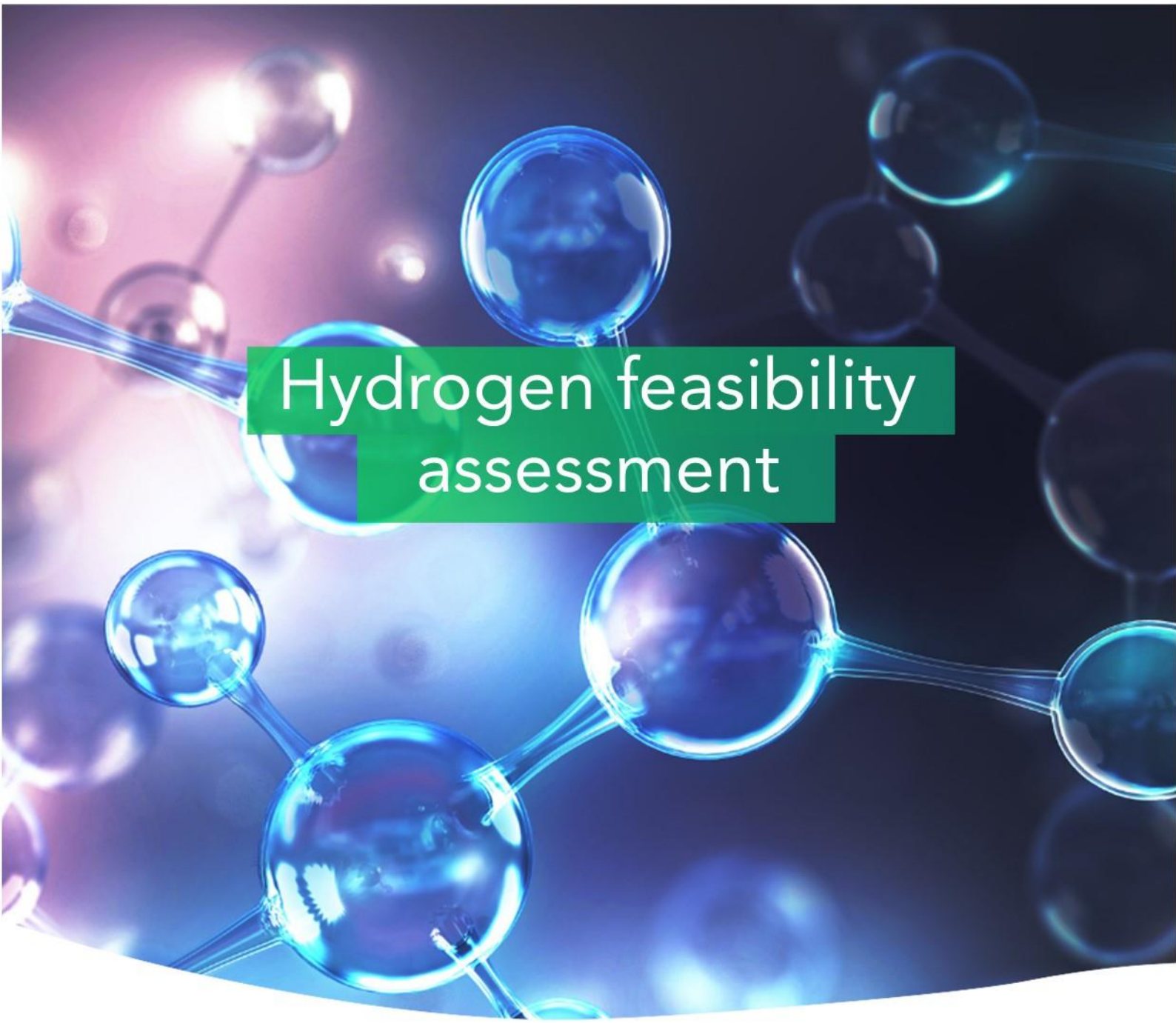

Cromarty Hydrogen Plant - Water Supply Feasibility Assessment

For Scottish Power

16th September 2022

Revision 4.0

Document Control

Date	Status	Revision	Produced	Checked	Approved
13/04/22	Draft for internal review	0	MS	CL	
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16/09/22	Programme update	4.0	MS	FT / CL	CL

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1.0 Executive Summary

1.1 Background

The purpose of this report is to assess the feasibility of providing raw water to a future hydrogen production facility in Beinn Tharsuinn windfarm in the Cromarty area.

The existing windfarm is remote from any Scottish Water mains, and at an elevation higher than can be supplied by gravity.

The assessment will review raw water supply options from several water bodies in the vicinity of the windfarm and will explore possible routes to provide a water demand of 0.8Ml/day to the hydrogen plant.

This feasibility study will focus more particularly on two water bodies that were deemed suitable for the hydrogen plant water needs: River Glass, whose source is Loch Glass, and Loch Morie.

Our study will identify the works required to supply the plant in water from both. It will describe the main infrastructure required as well as any non-infrastructure items (e.g. land agreements, traffic management, planning and SEPA licence requirements, etc.) associated with each option.

The criteria taken into consideration for the Feasibility Assessment and Comparison of each option are the following:

- Hydraulic Capacity
- Engineering and Construction
- Utilities
- Ground Conditions
- Traffic Management
- Land
- Environment
- Planning
- Archaeology and Built Heritage
- Health and Safety
- Public and Reputation
- Carbon
- Asset Ownership and Reputation
- Design Cost Estimate
- Construction Cost Estimate
- Annual Operational Cost Estimate
- 20 Year TOTEX Cost Estimate
- Design Programme Estimate
- Construction Programme Estimate

1.2 Recommendation

On the four water bodies in the vicinity of the windfarm originally considered for supplying raw water to the hydrogen plant, only two appears to have a volume large enough to meet a demand of 0.8Ml/day: Loch Glass via River Glass existing offtake and Loch Morie.

On the overall, River Glass supply option is associated with fewer risks and unknowns than Loch Morie supply option. More particularly, Loch Morie supply option would lead to noticeably higher constraints in hydraulic

capacity (no hydrology study available yet to fully confirm the suitability of the water resource), traffic management (higher impact in matter of road closures) and land (more landowners impacted with higher impact on their lands and businesses).

The design and construction cost estimates of River Glass supply option are higher than the Loch Morie supply option by [redacted] which makes a 6.5% difference and the operational cost estimate is [redacted] per year more which makes a 7.5% difference. It is however important to note that this cost difference in favour of Loch Morie option could be neutralised by the higher risk profile of this option.

When assessed as a whole, the Design and Construction programme estimate is similar for both options.

River Glass supply option has a smaller carbon footprint with a whole life carbon over 390,000 kg less than the Loch Morie supply option.

In conclusion, for all the reasons stated above, we would recommend the River Glass supply as the preferred option above the Loch Morie supply option.

2.0 Water Supply Options

2.1 Options Overview

Several water bodies have been considered for the provision of raw water for the hydrogen plant as part of this feasibility assessment:

- Loch Glass, owned by Scottish Water, at an elevation of 215m.
- Loch Morie, owned by the Scottish Ministers, at an elevation of 193m.
- Loch Bad a' Bhàthaich, owned by the Scottish Ministers, at an elevation of 318m.
- Loch Muigh-bhlàraidh, owned by a private owner, at an elevation of 397m.

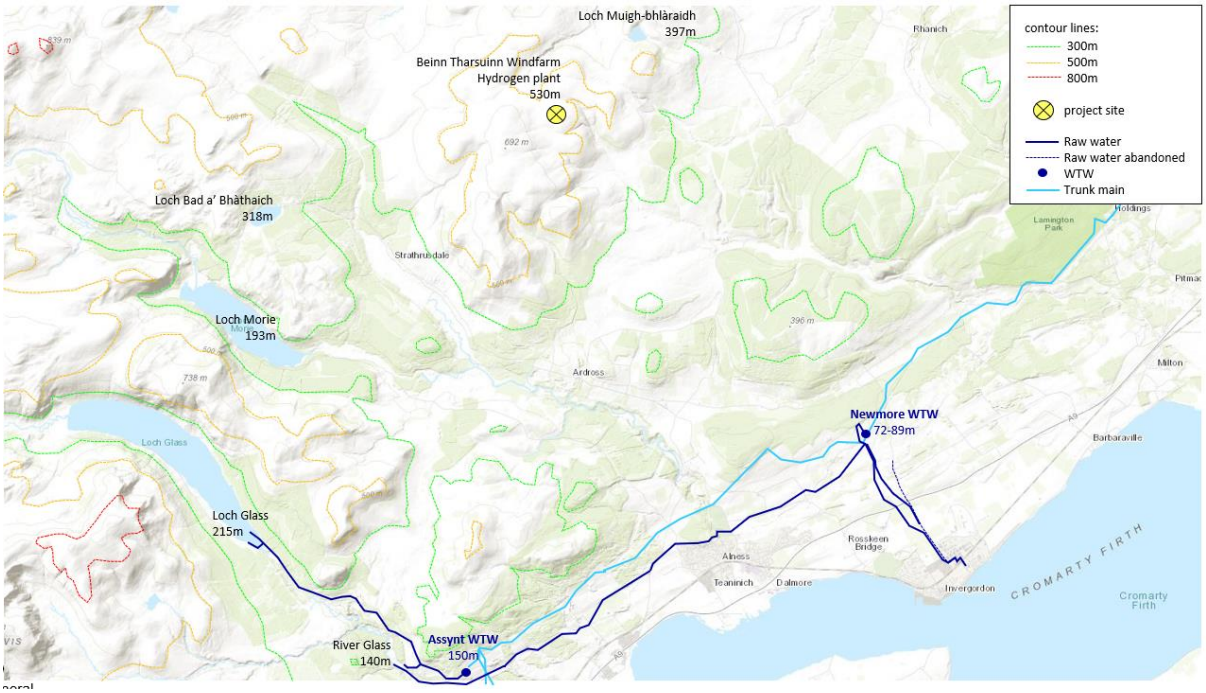


FIGURE 1 WATER BODIES OVERVIEW

2.2 Option 1: Supply from Loch Glass

Loch Glass is located to the South West of the windfarm. It is a Scottish Water reservoir and an abundant source of raw water. There are two existing raw water abstractions points associated directly or indirectly with Loch Glass water supply:

- One abstraction point directly in Loch Glass which supplies Assynt Water Treatment Works with an average abstraction 15Ml/day and peak daily volume of 21.4 Ml/day.

- One abstraction point from River Glass whose water originates from Loch Glass and which supplies Newmore Water Treatment Works with an average abstraction 25.8Ml/day and peak daily volume of 26.9 Ml/day.

The location of these Water Treatments Works and associated raw water mains is presented in Figure 1 above.

