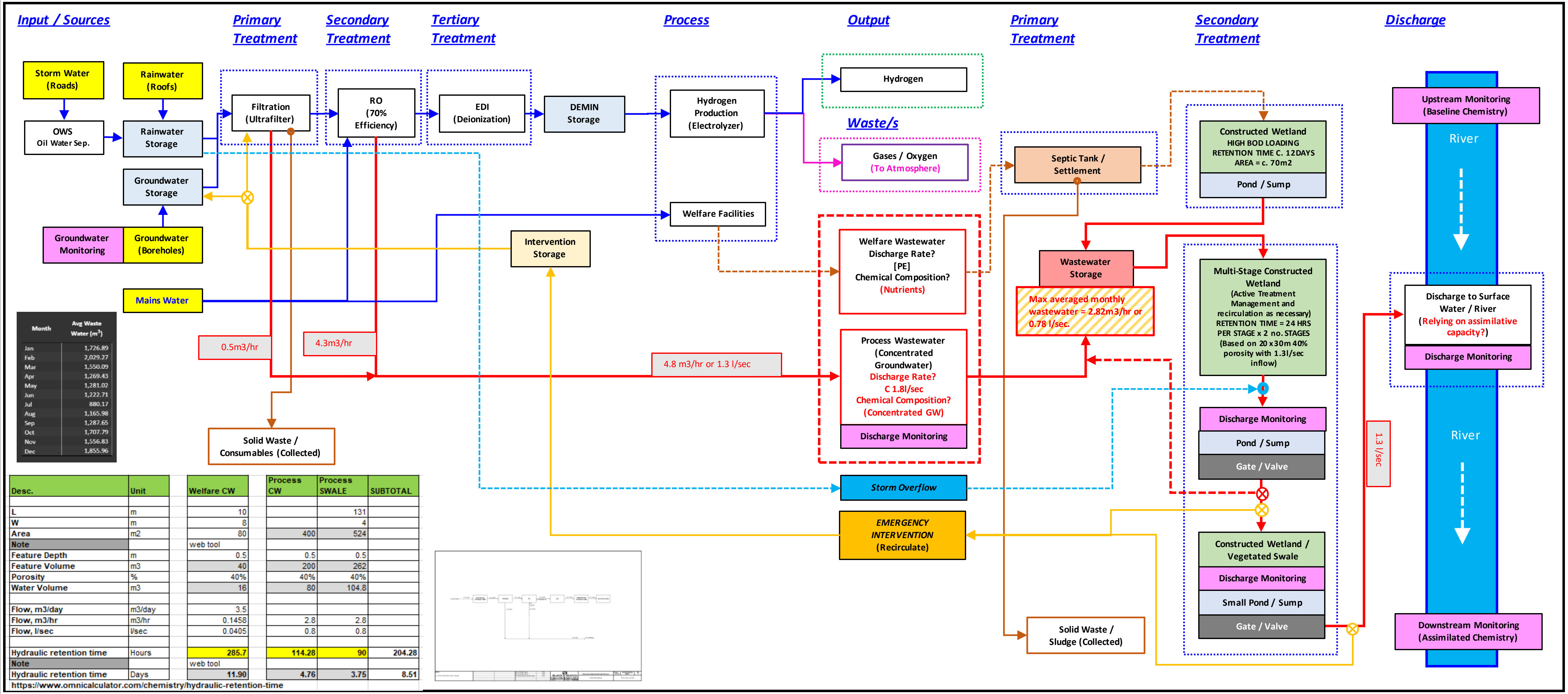
Site Name: **Firlough Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	Mercury Renewables			
Figure Name: **Conceptual Graphics – Tile 41** **WF Site – Conceptual Hardstand – Section A**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

ARCHIVE

Conceptual Treatment Train Flow Diagram

Flow / Discharge rates based on Peak Flow.



Month	Avg Waste Water (m^3)
Jan	1,726.89
Feb	2,029.27
Mar	1,550.09
Apr	1,269.43
May	1,281.02
Jun	1,222.71
Jul	880.17
Aug	1,165.98
Sep	1,287.65
Oct	1,707.79
Nov	1,556.83
Dec	1,855.96

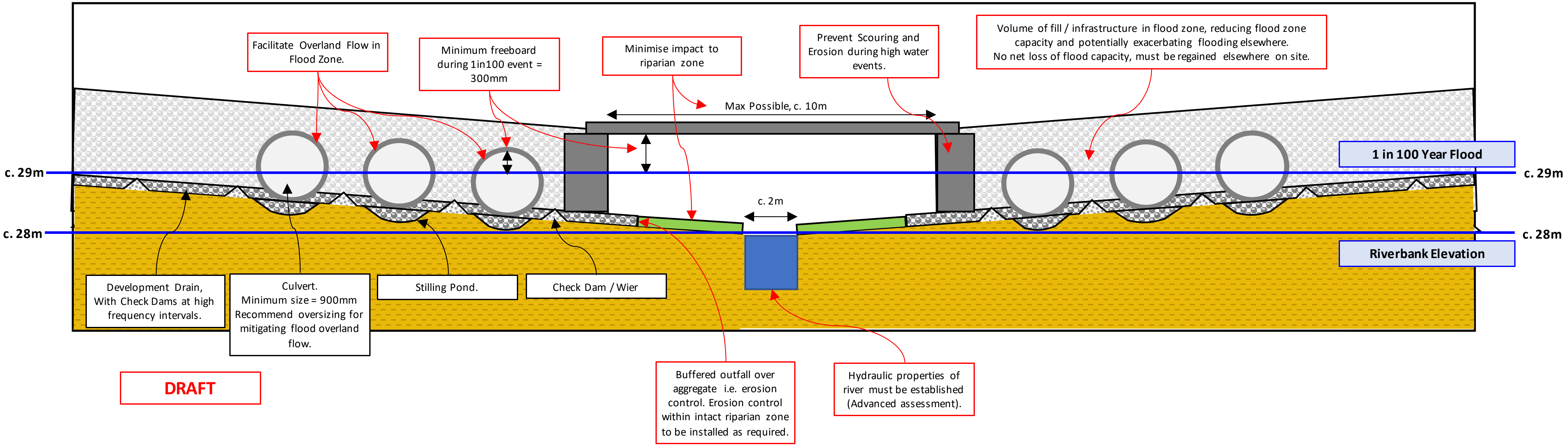
Desc.	Unit	Welfare CW	Process CW	Process SWALE	SUBTOTAL
L	m	10		131	
W	m	8		4	
Area	m2	80	400	524	
Note		web tool			
Feature Depth	m	0.5	0.5	0.5	
Feature Volume	m3	40	200	262	
Porosity	%	40%	40%	40%	
Water Volume	m3	16	80	104.8	
Flow, m3/day	m3/day	3.5			
Flow, m3/hr	m3/hr	0.1458	2.8	2.8	
Flow, l/sec	l/sec	0.0405	0.8	0.8	
Hydraulic retention time	Hours	285.7	114.28	90	204.28
Note		web tool			
Hydraulic retention time	Days	11.90	4.76	3.75	8.51

