10 Water, Hydrology & Flood Risk

EIA Addendum Update

The proposed reduction of 22 accommodation units at Woodbank and deletion of Area 10 does not change the outcome of the original assessment which raised no significant water, hydrology or flood risk issues. No changes have been made to this chapter.

10.1 Introduction

10.1.1 This chapter of the EIAR provides an assessment of the likely significant effects from the proposed development on water, hydrology and flood risk. The assessment is based on the characteristics of the site and surrounding area and the key parameters of the proposed development detailed in **Chapter 2 – Site and Proposed Development**.

10.1.2 This chapter has been prepared by Stantec. In accordance with Regulation 18(5) of the Town and Country Planning (Environmental Impact Assessment) Regulations 2017, as amended, a statement outlining the relevant expertise and qualifications of competent experts appointed to prepare this EIAR is provided in **Appendix 1.1.**

10.1.3 The aims of this chapter are to:

- Identify the relevant context in which the hydrological and flood risk assessment has been undertaken;
- Describe the methods used to undertake the assessment;
- Outline the relevant baseline conditions currently existing at the site and surroundings;
- Identify the potential direct and indirect effects of the proposed development on the water environment;
- Identify mitigation and enhancement measures where required to address identified effects;
- Assess residual predicted effects; and,
- Assess cumulative effects on the water environment from the proposed development in combination with other relevant cumulative developments.

10.1.4 This chapter is supported by the following figures and technical reports provided in **Appendices 10.1 - 10.3**:

- **Appendix 10.1 – Figures**;
- **Appendix 10.2 – Flood Risk Assessment (FRA); and,**
- **Appendix 10.3 – Drainage Strategy**.

10.2 Policy Context, Legislation, Guidance and Standards

Legislation

10.2.1 The overarching legislative framework applicable to this EIA for the proposed development is outlined in **Chapter 4 – Legislative and Planning Policy Context**. Subject specific legislation of relevance to this assessment is:

- Water Environment and Water Services (Scotland) Act 2003 (WEWS Act);
- Water Environment (Controlled Activities) (Scotland) Regulations 2011 (CAR);

- Water Environment (Controlled Activities) (Scotland) Amendment Regulations 2013;
- Water Environment (Miscellaneous) (Scotland) Regulations 2017;
- Flood Risk Management (Scotland) Act 2009;
- Water Environment (Oil Storage) (Scotland) Regulations 2006;
- Water Environment (Groundwater and Priority Substances) (Scotland) Regulations 2009; and,
- The Private Water Supplies (Scotland) Regulations 2006.

10.2.2 All activities with potential to impact on the water environment require to be authorised under the Water Environment (Controlled Activities) (Scotland) Regulations 2011, as amended (CAR). The level of authorisation required is dependent on the anticipated environmental risk posed by the activity to be carried out. Liaison with SEPA operations team will be undertaken at an early stage to further confirm this. These activities could include construction drainage, dewatering, storage of oil and the three watercourse crossings.

10.2.3 Revised levels of authorisation, including amendments to the General Binding Rules (GBR), came into effect on January 1st 2018. These include the need for CAR authorisation for drainage of construction sites over four hectares in size, as well as a change to the size of development that will require authorisation for the permanent surface water drainage. The below summarises the requirements of these regulations.

10.2.4 For the construction SUDs associated with a site of this size, a complex CAR licence will be required, as detailed in the CAR Practical Guide (SEPA, 2022)

Policy

10.2.5 The planning policy framework applicable to this EIA for the proposed development is outlined in **Chapter 4 – Legislative and Planning Policy Context**. The statutory Development Plan applicable to the site is the L**och Lomond and the Trossachs National Park (LLTNP) Local Development Plan (LDP) (2016**

10.2.6 LDP planning policy considerations of specific relevance to this assessment are:

- Adopted **Loch Lomond and the Trossachs National Park (LLTNP) Local Development Plan (LDP) (2016)** including relevant policies outlined in **Table 4-2**, in particular:
  - Overarching Policy 1 – Strategic Principles;
  - Overarching Policy 2 - Development Requirements;
  - Natural Environment Policy 11 – Protecting the Water Environment;
  - Natural Environment Policy 12 - Surface Water and Waste Water Management;
  - Natural Environment Policy 13 – Flood Risk;
  - **LLTNP Partnership Plan 2018 – 2023**, in particular outcomes 1-3 and 5-9; and,
  - **National Planning Framework 3 (NPF3) (2014)**.
- **Scottish Planning Policy (SPP) (2014)** including relevant provisions outlined in **Table 4-1**, in particular:
  - Principal Policy on Sustainability (paragraphs 24-35);
  - Valuing the Natural Environment Subject Policy (Paragraphs 193 - 233);
  - Managing Flood Risk & Drainage Subject Policy (Paragraphs 254-268);

- SEPA's Development Management Guidance: Flood Risk (2018);
- Scottish Government Online Planning Advice regarding Flood Risk (2015);
- PAN 61 Planning and Sustainable Urban Drainage Systems (July 2001); and,
- PAN 79 Water and Drainage (September 2006).

10.2.7 Other policy considerations of relevance to this assessment are:

- The River Basin Management Plan for Scotland: 2021–2027 (Scottish Government, 2021).

Guidance and Relevant Technical Standards

10.2.8 The following guidance and technical standards have informed this assessment:

- The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended): A Practical Guide (SEPA);
- Masters-Williams, H., Heap, A., Kitts, H., Greenshaw, L., Davis, S., Fisher, P., Owens, D. (2001). Control of water pollution from construction sites. Guidance for consultants and contractors (C532). London: CIRIA;
- SEPA (2006) Guidelines for Water Pollution Prevention from Civil Engineering Contracts;
- SEPA (Various). Guidance for Pollution Prevention including PPG 1, 3, and 6 and GPP2, 5 and 21;
- SEPA (2009). Engineering in the water environment good practice guide; Temporary construction methods;
- SEPA (2014). Land Use Planning System SEPA Guidance Note 31; Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems;
- SEPA (2019). Technical flood risk guidance for stakeholders;
- SEPA (2016). Supporting Guidance; General binding rules for surface water drainage systems (No. WAT-SG-12);
- SEPA (2019). Regulatory method; Sustainable Urban Drainage Systems (SUDs or SUD Systems) (No.WAT-RM-08);
- SEPA (2010). Good Practice Guide – River Crossings (No. WAT-SG-25);
- SEPA (2019). Climate Change Allowances for Flood Risk Assessment in Land Use Planning;
- SNH (2013). Environmental Assessment Handbook; and,
- Woods Ballard, B. (2015). The SUDS Manual: CIRIA.