The figure below summarises the information collected about this Loch:

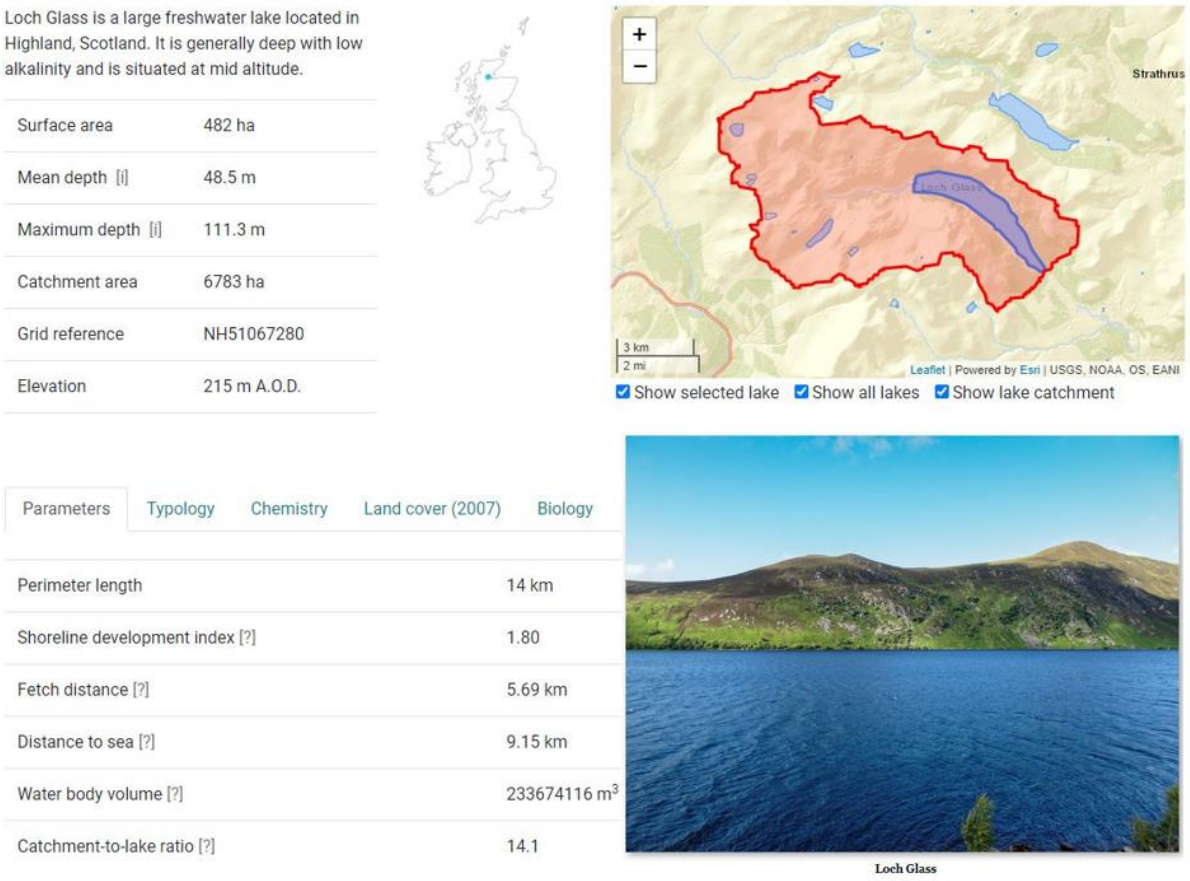


FIGURE 2 LOCH GLASS GENERAL INFORMATION

Considering its surface area, depth, volume of water and surface of catchment, Loch Glass appears as a suitable option for supplying the hydrogen plant with raw water.

2.3 Option 2: Supply from Loch Morie

Loch Morie is located to the South West of the windfarm. It is not currently used as a reservoir by Scottish Water but nonetheless seems to be an abundant source of raw water. It is owned by the Scottish Ministers.

The figure below summarises the information collected about this Loch:

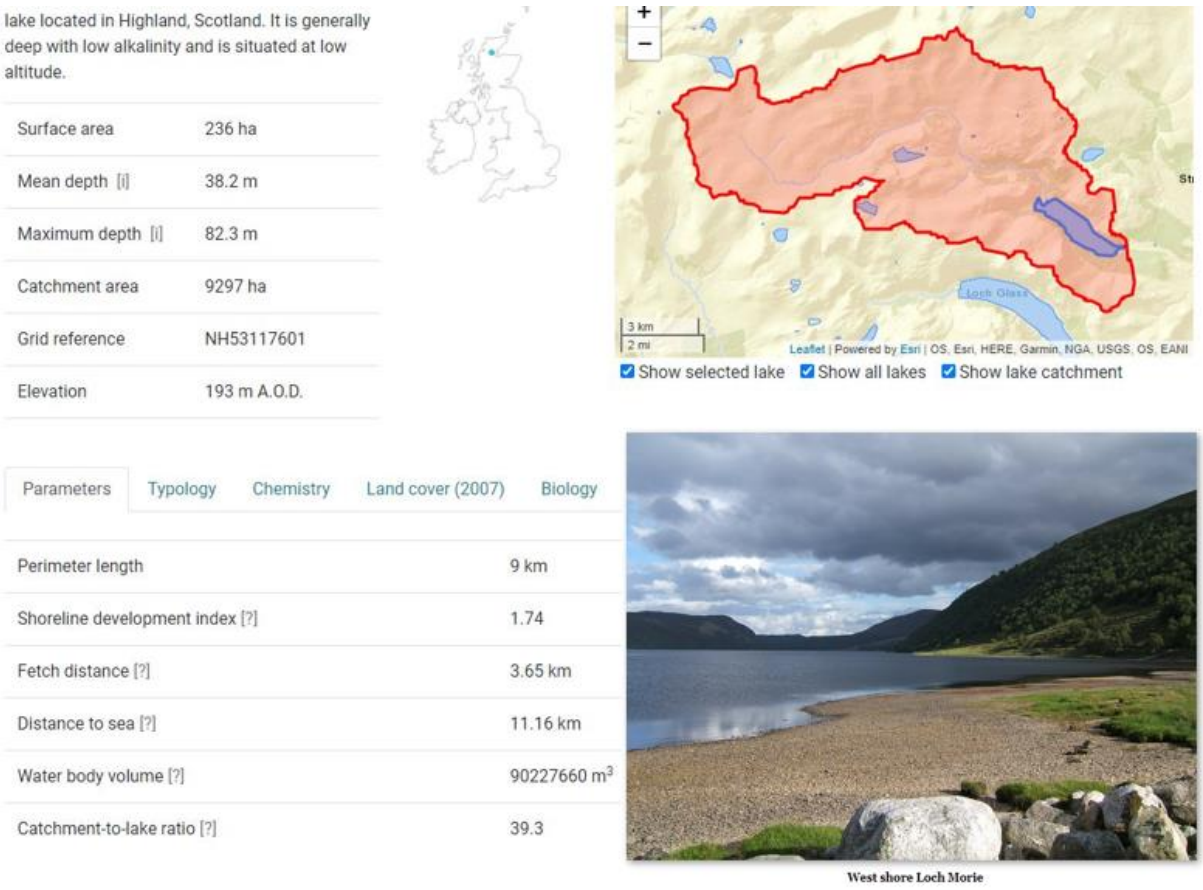


FIGURE 3 LOCH MORIE GENERAL INFORMATION

Considering its surface area, depth, volume of water and surface of catchment, Loch Glass appears as a suitable option for supplying the hydrogen plant with raw water.

2.4 Option 3: Supply from Loch Bad a' Bhàthaich

Loch Bad a' Bhàthaich is located to the South West of the windfarm, at a shorter distance and higher elevation than Loch Glass and Loch Morie but with significantly less capacity. It is owned by the Scottish Ministers.

The figure below summarises the information collected about this Loch:

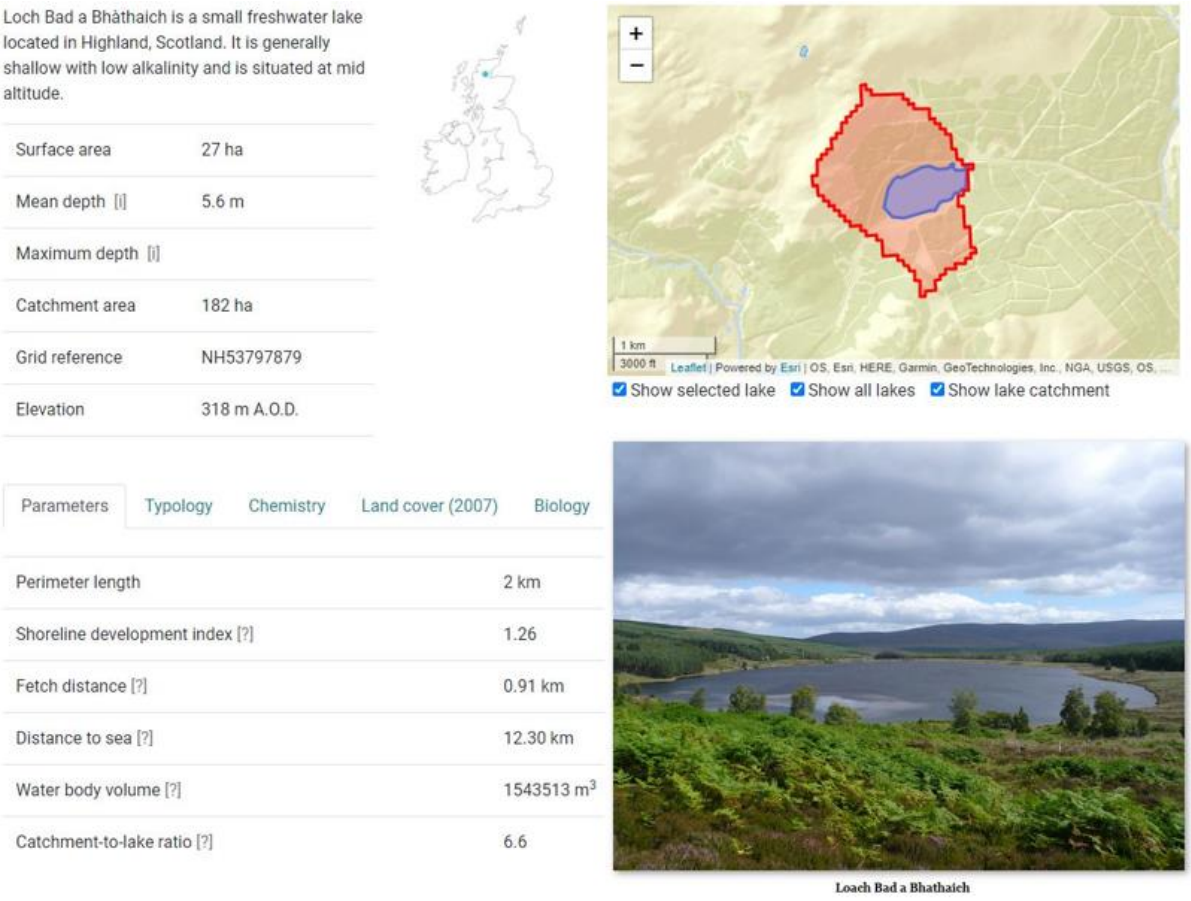


FIGURE 4 LOCH BAD A BHATHAICH GENERAL INFORMATION

Considering its surface area, depth, volume of water and surface of catchment, Loch Bad a' Bhàthaich does not appear as a suitable option for supplying the hydrogen plant with raw water.

2.5 Option 4: Supply from Loch Muigh-bhlàraidh

Loch Muigh-bhlàraidh is located to the South West of the windfarm, at a shorter distance and higher elevation than Loch Glass and Loch Morie but with significantly less capacity. It is owned by a private owner.