https://www.omnicalculator.com/chemistry/hydraulic-retention-time

Site Name: **Firlough Green Hydrogen**	**Project No.** 603676	**Drawn By:**	Sven Klinkenbergh, Principal Environmental Consultant
	Client: Mercury Renewables		
Figure Name: **Figure 4 Hydrogen Site – Conceptual Process & Treatment Train Flow Diagram**	**Date:** 28/11/2022	**Reviewed By:**	SK
	Revision: 00 DRAFT		

RSK

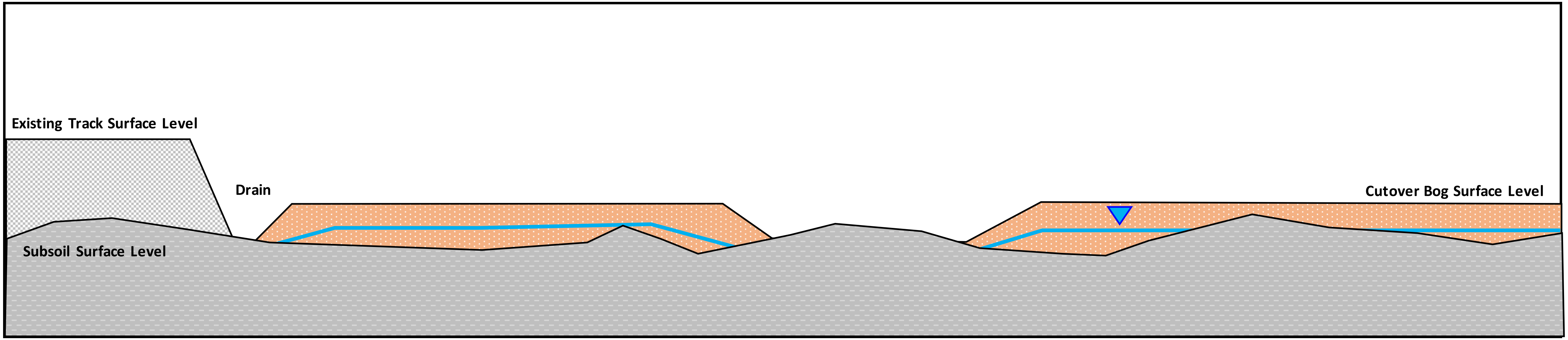
Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



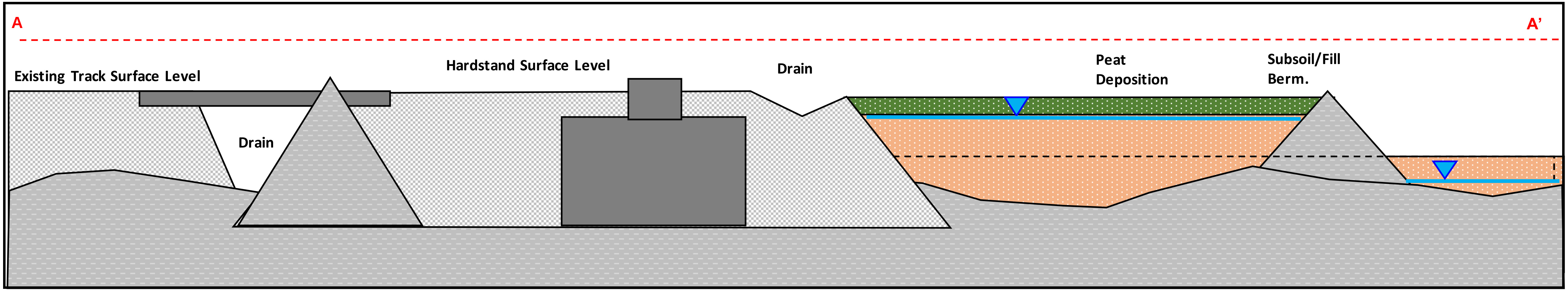
Site Name: **Ballykett Wind Farm, Co. Clare** DRAFT	**Project No.**	603008	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	JOD (Greensource)			
Figure Name: **Appendix XX – Conceptual & Information Graphics – Tile XX** **Design Considerations for Bridge in Flood Zone Area**	**Date:**	01/12/2022	**Reviewed By:**	SK	
	Revision:	00 DRAFT			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Existing Drainage Scenario