10.3 Methodology

Overview

Assessment Scope

10.3.1 The principal aspects considered within this assessment are:

- Flood risk;

- Surface water drainage;
- Pollution prevention and environmental management;
- Engineering activities in the water environment;
- Existing groundwater abstractions;
- Water abstractions; and,
- Disruption to wetlands.

10.3.2 The water, hydrology & flood risk chapter presents an assessment of likely significant effects on the water environment from the proposed development. The assessment presented in this chapter has been prepared in accordance with the EIA Regulations.

10.3.3 The assessment of likely effects makes comparison with the baseline year, 2022 during which time the site surveys including a walk over survey in 2017 were carried out.

Assessment Process

10.3.4 In undertaking the assessment presented in this ES chapter, the following activities have been carried out:

- EIA screening and scoping (see below);
- Desk based review of available information, including previous studies, topographic, flood and geological maps, identification of local water receptors, surface water drainage and wetlands;
- A walkover survey of the site;
- Evaluation of baseline water environment conditions (**Section 10.4**);
- Development of a drainage strategy for the proposed development, which is presented as **Appendix 10.3**; and,
- Identification and assessment of likely significant effects, taking into account proposed mitigation and enhancement measures and including consideration of likely cumulative effects (**Sections 10.7 - 10.8**).

Consultation

EIA Screening and Scoping

10.3.5 The assessment has been informed by an EIA Screening and Scoping Report (Stantec, May 2021) and subsequent EIA Screening and Scoping Opinions issued by LLTNPA (27th July 2021) in respect of the EIA for the proposed development. The EIA Scoping Opinion is provided in full in **Appendix 3.1**. Meetings and discussions with SEPA and West Dunbartonshire Council were undertaken as part of the original assessment in 2017 & 2018 to inform the design of the proposed development and the scope of the assessment. **Table 10-1** below provides a summary of relevant consultee responses from the EIA Scoping Opinion and other discussions.

Table 10-1: Summary of Consultation Responses

Consultee	Comment	How and Where Addressed
SEPA	SEPA stated within the formal Scoping Opinion that the assessment should cover the following: ■ Flood risk; ■ Waste water drainage; ■ Surface water drainage; ■ Pollution prevention and environmental management; ■ Engineering activities in the water environment; ■ Existing groundwater abstractions; ■ Water abstractions; and, ■ Disruption to wetlands.	These are addressed within of this chapter. Further detail is provided within **Appendix 10.2: Flood Risk Assessment** and surface and waste water drainage covered under **Appendix 10.3: Drainage Strategy.**
SEPA	SEPA advised that they have no record of CAR authorisation for any abstractions within the site, and no records of private water supplies were held.	Noted under **Section 10.4- Baseline Conditions.**
SEPA	Between July 2017 and January 2018, a number of meetings have been held with SEPA, along with email correspondence, with respect to the potential flood risk on site. SEPA hydrometry experts had flagged concerns with the flow data used within the flood study and Flood Risk Assessment due to poor recording at the gauging station on the River Leven. This raised questions as to the accuracy of the peak flood levels identified in the Flood Risk Assessment.	In order to provide more confidence in the flow data used within the study, and the subsequent design flood levels, additional hydrological analysis was undertaken. This additional work calculated flow rates using a number of methods to verify the existing available data and indicated that the outputs from the Flood Risk Assessments would be representative of the extreme flooding scenarios. This was issued to SEPA for review and initial consultation indicated that this was acceptable to them. The additional hydrological analysis and subsequent correspondence is appended to **Appendix 10.2: Flood Risk Assessment**.
West Dunbartonshire Council	Environmental health department advised that they have no private water supplies within the development site.	Noted under **Section 10.4- Baseline Conditions**.

Study Area

10.3.6 The study area for the assessment of potential effects on the water environment is generally consistent with the site boundary, as shown in **Appendix 2.1 – Site Location Plan**. The wider catchment area has also been considered where appropriate, for example the potential effect of the proposed development on downstream flood risk has been assessed.

10.3.7 The wider hydrological catchments include the upstream catchment of the River Leven, which encompasses Loch Lomond, as well as downstream along the River Leven through Balloch and Alexandria.

Information Sources

Desk Top Study

10.3.8 A review of relevant information, guidance and planning policy relating to the proposed development was undertaken to characterise the landscape and visual baseline of the site and surrounding area including:

- Ordnance Survey (OS) 1:10,000 & 1:25,000 digital mapping;

- Topographical survey of the Proposed Development site;
- British Geological Survey (BGS) 1:50,000 digital map data;
- British Geological Survey (BGS) User Guide: Aquifer Productivity (Scotland) GIS datasets, Version 2;
- Digital soil maps published by the Scottish Government and James Hutton Institute;
- Aerial photography of the site;
- Catchment extents and characteristics from the Flood Estimation Handbook (FEH) website (CEH, 2022);
- The online SEPA River Basin Management Plan Interactive Map and Flood Map;
- River Leven Flood Study undertaken by Jacobs in 2001, along with the updates to the study in 2003 and 2009; and,
- Annual Maximum (AMax) flow data from SEPA for the Linnbrane gauging station on the River Leven, covering the period 1963-2015.

Fieldwork

10.3.9 A site walkover for the flood risk assessment was undertaken on 3rd March 2017. The weather on the day was sunny and fine, and there had been little precipitation in the days prior to the site visit. A photographic record of this site walkover is presented in **Appendix 10.2: Flood Risk Assessment.**

10.3.10 This walkover covered the whole of the development site and included inspection of existing watercourses and water features on site, detailing their condition and any likely flood mechanisms.

Approach to Assessment

Identification of Relevant Receptors

10.3.11 Based on the information sources outlined above, the current baseline characteristics of the water environment at site and the surrounding area was characterised. This led to the identification of relevant sensitive receptors to consider within the assessment. Receptor sensitivity is defined based on the capacity of the receptor to accommodate change without fundamentally altering its character. The definitions provided in take into account the quality of the receptor, its purpose and the potential for substitution or replacement.