The figure below summarises the information collected about this Loch:

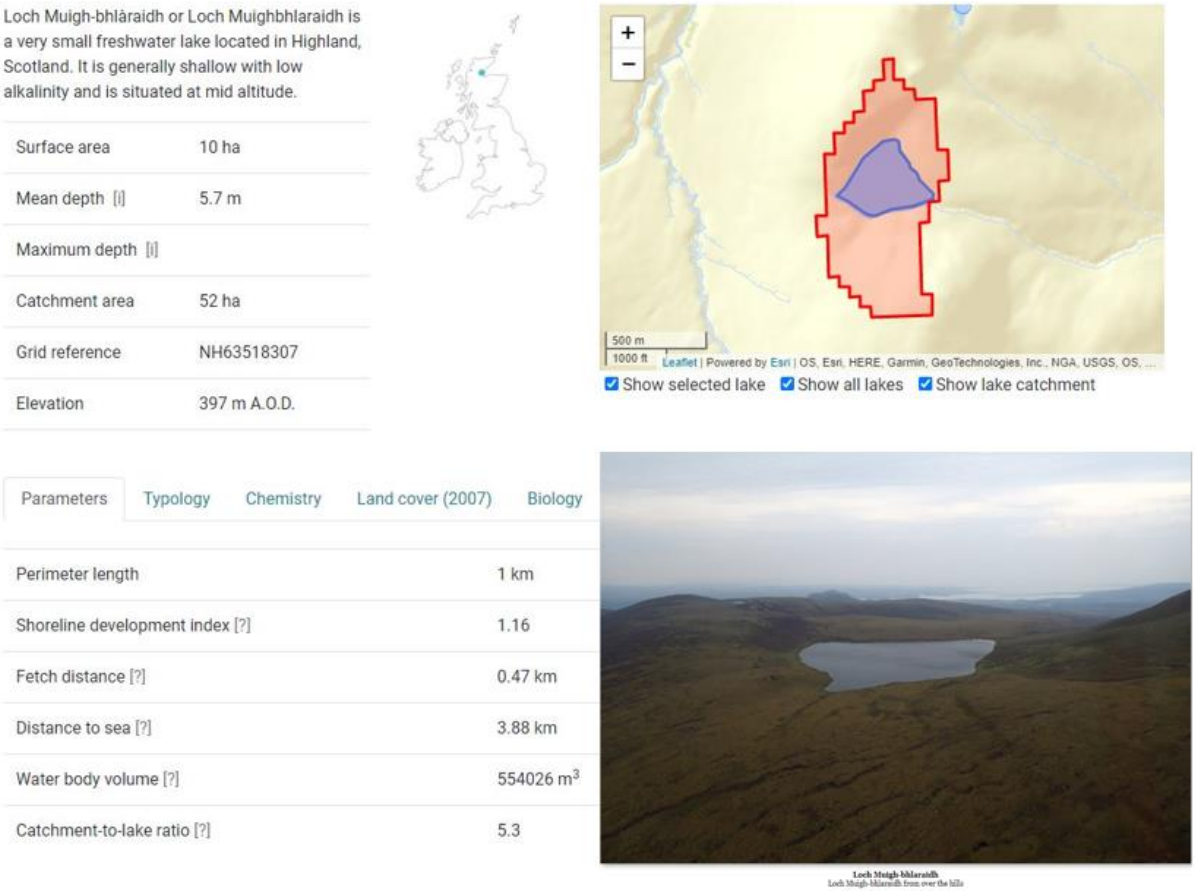


FIGURE 5 LOCH MUIGH-BHLARAIDH GENERAL INFORMATION

Considering its surface area, depth, volume of water and surface of catchment, Loch Muigh-bhlàraidh does not appear as a suitable option for supplying the hydrogen plant with raw water.

2.6 Water supply options - conclusion

On the four water bodies in the vicinity of the windfarm originally considered for supplying raw water to the hydrogen plant, only two appears to have a volume large enough to meet a demand of 0.8Ml/day: Loch Glass via River Glass existing offtake and Loch Morie.

It is however important to note that Loch Glass being already used as a Scottish Water reservoir we have more evidence to support our assessment. In the case of Loch Morie, the suitability of the supply is only assumed on the basis of a desktop assessment and will need to be backed up by further detailed studies.

3.0 Route optioneering

3.1 Routes Overview

For our routes optioneering exercise, we have considered all known roads, tracks and paths existing between the windfarm and the two selected water supplies.

The figure below summarises the information collected in this regard:

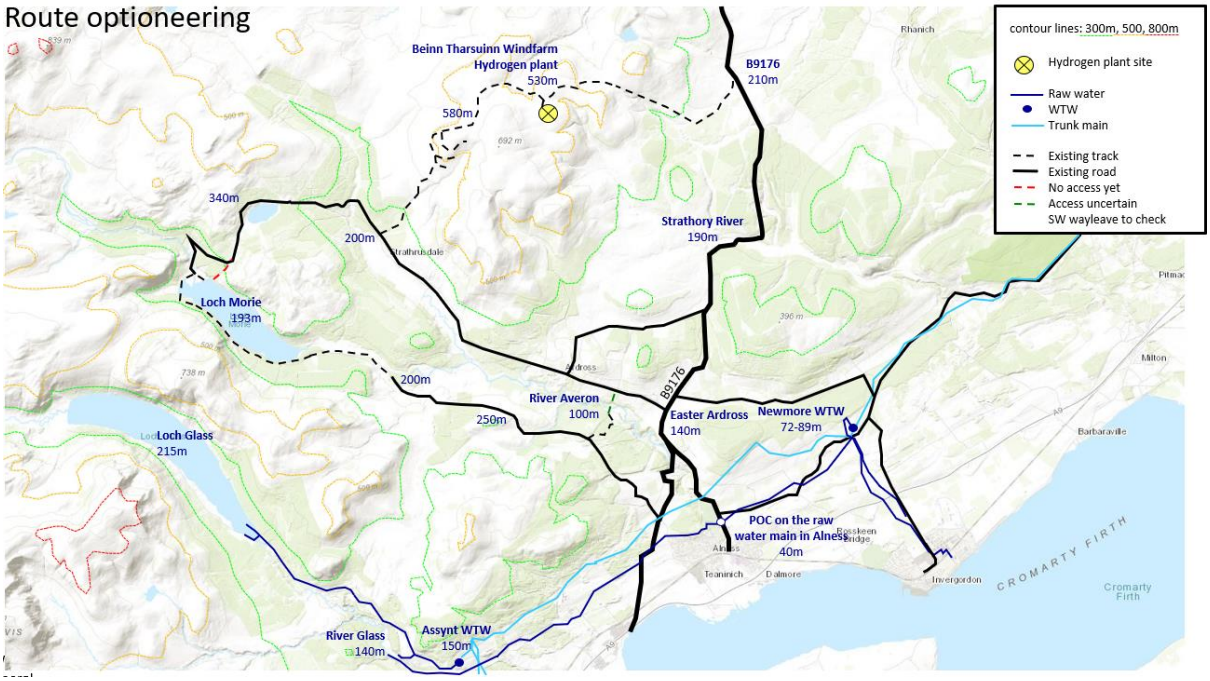


FIGURE 6 EXISTING ROUTES OVERVIEW

3.2 Supply from River Glass

Based on the information provided by with Scottish Water Operatives, creating new abstraction points on Loch Glass or River Glass does not seem feasible, however the demand for the hydrogen plan could be met by either creating a new point of connection on the existing raw water main supplying Newmore Water Treatment Works from River Glass or by arranging a connection directly within Newmore Water Treatment Works.

For the purpose of our route optioneering exercise we will consider a point of connection in Alness on the 27in diameter pre-stressed concrete raw water main supplying Newmore Water Treatment Works from River Glass as this route will be more direct and shorter than if the connection is made within Newmore Water Treatment Works.

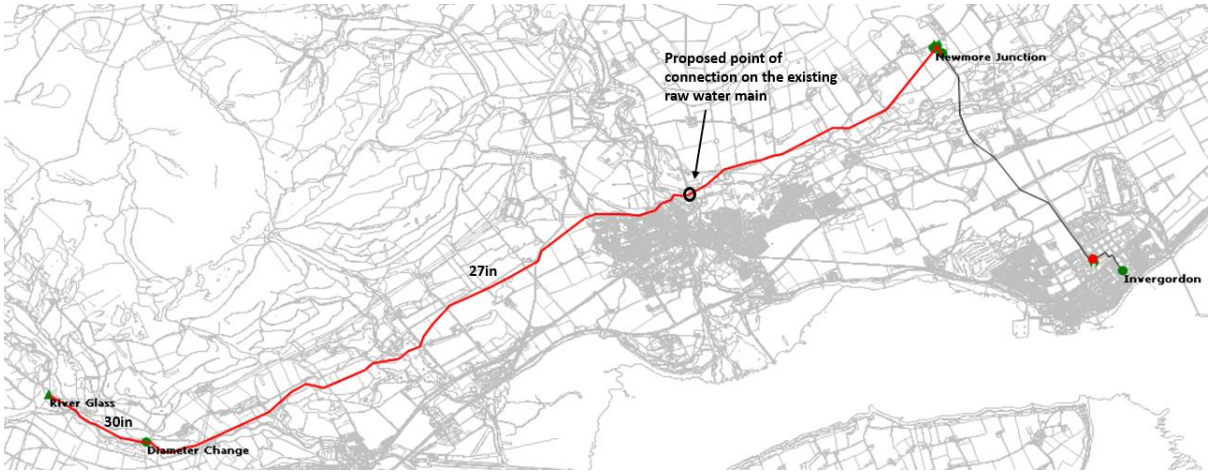


FIGURE 7 PROPOSED POINT OF CONNECTION ON THE EXISTING RAW WATER MAIN FROM RIVER GLASS

3.2.1 Hydraulic assessment of the existing infrastructure

A hydraulic assessment of the Concrete and Ductile Iron pipes between River Glass and Newmore Water Treatment Works has been conducted with the following assumptions:

- For the baseline, Newmore Water Treatment Works is set with a constant 373.6l/s flow to represent the peak flow extracted from River Glass (26.9Ml/day or 311.3l/s) on which an additional 20% (62.3l/s) has been applied to allow for future growth, additional losses, etc.

- In the absence of a calibrated model for this section of the network, we have tested a wide range of friction values for the existing pipe between River Glass and Newmore Water Treatment Works going from 1 (low friction value) to 10 (high friction value) to represent different internal pipe conditions as the information available suggests that these pipes have been laid in 1974, therefore more than 50 years ago.

In absence of any major restrictions on the existing raw water main and assuming there is no increase in elevation between River Glass extraction point and Newmore Water Treatment Works that would be above the hydraulic gradient, the additional demand (0.8Ml/day or 9.3l/s) required for the hydrogen plant should be met without the need to carry out any upgrade on the existing asset.

However, if it appears that too many sections of the existing main were in poor condition or if there were constraints unknown at this stage such as leakages or throttle valves, it would be necessary to replace the sections damaged and remove these restrictions before a new connection is created.

It is recommended that these results are clarified with a campaign of flow and pressure tests on the existing main followed by a specific hydraulic assessment to be done with a model calibrated on actual flow and pressure data.