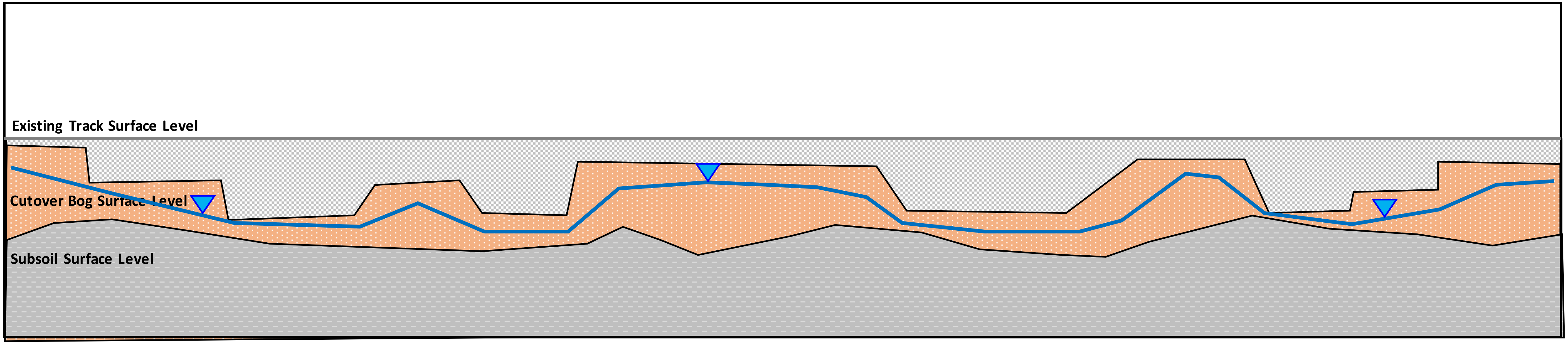
Proposed Drainage Scenario



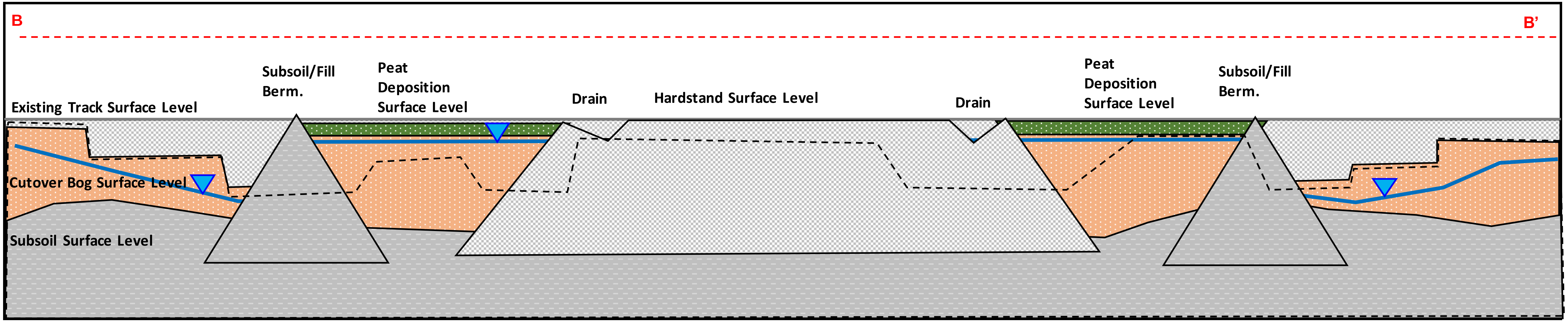
Site Name: **Firlough Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	Mercury Renewables			
Figure Name: **Conceptual Graphics – Tile 27 WF Site – Conceptual Hardstand – Section A**	**Date:**	03/05/23	**Reviewed By:**	SK	
	Revision:	02			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Existing Drainage Scenario