Impact Assessment Methodology

10.3.12 sets out the criteria for assessing the likely magnitude of the change due to the proposed development upon identified sensitive receptors.

Table 10-2: Criteria for Assessing Receptor Sensitivity

Receptor Sensitivity	Description
Low	Receptors with a high capacity to accommodate change, low value or poor condition and no significant uses, for example: ▪ Receptor is not an internationally, nationally or locally designated site; ▪ Not classified as a surface water body for the River Basin Management Plan; ▪ No sensitive flood risk receptors downstream; ▪ Surface water body not significant in terms of fish spawning and no other sensitive aquatic ecological receptors e.g. freshwater pearl mussels; ▪ Surface water body not used for abstraction; ▪ Surface water body not used for recreation directly related to water quality e.g. angling, swimming, and watersports; and, ▪ Aquifer with no identified abstractions.
Medium	Receptors with a moderate capacity to accommodate change, medium value or condition and limited use, for example: ▪ Receptor is not an internationally or nationally designated site. May be a locally designated site; ▪ Salmonid species may be present and surface water body may be locally important for spawning. No other sensitive aquatic ecological receptors e.g. freshwater pearl mussels; ▪ Surface water body used for private water supply or medium scale industrial/ agricultural abstractions; ▪ Surface water body used for occasional or local recreation e.g. local angling clubs; ▪ Groundwater body supports identified private water supplies or medium scale industrial/ agricultural abstractions; and, ▪ Carbon-rich soils which have been affected by historic or current land management practices.
High	Receptors with a low capacity to accommodate change, high value or condition and significant use, for example: ▪ Receptor is an internationally or nationally designated site. ▪ Surface water body supports sensitive aquatic ecological receptors e.g. freshwater pearl mussels; ▪ Surface water body used for public water supply or large scale industrial/ agricultural abstractions; ▪ Surface water body important for recreation directly related to water quality e.g. swimming, watersports, angling; ▪ Groundwater body supports public water supply or large scale industrial/ agricultural abstractions; and, ▪ Carbon-rich soils which form part of intact, active blanket bog in good condition.

Table 10-3: Criteria for Assessing Magnitude of Change

Magnitude of Change	Definition
Negligible or no change	Very light changes from baseline (pre-development) conditions. Change barely distinguishable, approximating to the “no change” situation.
Slight	Minor shift away from baseline (pre-development) conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of the baseline condition will be similar to pre-development circumstances/patterns.
Moderate	Loss or alteration to one or more key elements/features of the Baseline (pre-development) conditions such that post-development character/composition/attributes of baseline will be partially changed.

Magnitude of Change	Definition
Substantial	Total loss or major alteration to key elements/features of the baseline (pre-development) conditions such that post-development character/composition/attributes will be fundamentally changed.

Establishment of Effect Level and Significance

10.3.13 The criteria set out in **Table 10-3** and **Table 10-4** have been used to develop a simple table to assess the significance of likely effects of the proposed development on the water environment, as shown in **Table 10-5** below.

10.3.14 This methodology is derived from the NatureScot Environmental Assessment Handbook (NatureScot, 2018). The assessment of likely effects also considers the probability of the effect occurring (certain, likely, possible or unlikely) and the duration of the effect (short (less than 2 years), medium (2 – 5 years) or long term) (more than 5 years). Residual effects (direct and indirect) at levels of Moderate to Major as identified in **Table 10-5** are considered to be significant in terms of the EIA Regulations.

Table 10-4: Criteria for Assessing Significance of Effects

Sensitivity of Receptor	Magnitude of Change			
	Substantial	**Moderate**	**Slight**	**Negligible/None**
High	Major	Major	Moderate	Negligible/None
Medium	Major	Moderate	Minor	Negligible/None
Low	Moderate	Minor	Minor	Negligible/None

Approach to Cumulative Impact Assessment

10.3.15 Cumulative effects on the water environment could occur where more than one development is proposed within a catchment, and **Chapter 2 – The Proposed Development** identified the relevant cumulative developments within the area. This included:

- Replacement building and infrastructure for Sweeney's Cruises;
- Lomond Hotel Alterations and Extension;
- Woodbank Inn Hotel Extension; and,
- Balloch Street Design Project.

10.3.16 A cumulative impact assessment for effects impacting the water environment has been undertaken and is included in **Section 10.11**.

10.3.17 This assesses whether any of the above developments will have an impact upon the proposed development in terms of the water environment, both independently and cumulatively.

10.4 Baseline

The Site

10.4.1 The site comprises two distinct areas known respectively as West Riverside and Woodbank House. Old Luss Road is the interface between the two areas. The project boundary is defined in the Parameters Plan in **Appendix 2.1**. The proposed site comprises a total area of c. 18.9 hectares.

10.4.2 The West Riverside area is bounded generally by the River Leven to the East, Loch Lomond Shores and Loch Lomond to the north, Old Luss Road and Ben Lomond Way to the west and Balloch Road and the Clairinsh residential area to the south.

10.4.3 This area comprises woodland, existing footpaths and recreational parkland alongside the river with the northern river shoreline used for mooring boats with pontoons present in the water for this purpose.

10.4.4 The Woodbank House area comprises the grounds of the former Woodbank Estate and is bounded generally by the A82 to the west, Old Luss Road to the east and the Lower Stoneymollan Road to the South.

10.4.5 The Woodbank House area of the site currently encompasses two relatively flat grassy fields in its eastern area which are bisected by an access track running from east to west. The track leads to an area of mixed woodland in the western area which has a more varied topography with levels generally rising to the west and becoming particularly steep in the north-west. Within the woodland are the remnants of Woodbank House, outbuildings and a walled garden. The buildings are in a state of advanced dilapidation as a result of a fire (at the main hotel building) and subsequent dereliction.

Topography and Land Use

10.4.6 The general topography of the site falls from the west down to the east towards Loch Lomond and the River Leven. In the west of the site surrounding Woodbank House and adjacent to the A82, the ground is at a maximum elevation of approximately 45m AOD. From here the ground slopes down relatively steeply towards Old Luss Road, beyond which the ground levels off and undulates at 15-19m AOD. Adjacent to the shores of the Loch, the ground level is approximately 7.5m AOD.

