From:
To:
Date:

Red John Pumped Storage Scheme – consultation request re application for section 36 consents

Dear Sir/Madam

THE ELECTRICITY WORKS (ENVIRONMENTAL IMPACT ASSESSMENT) (SCOTLAND) REGULATIONS 2017
ELECTRICITY ACT 1989 : APPLICATION FOR SECTION 36 CONSENT FOR THE PROPOSED RED JOHN PUMPED STORAGE SCHEME IN THE PLANNING AUTHORITY AREA OF THE HIGHLAND COUNCIL

The Ness District Salmon Fishery Board (NDSFB) is the statutory body responsible for the protection and enhancement of migratory salmonid (salmon and sea trout) fisheries in the Ness District. This includes that area covered by the application for Section 36 Consent for the proposed Red John Pumped Storage Scheme. Our comments regarding this application are provided below.

Background

Loch Ness forms an important migratory route and refuge for Atlantic salmon and Sea trout (migratory salmonids) as they travel between the marine and freshwater environments. Fish originating in the upper Ness system (including the Rivers Oich, Garry, Tarff and Moriston), middle Ness system (Rivers Enrick, Coiltie, Foyers and Farigaig) and lower Ness system (River Ness and tributaries) all have the potential to be present in the area of the proposed development.

The River Moriston is a Special Area of Conservation (SAC) designated for Atlantic salmon and freshwater pearl mussel (which depend on the juvenile salmon for part of their lifecycle) which is currently deemed to be in ‘unfavourable’ status. Furthermore, abundance of salmon in the Upper River Garry has declined over the last fifty years and is showing little sign of recovery. Historical annual returns of up to 900 salmon through the fish counter in the Garry Dam have now reduced to a five-year average of just 70 fish (with only 27 in 2018). More widely, there has been a long-term decline in the annual Ness district and Scottish National salmon rod catch.

Potential Impact of Proposal on Salmon Populations

A general decline in the numbers of returning adult salmon places a greater emphasis on their protection. We aim to maximise the number of healthy wild salmon and sea trout that go to sea from the Ness system (referred to as ‘smolt escapement’). As such it is important that a robust assessment of likely impacts of the proposed Red John scheme is completed and adequate measures put in place to mitigate any potential negative impacts. A number of potential impacts associated with the proposed Red John scheme were highlighted in our scoping response:

- Entrainment and/or impingement of salmon and sea trout smolts at the Loch Ness inlet, in particular those originating from the River Moriston SAC;

- The cumulative effects of the proposed development on smolt escapement in combination with other projects that are under construction or going through planning, but also existing developments such as SSE Hydro Dams at Invergarry and Dundreggan, Foyers Power station and the Caledonian Canal;

- Reduction of water levels in Loch Ness resulting from the intake of water for the proposed development (particularly during low flow conditions). This has the potential to effect water levels in the River Ness and the ability of fish to negotiate the fish pass at Ness Weir; and

- Disruption of the migratory behaviour of salmon and sea trout resulting from the discharge of water from the outlet of the proposed development. This has the potential to leave them more vulnerable to illegal exploitation and predation.

Very little is known about the migrations or behaviour of salmon (smolts, adults or recovering kelts) in large water bodies such as Loch Ness. As such we have indicated that further field surveys are required to fill any gaps in knowledge and allow for a robust impact assessment.

Salmon smolts are believed to 'passively' migrate (drift downstream) during the majority of their migration to sea. This makes them very vulnerable to the effects of wind and currents in the Loch, meaning that they may be blown or pushed in the wrong direction. The Ness DSFB has received reports of large shoals 'super shoals' of salmon smolts in the Loch Ness during the spring period (estimated to number in the hundreds of thousands, i.e. a significant proportion of the total smolt run). One of the most common sightings has been at Dores Beach, close to the proposed development site. It is not known whether the fish were pushed to this location by the predominant wind or current direction, or whether they actively choose to gather (or stage) in this location prior to migrating through the River Ness on masse. In either case, the potential for significant numbers of smolts to be present in the proximity of the intake/discharge point significantly increases the risk of a potential impact on smolt survival.

Furthermore, it is generally excepted that a proportion of the salmon smolt run is drawn into the Caledonian Canal at Ness Weir (where the flow out of Loch Ness is split between the River Ness and the Canal). Smolts have a very limited period of physiological readiness in which they must enter the sea. In some cases, it is believed that this 'smolt window' may be as short as a week, which means that any fish delayed in the Canal are unlikely to survive.

Any change to the existing flow regime at Ness Weir associated with the proposed development (particularly in combination with the effects of other water users) will therefore have the potential to impact on smolt survival. Given the current lack of information available regarding the behaviour of smolts in these locations, we would need to take the 'precautionary approach' and assume the worst-case scenario, i.e. the scheme will have a negative impact of smolt survival. A well designed smolt

tracking study would however enable a more informed assessment of likely impact and help to inform any mitigation measures that might be required.

The same is true in regard to adult salmon migrations through Loch Ness. The fish pass (or 'spout') located in Dochfour Weir is believed to create a partial barrier to upstream migration of adult salmon under certain flow conditions, however the specific thresholds are not currently known. Without this information it will be difficult to make an informed assessment of the likely impacts of any changes in flow resulting from the operation of the proposed development on the efficiency of the existing fish pass.

Furthermore, adult fish are known to utilise the loch as a refuge. They are drawn into the lower reaches of the Rivers Oich and Moriston during hydro generation (and associated increase in flows) before dropping back into the loch. The same behaviour has been reported at the Glendoe tailrace, which has now become a popular poaching location. We will need confidence that any 'distraction' in adult salmon migration resulting from the discharge from the proposed development will not have a significant negative impact. A well-designed adult salmon tracking study would enable a more informed assessment of likely impact and help to inform any mitigation measures that might be required.

Specific Comments on EIA

It is disappointing to note that further studies to inform knowledge gaps and allow a robust impact assessment this has been discounted. The applicant states that a catchment-wide desk study has been carried out, which they believe 'adequately informs the assessment of likely impacts', we disagree with this assessment. Specific comments on the EIA are provided below:

- **Volume 2 7.4.11 No records of freshwater pearl mussel were identified in the catchment-wide data search. The potential for the aquatic habitats to support this species depends upon the presence of suitable salmonid host fish species, upon the gills of which the mussel's larval stage, Glochidia, attach.**

  The River Moriston is designated for freshwater pearl mussels. As such there are most definitely records of freshwater pearl mussels in the Ness Catchment.

- **7.4.59 Due to the high gradient, steep banks and the number of impassable barriers for migration throughout the catchment, migratory species including salmon, sea trout, sea lamprey and river lamprey are considered unlikely to be present and utilising the flowing watercourses for spawning throughout the Development Site (sites KS1-KS12).**

  Glacial relic trout populations are likely to be present in these 'inaccessible' areas. Given that brown trout and sea trout are the same species, there is the potential for a proportion of these populations to go through the smoltification process and migrate downstream, becoming sea trout smolts.

- **7.4.60 Salmon and sea trout are also unlikely to be utilising the margins of Loch Ness to spawn as it is widely understood that migratory salmonids prefer to spawn in rivers and streams (Jonsson and Jonsson, 2011).**

Migratory species however will be utilising the loch as a migratory pathway from the sea to rivers such as the river Moriston which is a designated SAC for salmon.