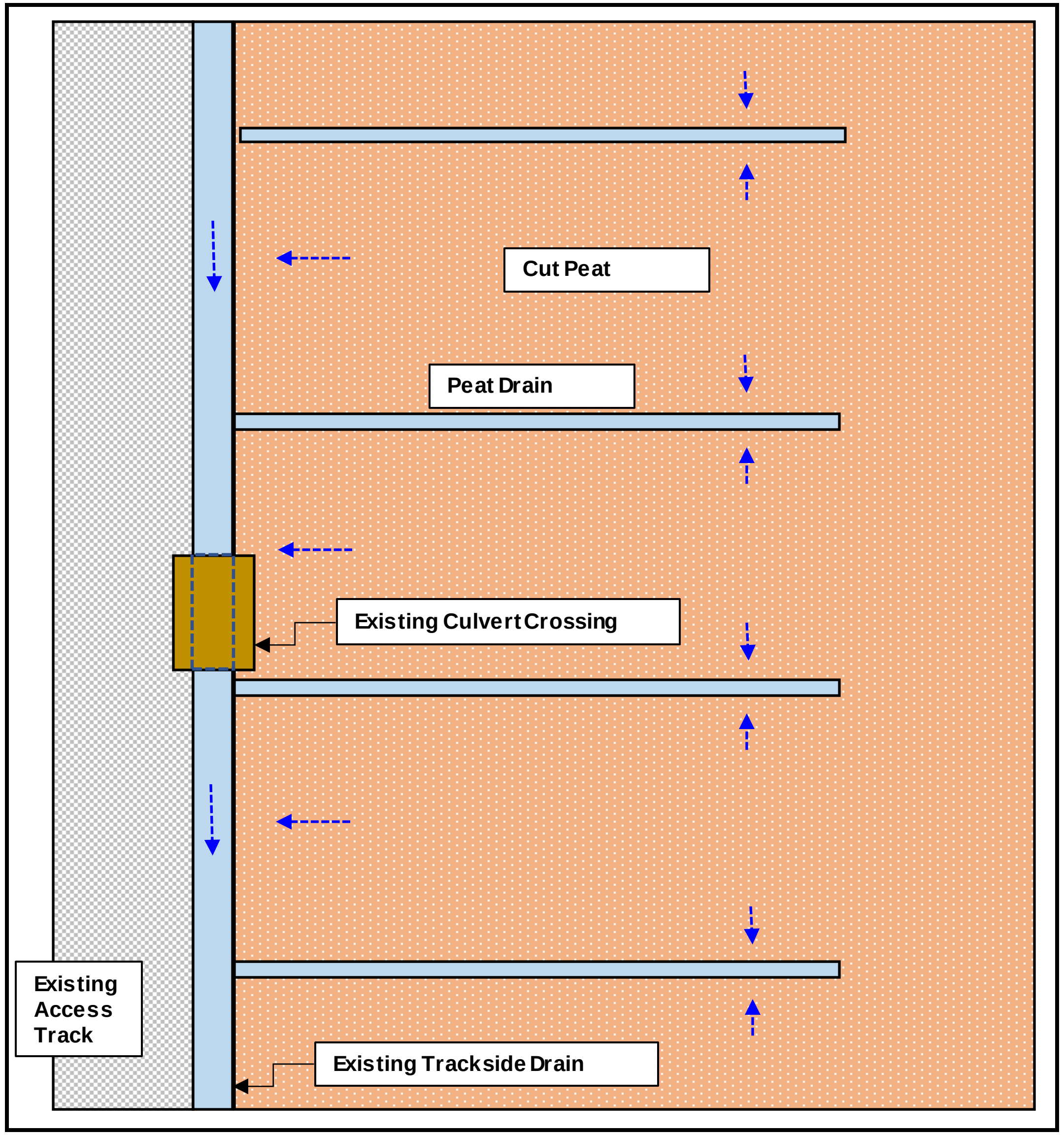
Proposed Drainage Scenario



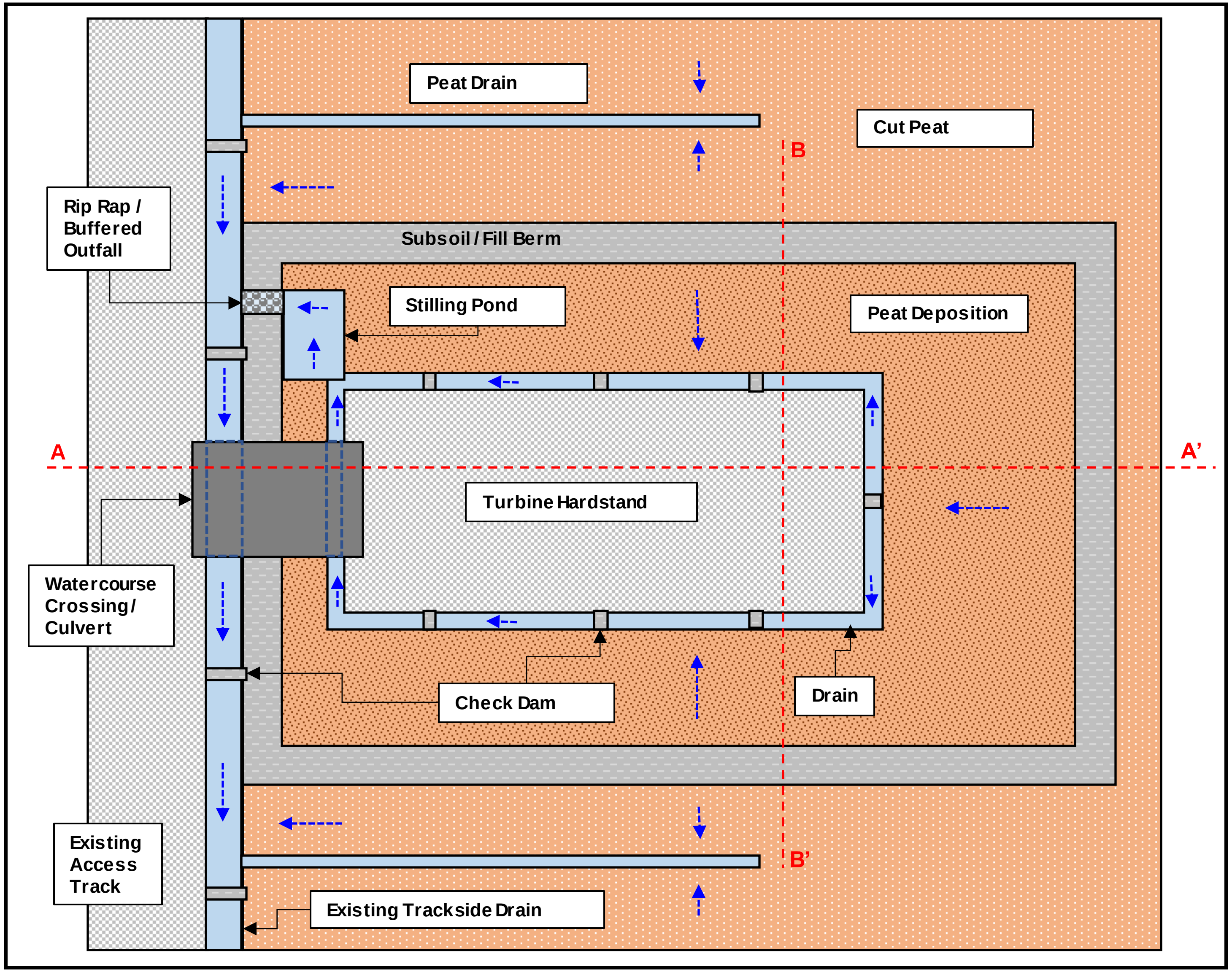
Site Name: **Firlough Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Conceptual Graphics – Tile 28** **WF Site – Conceptual Hardstand – Section B**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Existing Drainage Scenario