10.4.7 The topography of the West Riverside area varies along its length. In the north adjacent to the Pierhead and the shores of the loch, the ground levels rise from approximately 8.5m AOD up to a maximum of 15.5m AOD at the top of an embankment which is currently heavily vegetated. Alongside the River Leven the top of bank levels are approximately 8.0m AOD with the ground then raising up to approximately 10.5-11.0m AOD. In the southern area where the existing tourist information centre is located, the ground levels are approximately 11.0-12.0m AOD, with a general fall in ground levels towards the river.

10.4.8 The site currently consists of a range of different uses including leisure and recreation (water sports) along the shores of the loch, several areas of car parking which serve the public slipways as well as the neighbouring Loch Lomond Shores development and areas of woodland and open parkland along the banks of the River Leven.

10.4.9 A tourist information and visitor centre is located at the south eastern point of the site, opposite Balloch train station and Sweeney's Cruises.

Surface Water Hydrology

10.4.10 There are four watercourses which have been identified as flowing through the site. The major watercourse is the River Leven which flows to the east of the site. To the west of the site there are two smaller unnamed watercourses which are described in more detail below. A fourth smaller watercourse is marked upon the Ordnance Survey mapping within the wooded area at Woodbank House. A plan showing the location of these watercourses is presented as **Figure 10-1** in **Appendix 10.1 – Figures**. Additional details including photographs from the site walkover are included in **Appendix 10.2 - Flood Risk Assessment**.

River Leven

10.4.11 The River Leven flows to the east of the site in a southerly direction. It rises at the outflow from Loch Lomond to the north of the development site, and routes south through the towns of Balloch and Alexandria to outfall into the River Clyde at Dumbarton. The river is approximately 11.5km long and has tidal influence for approximately 5km upstream from its confluence with the River Clyde.

10.4.12 Adjacent to the site, the river is approximately 85-90m wide and contains a number of floating pontoons for mooring boats. Approximately 550m downstream of the Balloch Station area of the site, the River Leven Barrage is located. This is operated by Scottish Water and controls the outflow from the loch limiting the discharge and maintains water levels within Loch Lomond between 7 and 7.6m Above Ordnance Datum (AOD). However, it is not formally operated as a flood prevention structure.

10.4.13 Scotland's River Basin Management Plan (RBMP) (SEPA, 2021) classified the River Leven in 2020 as a heavily modified water body on account of physical alterations that cannot be addressed without a significant impact from an increased risk of subsidence or flooding. As such this has been classified as having Moderate ecological potential.

Loch Lomond

10.4.14 Loch Lomond is located to the north of the site and has a surface area of approximately 71 km^2. Areas within and adjacent to the water body are designated Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSI), Special Areas of Conservation (SAC), Ramsar Sites and National Nature Reserves. The loch is located wholly within the Loch Lomond and The Trossachs National Park and is used extensively for recreational use.

10.4.15 The RBMP classified Loch Lomond (south, ID:100257) as a heavily modified water body on account of modifications that cannot be fully addressed without a significant impact on an airport or major transport route. As such this has been classified as having Moderate ecological potential status in 2020.

Unnamed Watercourse 1

10.4.16 The Unnamed Watercourse 1 rises in the hills to the west of the A82. The burn flows in an easterly direction along the north-western boundary of the Woodbank House area and passes beneath Old Luss Road before routing north of the existing car park and Loch Lomond Shores development. It outfalls into Loch Lomond at the end of a small headland in the bay north of the site.

Unnamed Watercourse 2

10.4.17 Unnamed Watercourse 2 also rises in the hills to the west of the site and the A82, and routes in an easterly direction towards Drumkinnon Farm. The burn flows through a small caravan park to the south of the Woodbank House site and below Lower Stoneymollan Road before routing along the eastern boundary of the Woodbank House area of the site. The burn then passes below Old Luss Road and routes north towards the car park of the Loch Lomond Shores complex. The burn routes through a number of culverts as it passes beneath access roads and flows through an open channel through the car park area.

10.4.18 Downstream of the car park the burn routes to the east and flows parallel with unnamed watercourse 1 towards Loch Lomond where it outfalls adjacent to the aerial adventure course.

Unnamed Watercourse 3

10.4.19 Within the Woodbank House area of the site a small watercourse is shown on plan routing in an easterly direction before it sinks, with no downstream route marked on the maps. During the site walkover there was water present within the channel however there was very little flow. The channel appeared to route into a culvert structure, but it is not known where this routes to or if it discharges into the unnamed watercourse 1. There were no visible signs of a culvert downstream across this area of the site.

Geology & Hydrogeology

Bedrock Geology

10.4.20 The British Geological Survey's (BGS) geological data (BGS, n.d.-a) (1:50,000 scale) indicates that the site is underlain by Teith Sandstone Formation. No fault lines are present within the site.

Drift Deposits

10.4.21 The BGS (BGS, n.d.-a) data indicates that the superficial deposits are predominantly formed of Glaciofluvial Deposits - Gravel, Sand and Silt, which cover the southern and western parts of the site. To the north and surrounding the shore of Loch Lomond the superficial deposits consist of Raised Marine Deposits of Holocene Age - Clay, Silt, Sand and Gravel.

Soils

10.4.22 Soil survey of Scotland 1:25,000 scale mapping (Soil Survey of Scotland Staff, n.d.) shows the site to be underlain by brown soils which have been stated to have parent materials of

fluvioglacial sands and gravels derived from acid schists and Lower Old Red Sandstone sediments and lavas.

Hydrogeology

10.4.23 The Hydrogeological Map of Scotland (BGS, n.d.-b) shows that the site is underlain by the Strathmore Group, a moderate to highly productive aquifer with intergranular/fracture flow.

10.4.24 The Hydrogeological Maps highlight that superficial deposits classified as glaciofluvial are associated with high productivity intergranular flow, and raised marine deposits would be classified under low to moderate productivity with intergranular flow in the region of 0.1-10l/s.

10.4.25 The aquifer vulnerability is classed as 4a in the Groundwater Vulnerability dataset (Ó Dochartaigh, Doce, Rutter & MacDonald, 2011). Class 4a is groundwater which is described as being 'vulnerable to those pollutants not readily absorbed or transformed and may have low permeability soil and less likely to have clay present in superficial deposits.'