We agree that salmon are unlikely to spawn in the margins of Loch Ness. It is however possible that they spawn on gravel bars at the outflow of smaller burns. Further to this, juvenile salmon (fry and parr) originating from river spawning are believed to migrate into the loch and utilise areas of marginal habitat.

Trout are known to spawn in the margins of lochs, with evidence of this recorded locally in Loch Laidhe in Abriachan on the North bank of Loch Ness. It is therefore highly likely that there are loch spawning brown trout/sea trout (the same species) populations in Loch Ness. The same is true for Arctic charr which are a loch spawning species.

Given these points, juvenile salmonid surveys should be completed in the marginal areas of Loch Ness to determine the degree of utilisation. Only then can the potential impacts of the scheme on salmon/sea trout spawning and juvenile populations be adequately assessed.

- **7.4.62 Consultation with the NDSFB has established that during the annual migration of salmon**
  smolts, large shoals have been reported as gathering at Dores Beach. This means that significant numbers of smolts may be present close to the Tailpond Inlet / Outlet both during construction and operation. Given the know presence of salmon and other migratory fish species in Loch Ness, and the well-known timing of this migration, it is considered that further more detailed survey of fish in Loch Ness, for example smolt or adult salmon tracking studies, is not required to inform the impact assessment.

  The movement of smolts in large Lochs (including Loch Ness) is not fully understood. It is therefore essential that further, more detailed information, is collected to allow a robust assessment of the likely impact of the scheme.

- **7.5.8 The migratory route of salmon through Loch Ness is not known, but it is likely that salmon will be present in the vicinity of the Cofferdam during their migration: late spring and early summer for smolt migration; late autumn or early winter for adult migration.**

  Adult salmon are known to migrate through the Ness system throughout the year, with peak ‘runs’ in the Spring, Summer and Autumn periods. The smolt migration is known to begin in the upper system in mid-March, with smolts recorded in the River Ness as late as mid-June. Juvenile salmon (fry and parr) may be present throughout the year.

- **7.5.31 The effects of sediment input into watercourses and waterbodies on each receptor is**
  assessed in the points that follow. Salmon and lamprey in Loch Ness are considered unlikely to suffer any adverse effects of sediment run-off due to

the localised nature of the works on the loch shoreline in the context of the loch as a whole. Therefore this is assessed as a Negligible effect.

Salmon smolts are known to be highly sensitive to the impacts of water quality (including sediment). They are also known to 'passively' migrate during the majority of their migration to sea. This means that they are likely to be less able to avoid any sediment input. Given that large shoals of smolts have been reported as gathering at Dores Beach (potentially a large proportion of the entire population), any sediment run-off would have the potential for a significant impact on salmon populations (including those originating from the Moriston SAC).

- **7.5.39 Salmon and lamprey will continue to utilise Loch Ness as a migratory pathway, and may**
  therefore pass the Tailpond Inlet / Outlet structure. The Screen at the Inlet / Outlet structure will have a 2 mm aperture size to prevent the entrapment of fish. It is predicted that the maximum Inlet velocity will be 0.15 m/s.

  This is an extremely fine screen which is likely to block and require significant maintenance. Failure to do so will result in areas of much higher velocities over the surface of the screen, on which fish may become impinged. We require further information regarding the design and maintenance of the screen before we can make an assessment of the likely impacts.

- **7.5.40 The maximum sustained swimming speed of salmon has been shown to be 0.91 m/s (0.45 m body length) and 0.54 m/s (0.15 m body length) (Tang and Wardle, 1992), with burst swimming speeds much higher than this.**

  Of particular concern is the potential effect of the proposed intake on migratory fish during stages of their life cycle after which density dependent compensation for losses has been exhausted e.g. salmon or sea trout smolts. As mentioned previously, smolts are known to 'passively' migrate during the majority of their migration to sea. This means that they are programmed to drift downstream with the flow, making it less likely that they will swim away from the intake and more likely that they will be drawn towards it.

  Given that large shoals of smolts have been reported as gathering at Dores Beach (potentially a large proportion of the entire population), there is the potential for large numbers of smolts to become impinged on the intake screens. In the absence of any smolt tracking data to prove otherwise (i.e. that the smolts migrate 'actively' rather than 'passively' through the loch), we believe that there is the potential for impingement on the intake screen to have a significant negative impact on salmon populations (including those originating from the Moriston SAC).

- **7.5.41 The sustained / burst swimming speed of European eel has been shown to be 0.09 m/s / 1.01 m/s (0.10 m body length) and 0.58 m/s / 1.26 m/s (0.70 m body length) (Sheridan et al, 2011).**

  This seems to suggest that the proposed intake velocity could be greater than the swimming speed on an average sized elver (juvenile eel) of 70 to 90mm in length,

a critically endangered species. This could have a significant negative impact given that they migrate upstream 'on-masse' during the summer period.

- **7.5.43 Lamprey ammocoetes will be among the weaker swimming fish species in Loch Ness, and therefore the majority of fish in the loch will swim sufficiently fast to avoid impingement at the Inlet Screen. Sustained and burst swimming speeds of salmon and eel certainly indicate that they will be able to escape the Inlet Screen. It is not clear for how long the Inlet will operate during a pumping cycle, but it is anticipated that one cycle will operate each day.**

We do not agree with this assessment based on the available information (see the comments above).

- **7.5.44 Given the sporadic operation of the Inlet and the evidence that even the weaker swimming fish species swim sufficiently fast to escape the Inlet velocity, together with the very small size of the Inlet structure in the context of the size of Loch Ness, the potential impact of the Inlet / Outlet on salmon and lamprey is assessed as a Negligible effect.**

  We do not agree with this assessment based on the available information (see the comments above). In the absence of any tracking data to the contrary, there is a high risk that passively migrating smolts will be drawn to the intake and impinged on the screens. This risk is increased given the reports of large numbers of smolts gathering in the direct vicinity of the proposed intake location, i.e. the size of the loch is irrelevant if a large proportion of the smolts are gathering in Dores area.

- **7.5.45 As there will be a negligible effect on salmon through impingement at the Inlet, there is**
  considered to be no adverse effect on the integrity of the River Moriston SAC, in terms of freshwater pearl mussels that rely on salmon for the completion of their life cycle.

  We do not agree with this assessment based on the available information (see the comments above). In the absence of any tracking data to the contrary, there is a high risk that passively migrating smolts will be drawn to the intake and impinged on the screens. This risk is increased given the reports of large numbers of smolts gathering in the direct vicinity of the proposed intake location, i.e. the size of the loch is irrelevant if a large proportion of the smolts are gathering in Dores area.

- **7.5.46 The Outlet may present a rheotactic (the tendency of fish to face into an oncoming current) distraction by attracting migratory fish such as salmon from their migration path (O'Keeffe & Turnpenny, 2005). The main risk of such distraction is fish entering the Outlet and becoming trapped. This will not be the case for this Development, as the Outlet Screen will becompletely impassable to fish. The Outlet will not discharge constantly, and the sporadic nature of the discharge, albeit daily, will ensure that fish are not constantly distracted, and are able to continue on their migration. In addition, Loch Ness is approximately 2.1 km wide at the location of the Outlet and the main migration pathway is likely to be on the far side of the loch, downstream of**

which the River Ness flows out via Loch Dochfour. Therefore, the effect of distraction by the Outlet on salmon and other species is assessed as a Negligible effect.