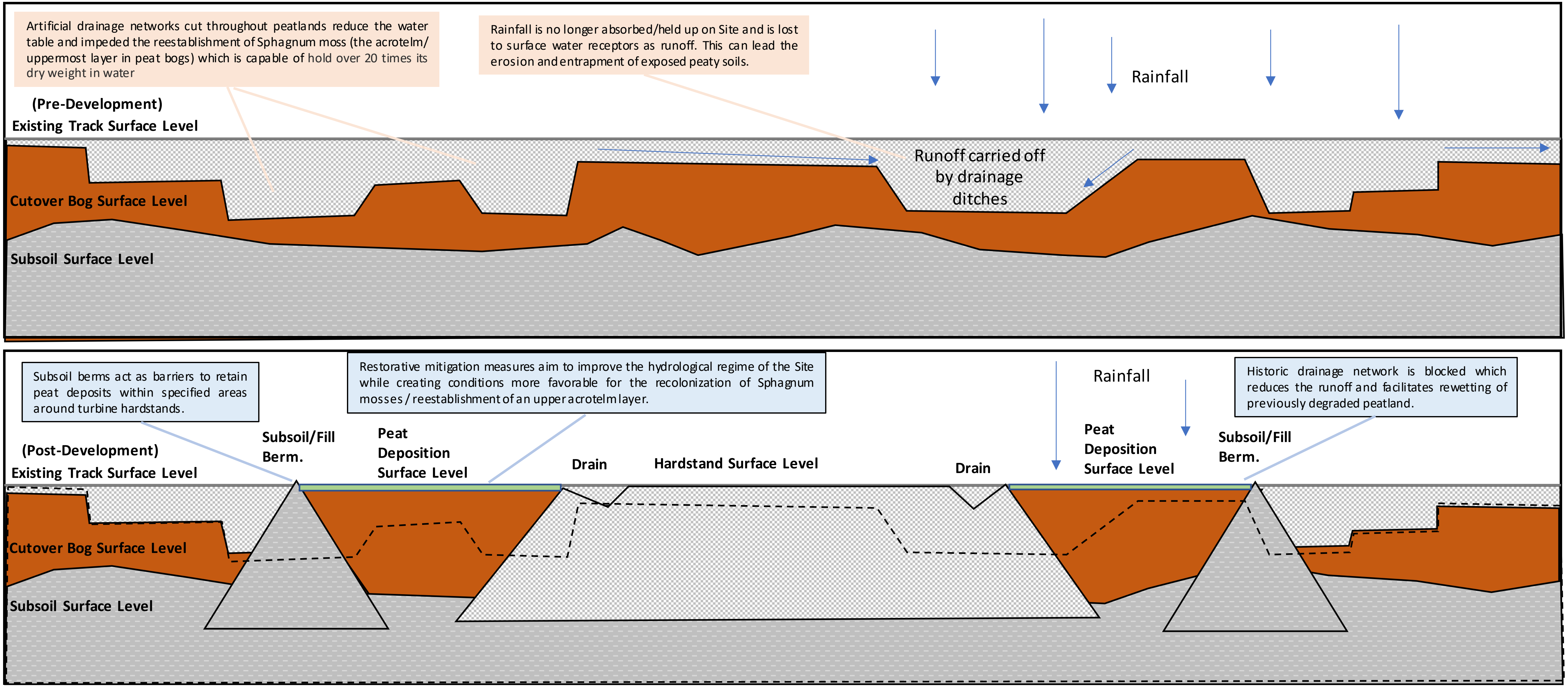


Proposed Drainage Scenario



Site Name: **Firlough Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 24 Examples of Conceptual Hardstand – Plan**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.



Site Name: **Firlough Green Energy – Wind Farm**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	JOD / Mercury Renewables		
Figure Name: **Appendix 9.7 – Conceptual & Information Graphics – Tile 26 Peat Deposition Areas – Linear view**	**Date:**	03/05/23	**Reviewed By:**	SK
	Revision:	02		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

https://www.chegg.com/homework-help/questions-and-answers/old-mathjax-webview-figure-shows-simplified-diagram-physical-chemical-process-treatment-po-q84945924

https://www.frontiersin.org/articles/10.3389/fenvs.2021.815159/full

Question: Old MathJax Webview The Figure Shows The Simplified Diagram Of The Physical-Chemical Process For The Treatment Of...

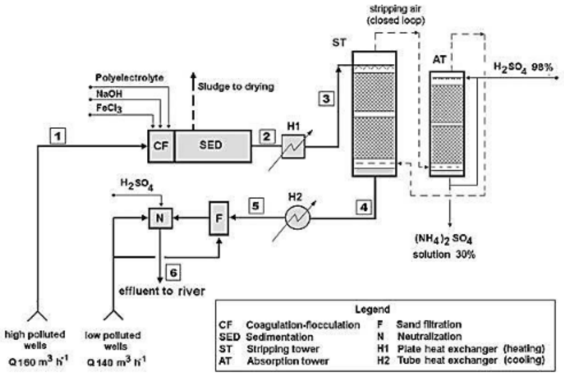
Old MathJax webview

The figure shows the simplified diagram of the physical-chemical process for the treatment of polluted groundwater. The plant is composed of two parallel lines. Highly contaminated groundwater (Q =160 m 3 h -1)is first treated by coagulation-flocculation, dosing 41% and 35% solutions of ferric chloride and sodium hydroxide, respectively (pH increase up to pH > 11, converting the ammonium ions into free ammonia in order to aid the subsequent stripping process). The effluent of the coagulation-flocculation step is heated to a temperature of 38°C. The stripping air (flow rate 120,000 Nm 3 h -1 for each line) flows through the towers in countercurrent to the water.

The two stripping towers (one tower per line) are made of concrete with an inner lining in polypropylene and have an internal diameter of 5.5 m and 12 m packing height (Pall rings).

The outgoing air from the stripping towers, enriched with ammonia, feeds the absorption towers (two towers per line), which are made of polypropylene, with an internal diameter of 3.6 m and a 9 m packing height. A countercurrent recirculating absorbent solution of sulfuric acid is fed to the towers. The bottom flow of the absorption towers consists of a 30% ammonium sulfate solution (approximately 2,500 kg d -1as pure ammonium sulfate). The top air flow is recirculated to the stripping tower. The liquid effluent from the stripping towers is cooled (with heat recovery) and then filtered through the sand beds prior to the final pH neutralization and discharge to the watercourse. Weakly contaminated groundwater (Q = 140 m 3 h -1) is fed through this final stage of filtration and neutralization, giving the added benefit of reducing the consumption of the neutralizing acid.

Calculate the material balance and energy balance of the Units (stripping tower, absorption tower and heat exchangers)



Take the missing parameters which are need to complate the calculstion with standard or closer to standard values.

frontiers | Environmental Science Sections Articles Research Topics Editorial

N Removal in Wastewater Treatments and Marine Environments

The classical technology for N removal in wastewater treatments is based on anaerobic denitrification (Figure 1). The microbiota involved in anaerobic denitrification include several strains, such as *Pseudomonas* and *Bacillus* stains and function enzymes are usually detected as NAS, NAR, NIR, etc. (Kuypers et al., 2018). Aerobic denitrification and Anammox are also key pathways in wastewater treatments and direct ammonia oxidation (Dirammox) is a newly recovered process for ammonia removal (Mai et al., 2021; Wu, M. R. et al., 2021). The microbiota of aerobic denitrification used in wastewater treatments are frequently identified as *Alcaligenes faecalis*, *Zoogloea* sp. and *Shinella zoogloeoides* (Ji et al., 2015), while Anammox bacteria, *Ca.* Brocadia sinica strains, are usually observed in wastewater treatments (Speth et al., 2016). In terms of other processes implemented in wastewater treatment, e.g., OLAND, SHARON and CANON, the participated microorganisms are frequently identified as strains found in nitrification, dentification and Anammox, such as *Sphingomonas* sp., *Ca.* Kuenenia and *Nitrosomonas* sp. (Schmidt et al., 2003).