3.2.2 Proposed route from point of connection on the raw water main in Alness

Supply from River Glass - From POC on the raw water main in Alness

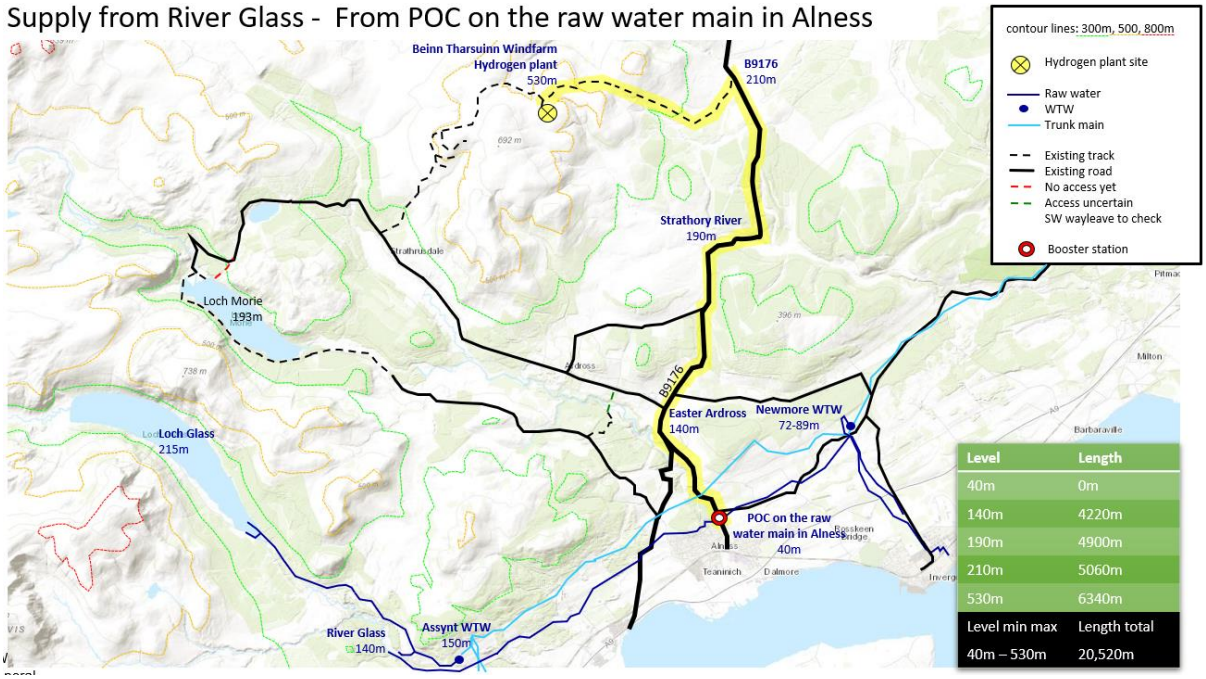
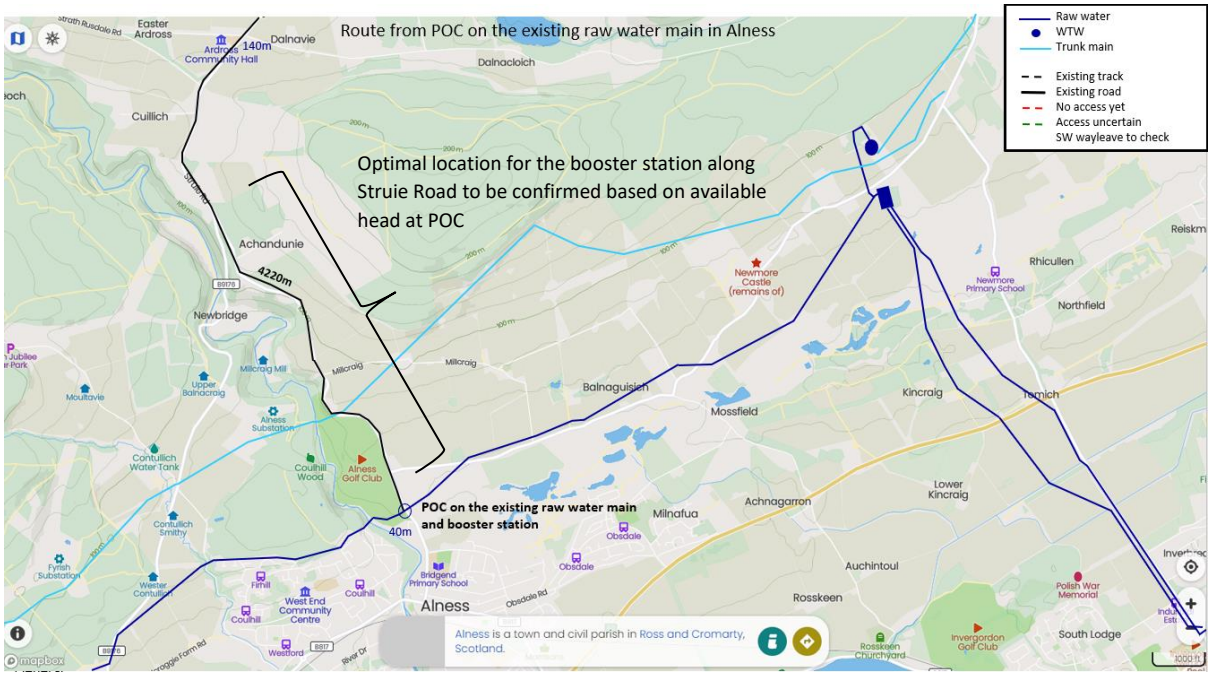


FIGURE 8 OVERVIEW OF THE ROUTE FROM POINT OF CONNECTION ON THE EXISTING RAW WATER MAIN IN ALNESS



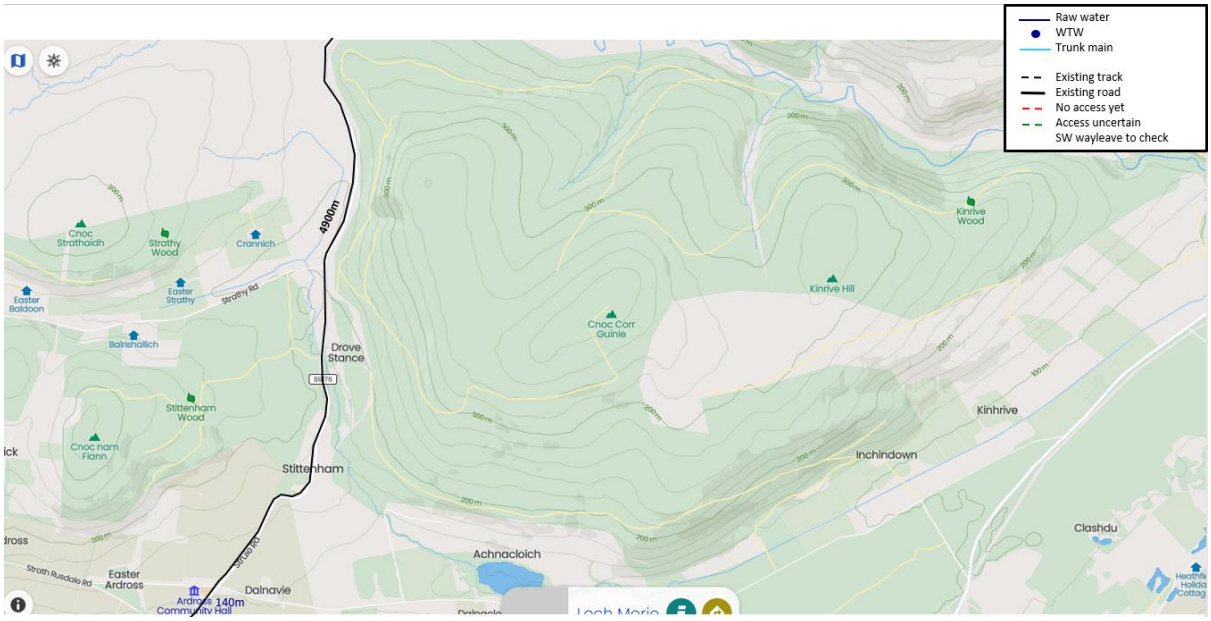


FIGURE 9 ROUTE FROM POINT OF CONNECTION ON THE EXISTING RAW WATER MAIN IN ALNESS (PARTS 1 AND 2)

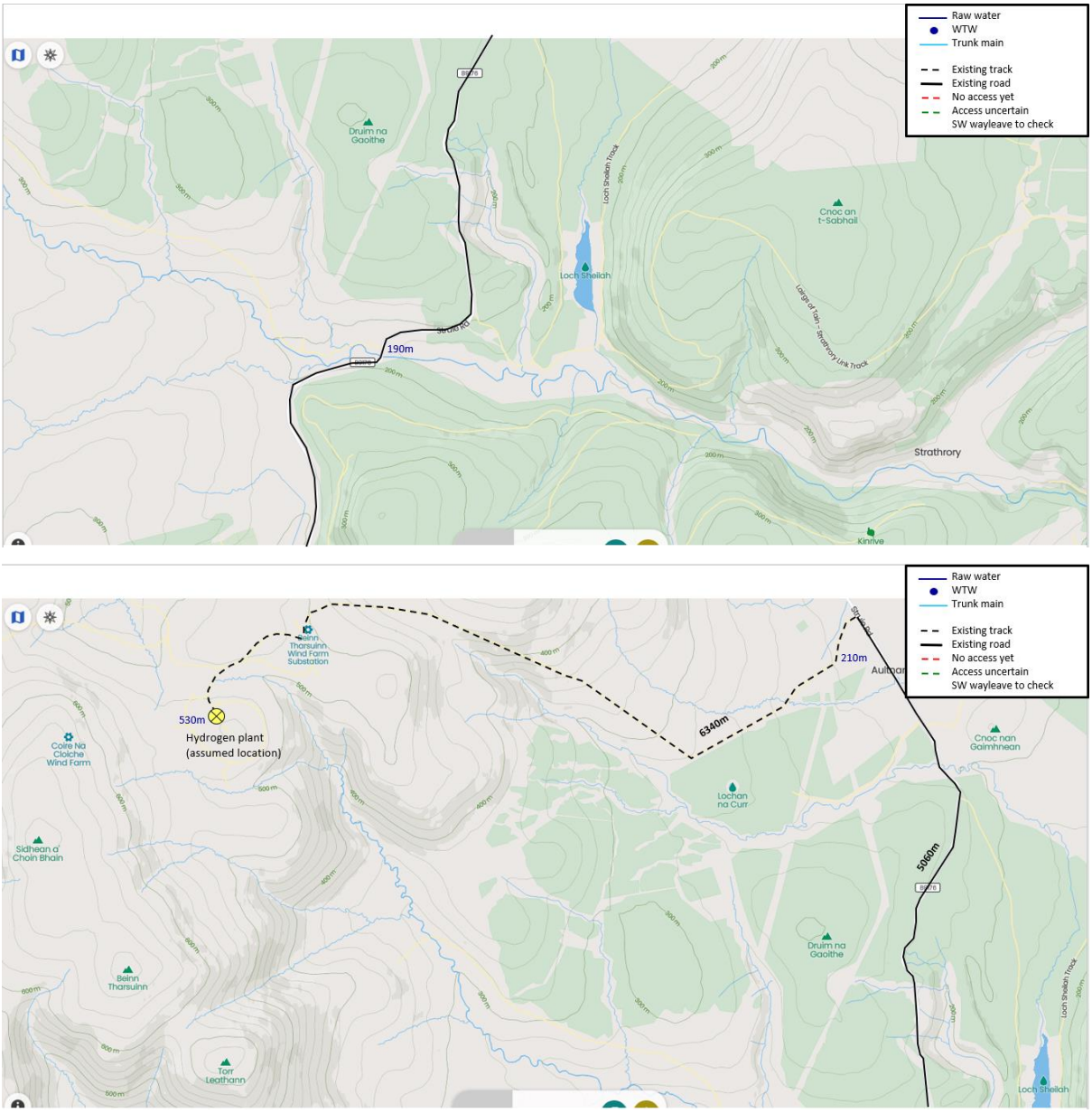


FIGURE 10 ROUTE FROM POINT OF CONNECTION ON THE EXISTING RAW WATER MAIN IN ALNESS (PARTS 3 AND 4)

The characteristics of the proposed route are:

- Estimated pipe length: 20,520m
- Min elevation: 40m
- Max elevation: 530m
- Estimated head at point of connection on existing raw water main: between 70m and 130m (to be confirmed)
- Proposed head at discharge point: 540m
- Estimated friction loss head: 57m
- Estimated total static head: between 410m and 470m
- Estimated total head: between 467m and 527m