We do not agree with this assessment. There are a number of risks associated with a rheotactic distraction. It is highly unlikely that an adult salmon would become impinged or entrained by the intake. They may however become distracted from their upstream migration long enough to become exposed to illegal exploitation or predation (there is evidence of the former at the Glendoe scheme).

In the absence of any robust data regarding the migratory routes of adult salmon through Loch Ness, it is impossible for the applicant to make any conclusions in terms of the main pathway taken. From our limited knowledge it is clear that the assumption that fish solely migrate up the far side opposite the outlet location is incorrect. Fresh run adult salmon are regularly captured by fishing boats on both sides of the loch. Furthermore, shoals of adult salmon are believed to more large distances around the loch during the summer and autumn period. Come spawning time, some of these fish move into the upper tributaries and others drop back down into the River Ness.

Therefore, in the absence of any adult tracking data to prove otherwise, we believe that there is the potential for adult salmon to be distracted by the intake (including those destined for the Moriston SAC), with the potential for a negative effect.

- **7.7.11 To minimise the effects of noise from piling on fish, there should be a 'soft start' to piling works to deter fish from the immediate area where physical injury may occur. Mason and Collett (2011) suggest a soft start to piling using a blow energy of 150 kJ, and show that using a soft start will have a lower impact on the salmon initially.**

  By using terms such as 'minimise' and 'a lower impact' the EIA recognises that piling has the potential for a significant impact on salmon populations. Soft start is likely to be an effective mitigation for adult fish, which are relatively mobile should be able to avoid the area. Piling should not however be carried out during the smolt migration period (mid-March to the end-June) as they passively migrate and less likely to react to the 'soft start'. If juvenile salmon or trout (fry or parr) are found to be present in the area, then further mitigation may be required as they are less mobile and unlikely to be able to avoid the effects of piling.

  Given these points, juvenile salmonid surveys should be completed in the marginal areas of Loch Ness to determine the degree of utilisation. Only then can the potential impacts of the scheme on salmon/sea trout spawning and juvenile populations be adequately assessed.

Finally, our concerns regarding the potential reduction of water levels in Loch Ness resulting from the intake of water for the proposed development (particularly during low flow conditions) have not been addressed in the Aquatic Ecology Chapter. Any reduction in loch level has the potential to effect water levels in the River Ness and the ability of fish to negotiate the fish pass at Ness Weir.

This was a ‘live’ issue during the 2018 season during exceptionally low flows. Rod catch data suggests that the ability (or willingness) of adult salmon to negotiate the weir is affected by river level. As such we would require an assessment of the likely impact of the intake on the efficiency of the existing fish pass (or ‘spout’) located in Ness Weir. Furthermore, we would require an assessment of the likelihood of an increase in the losses of smolts to the Caledonian Canal as a result of the intake.

Conclusion

We do not believe that the EIA in its current form gives an accurate assessment of the potential impacts of the Red John Pumped Storage Hydro Scheme on salmon and sea trout population in the Ness system. Further detailed information regarding the migratory routes and behaviour of both adult and juvenile salmon (and sea trout) in Loch Ness is required to allow a robust assessment of the potential impacts to be made. As such we must object to the EIA in its current form.

Yours Sincerely

Chris

Chris Conroy *BSc (Hons) MSc MIFM*
River Director & Clerk
Ness District Salmon Fishery Board

Red John Pumped Storage Scheme

Ness District Salmon Fisheries Board – Section 36 Response

Thank you for your response which was received on the 21st December 2018. I apologise in the delay in responding, but please find the Applicants response below. We have separated out to response to specific points for ease of reference. We welcome the opportunity to meet with Ness District Salmon Fisheries Board to aid any further discussions.

Paragraph Reference	Ness District Salmon Fishery Board Representation Comment	Applicants Response
7.4.11	The River Moriston is designated for freshwater pearl mussels. As such there are most definitely records of freshwater pearl mussels in the Ness Catchment.	A catchment-wide data request for aquatic species was submitted to the Highland Biological Recording Group (HBRG) and SEPA. Despite records of species up to 48 km distant to the Development being returned, no records of freshwater pearl mussel were provided by either organisation. Information obtained during the course of a desk study such as this is dependent upon people and/or organisations having made and submitted records for the area of interest. As such, a lack of records for a particular species does not necessarily mean that the species do not occur in the study area. Accordingly, while no records of freshwater pearl mussel were returned during the desk study, it is acknowledged in Chapter 7 of the EIA Report that this species is known to be present in the River Moriston (see paragraph 7.4.16). In addition, consideration is also given to the potential for impacts to freshwater pearl mussel as a result of the Development in paragraph 7.5.45. The field survey completed to inform the EIA also included search for habitat which may be suitable for freshwater pearl mussel and for live individuals. No freshwater pearl mussels were found during field survey (see Appendix 7.1 of the EIA Report).
7.4.59	Glacial relic trout populations are likely to be present in these 'inaccessible' areas [the watercourses within the boundary of the Site]. Given that brown trout and sea trout are the same species, there is the potential for a proportion of these populations to go through the smoltification process and migrate downstream, becoming sea trout smolts.	It is understood that glacial relic brown trout populations are likely to be present in the watercourses which flow through the Site. However, the fish habitat assessment carried out to inform the EIA identified the presence of major barriers to fish movement on the watercourses within the boundary of the Site. It is noted that while relic brown trout populations may result in sea trout migration downstream, the likelihood of sea trout returning up these watercourses is negligible given the presence of existing barriers, steep gradients and a lack of suitable spawning habitat (again, please refer to Appendix 7.1 of the EIA Report). There are four watercourse crossings which have been identified that may need to be upgraded or created as part of the Development. In addition, the Allt a'Chruineachd may need to be diverted for

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		approximately 50 m near to the Tailpond works location, which will require that the watercourse be passed beneath a new concrete hard-standing via a culvert. All watercourse crossings (new and upgraded) will be installed following SEPA good practice guidelines, ensuring that fish are removed from the works area prior to dewatering. They will be constructed so as to remain passable to local populations of brown trout. As a result, there will be no significant effect on relict brown trout populations which are contained within the watercourses on Site.
7.4.60	We agree that salmon are unlikely to spawn in the margins of Loch Ness. It is however possible that they spawn on gravel bars at the outflow of smaller burns. Further to this, juvenile salmon (fry and parr) originating from river spawning are believed to migrate into the loch and utilise areas of marginal habitat. Trout are known to spawn in the margins of lochs, with evidence of this recorded locally in Loch Laidhe in Abriachan on the north bank of Loch Ness. It is therefore highly likely that there are loch spawning brown trout/sea trout (the same species) populations in Loch Ness. The same is true for Arctic charr which are a loch spawning species. Given these points, juvenile salmonid surveys should be completed in the marginal areas of Loch Ness to determine the degree of utilisation. Only then can the potential impacts of the scheme on salmon/sea trout spawning and juvenile populations be adequately assessed.	No outflows of smaller burns into Loch Ness are to be impacted by the Development. A fish habitat assessment of the Inlet / Outlet location on the shore of Loch Ness was completed during baseline surveys for the Development. No suitable spawning habitat was identified due to the dominance of large boulders and the wave-exposed nature of the shoreline. It is acknowledged that juvenile salmonids and other species will utilise the margins of the loch. However, given the assumed presence of fish, including juvenile salmonids, in the margins of Loch Ness, it is considered that further surveys are not required as the mitigation to be implemented during construction works in this area have been adopted on the basis of the precautionary principle.
7.4.62	The movement of smolts in large lochs (including Loch Ness) is not fully understood. It is therefore essential that further, more detailed information, is collected to allow a robust assessment of the likely impact of the scheme.	Ness District Salmon Fisheries Board (NDSFB) advised as part of on-going consultation during the EIA process that shoals of salmon smolts have been reported gathering at Dores Beach during the annual migration period. This would mean that potentially significant numbers of smolts may be present in relatively close proximity (approximately 2 km) to the Inlet / Outlet structure on Loch Ness during construction and operation of the Development. However, given the known presence of salmon and other migratory fish species in Loch Ness, and the well-known timing of this migration, it is considered that further more detailed survey of fish in