Figure 1

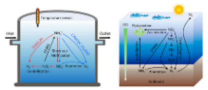
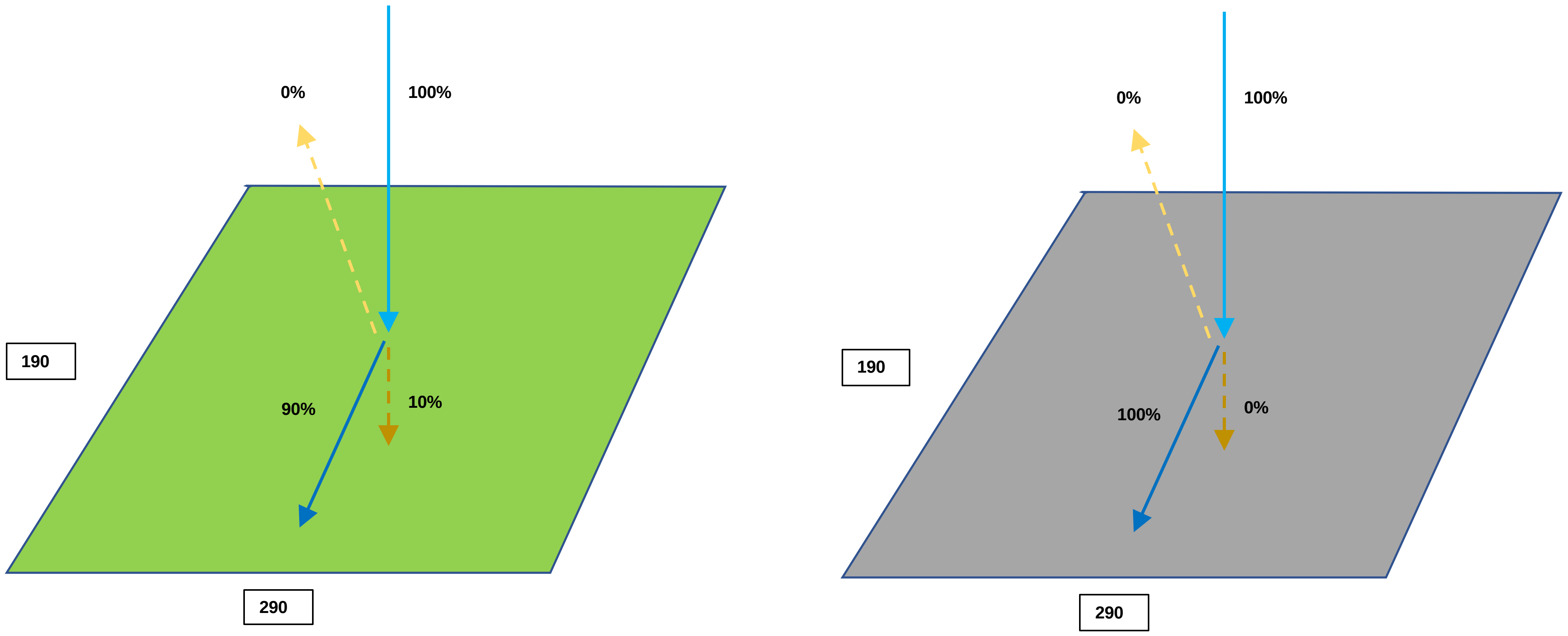


FIGURE 1. N removal process in wastewater treatments and marine systems. In wastewater treatments, N removal pathways, including nitrification/denitrification, Anammox and dissimilatory nitrate reduction to ammonium (DNRA), were outlined and different techniques (SHARON, CANON, OLAND) based on the present reactions were highlighted by colors. In marine systems, biological assimilation occurs in the surface water, while anaerobic denitrification, Anammox and DNRA prefer DO-insufficient environments, such as oxygen minimum zone and sediments. Compared with marine systems, environmental factors, such as temperature, could be well controlled in wastewater treatment tanks.