The proposed infrastructure would be:

- A connection made to the existing Scottish Water 27in diameter pre-stressed concrete raw water main on Ardross Road in Alness.
- A 20,520m long 180mm diameter SDR11 PE80 raw water main to provide water from the point of connection on Ardross Road in Alness to the hydrogen plan. The proposed route would follow:
    - The verges of the B9176 or public roads of similar size owned by the Highland Council (approx. 14,180m long
    - The verges of the existing private tracks leading to the windfarm (approx. 6,340m long) from the B9176 (one known landowner).
- A new booster Station to be located in the vicinity of the point of connection on Ardross Road or Struie Road in Alness (public roads owned by the Highland Council). Due to the high discharge pressure required to overcome the total head on the system, none of the conventional standard pressure clean water booster stations (CWBS) from Scottish Water Standard Product Catalogue would be fit for purpose. A bespoke design booster station would be required instead. Based on our initial assessment for this route duties, we would recommend using pumps from Xylem Lowara eMP range of products, eg. a MPV50B unit fitted with 90 kW motor. Note that the booster station will require a power supply from a nearby existing infrastructure and either a telecoms line or GPS signal to allow communication with the hydrogen plant and maintenance provider.
- A Water Treatment Works (WTW) to be installed at the hydrogen plant to treat the raw water to the required standard for hydrogen production. Raw water quality will still need to be investigated further to determine which type of treatment would be the best to ensure a constant quality of water at the hydrogen plant. In the absence of more detailed information, we are proposing the use of a membrane type WTW which has the following characteristics:
    - Uses filter units to remove impurities and treat the raw water.
    - Can deal with a variety of inflow qualities.

- Has a small area footprint and can be manufactured offsite and utilises industry standard plant and equipment.
- Process stages within a membrane type plant can be added, removed, or amended to suit individual applications and additional units can be added to increase treatment capacity.
- Has a lower standard operational staff requirement and no need for chemicals for treatment.

Note that the WTW will require a power supply from nearby existing infrastructure and either a telecoms line or GPS signal.

- A storage tank capable of holding 800m3 of water equivalent 24-hour storage for the 0.8Ml/day demand is recommended at the hydrogen plant as mitigation to interruptions to water supply from issues at the intake in River Glass, issues with the raw water mains (Scottish Water existing main or the new main supplying the plant), booster station faults, issues or routine maintenance of the modular WTW.

3.3 Supply from Loch Morie

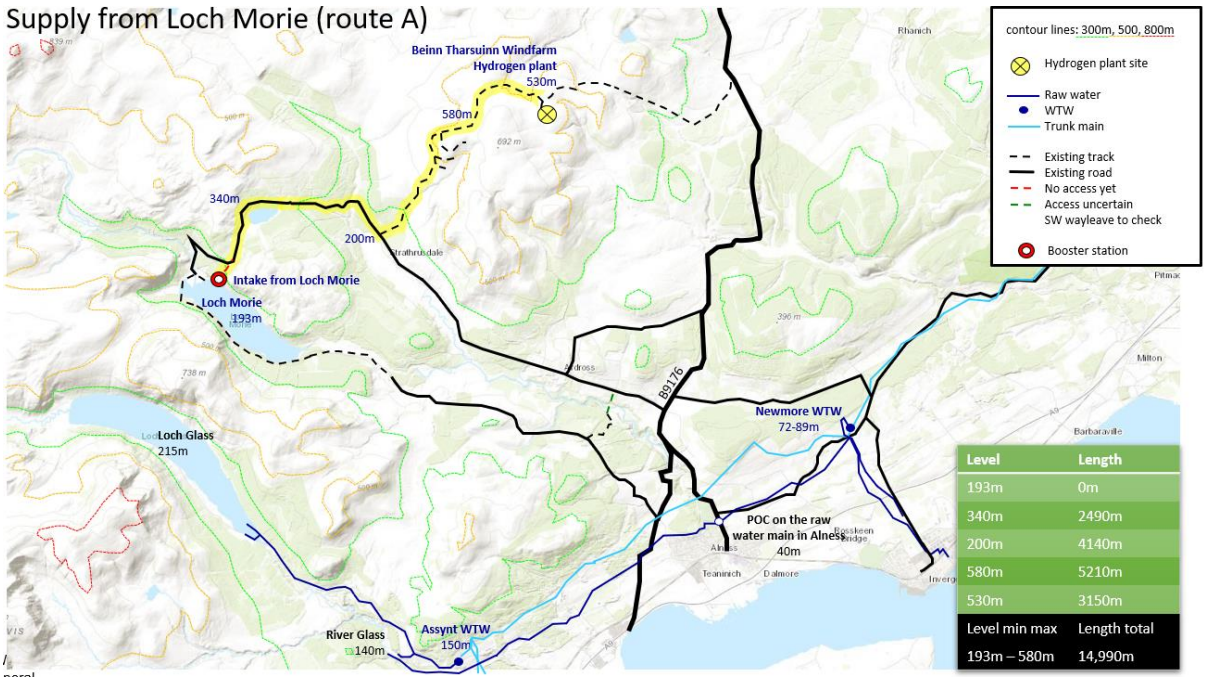


FIGURE 11 OVERVIEW OF THE ROUTE FROM LOCH MORIE (ROUTE A)

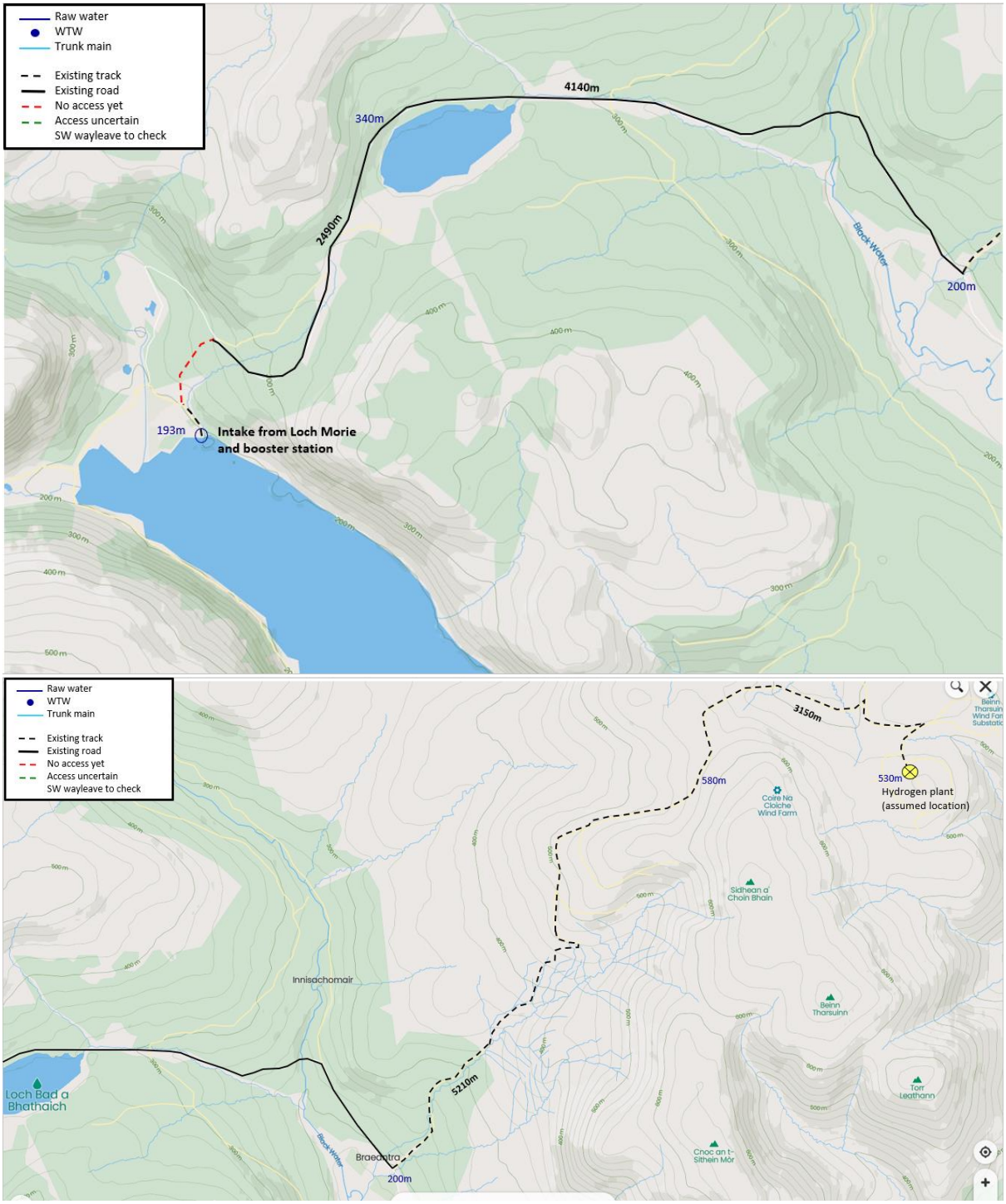


FIGURE 12 ROUTE FROM LOCH MORIE (ROUTE A PARTS 1 AND 2)

The characteristics of the proposed route are:

- Estimated pipe length: 14,990m
- Min elevation: 193m
- Max elevation: 580m
- Estimated head at the intake in Loch Morie: 193m
- Proposed head at discharge point: 540m
- Estimated friction loss head: 42m
- Estimated total static head: 387m
- Estimated total head: 429m

The proposed infrastructure would be:

- A new offtake to be constructed at Loch Morie. Access to the offtake will need to be arranged on Kildermorie Partnership Estate both by using existing access track nearby and by creating new tracks where none already exists.
- A 14,990m long 180mm diameter SDR11 PE80 raw water main to provide water from the offtake in Loch Morie to the hydrogen plan. The proposed route would follow:
    - An existing narrow road (approx. 6,630m long) between Kildermorie Lodge and Braentra. This road goes through an estate and a woodland. It is privately owned by Kildermorie Partnership for the section between the Lodge and Loch Bad a Bhathaich and owned by Forestry and Land Scotland for the section between Loch Bad a Bhathaich and Braentra.
    - The verges of the existing private tracks leading to the windfarm (approx. 8,360m long) from Braentra (six known owners).
- A new booster Station to be located in the vicinity of the offtake on Kildermorie Partnership estate. Due to the high discharge pressure required to overcome the total head on the system, none of the conventional standard pressure booster stations (CWBS) from Scottish Water Standard Product Catalogue would be fit for purpose. A bespoke design booster station would be required instead. Based on our initial assessment for this route duties, we would recommend using pumps from Xylem Lowara eMP range of products, eg. a MPV50B unit fitted with 90 kW motor. Note that the booster station will require a power supply from a nearby existing infrastructure and either a telecoms line or GPS signal to allow communication with the hydrogen plant and maintenance provider.
- A Water Treatment Works (WTW) to be installed at the hydrogen plant to treat the raw water to the required standard for hydrogen production. Raw water quality will still need to be investigated further to determine which type of treatment would be the best to ensure a constant quality of water at the hydrogen plant. In the absence of more detailed information, we are proposing the use of a membrane type WTW which has the following characteristics:
    - Uses filter units to remove impurities and treat the raw water.
    - Can deal with a variety of inflow qualities.

- Has a small area footprint and can be manufactured offsite and utilises industry standard plant and equipment.
- Process stages within a membrane type plant can be added, removed, or amended to suit individual applications and additional units can be added to increase treatment capacity.
- Has a lower standard operational staff requirement and no need for chemicals for treatment.