Paragraph Reference	Ness District Salmon Fishery Board Representation Comment	Applicants Response
		Loch Ness, for example smolt or adult salmon tracking studies, is not required to inform the impact assessment. In the absence of information regarding the detailed migration route of salmon smolts, a precautionary approach has been adopted and embedded mitigation will be provided on the assumption that they will be present. Embedded mitigation measures include, but are not limited to, pollution prevention measures such as silt screens during construction, a 2 mm mesh screen over the Inlet / Outlet to prevent entrainment and reduced intake velocities (0.15 m/s) to prevent impingement on this screen.
7.5.8	Adult salmon are known to migrate through the Ness system throughout the year, with peak 'runs' in the spring, summer and autumn periods. The smolt migration is known to begin in the upper system in mid-March, with smolts recorded in the River Ness as late as mid-June. Juvenile salmon (fry and parr) may be present throughout the year.	Please refer to the response above in relation to Paragraph 7.4.62. Additionally, the timing of adult salmon migration is considered within the mitigation measures to be implemented as part of the Development. As part of the conditions of the CAR [The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended)] licence, the timing of works in Loch Ness will be restricted in order to avoid the salmon migratory season, at which time they may be expected to be moving through Loch Ness. It is therefore likely that construction works in Loch Ness will be limited to the period of July to October, inclusive (or similar). This would also include the season during which smolts may be expected to be migrating and therefore effects to the species at this lifecycle stage will also be avoided.
7.5.31	Salmon smolts are known to be highly sensitive to the impacts of water quality (including sediment). They are also known to 'passively' migrate during the majority of their migration to sea. This means that they are likely to be less able to avoid any sediment input. Given that large shoals of smolts have been reported as gathering at Dores Beach (potentially a large proportion of the entire population), any sediment run-off would have the potential for a significant impact on salmon populations (including those originating from the Moriston SAC).	This point is understood. The mitigation measures for the Development set out in the EIA Report include for supervision to be provided by an Ecological Clerk of Works (ECoW) whose responsibilities will include ensuring that water management measures, including Sustainable Drainage Systems (SuDS), drainage ditches, attenuation ponds etc., are effective in preventing the run-off of sediment-laden water to watercourses and waterbodies. Additionally, silt curtains will surround any areas of piling in Loch Ness to prevent any egress of sediment. These will be managed by an appropriately qualified person. As a consequence of these measures, it is concluded that there will be no significant effects from sediment on ecological features, including salmon smolts.
7.5.39	This is an extremely fine screen which is likely to block and require significant maintenance. Failure to do so will result in areas of much higher velocities over the surface of the screen, on which fish may become impinged. We require	The 2 mm mesh screen is required to prevent the entrainment of any juvenile fish. The large size of the Inlet / Outlet structure and the fine mesh of the screen have been purposely designed to allow the intake velocity to be minimised while preventing the entrainment of fish.

Paragraph Reference	Ness District Salmon Fishery Board Representation Comment	Applicants Response
	further information regarding the design and maintenance of the screen before we can make an assessment of the likely impacts.	A strict and robust maintenance regime will be implemented to ensure that blockage of the screen does not occur, and this is described in Chapter 02 of the EIA Report. The screen will be fitted with an automated cleaning mechanism, which will be of moving brush-type. Cleaning of the screen will take place up to once per day.
7.5.40	Of particular concern is the potential effect of the proposed intake on migratory fish during stages of their lifecycle after which density-dependent compensation for losses has been exhausted (e.g. salmon or sea trout smolts). As mentioned previously, smolts are known to 'passively' migrate during the majority of their migration to sea. This means that they are programmed to drift downstream with the flow, making it less likely that they will swim away from the intake and more likely that they will be drawn towards it. Given that large shoals of smolts have been reported as gathering at Dores Beach (potentially a large proportion of the entire population), there is the potential for large numbers of smolts to become impinged on the intake screens. In the absence of any smolt tracking data to prove otherwise (i.e. that the smolts migrate 'actively' rather than 'passively' through the loch), we believe that there is the potential for impingement on the intake screen to have a significant negative impact on salmon populations (including those originating from the Moriston SAC).	Please refer to response in relation to paragraph 7.4.62. While it is acknowledged that smolts rely to some extent on passive migration downstream, they are also reasonably strong swimmers. For example, refer to Chapter 07, Paragraph 7.5.40 which states that the maximum sustained swimming speed for salmon smolts is 0.54 m/s, considerably higher than the 0.15 m/s operational velocity. However, to provide further reassurance that there will be no impacts to salmon smolts during the migration period, further investigation of additional mitigation measures will be undertaken. The current preferred option would be to use a 'bubble screen' to deflect salmon smolts from the Inlet / Outlet. This would need to be sufficiently far from the structure for the bubbles to be effective and the practicality of this measure requires further investigation (e.g. into the depth of the loch bed at this location etc.). However, were this to prove a feasible approach, a bubble screen could be used during the salmon smolt migration period at all times of operation, to prevent them from coming into contact with the Inlet / Outlet.
7.5.41	This seems to suggest that the proposed intake velocity could be greater than the swimming speed of an average sized elver (juvenile eel) of 70 to 90 mm in length, a critically endangered species. This could have a significant negative impact given that they migrate upstream 'on-	Swimming speed measurements for elvers of *Anguilla anguilla* made as part of the Environment Agency National R & D Project No. W2-049 "Swimming Speeds in Fish" (associated Technical Report available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/290591/scho0404bipv-e-e.pdf) indicate that upstream-migrating elvers can attain an average burst speed of 0.5 m/s. This is considerably higher than the predicted maximum Inlet velocity of 0.15 m/s,