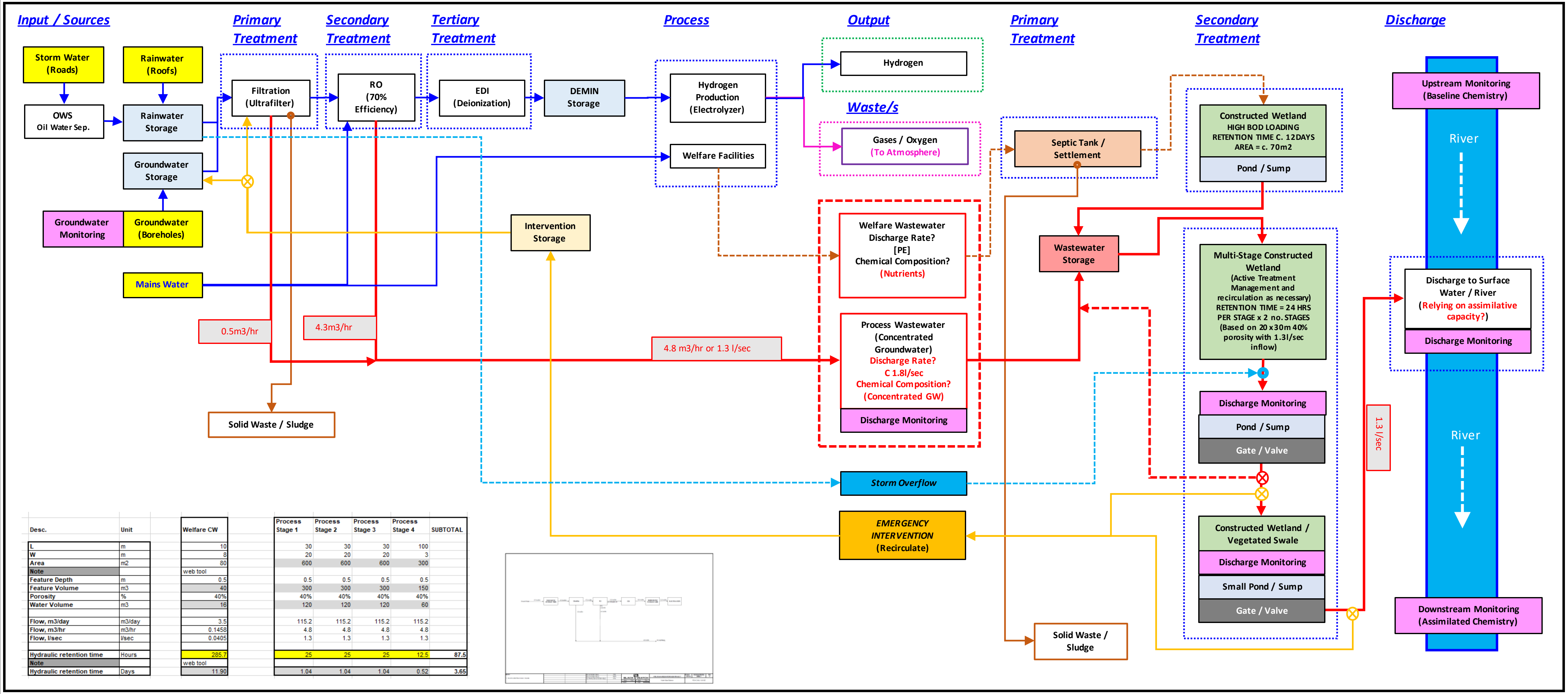
190 x 290 = 55,100
55100 x 0.05 = 2755 m3

Site Name: **Firloiugh Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 3** **Site Location & SW Baseline Locations**	**Date:**	28/11/2022	**Reviewed By:**	SK
	Revision:	00 DRAFT		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

Conceptual Treatment Train Flow Diagram

Flow / Discharge rates based on Peak Flow. Loading based on GW.



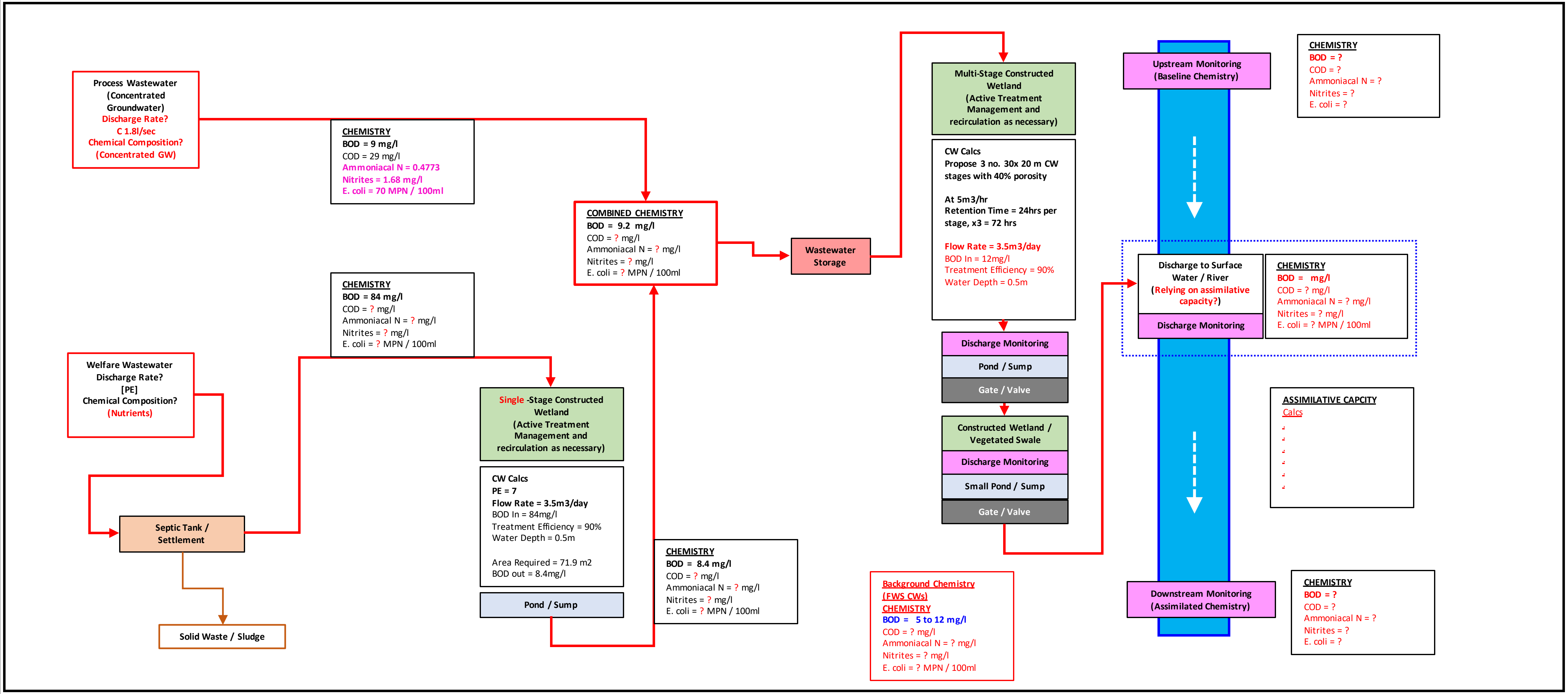
Desc.	Unit	Welfare CW	Process Stage 1	Process Stage 2	Process Stage 3	Process Stage 4	SUBTOTAL
L	m	10	30	30	30	100	
W	m	8	20	20	20	3	
Area	m2	80	600	600	600	300	
Note		web tool					
Feature Depth	m	0.5	0.5	0.5	0.5	0.5	
Feature Volume	m3	40	300	300	300	150	
Porosity	%	40%	40%	40%	40%	40%	
Water Volume	m3	16	120	120	120	60	
Flow, m3/day	m3/day	3.5	115.2	115.2	115.2	115.2	
Flow, m3/hr	m3/hr	0.1458	4.8	4.8	4.8	4.8	
Flow, l/sec	l/sec	0.0405	1.3	1.3	1.3	1.3	
Hydraulic retention time	Hours	285.7	25	25	25	12.5	87.5
Note		web tool					
Hydraulic retention time	Days	11.90	1.04	1.04	1.04	0.52	3.65