Note that the WTW will require a power supply from nearby existing infrastructure and either a telecoms line or GPS signal.

- A storage tank capable of holding 800m3 of water equivalent 24-hour storage for the 0.8Ml/day demand is recommended at the hydrogen plant as mitigation to interruptions to water supply from issues at the intake in Loch Morie, issues with the new main supplying the plant, booster station faults, issues or routine maintenance of the modular WTW.

3.4 Supply from Loch Morie (route B): option dismissed

We have considered but dismissed alternative routes from Loch Morie such as the route B presented below as they would not bring any benefit in matter of access constraints while almost doubling the length of the main required and implying the construction of additional infrastructure: more particularly two booster stations and one intermediary reservoir would be required for route B.

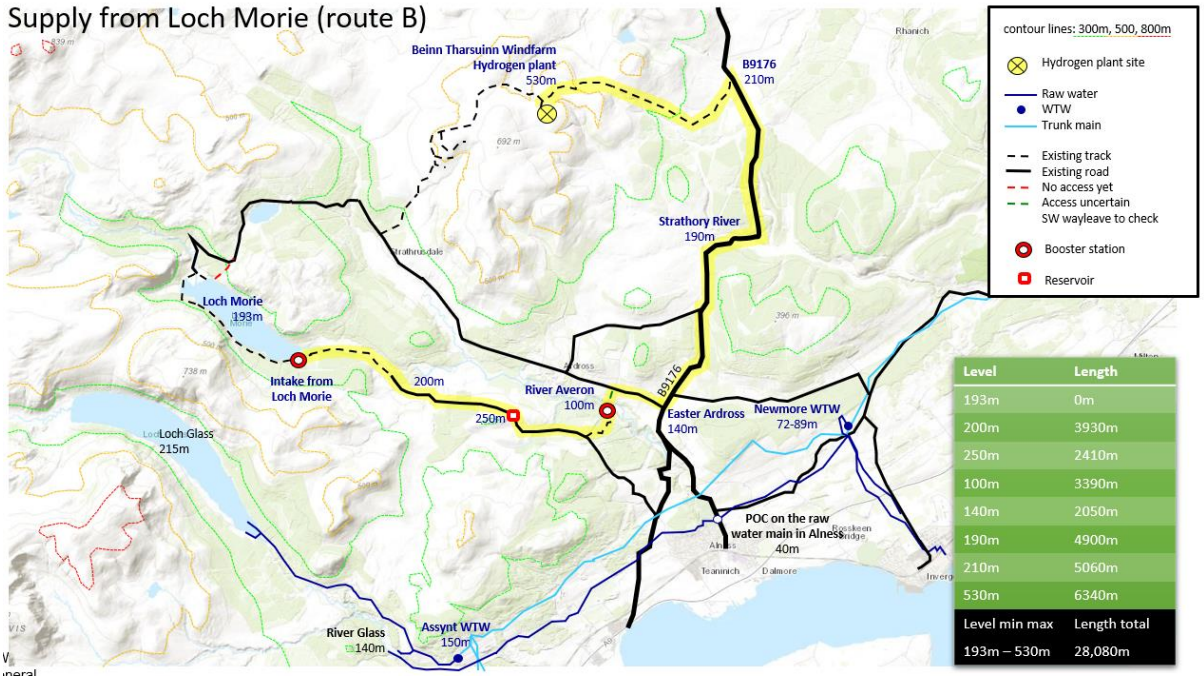


FIGURE 13 LOCH MORIE (ROUTE B) – OPTION DISMISSED

4.0 Feasibility Assessment

4.1 Assessment Criteria

4.1.1 Hydraulic Capacity

- Supply from River Glass: a further model calibration study is recommended to confirm the actual flow and pressure in the existing raw water main but assuming there is not any major restrictions or defects on the main and assuming there is no increase in elevation between River Glass extraction point and Newmore Water Treatment Works that would be above the hydraulic gradient, the additional demand (0.8Ml/day or 9.3l/s) required for the hydrogen plant should be met without the need to carry out any further upgrade on the existing asset.

- Supply from Loch Morie: further investigation and hydrology study would be required at the Loch to confirm the suitability and availability of this Loch's raw water to supply the hydrogen plant (e.g. possible restrictions to supply during drought conditions).

4.1.2 Engineering and Construction

- Supply from River Glass:
  - The feasibility of connecting the new main directly onto the existing pre-stressed concrete raw water main will need to be confirmed.
  - This solution implies a crossing of Strathrory River on the B9176.

- Supply from Loch Morie:

  - This solution implies works within Loch Morie to construct a new offtake from the Loch with temporary works to create access from the existing track. A SEPA Licence (under The Water Environment (Controlled Activities) (Scotland) Regulations 2011) will be required for these construction works.
  - The suitability for plant access of the existing roads, especially the private road going through the woodland and Kildermorie Estate, will need to be confirmed.
  - This solution implies a crossing of a tributary of Black Water river between Kildermorie Estate and Braentra.

4.1.3 Utilities

- Supply from River Glass: utilities records will need to be investigated at Design stage. Existing power and telecoms (unknown if existing telecoms infrastructure or would require GPS signal) at booster station near point of connection and proposed WTW near the hydrogen plant would need checked for capacity. Wind farm power cables will need crossed with new water main.

- Supply from Loch Morie: utilities records will need to be investigated at Design stage. Existing power and telecoms (unknown if existing telecoms infrastructure or would require GPS signal) at

Loch Morie offtake and booster station, and proposed WTW near the hydrogen plant would need checked for capacity. Wind farm power cables will need crossed with new water main.

4.1.4 Ground Conditions

- Supply from River Glass: ground conditions are unknown and will need to be investigated at Design stage. No usable records were found on British Geological Survey records.

- Supply from Loch Morie: ground conditions are unknown and will need to be investigated at Design stage. No usable records were found on British Geological Survey records.

4.1.5 Traffic Management

- Supply from River Glass: traffic management required on Highland Council roads for water main and booster station installation in verge. Minimal site traffic to be managed along with pedestrians on the tracks going to the windfarm from B9176.

- Supply from Loch Morie: having working areas on the narrow private roads and tracks will likely imply closing them for the duration of the works which could be a problem for some of the landowners especially if it has an impact on their businesses (e.g. accommodations at Kildermorie Lodge, Forestry business in the woodland, etc.).

FIGURE 14 PRIVATE ROAD BETWEEN KILDERMORIE ESTATE AND BRAENTRA

4.1.6 Land

- Supply from River Glass: a servitude or wayleave agreement would be required with landowners for the construction of infrastructure and possible land purchase for the booster station near the point of connection and the WTW and storage tank near the hydrogen plant. Based on our initial assessment:

- One landowner has been identified for the private tracks leading to the windfarm from B9176.

- Supply from Loch Morie: a servitude or wayleave agreement would be required with landowners for the construction of infrastructure and possible land purchase for the offtake and booster station at the Loch and WTW and storage tank near the hydrogen plant. Based on our initial assessment:
  - Two landowners have been identified for the private road between Kildermorie Lodge and Braentra.
  - Six landowners have been identified for the private tracks leading to the windfarm from Braentra.

  Due to the disruption caused by traffic management identified above, potentially complex negotiations should be anticipated with some of these landowners with a high likelihood of a compensation scheme for lost business to be required in order to secure land deals and access agreements.

4.1.7 Environment

- Supply from River Glass: no exceptional constraints noted at this stage.

- Supply from Loch Morie: A SEPA Licence under The Water Environment (Controlled Activities) (Scotland) Regulations 2011 will be required for abstraction of raw water from the Loch.

4.1.8 Planning

- Supply from River Glass: Permitted Development approval will be required for the booster station and WTW and either Permitted Development approval or Planning Permission for the storage tank.

- Supply from Loch Morie: Planning Permission will be required for the Loch offtake, booster station and WTW and either Permitted Development approval or Planning Permission for the storage tank.

4.1.9 Archaeology and Built Heritage

- Supply from River Glass: no exceptional constraints noted at this stage.

- Supply from Loch Morie: no exceptional constraints noted at this stage.

4.1.10 Health and Safety

- Supply from River Glass: no exceptional constraints noted at this stage.

- Supply from Loch Morie: no exceptional constraints noted at this stage.

4.1.11 Public and Reputation

- Supply from River Glass: disruption from raw water main construction to B9176 road and local paths users.

- Supply from Loch Morie: disruption from raw water main construction to Kildermorie Lodge, Loch Morie and local paths users.

4.1.12 Carbon

- Supply from River Glass:

Our evaluation of embodied emissions for this option is based on the following figures (no transport emissions included):

- Booster station: 40,000 kgCO2e
- Water main up to 200mm dia. MDPE pipeline laid in field (assuming the main will be laid on the verges of the road): 23,172 kgCO2e per km hence for a length of 20.52km a total of 475,489 kgCO2e
- Concrete structures (800m3 storage tank): 92,820 kgCO2e
- 0.8Ml/day modular Water Treatment Works: 854,665 kgCO2e

On that basis our estimate of the total embodied emissions for the supply from River Glass is **1,462,964 kgCO2e**.

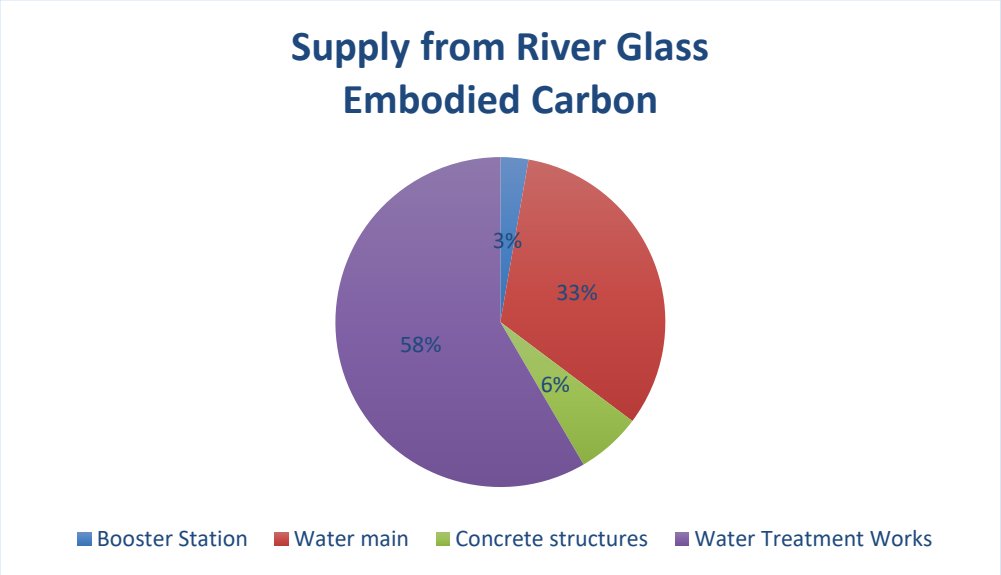


FIGURE 15 SUPPLY FROM RIVER GLASS – EMBODIED CARBON

Our evaluation of operational emissions over the lifetime of the asset (assumed 25 years) for the supply from River Glass is based on the following figures:

- Average power consumption at the booster station and WTW - the actual power required at these assets will need to be calculated at Design stage. For the current carbon assessment, we

have assumed that an average of 85kW will be required and that both the booster station and WTW will run 24h daily all year long: 1,524,439 kgCO2e over 25 years.

- The ongoing maintenance of the asset was assumed to result in carbon emissions at a rate of 2% of the embodied carbon per year hence a total of 731,482 kgCO2e over 25 years.