10.4.26 Under the RBMP the development site is located within the *Loch Lomond and Leven Sand and Gravel (ID:150766)* and *Balloch (ID:150651)* groundwater bodies, both of which have overall classifications of Good.

Flood Risk

10.4.27 In line with the SPP (2014) at paragraphs 254-268 and the recommendations of SEPA and West Dunbartonshire Council in relation to the proposed development, a comprehensive site-specific flood risk assessment (FRA) was undertaken to assess the risks associated with all potential flood sources. The FRA is included as **Appendix 10.2** and the key findings in relation to flood risk under existing site conditions are described here.

10.4.28 A flood study of the River Leven was first undertaken in 2001 and then updated in 2003. This assessed the flood risk along the length of the River Leven, from Loch Lomond through to Dumbarton in the south. In 2009 the hydraulic model was updated to include more recent hydrological analysis as well as calibration of the model using the December 2006 flood event. The FRA undertaken for this proposed development included additional hydrological analyses to verify the flow rates and flood levels output from the original flood study, and to provide a level of confidence in the results. This is presented in **Appendix 10.2 - Flood Risk Assessment**.

10.4.29 The FRA concluded that the areas in the northeast of the site adjacent to the head of the River Leven and Loch Lomond would be at risk of fluvial flooding during the 0.5% Annual Exceedance Probability (AEP) event, and the area surrounding the existing tourist information centre is located immediately adjacent to the 0.5% AEP flood extents. The flood extents plans showing the maximum flood levels for the 0.5% AEP + climate change and the 0.2% AEP events is presented in **Figure 10-2 in Appendix 10.1**.

Water Supplies

10.4.30 Information supplied by SEPA and West Dunbartonshire Council confirmed that there are no private water supplies or CAR licensed abstractions within the site.

10.4.31 SEPA confirmed that there are no abstractions from the River Leven, and no groundwater abstractions within 1km.

Wetlands

10.4.32 During the field survey undertaken to inform the ecological studies, it was noted that no GWDTEs were present on site. This is noted in **Chapter 5 – Ecology.**

Summary of Receptor Sensitivity

10.4.33 The sensitivity of identified water environment receptors to be considered in this assessment is detailed in **Table 10-5** below.

Table 10-5: Receptor Sensitivity

Receptor	Sensitivity	Rationale
Loch Lomond	High	International and national designations within and adjacent to the Loch. Used extensively for recreation.
Watercourses: River Leven and three unnamed watercourses	Medium	River Leven used for boating recreation and classified as Moderate Ecological Potential. Smaller watercourses not identified on RBMP.
Groundwater - Bedrock	Low	Bedrock: Moderate productivity aquifer with no identified abstractions within 1km proximity to site. Drift: Low productivity and very localised nature of present glaciofluvial deposits.

10.5 Baseline Evolution

10.5.1 In the absence of the proposed development, future baseline conditions would likely remain consistent with existing conditions on site.

10.5.2 Increasing climate change may however affect the hydrological cycles within the catchments surrounding the site, resulting in marginally higher flows and more extreme intense rainfall events, which may result in higher water levels with Loch Lomond and the River Leven, as described above. This however is a change which would be relatively consistent across Scotland and would not be limited to this site.

10.6 Embedded Mitigation

10.6.1 As detailed in **Chapter 2 – The Proposed Development**, a number of design features and embedded mitigation measures have been incorporated into the design and construction of the proposed development to avoid, prevent or minimise significant adverse environmental effects and to enhance beneficial effects. Embedded mitigation measures of relevance to this assessment are:

- No buildings within the functional floodplain and finished floor levels of buildings adjacent to the water bodies to be above the 1 in 200yr + climate change peak flood level;
- Avoid crossings of existing watercourse to prevent pollution; and,
- Development within a 5m strip along waterfronts will be subject to specific consideration within a CEMP to be agreed with the NPA prior to commencement.

10.6.2 The surface water drainage scheme for the proposed development will be designed in accordance with Sustainable Drainage Systems (SUDs) principles and such that the maximum discharge rate will be equivalent to the greenfield (i.e. pre-development) runoff rate.

10.6.3 Additional mitigation measures identified through the EIA process are detailed in **Section 10.8** below before likely residual effects from the proposed development are then stated in **Section 10.9**.

10.7 Assessment of Likely Effects

10.7.1 Potential effects on the water environment that could arise during the construction and post-completion phases of the proposed development are summarised in **Table 10-6** and are discussed further in the following sections.

Overview

10.7.2 The construction phase is the most important in terms of potential impacts on the water environment, with key activities including:

- Earthworks, including alteration of site ground levels;
- Excavation for foundations of properties and site infrastructure;
- Stockpiling of excavated materials;
- Creation of impermeable surfaces;
- Construction of new stormwater drainage system; and,
- Use and storage of oils and fuels.

10.7.3 During the operational phase, the most important potential impact is the potential change in surface water quality and volume of runoff, arising from increased impermeable surfaces, and associated downstream flood risk.

10.7.4 Watercourse crossings have the potential to impact upon the water environment in terms of flows within channels and sediment release during construction. There are however no watercourse crossings identified on the proposed masterplan, and so this has not been considered further.

Table 10-6: Summary of Potential Effects

Receptor	Potential Effect
Loch Lomond and Watercourses	Flow alterations (increased runoff/ alteration of flow paths, and associated flood risk).
	Increased pollution from sediments – within watercourses and locally within Loch Lomond.
	Pollution from chemicals.
Groundwater	Flow and level alterations (groundwater drawn down/ alteration of flow paths).
	Pollution from chemicals.

Construction Phase

Surface Water Flow Alterations and Flood Risk

10.7.5 During construction, existing drainage patterns and flow pathways would be altered by the introduction of impermeable surfaces, change in site ground levels and presence of stockpiles or foundation voids. Impermeable surfaces arising from the compaction of soils and construction of infrastructure would reduce infiltration and may lead to an increase in surface water runoff. The potential environmental impacts of this include increase in flow rates within the on-site or adjacent watercourses, potentially leading to increases in channel erosion, sediment transport and both on-site and downstream flood risk.

10.7.6 Potential surface water flow alterations are assessed as having a possible, short-term, moderate magnitude adverse impact on the identified watercourses and Loch Lomond (medium and high sensitivity receptors respectively).

