

Introduction

The Allt a' Chaorainn is a renowned and popular whitewater kayaking destination for both Scottish kayakers and those from further afield. Its gradient coupled with its smooth rock and crystal-clear water make it unique in providing spectacular cascades for relative novices and experts alike depending on the flow. Due to the moderate flows required to navigate it safely it is suitable for kayaking for approximately half of the days of the year. The range of flows suitable for kayaking range between 0.5m³/s and 4.0m³/s.

A review of the "Hydrometry Report" and the "Allt Chaorainn Eia Report Volume 1" submitted to the planning portal on the 4th of July 2018 has been carried out and an analysis of the impact the scheme would have on the number of days a year the river would be navigable. In addition, the increase in risk to paddlers as a result of the steepening of the hydrograph rising limb at low flows is discussed.

The report also discusses the option of a push button on the turbine house as discussed in the report "*Proposal to The Scottish Canoeing Association concerning river flows on the Allt na Chaorainn and Allt Mheuran and other tributaries of the River Etive, Glen Etive: For the purpose of canoeing during hydro electricity generation*" issued to the SCA.

Assumptions

Based on the EIA Report statement of:

"The main embedded design measures for operation are in accordance with SEPA guidance, which includes:

- *Protection of low flows via a Hands off Flow (HoF) of Q90;*
- *Protection of flow variability in that the flow downstream increases in proportion to flow upstream rising to Q80 when flows upstream are Q30; and*
- *Protection of high flows. The maximum abstraction will not exceed 1.5 mean daily flow"*

It is understood that no flow will be abstracted when the watercourse is flowing below Q90 = 0.194m³/s.

It is understood that the compensation flow from the intake will increase proportionally to the flow in the watercourse such that when the flow in the watercourse is Q30 = 2.142m³/s the compensation flow will be Q80 = 0.311m³/s. In the absence of precisely what proportion will be released as compensation it has therefore been assumed that for the purpose of this analysis the flow increases linearly between the "Hands off flow" and the Q80 compensation flow.

It is understood that the maximum abstraction rate at the intake will be no greater than 1.5 mean daily flow. In the absence of data on mean daily flow in the available literature it is max abstraction rate issued to the SCA is 2.644m³/s and all flows above the compensation flows will be abstracted until the abstraction capacity is exceeded.

Analysis

Table 1 and Figure 1 below show how the exceedance flows in the watercourse will be affected by the abstraction based on the above assumptions.

Table 1: Analysis of change in exceedance flows.

Exceedance (% of time)	Days a year exceeded	Allt Coire a Chaolain Flow (m ³ /s)	Allt a Chaorainn Flow (m ³ /s)	Allt a Ghiubhasan Flow (m ³ /s)	Total Existing Flow (m ³ /s)	Total Proposed Flow (m ³ /s)
5	18	3.846	3.737	2.695	10.278	7.634
10	37	2.476	2.242	1.758	6.476	3.832
20	73	1.377	1.135	0.995	3.507	0.863
24	88	n/a	n/a	n/a	2.955	0.311
30	110	0.858	0.655	0.629	2.142	0.311
40	146	0.572	0.409	0.424	1.405	0.292
50	183	0.392	0.264	0.294	0.950	0.272
60	219	0.275	0.175	0.209	0.659	0.253
70	256	0.193	0.116	0.148	0.457	0.233
80	292	0.133	0.075	0.103	0.311	0.214
90	329	0.084	0.044	0.066	0.194	0.194
95	347	0.060	0.030	0.048	0.138	0.138
99	361	0.033	0.015	0.026	0.074	0.074

*Grey shaded row has been interpolated between the two adjacent rows to give the point at which the abstraction capacity is exceeded.