On that basis our estimate of the total operational emissions over 25 years for the supply from River Glass is **2,255,921 kgCO2e over 25 years**.

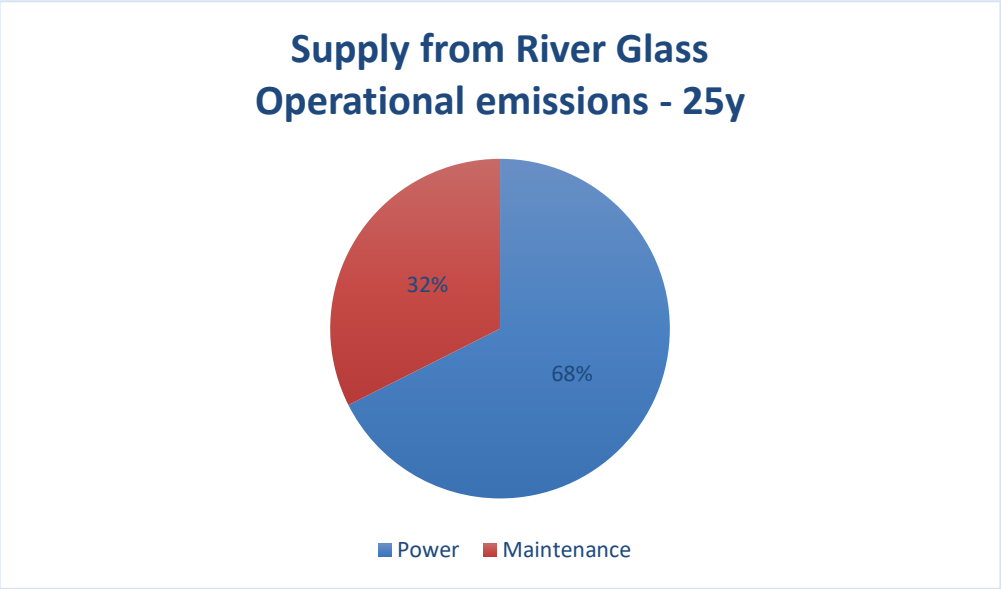


FIGURE 16 SUPPLY FROM RIVER GLASS – OPERATIONAL EMISSIONS

As a result, the whole-life emissions for the supply from River Glass is **3,718,885 kgCO2e** (1,462,964 kgCO2e for embodied emissions and 2,255,921 kgCO2e for operational emissions)

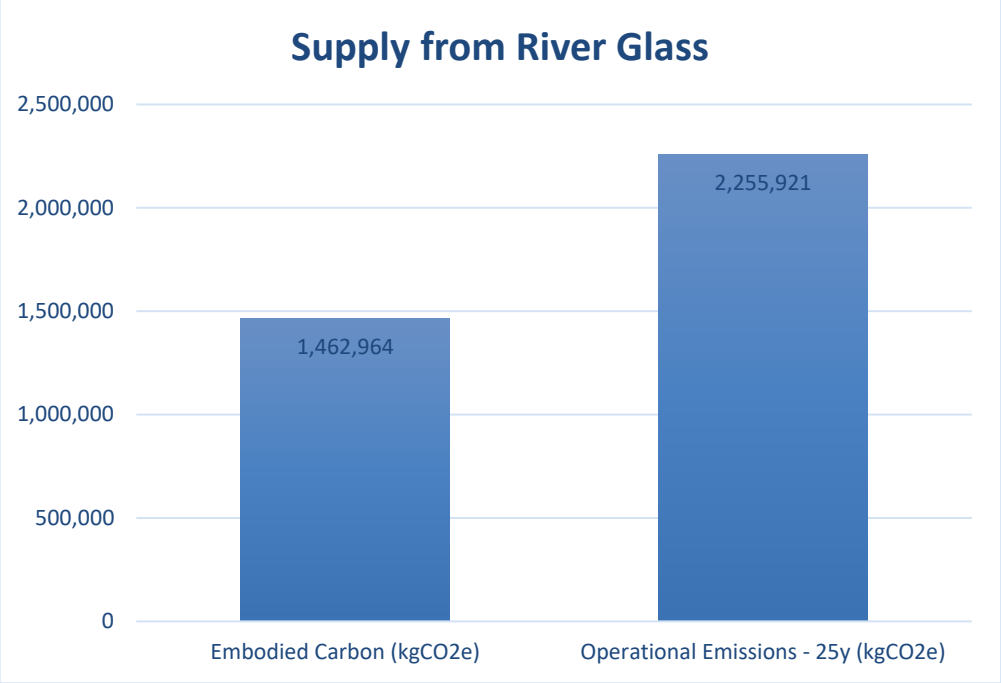


FIGURE 17 SUPPLY FROM RIVER GLASS – WHOLE-LIFE CARBON

- Supply from Loch Morie:

Our evaluation of embodied emissions for the supply from Loch Morie is based on the following figures (no transport emissions included):

- Booster station: 40,000 kgCO2e
- Water main up to 200mm dia. MDPE pipeline laid in field (assuming the main will be laid on the verges of the road): 23,172 kgCO2e per km hence for a length of 8,36km a total of 193,718 kgCO2e
- Water main up to 200mm dia. MDPE pipeline laid under a road: 73,172 kgCO2e per km hence for a length of 6,13km a total of 448,544 kgCO2e
- Concrete structures (800m3 storage tank and Loch offtake): 105,250 kgCO2e
- 0.8Ml/day modular Water Treatment Works: 854,665 kgCO2e
- Access road (assumption: 500m long, 5m wide, 500mm thick type 1 granular sub-base, 200mm thick reinforced concrete): 83,340 kgCO2e

On that basis our estimate of the total embodied emissions for the supply from Loch Morie is **1,725,507 kgCO2e**.

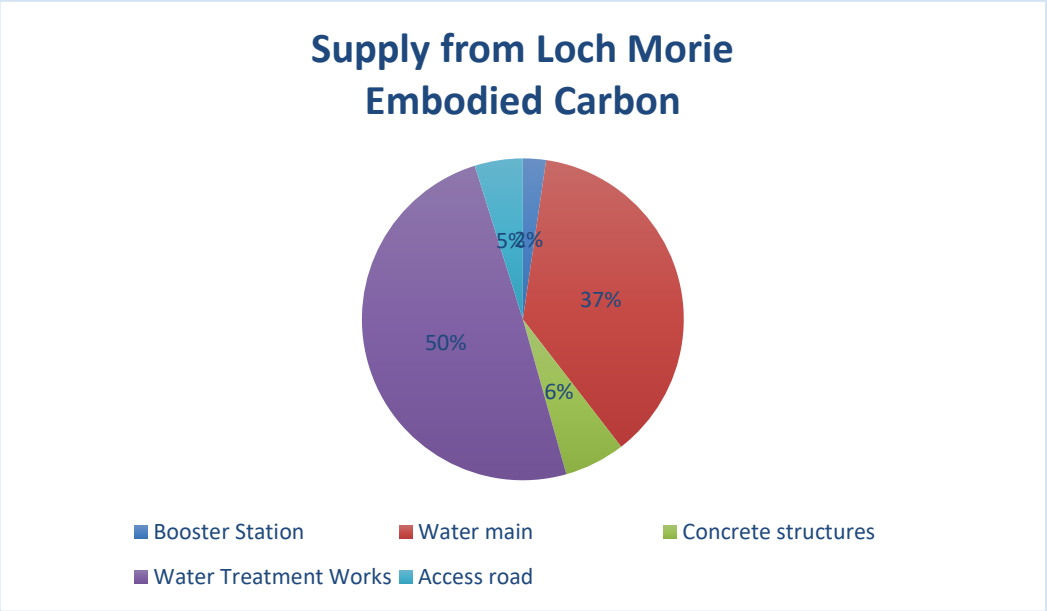


FIGURE 18 SUPPLY FROM LOCH MORIE – EMBODIED CARBON

Our evaluation of operational emissions over the lifetime of the asset (assumed 25 years) for the supply from Loch Morie is based on the following figures:

- Average power consumption at the booster station and WTW - the actual power required at these assets will need to be calculated at Design stage. For the current carbon assessment, we have assumed that an average of 85kW will be required and that both the booster station and WTW will run 24h daily all year long: 1,524,439 kgCO2e over 25 years.

- The ongoing maintenance of the asset was assumed to result in carbon emissions at a rate of 2% of the embodied carbon per year hence a total of 862,754 kgCO2e over 25 years.

On that basis our estimate of the total operational emissions over 25 years for the supply from Loch Morie is **2,387,193 kgCO2e over 25 years**.

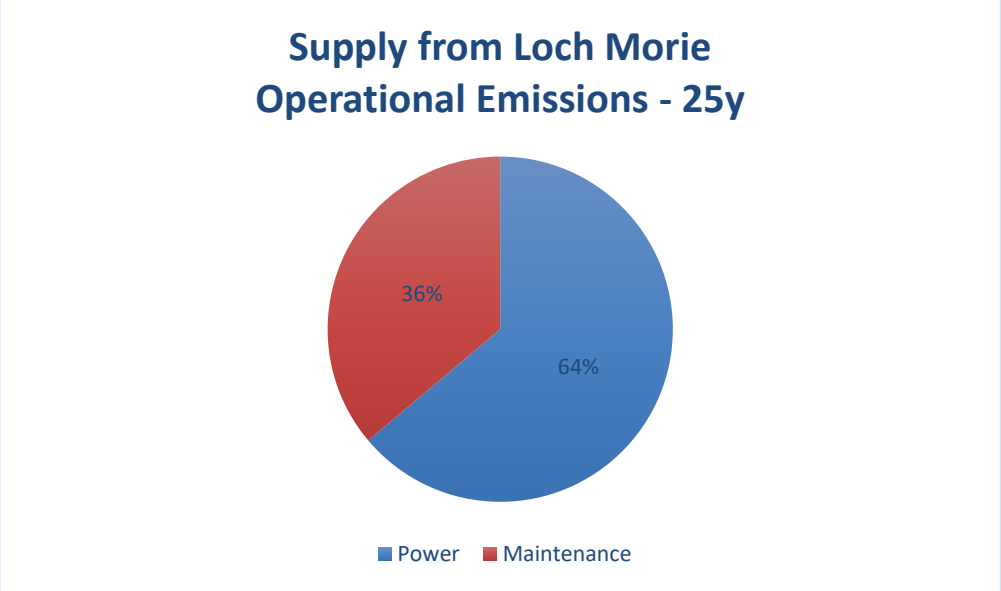


FIGURE 19 SUPPLY FROM LOCH MORIE – OPERATIONAL EMISSIONS

As a result, the whole-life emissions for the supply from Loch Morie is **4,112,700 kgCO2e** (1,725,507 kgCO2e for embodied emissions and 2,387,193 kgCO2e for operational emissions)