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	masse' during the summer period.	which should allow all average-sized elvers to swim away from the screen to prevent impingement. However, as outlined in the response to 7.5.40, the use of a bubble screen as an additional mitigation measure to prevent elvers from becoming impinged on the screen will be investigated.
7.5.43	We do not agree with this assessment based on the available information (see the comments above).	Please refer to responses to 7.5.40 and 7.5.41. The use of a bubble screen during the migratory season for lamprey species would also provide additional mitigation to ensure that ammocoetes do not become impinged on the Inlet / Outlet screen.
7.5.44 & 7.5.45	We do not agree with this assessment based on the available information (see the comments above). In the absence of any tracking data to the contrary, there is a high risk that passively migrating smolts will be drawn to the intake and impinged on the screens. This risk is increased given the reports of large numbers of smolts gathering in the direct vicinity of the proposed intake location, i.e. the size of the loch is irrelevant if a large proportion of the smolts are gathering in Dores area.	Please refer to response to 7.5.40, 7.5.41 and 7.5.43.
7.5.46	We do not agree with this assessment. There are a number of risks associated with a rheotactic distraction. It is highly unlikely that an adult salmon would become impinged or entrained by the intake. They may however become distracted from their upstream migration long enough to become exposed to illegal exploitation or predation (there is evidence of the former at the Glendoe scheme). In the absence of any robust data regarding the migratory routes of adult salmon through Loch Ness, it is impossible for the applicant to make any conclusions in terms of the main pathway taken. From our limited knowledge it is clear that the assumption that fish solely migrate up the far side opposite the outlet location is incorrect.	The main risk from rheotactic distraction is fish entering the Outlet and becoming trapped. This will not be the case for this Development, as the Outlet screen will be completely impassable to fish. The Outlet will not discharge constantly, and the sporadic nature of the discharge, albeit daily, will ensure that fish are not constantly distracted, and are able to continue on their migration. There is a difference between how Glendoe operates and how the Development is anticipated to operate. Glendoe is a large-scale Run of River hydropower scheme that typically will discharge a range of flows for the majority of the time. This is different to this Development, which will discharge and abstract intermittently and could have extended dormant periods between each operating cycle. Although at the time of writing the exact velocity of water at the outlet of Glendoe is not known, it is understood to be higher than the 0.15 m/s which will be achieved by the Red John Development. The design of the outlets is also different, and the depth of discharge of the Red John Inlet / Outlet structure is around 15 m deep which is anticipated to be deeper than the outlet structure at Glendoe. Due to the above it is anticipated that the Development Inlet / Outlet structure will not result in substantial distraction of fish in Loch Ness.

Paragraph Reference	Ness District Salmon Fishery Board Representation Comment	Applicants Response
	Fresh run adult salmon are regularly captured by fishing boats on both sides of the loch. Furthermore, shoals of adult salmon are believed to more large distances around the loch during the summer and autumn period. Come spawning time, some of these fish move into the upper tributaries and others drop back down into the River Ness. Therefore, in the absence of any adult tracking data to prove otherwise, we believe that there is the potential for adult salmon to be distracted by the intake (including those destined for the Moriston SAC), with the potential for a negative effect.	The water composition being discharged from both schemes is also different. The two schemes are fundamental different as the Glendoe catchment is approximately 81 km² which feeds into a reservoir located approximately 630 mAOD that has inundated a moorland area. The Development which is an isolated lined head pond that has a Top Water Level of approximately 269 mAOD and no additional inflows. Furthermore, the potential for the illegal exploitation of fish will be minimised through the installation of security fencing at the Inlet / Outlet to prevent vehicular and pedestrian access. CCTV will also be used at all times. Regardless of the above, the Applicant proposes, as part of a Section 75 agreement, to commit to providing funding towards a fisheries bailiff to support the anti-poaching efforts of the NDSFB. This would be of benefit to salmon across the entire Ness catchment and not just at the location of the Development. To reiterate, a precautionary approach has been applied and it has been assumed that salmon are present, therefore, it is not considered necessary that further tracking surveys are required.
7.7.11	By using terms such as ‘minimise’ and ‘a lower impact’ the EIA recognises that piling has the potential for a significant impact on salmon populations. Soft start is likely to be an effective mitigation for adult fish, which are relatively mobile should be able to avoid the area. Piling should not however be carried out during the smolt migration period (mid-March to the end-June) as they passively migrate and less likely to react to the ‘soft start’. If juvenile salmon or trout (fry or parr) are found to be present in the area, then further mitigation may be required as they are less mobile and unlikely to be able to avoid the effects of piling. Given these points, juvenile salmonid surveys should be completed in the marginal areas of Loch Ness to determine the degree of utilisation. Only then can the potential impacts of the scheme on salmon/sea trout spawning and juvenile populations be adequately assessed.	The purpose of an EIA is to identify potentially significant impacts and this has been done for the Development, which recognises piling as a potential impact pathway. Mitigation measures have therefore been recommended to minimise the risk of such impacts occurring or of becoming significant. This includes the restriction of piling to periods outside of the salmon migration season and the use of soft-start techniques to allow fish to move away from affected areas. These have been committed to again adopting a precautionary approach which assumes that fish will be present in the margins of the loch. There is therefore no benefit to conducting further survey in this area as robust mitigation measures are already in place.

Paragraph Reference	Ness District Salmon Fishery Board Representation Comment	Applicants Response
	Finally, our concerns regarding the potential reduction of water levels in Loch Ness resulting from the intake of water for the proposed development (particularly during low flow conditions) have not been addressed in the Aquatic Ecology Chapter. Any reduction in loch level has the potential to effect water levels in the River Ness and the ability of fish to negotiate the fish pass at Ness Weir. This was a 'live' issue during the 2018 season during exceptionally low flows. Rod catch data suggests that the ability (or willingness) of adult salmon to negotiate the weir is affected by river level. As such we would require an assessment of the likely impact of the intake on the efficiency of the existing fish pass (or 'spout') located in Ness Weir. Furthermore, we would require an assessment of the likelihood of an increase in the losses of smolts to the Caledonian Canal as a result of the intake.	Please refer to Chapter 09 of the EIA Report for a detailed assessment of the potential effects to water levels in Loch Ness and other surface water systems as a result of the Development. Water will be abstracted from Loch Ness to recharge the Headpond. A maximum operating volume of 4,900,000 m^3 of water will be pumped from Loch Ness over a 7.9 hour period. This equates to approximately 87 mm depth over the surface area of Loch Ness. Currently, during drought conditions, SSE is required to release water from upstream catchments and reservoirs to provide minimum 'compensation' flows and maintain minimum navigational depths. A minimum pass forward flow must be maintained to the River Ness over the Ness Weir and a minimum water level must be maintained at the Ness Weir. As such, abstraction for the Development may result in an increase in the frequency of requirement for others to provide compensatory flows. It is therefore proposed that abstraction is limited based on a minimum water level in Loch Ness at the commencement of the abstraction cycle, further based on the proposed volume of abstraction. A monitoring arrangement and control procedures will be installed at the Inlet / Outlet structure on Loch Ness to measure water level at Loch Ness and to limit or stop the abstraction of water if water levels in Loch Ness falls below the levels set out in the proposed operational rules (which are set out in Chapter 9 of the EIA Report). Any operational discharges or abstractions required by the Development will be controlled by the CAR licence, as regulated by SEPA. Therefore the appropriate operational levels for either activity will be agreed and secured via this regulatory regime. The implementation of the above operation rules will ensure that the abstraction of water from Loch Ness will have negligible impact on available water resources.

Red John Pumped Storage Hydro

Response to Ness District Salmon Fisheries Board

Additional Mitigation in Relation to Salmon Smolts, Lamprey and Elvers

This additional information supplements our initial response to Ness District Salmon Fisheries Board to their Section 36 consultation dated 21 December 2018.

In addition to the design measures outlined in the EIA Report Chapter 2 and the ecological assessment outlined in Chapter 7, this further information outlines the additional mitigation measures which the Applicant can implement to reduce the potential for fish injury and mortality resulting from entrainment and impingement on the 2 mm physical screen across the Inlet / Outlet structure of the Development. Additional effective behavioural mitigation measures are proposed in relation to Atlantic salmon *Salmo salar* smolts, juvenile lamprey (ammocoetes) and juvenile eels *Anguilla anguilla* (also known as elvers). The most suitable behavioural measures for salmon smolts, lamprey ammocoetes and elvers will be determined by the seasonal timings of their downstream migration which will dictate the critical times of the year and the most feasible behavioural mitigation measures.