Pollution from Sediments

10.7.7 There is the potential for increased release of fine sediment into watercourses and Loch Lomond arising from sediment-laden runoff from areas of soil stripping, earthworks and stockpiles.

10.7.8 Increased sediment loading to watercourses can degrade water quality and change substrate characteristics, which may affect the quality of the aquatic habitat. Sedimentation of watercourses can also have a detrimental effect on flow conveyance of the channel and downstream culverts, affecting flood risk.

10.7.9 Potential increased pollution from sediments would be short to medium term in duration and are assessed as having a likely, moderate magnitude adverse impact on Loch Lomond and the identified watercourses (high and medium sensitivity receptors respectively).

Pollution from Chemicals

10.7.10 During construction there is a risk of accidental pollution incidences affecting the water environment (watercourses, loch & groundwater) from the following sources:

- Spillage or leakage of oils and fuels;
- Stored on site;
- From construction machinery or site vehicles;
- From refuelling machinery on site;
- Spillage or leakage from on-site toilet facilities;
- Cement, concrete or grout getting polluting surface water or groundwater; and,
- Spillage or leakage from use or storage of other chemicals and hazardous substances.

10.7.11 Oil spillages to the water environment would be detrimental to water quality and could affect fauna and flora. Oils and fuels are hazardous (List 1) substances under the Groundwater and Priority Substances (Scotland) Regulations 2009 and their ingress to groundwater must be prevented. Groundwater vulnerability to pollutants may increase in areas where drift deposits are excavated, for example for foundations or alteration of site ground levels. Potential contaminants could leak through fractures and cavities in the bedrock and affect groundwater quality.

10.7.12 Cement, concrete and grouts used for construction are highly alkaline and corrosive and can cause serious pollution to the ground and water environment. Water wildlife, such as invertebrates and fish, are very sensitive to changes in pH (acid/alkaline) levels.

10.7.13 Other chemicals and hazardous substances used and stored on site (e.g. cleaning products, solvents, and pesticides) could cause pollution if they enter surface waters or groundwater.

10.7.14 The potential impact of contaminant discharges on the identified receptors is likely to be short-term in nature. Potential contaminant discharges are assessed as having a possible, moderate magnitude adverse impact on Loch Lomond and identified watercourses (high and medium sensitivity receptors respectively), and groundwater (low sensitivity receptor).

Groundwater Flow and Level Alterations

10.7.15 Groundwater is expected to be at shallow depth in areas of lower ground. Excavations below groundwater level, for example for foundation construction, could lead to localised groundwater drawdown. Open excavations that cannot be drained by gravity may require dewatering. Groundwater pathways could also be altered by construction of foundations and road infrastructure.

10.7.16 The potential effect would be localised in extent and short-term in nature (duration of open excavation or dewatering). Groundwater flow and level alterations are assessed as having a likely, slight magnitude adverse impact on the underlying moderate productivity aquifers (low sensitivity receptor).

Operational Phase

Surface Water Flow Alterations and Flood Risk

10.7.17 Once the proposed development is completed and operational, in the absence of further mitigation, surface water runoff volumes would be increased due to the increase in impermeable area across the site, and surface water flow pathways would be altered by the drainage scheme. However as identified in **Section 10.6 - Embedded Mitigation**, the drainage scheme for the proposed development has been designed to attenuate runoff from impermeable areas within the development site to Greenfield (i.e. pre-development) rates. The discharge of flows from the site into the River Leven will be restricted so that is no increase in flood risk downstream.

10.7.18 Potential surface water flow alterations post-completion are assessed as having a likely, positive, long-term, negligible magnitude impact on Loch Lomond and the identified

watercourses (high and medium sensitivity receptors respectively) and a negligible impact upon downstream flood risk.

Pollution from Sediment

10.7.19 Pollution from sediment may be reduced compared to baseline conditions due to the site SUDs scheme attenuating the sediment content in runoff from the development. Potential increased pollution from sediments are assessed as having an unlikely, long term, slight magnitude adverse impact on Loch Lomond (high sensitivity receptor) and identified watercourses (medium sensitivity receptor).

Pollution from Chemicals

10.7.20 During the operational phase of the proposed development, oils and fuels within surface runoff from roads will be the main potential source of contaminant discharges. The SUDs scheme for the proposed development will include treatment of runoff in accordance with published standards and guidance. Increased contaminant discharges are therefore assessed as having an unlikely, short-term, slight magnitude impact on Loch Lomond (high sensitivity), watercourses (medium sensitivity receptor) and groundwater (low sensitivity).

Groundwater Flow and Level Alterations

10.7.21 During the operational phase, the on-going impact of the proposed development on groundwater flow and levels would be negligible due to the nature of the development and no anticipated disturbance of the ground.

10.7.22 The proposed development is assessed as having a possible, long term, negligible magnitude impact on groundwater levels (low sensitivity receptor).

10.8 Further Mitigation and Enhancement

10.8.1 The assessment of potential effects from the proposed development in **Section 10.7** indicates that in the absence of further mitigation, a number of significant adverse effects on the water environment would be likely. To address this and minimise the likelihood of significant adverse effects arising, as well as to maximise environmental opportunities from the proposed development, further mitigation and enhancement measures are proposed below. These are then taken into account in the assessment of residual effects provided in **Section10.9**.

10.8.2 The proposed further mitigation and enhancement is grouped into the following areas:

Construction Phase

Further Mitigation to be Included Within CEMP

10.8.3 As noted in **Section 10.6**, the commitment to develop and implement a CEMP for the construction phase of the proposed development is treated an embedded mitigation measure, as are the provision of certain standard information and environmental management measures within the CEMP (refer to **Section 10.6**). Over and above this, the assessment in this ES chapter has identified the need for the following further mitigation measures to also be detailed within and implemented through the CEMP:

- Any construction activities within a 5m strip along waterfronts will be subject to specific consideration within the CEMP to be agreed with the National Park Authority (NPA) prior to commencement;
- An Environmental Clerk of Works (ECoW) will ensure that the CEMP and associated mitigation measures are implemented effectively; and,
- A pollution prevention and response plan will be set out in the CEMP. This will provide site spill response procedures, emergency contact details and equipment inventories and their location. All staff will be made aware of this document and its content during site induction. A copy will be available in the site office at all times.