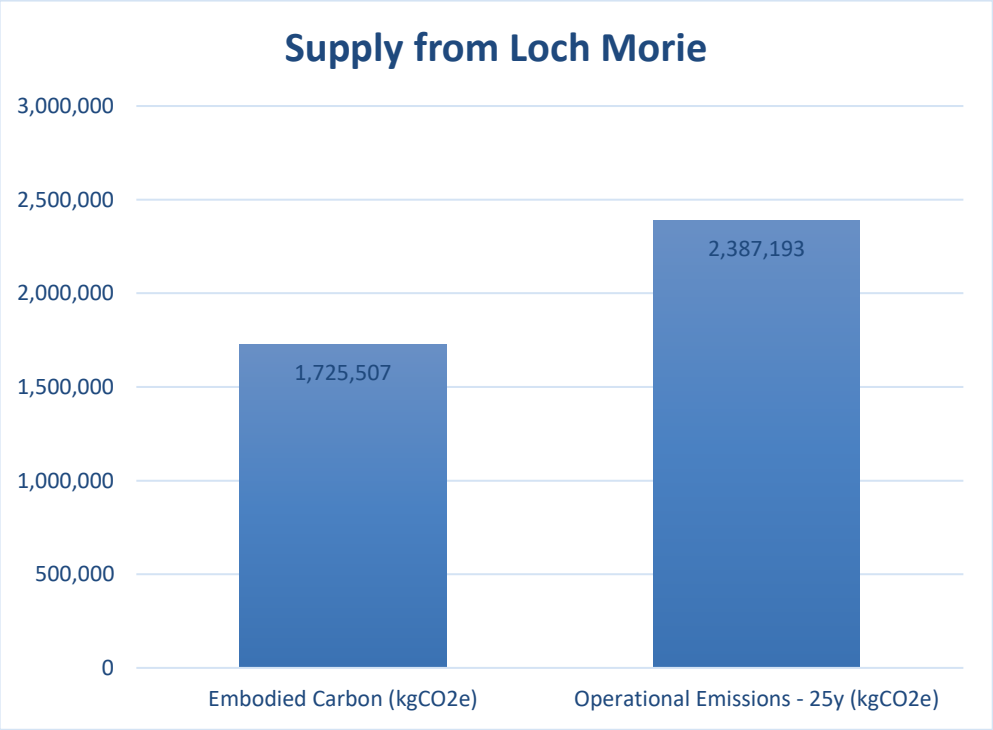


FIGURE 20 SUPPLY FROM LOCH MORIE – WHOLE-LIFE CARBON

- Supply from River Glass v Loch Morie

The comparison of whole-life emissions over 25 years for the proposed supply options is:

- Supply from River Glass: 3,718,885 kgCO2e (1,462,964 kgCO2e for embodied emissions and 2,255,921 kgCO2e for operational emissions)

- Supply from Loch Morie: 4,112,700 kgCO2e (1,725,507 kgCO2e for embodied emissions and 2,387,193 kgCO2e for operational emissions)

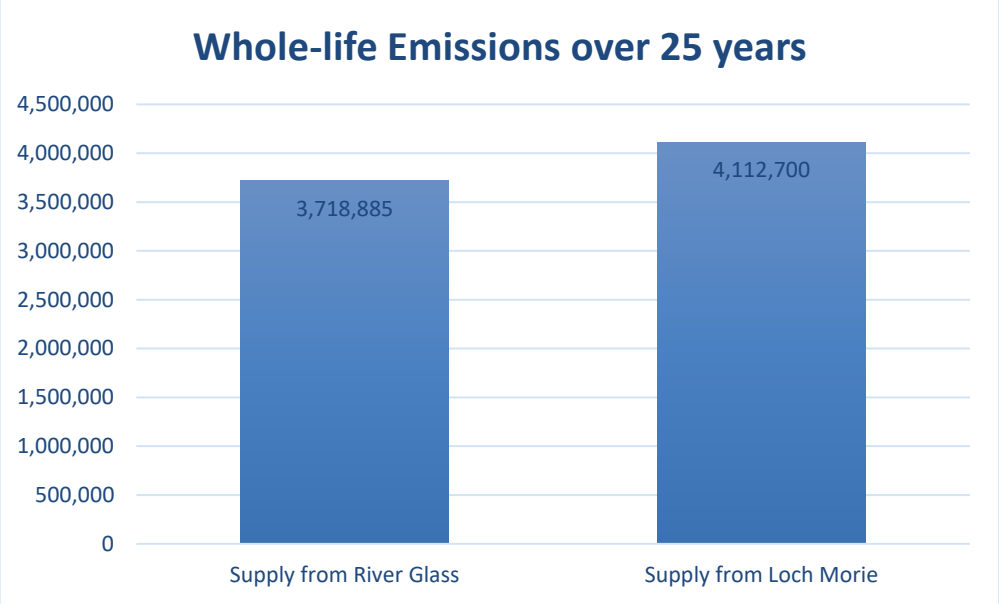


FIGURE 21 SUPPLY FROM RIVER GLASS V LOCH MORIE – WHOLE-LIFE CARBON COMPARISON

4.1.13 Asset Ownership and Operation

- Supply from River Glass: the new booster station, raw water main, WTW and storage tank would be owned and operated by Scottish Power Renewables.

- Supply from Loch Morie: the new Loch offtake, booster station, raw water main, WTW and storage tank would be owned and operated by Scottish Power Renewables.

4.1.14 Design Cost Estimate

- Supply for River Glass: [redacted] Scope includes model calibration to determine hydraulic restriction in existing network, raw water quality and treatment assessment, utility search, topographical survey, geotechnical investigation to determine ground conditions, site investigation to locate existing raw water main, detailed design of new raw water main, bespoke booster station, WTW and storage, third party engagement and approvals (including utilities, land, planning and stakeholders), construction pricing and programming.

- Supply for Loch Morie: [redacted] Scope includes hydrology study of Loch Morie to confirm water supply suitability, raw water quality and treatment assessment, utility search, topographical survey, geotechnical investigation to determine ground conditions, detailed design of new raw water main, bespoke booster station, WTW and storage, third party engagement and approvals (including utilities, land, planning, environmental and stakeholders), construction pricing and programming.

4.1.15 Construction Cost Estimate

- Supply from River Glass: [redacted] Scope includes construction and commissioning of raw water main, bespoke booster station and WTW (including power and telecom), storage tank, traffic management and reinstatement along with management of the works and associated activities. A risk allowance has been made for threats and opportunities from existing raw water network upgrades, ground conditions (hard, poor, groundwater and contamination), third party restrictions and design refinement.

- Supply from Loch Morie: [redacted] Scope includes construction and commissioning of reservoir offtake structure, raw water main, bespoke booster station and WTW (including power and telecom), storage tank, temporary access works, reinstatement along with management of the works and associated activities. A risk allowance has been made for threats and opportunities from ground conditions (hard, poor, groundwater and contamination), third party restrictions, landowner requirements, temporary works and design refinement.

Note: no allowance has been made for land purchase or wayleave payments for any option.

4.1.16 Annual Operational Cost Estimate

- Supply from River Glass: [redacted] An estimate of the operational costs including power and telecoms (24.4%), water (57.0%), operational attendance, routine maintenance, servicing and replacing pumps, membranes and other wearing parts (18.6%) has been provided as an annual cost from a 20-year OPEX estimate.

- Supply from Loch Morie: [redacted] An estimate of the operational costs including power and telecoms (26.3%), water (53.7%), operational attendance, routine maintenance, servicing and replacing pumps, membranes and other wearing parts (20%) has been provided as an annual cost from a 20-year OPEX estimate.

4.1.17 20 Year TOTEX Cost Estimate

- Supply from River Glass: [redacted]

- Supply from Loch Morie: [redacted]

4.1.18 Design Programme Estimate

Note: our programme estimates are made on the assumption that site investigations can be carried out from the road verges without the need for road closures and excludes any re-design if the location of any plant items or the raw water main route were to be changed.

- Supply from River Glass: 7 months. This includes reasonable time for works to obtain third party approvals for utility services, land access, traffic management, environmental and planning. Protracted negotiations for these will extend the design duration.
- Supply from Loch Morie: 7 months. This includes reasonable time for works to obtain third party approvals for utility services, land access, environmental and planning. Protracted negotiations for these will extend the design duration.

4.1.19 Construction Programme Estimate

- Supply from River Glass: 18 months. This assumes simultaneous works carried out for:
  - The booster station, tank and WTW
  - The raw water main construction assuming it will be possible:
    - To have 4 working areas progressing in parallel on different locations i.e. 5,130m of main at each location
    - To lay 350m of main per month (80m per week).
    - To have a 3 month lead-in time for land access, traffic management and procurement

- Supply from Loch Morie: 18 months. This assumes simultaneous works carried out for:
  - The Loch offtake, booster station, tank and WTW
  - The raw water main construction assuming it will be possible:
    - To have 3 working areas progressing in parallel on different locations i.e. 5,000m of main at each location
    - To lay 350m of main per month (80m per week)
    - To have a 3 month lead-in time for land access, traffic management and procurement

Note:

- On that basis, it means that if the works were to start early July 2023, the scheme could be delivered by the end of December 2024.
- As the critical path is the completion of the raw water main construction, if necessary contingency plans for having a temporary raw water supply in place no later than December 2024 can be considered in addition to the current scheme such as:
  - Provision of raw water tankers
  - Temporary license agreement for extracting water from Loch Muig-Bhlàraidh (discounted for being used as a permanent supply due to its limited capacity) provided the water sampling results for this Loch confirmed its suitability for a temporary use.

3.2 Feasibility Comparison

The options have been given a red-amber-green status as per the definitions below.

- Red – Major known issues, significant unknowns or risks with further information/works required. Potential project blocker.
- Amber – Known issues, unknowns or risks with further steps and management identified. Potential cost and time impact. Unlikely project blocker.
- Green – No known issues or unknowns, minimal risk with known actions required. Minimal impact to cost and time. Minimal risk as project blocker.

Criteria	0.8Ml/day	
	River Glass	Loch Morie
Hydraulic Capacity		
Engineering and Construction		
Utilities		
Ground Conditions		
Traffic Management		
Land		
Environment		
Planning		
Archaeology and Built Heritage		
Health and Safety		
Public and Reputation		
Carbon	Lower	Higher
Asset Ownership and Operation		
Design Cost Estimate	Higher	Lower
Construction Cost Estimate	Higher	Lower
Operational Cost Estimate	Higher	Lower
20 Year TOTEX Cost Estimate	Higher	Lower
Design Programme Estimate	Similar	Similar
Construction Programme Estimate	Similar	Similar

FIGURE 22 FEASIBILITY COMPARISON

5.0 Next Steps

We would welcome a workshop with Scottish Power Renewables to present and discuss the feasibility report and to allow any further assessment or information gathering to be carried out. The items listed in the sections below are recommended to address unknowns or risks with each option.

5.1 Supply from River Glass

To further assess the feasibility of the River Glass supply option the following next steps are recommended:

1. Flow and pressure test on existing 27" water main to confirm actual available flow and pressure at proposed point of connection and to investigate head losses from the point of abstraction in River Glass to Newmore Water Treatment Works in order to identify potential restrictions, defects or anomalies that would need to be addressed.
2. Model calibration and hydraulic modelling based on the results of the above flow and pressure testing.
3. Samples of raw water from the existing raw water main and water quality analysis.
4. Initial engagement with landowners for agreement in principal and terms for infrastructure in their land.
5. Further work to develop WTW and bespoke booster station specification.
6. Initial engagement for Permitted Development and Planning applications.
7. Initial engagement with utility providers for power and telecoms supplies.
8. Limited scope of geotechnical investigation.
9. Refine cost and programme estimates.

5.2 Supply from Loch Morie

To further assess the feasibility of the raw option the following steps are recommended:

1. Detailed hydrology study, including samples of raw water and water quality analysis, to fully assess the availability and suitability of raw water from Loch Morie.
2. Initial engagement with landowners for agreement in principal and terms for infrastructure in their land.
3. Further work to develop WTW and bespoke booster station specification.
4. Initial engagement for Permitted Development and Planning applications.
5. Initial engagement with utility providers for power and telecoms supplies.
6. Initial engagement with SEPA for environmental licencing requirements.
7. Limited scope of geotechnical investigation.
8. Refine cost and programme estimates.