Our previous response has outlined the approach to seasonal timing of construction phase activities and so these are not repeated here.

As outlined in our previous response (to point 7.5.43), a bubble curtain is a behavioural mitigation measure that generates a wall of sound via a submerged perforated tube through which compressed air is released. It is proposed that a bubble curtain is a suitable behavioural deterrent to guide downward migrating fish away from the water Inlet / Outlet structure. Turnpenny and O'Keeffe (2005) have reported that bubble screens work well for migratory species such as salmon smolts and, if used seasonally during their migration, fish will not habituate to the barrier. There have been mixed reports from past studies on the efficiency of bubble screens as a single behavioural method. This ranges from not deterring fish, to a deflection rate of 98% (Brett and MacKinnon 1953, Patrick *et al*, 1985). Given that smolts are known to shoal at Dores Beach, a behavioural deterrent system will serve to guide fish around the Inlet / Outlet structure. Furthermore, it will also deter and guide elvers and lamprey that actively swim in a downstream direction during their migration to sea. Nonetheless, it should be reiterated that all life stages of the species aforementioned are sufficiently strong swimmers, and given the operational velocities of the Development, the risk of impingement is still considered to be very low.

With this in mind, the bubble screen would be operational from December to June, inclusive, to deter downstream migrating smolts in spring (March to May), juvenile lamprey in winter / spring (December to February) and elvers in spring / summer (April to June) (Lucas *et al*, 1998).

When installing a bubble screen at the Development, important factors that will need to be considered are size and spacing of bubbles, volumes of air discharged, air pressure, water velocity, screen layout and maintenance (Solomon, 1992), in addition to site specific characteristics such as water depth and velocity. It is proposed the deterrent system would need to be located a reasonable distance from the intake at the Development to be effective. The detailed design of the system will be agreed with The Highland Council, in consultation with Scottish Natural Heritage and the Ness District Salmon Fisheries Board, prior to installation.

In summary, a bubble screen used as a behavioural deterrent will not only reduce the likelihood of migratory fish being impinged or entrained at Red John, but will also serve to guide fish around the Inlet / Outlet, reducing possible delays in their migration and subsequently removing any indirect impacts to fish health such as predation or disease.

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Brett, J.R. and MacKinnon, D. (1953). Preliminary experiments using lights and bubbles to deflect migrating young spring salmon. J. Fish. Res. Bd Canada, 10: 548-559.

Lucas, M.C., Thom, T.J, Duncan, A. and Slavik, O. (1998). Coarse fish migration: occurrence, causes and implications. Environment Agency R & D Technical Report W152, 161pp.

Patrick, P.H., Christie, A.E., Sager, D.R., Hocutt, C.H. and Stauser, J.R., Jr. (1985). Responses of fish to strobe light/ air-bubble barrier. Fisheries Research 3, 157-172.

Turnpenny, A. W. H. and O'Keeffe, N. (2005). Screening for intake and outfalls: A best practise guide. Environment Agency Science Report SC030231. Bristol: Environment Agency.

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Environment Agency. Screening at intakes and outfalls: measures to protect eel.

Turnpenny, A.W.H. and Horsfield, R.A. (2011). International Fish Screening Techniques. WIT Transactions on State- of -the-at in Science and Engineering. Vol 71.

Welton, J.S., Beaumont, W. R. C., and Clarke, R.T. (2002). The efficiency of air, sound and acoustic bubble screens in deflecting Atlantic salmon. *Salmo salar* L., smolts in the River Frome, UK. *Fisheries Management and Ecology* **9**, 11-18.

Brett, J.R. and MacKinnon, D. (1953). Preliminary experiments using lights and bubbles to deflect migrating young spring salmon. J. Fish. Res. Bd Canada, 10: 548-559.

Lucas, M.C., Thom, T.J, Duncan, A. and Slavik, O. (1998). Coarse fish migration: occurrence, causes and implications. Environment Agency R & D Technical Report W152, 161pp.

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Solomon, D.J. (1992). Diversion and entrapment of fish at water intakes and outfalls. R & D Report No. 1, National Rivers Authority, Bristol, 51 pp.

Turnpenny, A. W. H. and O'Keeffe, N. (2005). Screening for intake and outfalls: A best practise guide. Environment Agency Science Report SC030231. Bristol: Environment Agency.

From: Chris Conroy [redacted]
Sent: 05 March 2019 14:36
To: McFadden S (Stephen) [redacted]
Subject: RE: Red John Pumped Storage Scheme - Acquisition of Water Rights

Dear Stephen

Thank you for your email.

Our response has taken into consideration AECOM's 'clarification and explanation' note. We have number of outstanding concerns, the most significant of which relates to the potential impact of the scheme on the ability of fish (in particular salmon) to negotiate Ness Weir.

In their response, the applicant acknowledges that abstraction for the proposed development may result in an increase in the frequency of compensation flows. As we have highlighted in previous responses, it is generally excepted that a proportion of the salmon smolt run is already drawn into the Caledonian Canal at Ness Weir under the existing situation. There are also indications that the upstream migration of adult salmon may be impaired under low flow conditions.

As such, an assessment of the likely effect of an increased frequency of compensation flows on the upstream and downstream passage of fish is required – i.e. what is the current situation, is the proposal likely to make the situation any worse and, if so, is there any mitigation that could be put in place to prevent it from doing so (e.g. alterations to the existing fish pass or provision of a bubble curtain to direct smolts away from the canal). This is a particularly important issue in terms of potential impacts on the status of salmon populations in both the River Moriston SAC and wider Ness system.

We acknowledge that the applicant is proposing additional mitigation measures in terms of the provision of a bubble curtain around the intake screen. However, we would appreciate further detail relating to the assessment of the likely effect of the intake on the downstream migration of smolts, e.g. the output of the models used to calculate escape velocities across the surface of the screen, etc.

I would be happy to meet with the applicant or AECOM to discuss this points in further detail.

Best Regards

Chris

Chris Conroy BSc (Hons) MSc MIFM
River Director & Clerk
Ness District Salmon Fishery Board
[redacted]

Board Webpage: www.ness.dsfb.org.uk
Trust Webpage: www.nessandbeauly.org.uk

[redacted]
Sent: 04 March 2019 12:54
[redacted]
Subject: RE: Red John Pumped Storage Scheme - Acquisition of Water Rights

Good afternoon Chris

Re your response below, was AECOM's 'clarification and explanation' which was emailed to you on 25 February 2019 taken into consideration before the decision to object the application for Acquisition of Water Rights was made? If not, why not? If it was considered, in what way/s is its contents not sufficient to overcome an objection?

Many thanks for your continuing cooperation.

Regards

Stephen

Stephen McFadden
Consents Manager | Energy Consents Unit
[redacted]
To view our current casework please visit www.energyconsents.scot
To read the Energy Consents Unit's privacy notice on how personal information is used, please visit http://www.energyconsents.scot/Documentation.aspx

From: Chris Conroy [redacted]
Sent: 01 March 2019 20:26
To: McFadden S (Stephen [redacted]>
Subject: RE: Red John Pumped Storage Scheme - Acquisition of Water Rights

Dear Stephen

Thank you for consulting the Ness District Salmon Fishery Board on the Red John Pumped Storage Scheme application for acquisition of water rights.