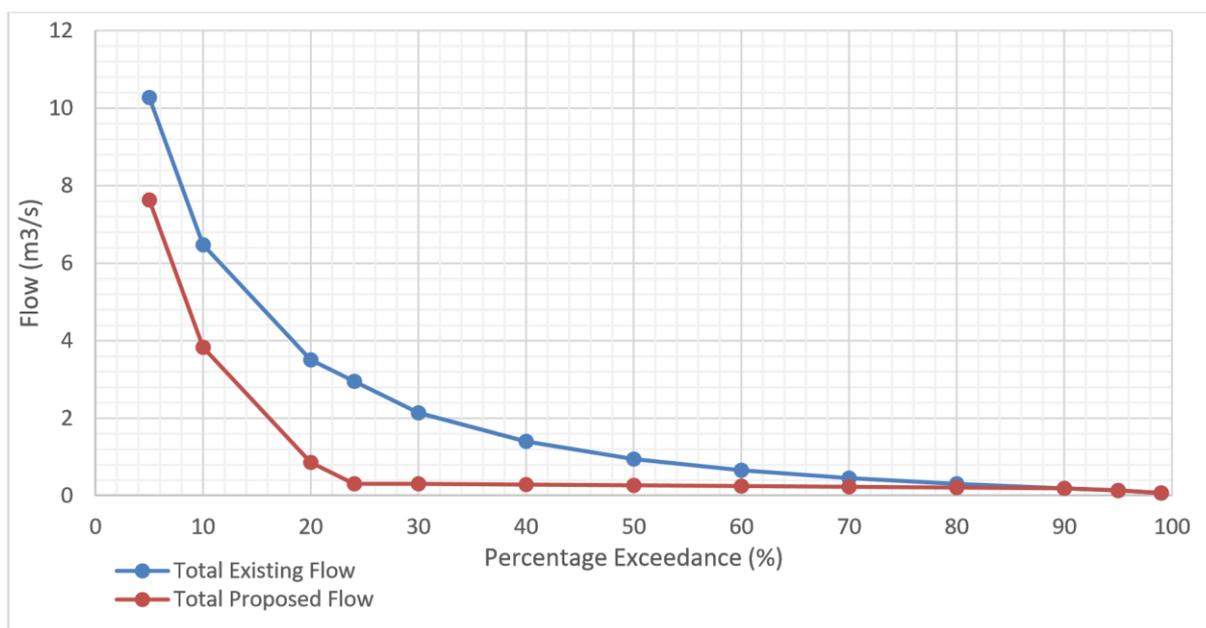


Figure 1: Analysis of change in exceedance flows.

These flows and the number of days where the flow exceeds each given flow have been used to derive the number of days where the river is navigable. Linear interpolation between the data points has been used to bridge the variation between each data point.

In the existing case the number of days a year where the flow is between $0.5\text{m}^3/\text{s}$ and $4.0\text{m}^3/\text{s}$ is 180.8 days.

In the proposed case the number of days a year where the flow is between $0.5\text{m}^3/\text{s}$ and $4.0\text{m}^3/\text{s}$ is 61.3 days.

The number of days the river will in theory be navigable in the proposed case is approximately a third of the days it is navigable in the existing case.

Flows greater than $1.5\text{m}^3/\text{s}$ are only suitable for a small number of expert kayakers and most of the paddlers who paddle the river are novice – intermediate. Therefore the number of days novice – intermediate paddlers can enjoy the river has been derived for comparison.

In the existing case the number of days a year where the flow is between $0.5\text{m}^3/\text{s}$ and $1.5\text{m}^3/\text{s}$ is 106.4 days.

In the proposed case the number of days a year where the flow is between $0.5\text{m}^3/\text{s}$ and $1.5\text{m}^3/\text{s}$ is 31.8 days.

This results in novice – intermediate paddlers being impacted to a greater extent by the development with only 30% of the days they could have previously paddled being available.

Increase in risk to kayakers

In all situations it is well understood that rapidly rising rivers are far more dangerous than slowly rising rivers as there is less time for people to react to a changing environment.

Though it is recognised that the hydro scheme will reduce the peak flows through abstraction there is an increase in the risk to kayakers during the rising limb of a hydrograph as the scheme will often push the “navigable region” into more rapidly rising sections of the hydrograph.

The following scenario is hypothetical but is based on the type of situation that commonly occurs on this type of river. The “Hydrometry Report” shows that the Allt a Chaorainn follows a similar pattern of hydrographs as the River Nevis therefore the flow/time data for the Nevis @ Claggan has been obtained from SEPA and a typical hydrograph extracted and flows scaled for the purpose of illustrating this scenario.

Scenario:

- 1. An intermediate group decides to get on the river as it is low and they are confident it is within their ability at this level.*
- 2. 1 hour into running the river one of the more experienced members of the group decides to run one of the harder rapids and in doing so dislocates their shoulder and ends up swimming in a pool in a gorge.*
- 3. Given the experience levels of the rest of the group they do not feel comfortable extracting their injured friend from the gorge and call mountain rescue for help. Given their proximity to Glencoe members of the rescue team are able to reach them and provide assistance within an hour.*

As illustrated in Figure 2 in the existing case the group got on the river when it was low ($0.5\text{m}^3/\text{s}$). As in the proposed condition it is not possible for them to get on the river as the compensation flow is too little for them to paddle they got on when the flow reaches a sufficient flow for them to paddle it.

In the existing case by the time the accident happened the flow had only increased to $0.65\text{m}^3/\text{s}$ (still low) as they are in a slowly rising portion of the hydrograph. In the proposed case the level at the time of the accident is $1.85\text{m}^3/\text{s}$ (medium) as they are in a more rapidly rising portion of the hydrograph.

By the time the mountain rescue arrive and are in a position to rescue the injured paddler, in the existing case the level is still low ($1.0\text{m}^3/\text{s}$) where as in the proposed case the level has risen to $4.8\text{m}^3/\text{s}$ and is now far higher than the most experienced kayakers would consider navigating it and as a result the paddler (unable to exit the gorge in the state they are in) may be swept downstream with potentially fatal consequences.