Site Name: **Firloiugh Green Hydrogen**	**Project No.** 603676		**Drawn By:** Sven Klinkenbergh, Principal Environmental Consultant
	Client: Mercury Renewables		
Figure Name: **Conceptual Graphics** **Hydrogen Site – Conceptual Treatment Train Flow Diagram**	**Date:** 28/11/2022		**Reviewed By:** SK
	Revision: 00 DRAFT		

RSK

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

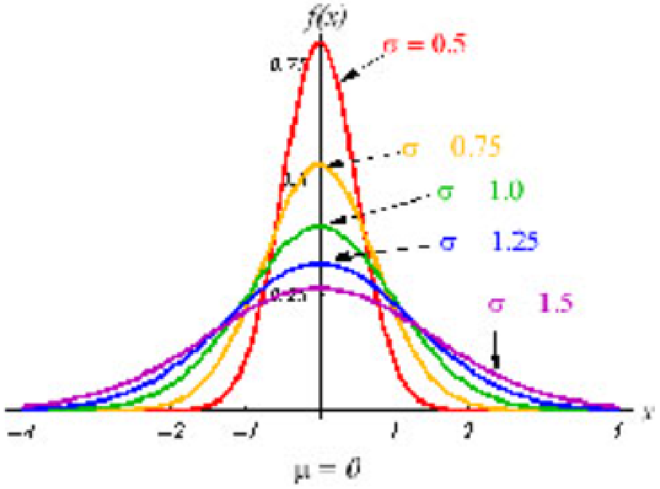
Conceptual Treatment Train Flow Diagram - Contam Loading



Site Name: **Firloiugh Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant	RSK
	Client:	Mercury Renewables			
Figure Name: **DRAFT Conceptual Graphics** **Hydrogen Site – Conceptual Treatment Train Flow Diagram – Contam Loading**	**Date:**	28/11/2022	**Reviewed By:**	SK	
	Revision:	00 DRAFT			

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

P90



P90 is all about quantifying the uncertainty of annual energy yield predictions. P90 is the energy WMI predicts that a wind turbine is 90% likely to produce over an average year, given the uncertainties in the measurement, analysis and wind turbine operation. P50, on the other hand, is the average annual energy yield predicted for your site - the annual energy output you are most likely to achieve.

Investor decisions are commonly based on P90 (P95 or even P80 are sometimes used). Better instrumentation, long term data, analysis and wind turbine operation are all able to close the gap between P90 and P50, so increasing your project value.

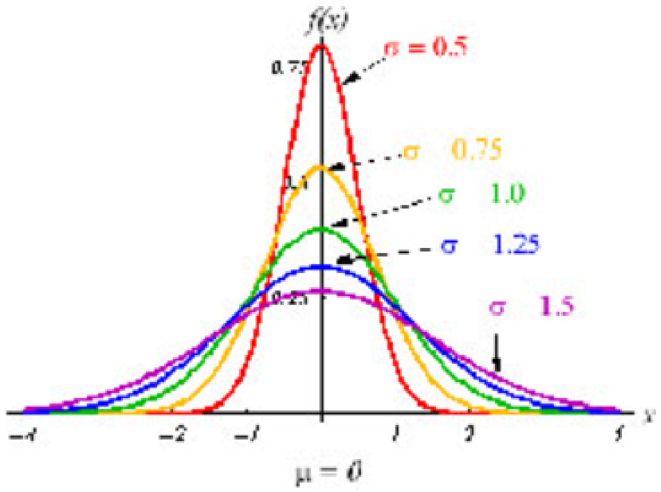
Wind Measurement International aims to maximise P90 from initial survey to final bankable report. Our range of services offer a consistent P50/P90 through the energy valuation matched to your risk/cost requirements.

P50/ P90

https://greensolver.net/wind-p50-and-p90/#:~:text=The%20P50%20figure%20is%20the,90%25%20of%20the%20projects%20life.

Site Name: **Firloiugh Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 3** **Site Location & SW Baseline Locations**	**Date:**	28/11/2022	**Reviewed By:**	SK
	Revision:	00 DRAFT		

P90



P90 is all about quantifying the uncertainty of annual energy yield predictions. P90 is the energy WMI predicts that a wind turbine is 90% likely to produce over an average year, given the uncertainties in the measurement, analysis and wind turbine operation. P50, on the other hand, is the average annual energy yield predicted for your site - the annual energy output you are most likely to achieve.

Investor decisions are commonly based on P90 (P95 or even P80 are sometimes used). Better instrumentation, long term data, analysis and wind turbine operation are all able to close the gap between P90 and P50, so increasing your project value.

Wind Measurement International aims to maximise P90 from initial survey to final bankable report. Our range of services offer a consistent P50/P90 through the energy valuation matched to your risk/cost requirements.

P90 in wind measurement:

http://www.windmeasurementinternational.com/wind-analysis/p90-wind_anyalsis.php#:~:text=P90%20is%20the%20energy%20WMI,analysis%20and%20wind%20turbine%20operation.

Site Name: **Firloiugh Green Hydrogen**	**Project No.**	603676	**Drawn By:**	Sven Klinkenbergh Principal Environmental Consultant
	Client:	Mercury Renewables		
Figure Name: **Figure 3** **Site Location & SW Baseline Locations**	**Date:**	28/11/2022	**Reviewed By:**	SK
	Revision:	00 DRAFT		

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.