We do not believe that the EIA for the scheme gives an accurate assessment of its potential impact on salmon and sea trout population in the Ness system (see our response to the application for Section 36 consent attached). More specifically, any reduction of water levels in Loch Ness resulting from the intake of water for the proposed development (particularly during low flow conditions) has the potential

to effect water levels in the River Ness and the ability of salmon and sea trout (both adults and smolts) to negotiate Ness Weir (at the downstream end of Loch Ness).

Further detailed information regarding the migratory routes and behaviour of both adult and juvenile salmon (and sea trout) is required to before a robust assessment of the potential effects can be made.

As such we must formally object to this application in its current form.

Best Regards

Chris

Chris Conroy BSc (Hons) MSc MIFM
River Director & Clerk
Ness District Salmon Fishery Board
[redacted]

Board Webpage: www.ness.dsfb.org.uk
Trust Webpage: www.nessandbeauly.org.uk
<image001.jpg><image002.png><image003.jpg>

From: [redacted]
Sent: 01 March 2019 14:52
Subject: Red John Pumped Storage Scheme - Acquisition of Water Rights

Dear Consultee

APPLICATION FOR AUTHORISATION UNDER SECTION 10 (5) AND SCHEDULE 5, ELECTRICITY ACT 1989 FOR THE RED JOHN PUMPED STORAGE SCHEME ACQUISITION OF WATER RIGHTS

On 25 February 2019 AECOM Infrastructure & Environment UK Limited on behalf of Intelligent Land Investments (ILI)(Highlands PSH) Ltd submitted an application for authorisation under section 10(5) and Schedule 5 of the Electricity Act 1989 for the right to abstract water from within the catchment area of Loch Ness for the purposes of construction and operation of the proposed Red John Pumped Storage Scheme.

Details of the application will be published in the local and national press. An advert will appear in the Inverness Courier on 01 March 2019 and 08 March 2019 and in the Edinburgh Gazette on 01 March 2019.

A copy of the Application and Draft Order are attached this email. They can also be viewed if you:

- go to www.energyconsents.scot; then
- click on the **Search** tab;
- click on **Advanced Search** tab;
- type ECU00000728 into **ECU Reference** box and then click on **Go**;
- click on **ECU00000728** and then click on **Documents** tab then click on **Other** tab.

Section 8 of Schedule 5 to the Electricity Act 1989 requires consultation with the relevant planning authority, Scottish Water, the District Salmon Fishery Board and any other relevant parties hence this email. I would be grateful for any comments you wish to make on the application. In this instance, the deadline for submitting a response is **29 March 2019**.

Please note reminder letters are no longer issued by the Energy Consents Unit for any project. If we have not received your comments, nor have we received any extension request by 29 March 2019 we will assume you have no comments to make.

If you have any queries regarding this email or you have any problems accessing the documentation or you require a hard copy of the documentation please contact me as soon as possible.

Yours faithfully

Stephen McFadden
Consents Manager | Energy Consents Unit
The Scottish Government [redacted]
To view our current casework please visit www.energyconsents.scot
To read the Energy Consents Unit's privacy notice on how personal information is used, please visit http://www.energyconsents.scot/Documentation.aspx

foillseachadh neo sgaoileadh, gun chead. Ma ’s e is gun d’fhuair sibh seo gun fhiosd’, bu choir cur às dhan phost-d agus lethbhreac sam bith air an t-siostam agaibh agus fios a leigeil chun neach a sgaoil am post-d gun dàil.
Dh’fhaodadh gum bi teachdaireachd sam bith bho Riaghaltas na h-Alba air a chlàradh neo air a sgrùdadh airson dearbhadh gu bheil an siostam ag obair gu h-èifeachdach neo airson adhbhar laghail eile. Dh’fhaodadh nach eil beachdan anns a’ phost-d seo co-ionann ri beachdan Riaghaltas na h-Alba.
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Red John Pumped Storage Scheme

Technical Note for Ness Fisheries

Introduction

The following technical note outlines the operation regime of The Development and a review of how it may affect passage for fish over the Ness Weir.

Operational Regime

AECOM have reviewed the flows in the channel and under the lift gate. The table below summarises the proposed operational regime based on limiting draw down during periods of drought.

Flows have been calculated using a broad crested weir equation. Levels of the weir have been based on historic drawings of the Ness Weir, as-built drawings of the intake structure and a level survey undertaken by Scottish Canals.

Lower limit water level at Loch Ness at the start of the abstraction cycle (mAOD)	Maximum Abstraction Volume per cycle (Mm^3)	Level at the end of the cycle (mAOD)	Flow over the Fish Pass m/s	Flow through radial gates m/s
15.43	5	15.34	5.63	22.87
15.38	2.5	15.33 (15.29)	5.63	22.87
15.36	1.25	15.33 (15.27)	5.63	22.87
15.33	0 (hands-off)	15.33 (15.24)	5.63	22.87

Estimation of Gates and Weir

A review of the flow over the fish pass and under the gate for various loch levels has been undertaken. Annual data was used to calculate the annual percentile of time that the flow over the weir exceeds the respective rate.

When loch levels fall below 15.62mAOD the first gate is partially opened to maintain a pass forward flow of 28.3 m3/s (1000 cubic feet per second) into the River Ness. As levels fall beyond this the gates are opened further and hence a greater percentage of the flow pass through the gate as oppose to over the waste weir and fish pass. Based on available information, it is assumed that fish passage is not available through the existing radial gates.

The waste weir is set at 15.53 mAOD, once loch levels fall below this level flow is limited to the fish pass and the gate. The long term modelled water levels show that water levels exceed this level 52% of the time based on an annual assessment. This level however is only exceeded 20% of the time based on analysis of the July, August, September and October model results.

As water levels fall, in order to maintain the downstream flows the gates are opened further. A greater percentage of the flow therefore goes under the gate rather than over the fish pass.

When water levels reach the **waste weir crest** level 15.53 mAOD, flow is limited to the fish pass with the remainder of the required flow under the gates. 10.83 m3/s goes over the fish pass and 17.67 m3/s goes under the gate. The average depth of flow and velocity over the fish pass is 0.61m and 1.29 m/s respectively. The first gate will need to be raised fully, 10” (approximately 250mm) to allow the flow to pass. This has an average velocity under the gate of 8.81m/s.

At the **minimum level for full abstraction** (15.43 mAOD) 7.89 m3/s goes over the fish pass and 20.61 m3/s goes under the gate. The average depth of flow and velocity over the fish pass is 0.51m and 1.12 m/s respectively. The first gate will need to be raised fully, 30" (760mm) to allow the flow to pass. This has an average velocity under the gate of 3.42m/s.

At the **hands-off level** of (15.33 mAOD) 5.40 m3/s goes over the fish pass and 23.10 m3/s goes under the gate. The average depth of flow and velocity over the fish pass is 0.41m and 0.96 m/s respectively. The first gate will need to be raised fully, 30" (760mm) and the second gate opened 5" (approximately 130mm) to allow the flow to pass. This has an average velocity under the gate of 3.29m/s.