There is therefore clearly an increase in risk to the kayakers as a result of the proposed scheme and this does not even take into account the potential for emergency shutdowns of the turbine causing a rapid increase of up to $2.644\text{m}^3/\text{s}$ within seconds or minutes which could cause a fun day out to become a serious accident.

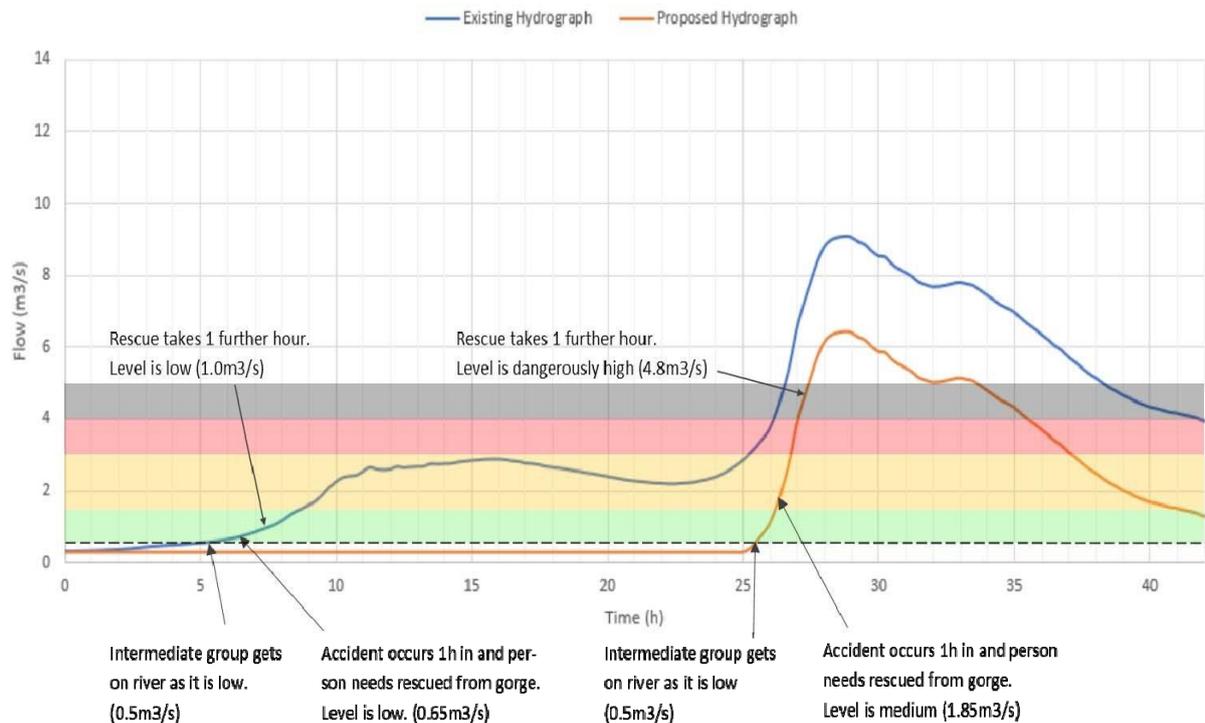


Figure 2: Illustration of scenario in relation to realistic hydrograph

Discussion of “Push Button Mitigation Option”

The developer has proposed mitigation through the installation of a push button at the turbine house that would allow paddlers to effectively turn the river on for 4 hours. While it is appreciated that if implemented correctly this could mitigate the impacts to kayaking the river, the developer has not committed to this in any of the planning documentation submitted to the planning portal.

Additionally, there are numerous issues including liability (if the use of the button were to cause injury or death to kayakers or other parties) the operational technicalities and the CAR licensing process that the developer would need resolve to ensure the button were installed and maintained.

Given the impact turning of the turbine may have on revenue from the scheme it is likely that the developer will look for options to renege on their as yet not forthcoming commitment to install such mitigation justifying it on factors “out of their control”.

There therefore needs to be a far more detailed plan of the mitigation proposed and a water tight commitment to install and maintain the mitigation before the paddling community should be prepared to remove objection to the scheme.

Conclusion

This report has discussed the impact of the proposed scheme on the number of days a year the river is navigable in addition to the increased risk to paddlers as a result of the proposed scheme.

The number of days the river is navigable is cut to approximately 1/3rd the number of days it is currently navigable with this impact being even greater for novice and intermediate kayakers.

Given the shift in the region of the hydrograph that the river will be navigable during there is an increased risk to paddlers with the potential for flows to increase rapidly from a low flow to an un-navigable and dangerous flow within hours, or in the case of an emergency shutdown of the turbines a matter of minutes.

It is therefore considered that the developer has not considered the impacts this scheme will have on white water kayaking on this river.

C.Peden
Civil & Water Engineer

July 2018