Surface Water Management

10.8.4 Surface water drainage arrangements for the construction phase will be in line with SUDs principles, incorporating appropriate treatment and attenuation prior to discharge to the water environment in accordance with the required CAR authorisation and relevant GBR. It is proposed to replicate natural drainage around construction areas and to use source control to manage rainfall where, or adjacent to where, it lands.

10.8.5 The implementation of a given SUDs measure will be dependent upon detailed site and hydrological investigations. Detailed surface water drainage proposals and methodology for the construction phase will be detailed within a Pollution Prevention Plan (PPP) which will be included within the CEMP as noted above. The SUDs features will be installed prior to the main construction activities (including removal of vegetation and any earthworks). Suitable measures will be in place at all times for treatment of runoff from construction areas, to prevent the release of pollutants including sediment to adjacent surface water features.

10.8.6 Clean runoff from vegetated areas or offsite will be kept clean and diverted around works to prevent mixing with silt-laden water.

10.8.7 Surface water management measures employed during the construction phase should be regularly inspected and maintained to check that they are working effectively and that there are no blockages or unexpected discharges.

10.8.8 The risk of oil contamination will be minimised by good site working practice (further described below) but should a higher risk of oil contamination be identified then an oil separator will be considered.

10.8.9 A minimum buffer zone of 5m will be maintained along the waterfronts. No construction activities will take place within this buffer zone, including movement of construction machinery, stockpiling and construction of SUDs features unless they have been specifically considered and allowed within the CEMP.

10.8.10 Routing of construction discharges should ideally be through at least three levels of SUDs to ensure that water quality of high sensitivity receptors is not adversely affected.

Earthworks

10.8.11 Areas stripped of earth and vegetation will be kept to a minimum at any one time – this is in accordance with the GBR11 of CAR. Soil loss and erosion will be minimised through careful storage, reinstatement and re-vegetation. Stockpiles will be placed in areas of minimal risk of slippage or erosion from drainage and will not be located within 20m of any watercourses or ditches.

10.8.12 Any runoff from earthworks and stockpiles will be passed through appropriate construction SUDs measures prior to discharge to the water environment.

10.8.13 The time excavations are kept open for will be kept to a minimum to avoid ingress of water, minimise erosion and the need for dewatering. Drainage or pumping from excavations will be minimised through appropriate design. Temporary cut-off drains will be installed if required to prevent surface water runoff entering excavations.

10.8.14 Any dewatering will comply with GBR2 and GBR5. If abstraction exceeds 10m^3 per day a CAR registration or licence will be required, which will be obtained prior to the commencement of the abstraction. Any water pumped out of excavations will be treated by passing through a SUDs feature prior to discharge to the water environment.

Construction Tracks

10.8.15 Access tracks used during construction (i.e. not the final road layout) will incorporate appropriate drainage measures including ditches, camber to shed water to the edges, frequent cross drains and trackside grips/offlets to prevent the tracks acting as a preferential drainage route and to protect the water environment. Any trackside discharge will be passed through appropriate construction SUDs measures prior to discharge to the water environment. Water will not be allowed or encouraged to pond in the track where possible.

Oils, Fuels, Site Vehicles and Welfare Facilities

10.8.16 The mitigation measures to minimise risk of contaminant release will be in line with the Controlled Activities (Scotland) Regulations which came into force on 1st January 2018. These General Binding Rules (GBRs) consolidate the provisions of the Water Environment (Oil Storage) (Scotland) Regulations 2006 into CAR and extend the application of those provisions. Mitigation measures will follow these GBRs. The relevant PPGs will also be used to guide the embedded mitigation. This includes the following:

- Storage of oil and fuels on site will be designed to be compliant with GBRs 26-28 and any bunds will provide storage of at least 110% of the largest tank's maximum capacity;
- The storage of oil in a portable container with a capacity of greater than 200 litres on site will not be permitted;
- Multiple spill kits will be kept on site;
- Drip trays will be used while refuelling; and,
- Regular inspection and maintenance of vehicles, tanks and bunds will be undertaken.

10.8.17 Welfare facilities will include closed-system toilets, with disposal of foul drainage at a suitable off-site facility.

10.8.18 Concrete and cement mixing will be sited on an impermeable designated area and at least 10m away from a watercourse or surface water drain, to reduce the risk of run-off entering a watercourse. Equipment will be washed out in a designated area, specifically designed to contain wet concrete and wash water. Wash waters will be discharged to the foul sewer with prior permission from Scottish Water or disposed off-site at an authorised facility.

10.8.19 All chemicals and hazardous substances will be stored safely, away from watercourses and drains in line with current best practice. They will be disposed of in line with duty of care requirements.

Operational Phase

10.8.20 The proposed surface water and SUDs scheme (see **Section 10.6**) will require regular maintenance during its operational life. This maintenance will include the regular debris clearing and cutting of grass of surface SUDs features, and the inspection and repairs to underground features if necessary. The responsibility for the maintenance of the drainage network will lie with the organisation that adopts the network. Details of the proposed drainage strategy for the site are covered in **Appendix 10.3**.

10.8.21 During the operational phase there should be no requirement for groundworks. However, should groundworks be required mitigation highlighted in the construction sections above will be adopted as appropriate.

10.9 Residual Effects

10.9.1 As shown in **Table 10-7**, the influence of the further mitigation identified in **Section 10.8** means that with one exception (effects on groundwater flow) the level of predicted effects would reduce such that the residual effect would become Negligible and not significant in the context of the EIA Regulations. The rationale for the predicted level (and thus significance) of effects on groundwater flow is provided in **Section 10.7.15**.