Atlantic Salmon and Fish Passage at Ness Weir

Atlantic salmon return to their river of birth to spawn and may migrate upstream in Scottish rivers at any time of the year, although this migration peaks in two distinct seasons. Those returning upstream between January and June are called Spring salmon. The Autumn salmon run peaks during September and October, with spawning taking place in the late autumn or winter (October to February) in catchment headwaters.

Salmon must navigate the Ness Weir to pass upstream and reach their spawning grounds in the tributaries of Loch Ness. The existing fish pass is assumed to have been in situ since the construction of the weir between 1825 and 1830, and therefore it does not adhere to current best practice guidance. As such, there is the potential for improvements to the weir to improve fish passage for salmon.

In all three scenarios described above, there is the potential for any migrating fish to be distracted by the greater attractant flow of the radial gates rather than the fish pass. This will make fish more susceptible to mortality as they are likely to get fatigued and predated as they shoal at the outfall of the radial gates.

The maximum sustained swimming speed of salmon has been shown to be 0.91m/s (0.45m body length) and 0.54m/s (0.15m body length) (Tang and Wardle, 1992), although burst swimming speeds reach 4.13 m/s for the largest fish (8.35 body lengths per second). This maximum speed is unsustainable, and a maximum of 1.92 m/s is realistic in allowing fish to navigate a flume or fish pass (Colavecchia et al, 1998). Therefore, as flow velocity is between 0.9 and 1.44 m/s over the fish pass, there is currently a high probability that somem fish, especially the smaller specimens, are unable to navigate the fish pass, with the added disadvantage of becoming distracted by high flows from the gate.

As the water level in Loch Dochfour drops and flow is channelled through the gates, flow velocity over the fish pass decreases and the potential passability of the weir to salmon increases. At the hands-off level the flow velocity beneath the gates exceeds that over the fish pass by a reduced ratio of 3:1, meaning that fish are less distracted by the attractant flow from the gates, but may still fail to find the fish pass.

At the hands-off level of 15.33 m AOD the modelled figures in Table 1 (Appendix A) indicate that the fish pass will remain passable to fish, with a low ratio between flow velocity over the pass and through the gates.

It is clear that under the current configuration the weir and existing fish pass are not conducive to successful migration of Atlantic salmon upstream, which is exacerbating this existing problem. In order to negate the potential increased risk of reduced loch levels due to abstraction of the Development, the applicant wishes to meet to discuss possible options which are within the consentable remit of the Section 36 application.

Downstream Migration of Salmon Smolts

Salmon smolt migrate to the sea in late spring or June having spent two to three years in rivers. The downstream migration is largely passive, with smolts drifting downstream with the current. However, smolts gather in shoals and stage while awaiting suitable conditions to migrate downstream.

While it is considered that the intake of the Development will not pose a significant impact to the downstream migration of smolts, it has been proposed that a bubble screen is used to deter them from the intake location during their migration.

It is not clear how the smolt migration is affected by low water levels in the loch, however it is understood that a proportion of smolts are carried into the canal and fail to successfully complete their migration to the sea. It is likely that as a significant flow remains over the fish pass, and the adjacent smolt pass on the weir, a proportion of smolts will be passively carried over the weir even when loch levels are at their lowest.

References

Colavecchia, M. *et al.* (1998) *Measurement of burst swimming performance in wild Atlantic salmon (*Salmo salar *L.) using digital telemetry*. River Research and Applications: Volume14, Issue1: Special Issue: Ecohydraulics, Pages 41-51.

Remen, M. *et al.* (2016) *Critical swimming speed in groups of Atlantic salmon* Salmo salar. Aquaculture Environment Interactions: Vol. 8: 659–664.

Tang, J. and Wardle, C.S. (1992) *Power output of two sizes of atlantic salmon (salmo salar) at their maximum sustained Swimming speeds*. J. exp. Biol. 166, 33-46.

Appendix

Table 1. A review of the flow over the fish pass and under the gate for various loch levels

Level in Loch Dochfour (mAOD)	Flow over the Waste Weir (m^3/s)	Flow over the Fish Pass (m^3/s)	Depth of flow over Fish Pass crest (m)	Velocity over Fish Pass crest (m/sec)	Flow under the gates (m^3/s)	Depth of opening under the gates (feet)	Depth of opening under the gates (m)	Area (m^2)	Velocity under the gates (m/sec)	Annual Percentile flow over the weir (%)	Seasonal (July- Oct) Percentile flow over the weir (%)
15.62	14.1	13.9	0.70	1.44	0.5						
15.61	11.8	13.5	0.69	1.42	3.2						
15.6	9.7	13.2	0.68	1.40	5.7						
15.59	7.7	12.8	0.67	1.39	8.0						
15.58	5.8	12.5	0.66	1.37	10.2					43%	26%
15.57	4.2	12.1	0.65	1.35	12.2					45%	27%
15.56	2.7	11.8	0.64	1.34	14.0					46%	29%
15.55	1.5	11.5	0.63	1.32	15.6					48%	30%
15.54	0.5	11.2	0.62	1.30	16.8					50%	32%
15.53		10.8	0.61	1.29	17.7	1st open 10 inches	0.25	2.01	8.8	52%	33%
15.52		10.5	0.60	1.27	18.0					54%	35%
15.51		10.2	0.59	1.25	18.3					56%	37%
15.50		9.9	0.58	1.24	18.6	1st open 15 inches	0.38	3.01	6.2	59%	40%
15.49		9.6	0.57	1.22	18.9					61%	42%
15.48		9.3	0.56	1.20	19.2					63%	44%
15.47		9.0	0.55	1.19	19.5					66%	47%
15.46		8.7	0.54	1.17	19.8					68%	49%
15.45		8.4	0.53	1.15	20.1	1st open 20 inches	0.51	4.01	5.0	70%	52%

Level in Loch Dochfour (mAOD)	Flow over the Waste Weir (m^3/s)	Flow over the Fish Pass (m^3/s)	Depth of flow over Fish Pass crest (m)	Velocity over Fish Pass crest (m/sec)	Flow under the gates (m^3/s)	Depth of opening under the gates (feet)	Depth of opening under the gates (m)	Area (m^2)	Velocity under the gates (m/sec)	Annual Percentile flow over the weir (%)	Seasonal (July- Oct) Percentile flow over the weir (%)
15.44		8.2	0.52	1.1	20.3					73%	55%
15.43		7.9	0.51	1.1	20.6	One full open	0.76	6.02	3.4	75%	59%
15.42		7.6	0.50	1.1	20.9					78%	63%
15.41		7.4	0.49	1.1	21.2					80%	67%
15.40		7.1	0.48	1.1	21.4					83%	71%
15.39		6.8	0.47	1.1	21.7					85%	75%
15.38		6.6	0.46	1.0	21.9	One full open	0.76	6.02	3.6	88%	80%
15.37		6.3	0.45	1.0	22.2					90%	84%
15.36		6.1	0.44	1.0	22.4	One full open	0.76	6.02	3.7	93%	88%
15.35		5.9	0.43	1.0	22.6					95%	92%
15.34		5.6	0.42	1.0	22.9					97%	96%
15.33 (Hands off)		5.4	0.41	1.0	23.1	One full open and second 5 inches	0.89	7.02	3.3	99%	99%
15.32		5.2	0.40	0.9	23.3					100%	100%
15.31		5.0	0.39	0.9	23.5					100%	100%
15.30		4.8	0.38	0.9	23.8					100%	100%