Table 10-7: Summary of Likely Residual Effects

Potential Impact	Receptor, Sensitivity	Source of Impact	Type of Effect	Duration	Probability of Effect Occurring on Receptor	Pre-Mitigation Magnitude of Change	Pre-Mitigation Level of Effect	Post Mitigation Magnitude of Impact	Residual Significance of Effect	Residual Effect Significance
	Construction Phase									
Surface water flow alterations and flood risk	Loch Lomond, High	Impermeable surfaces, change in site levels, stockpiles, voids	Negative	Short	Possible	Moderate	Major	Negligible	Negligible	Not Significant
	Watercourses, Medium		Negative	Short	Possible	Moderate	Moderate	Negligible	Negligible	Not Significant
Pollution from sediments	Loch Lomond, High	Soil stripping, earthworks, stockpiles	Negative	Short – medium	Likely	Moderate	Major	Negligible	Negligible	Not Significant
	Watercourses, Medium		Negative	Short – medium	Likely	Moderate	Moderate	Negligible	Negligible	Not Significant
Pollution from chemicals	Loch Lomond, High	Oils, fuels, machinery, welfare facilities	Negative	Short	Possible	Moderate	Major	Negligible	Negligible	Not Significant
	Watercourses, Medium		Negative	Short	Possible	Moderate	Moderate	Negligible	Negligible	Not Significant
	Groundwater, Low		Negative	Short	Possible	Moderate	Minor	Negligible	Negligible	Not Significant
Groundwater flow and level alterations	Groundwater, Low	Excavations and dewatering	Negative	Short	Likely	Slight	Minor	Low	Minor	Not Significant
	Operational Phase									
Downstream & on-site flood risk	Loch Lomond, Medium	Impermeable surfaces, drainage system	Positive	Long	Likely	Negligible	Negligible	Negligible	Negligible	Not Significant
	Watercourses, Medium		Positive	Long	Likely	Negligible	Negligible	Negligible	Negligible	Not Significant
Pollution from sediments	Loch Lomond, High	Increased runoff from impermeable surfaces, roads	Negative	Long	Unlikely	Low	Moderate	Negligible	Negligible	Not Significant
	Watercourses, Medium		Negative	Long	Unlikely	Low	Minor	Negligible	Negligible	Not Significant
Pollution from chemicals	Loch Lomond, High	Vehicle use	Negative	Short	Unlikely	Low	Moderate	Negligible	Negligible	Not Significant

Potential Impact	Receptor, Sensitivity	Source of Impact	Type of Effect	Duration	Probability of Effect Occurring on Receptor	Pre-Mitigation Magnitude of Change	Pre-Mitigation Level of Effect	Post Mitigation Magnitude of Impact	Residual Significance of Effect	Residual Effect Significance
	Watercourses, Medium		Negative	Short	Unlikely	Low	Minor	Negligible	Negligible	Not Significant
	Groundwater, Low		Negative	Short	Unlikely	Low	Minor	Negligible	Negligible	Not Significant
Groundwater flow and level alterations	Groundwater, Low	Built infrastructure	Negative	Long	Possible	Negligible	Negligible	Negligible	Negligible	Not Significant

10.10 Monitoring

10.10.1 In the absence of any likely significant adverse effects, no monitoring is considered to be proportionate or required.

10.11 Cumulative Effects

10.11.1 Cumulative effects on the water environment could occur where more than one development is proposed within a catchment, and **Chapter 2 – Site and Proposed Development** identified the relevant cumulative developments within the area.

10.11.2 The relevant cumulative developments are:

- Replacement building and infrastructure for Sweeney's Cruises;
- Replace fixed jetties providing 50 moorings with floating pontoons providing 48 moorings for Riverside Leisure Ltd;
- Lomond Hotel Alterations and Extension;
- Woodbank Inn Hotel Extension; and,
- Balloch Street Design Project.

10.11.3 With reference to impact upon the water environment, it is not considered that any cumulative development listed above would have any impact. As such there would be negligible/no cumulative effects on the water environment.

10.12 Summary

10.12.1 This chapter of the EIAR has assessed the impact of the proposed development upon the water environment which includes surface water and fluvial hydrology (including flooding), water quality, drainage, groundwater, water supplies and wetlands.

10.12.2 A suite of embedded and further mitigation has been proposed to avoid, prevent and minimise likely significant effects on the water environment. This includes:

- A buffer for construction activities within a 5m strip along waterfronts;
- Adherence to relevant national guidance, legislation and good practice in construction methods;
- Development and adhering to a Construction Environmental Management Plan (CEMP) containing a Pollution Prevention Plan (PPP), which will include monitoring of the site activities to ensure compliance;
- The use of construction phase Sustainable Drainage Systems (SUDs);
- An Environmental Clerk of Works (ECoW) will supervise the construction works to ensure compliance with the above;
- Permanent surface water drainage network incorporating SUDs to ensure sufficient levels of treatment and attenuation of surface water discharges from site;
- All proposed development is to be located outwith the functional floodplain as identified in the Flood Risk Assessment, and the minimum finished floor levels of buildings on site are to be above the maximum flood level estimated for the 1 in 200 year + climate change event; and,
- Routing of construction discharges through at least three levels of SUDs to ensure that water quality of high sensitivity receptors is not adversely affected.

10.12.3 With the above mitigation measures in place, the assessment has concluded that the proposed development would not generate any significant effects upon the water environment.

10.13 References

- BGS (n.d.-a). Geology of Britain viewer. Retrieved from https://mapapps.bgs.ac.uk/geologyofbritain/home.html.
- BGS (n.d.-b). GeoIndex Onshore Viewer. British Geological Society. Retrieved from http://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSHydroMap.
- CEH (2022). Flood Estimation Handbook (FEH) Web Service. Centre for Ecology & Hydrology. Retrieved from https://fehweb.ceh.ac.uk/.
- NatureScot (2018). A handbook on environmental impact assessment. Scottish Natural Heritage.
- Ó Dochartaigh, B., Doce, D., Rutter, H. & MacDonald, A. (2011). User Guide: Aquifer Productivity (Scotland) GIS datasets. British Geological Survey Open Report, Version 2, OR/11/065, 17. Retrieved from http://nora.nerc.ac.uk/16222/1/OR11065.pdf.
- SEPA (2014). Land Use Planning System SEPA Guidance Note 31: Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (No. LUPS-GU31). Stirling: Scottish Environment Protection Agency.
- SEPA (2022). The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended); A Practical Guide (No. Version 9). Holytown: SEPA.
- Soil Survey of Scotland Staff (n.d.). Soil maps of Scotland (partial coverage) at scale of 1:25,000. Aberdeen: Macaulay Institute for Soil Research. Retrieved from http://map.environment.gov.scot/Soil_maps/.
- The Scottish Government (n.d.). Scotland's environment web. The Scottish Government. Retrieved from http://www.environment.scotland.gov.uk/.
- SEPA (2021). Water Environment Hub. SEPA. Retrieved from https://informatics.sepa.org.uk/RBMP3/.