Hydropower Sustainability
ESG Gap Analysis Tool

Stortemelk Hydro

Hydropower Sustainability Environmental, Social and Governance Gap Analysis Tool

Operation Stage Assessment: **Stortemelk Hydro, South Africa**

December 2020

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Hydropower Sustainability Environmental, Social and Governance Gap Analysis Tool

About the HESG	The Hydropower Sustainability Environmental, Social and Governance Gap Analysis Tool (HESG) enables hydropower project proponents and investors to identify and address gaps against good international industry practice. The HESG is based on the assessment framework of the Hydropower Sustainability Assessment Protocol (HSAP) and draws from the definitions of good international industry practice of the Hydropower Sustainability Guidelines on Good International Industry Practice (HGIIP).
Intended users and uses	The HESG includes three separate stage tools: Preparation, Implementation and Operation. These reflect the different stages of hydropower development and have been designed to be used as standalone documents. Each tool provides an action plan to help project teams address any gaps against good practice. Official HESG assessments are carried out by accredited assessors, who take an evidence-based approach. All findings are supported by objective evidence, which is factual, reproducible, objective and verifiable. The HESG is most effective when operators and developers commit to implement the recommendations provided and resolve identified significant gaps. In addition, the tool is aligned with the safeguards and standards of international financial institutions and can be used to attract climate-aligned investment. Hydropower development and operation may involve public entities, private companies or combined partnerships, and responsibilities may change as the project progresses through its life cycle. It is intended that the organisation with the primary responsibility for a project at its particular life-cycle stage will have a central role in any HESG assessment.
Structure of the tool	The HESG comprises 12 sections that cover the environmental, social, governance and climate change topics of the HSAP and HGIIP. A summary at the beginning of the report presents any significant gaps against basic good practice and outlines an action plan for improved performance. Within each section, requirements for good international industry practice are presented and project findings are provided. For each finding, a key indicates whether the requirement is met. A summary section analyses significant gaps and identifies each one with the symbol ●.
Supporting resources	Additional guidance on the structure, content and history of the HESG can be found online at: www.hydrosustainability.org
Version date	May 2020

Operation

Executive Summary

Overview of Project	The 4.3 MW Stortemelk run-of-river hydropower plant was commissioned in 2016. It was added to an existing dam commissioned in 2001, which is owned by the South African government Department of Water and Sanitation (DWS) and receives water transferred from the Lesotho Highlands Water Project (LHWP). The dam is located on a small, previously intermittent tributary of the Ash River in the Free State province. Stortemelk Hydro is majority owned by REH Group.
Assessment Results	Site selection and design of the Stortemelk project have resulted in an exceptionally small environmental and social footprint. The project uses an existing dam, reservoir and access road. It was constructed on a small parcel of previously disturbed land and operates on a river previously transformed by the LHWP. It is well integrated within a private nature reserve and has won an architectural award. There are no significant social impacts, but substantial benefits for the local community. The project is also very efficient, has a high load factor and contributes to South Africa's transition to a low-carbon economy. Two significant gaps were identified and corrective actions agreed. The developer will improve public access to project information, and will work with the dam owner DWS to clarify responsibilities for maintenance and emergency preparedness. The assessment contributes to REH's continuous improvement of its project portfolio across southern Africa. The Stortemelk project can serve as a model for sustainable development of small hydropower, based on avoiding impacts and reducing costs through good site selection, systematic management of any remaining impacts, and enhancement of positive impacts.

Contents

A. Assessment Details

Project sponsor	Stortemelk Hydro (RF) Proprietary Limited
Assessor(s)	Joerg Hartmann PhD, Sustainable Water & Energy LLC
Assessment objectives	• Improved communications, transparency and stakeholder relations • Internal skills development • Qualification for possible green/climate bond financing
Assessment dates	November 9 – 20, 2020
Assessment report date	December 8, 2020
Prepared for	Anton-Louis Olivier and Jan-Louis Janse van Vuuren (REH) Nyundo Armitage from Armitage Consulting in Zambia, who recently participated in IHA's Certified User Training and works with REH in Zambia, also reviewed this Assessment Report to become more familiar with the Hydropower Sustainability Tools.
Limitations of the assessment	This assessment was conducted remotely from the assessor's home office in Colorado, US. It followed the guidance in the IHAS' White Paper on Remote HSAP and HESG Assessments, approved by the Hydropower Sustainability Governance Committee in October 2020. A remote assessment was possible in this case because Stortemelk is a small, recently commissioned, well documented and low-impact project. It does not have permanent staff on site and can be partially controlled and operated remotely, so that some facilities for a remote assessment are already available (such as surveillance cameras). The client's project manager travelled to the site to enable the assessor to visit the plant on a live video link, to provide up-to-date photos and video/drone footage, and to set up and participate in several video calls with local stakeholders. All the assessor's requests for access to different project components, documents, staff and stakeholders were met. Some stakeholders did not respond to repeated invitations to comment, which is interpreted as a lack of concern over, or interest in the project. The remote assessment presented a small number of logistical difficulties, such as internet bandwidth on some occasions as well as the difference in time zones, but the depth and breadth of information available to the assessor left nothing to be desired. The assessor and client agree that the remote assessment approach can work well under conditions similar to this assessment, as well as reducing the medical risks, environmental footprint and costs of an assessment. The 22kV transmission line, which was built and is operated by the offtaker Eskom under a different set of permits and servitude arrangements with private landowners, was only partially reviewed under this assessment, but there are no indications that is has caused significant impacts.

B. Project Details

Project name	Stortemelk Hydro
Country	South Africa
Location	Free State province, Dihlabeng municipality, on the Ash River
Purpose	Hydropower plant retrofitted on an existing energy dissipation/erosion control dam
Developer / Owner	Renewable Energy Holdings (REH)
Financer(s)	Mertech/Mergon Group, H1 Capital, CCIA (equity contributions), Rand Merchant Bank (15-year project finance loan)
Installed capacity (MW)	4.3 MW
Construction start date (planned or actual)	2014
Commercial Operations Date (planned or actual)	2016
Annual average generation (GWh / year)	27.5 GWh/year
Associated infrastructure: road(s) (length)	No new roads, some improvements to short access road
Transmission lines and sub-stations (names, lengths and capacities)	9 km 22 kV transmission line to ESKOM Node substation, south-east of Stortemelk
Total cost (USD m)	USD 18 million
Annual operating costs (USD m)	USD 240,000 (2018-2019)
Transmission costs for project development (USD m)	USD 400,000 at the mid-2016 exchange rate, reimbursed to ESKOM
Specific investment cost (USD m / MW)	USD 4.2 million / MW
Levelized cost of energy (USD / kWh)	Not calculated in project documentation, but project selected through competitive bidding
Dam type	Pre-existing RCC dam and spillway, with earth embankment dam flanks on left and right bank
Dam height (m)	16 m
Dam length at crest (m)	50 m left earth embankment, 30 m concrete spillway, and 180 m right earth embankment
Units (number, type, MW)	1 vertical Kaplan unit
Reservoir area at Full Supply Level (FSL) (km^2)	20 ha
Average net head at FSL (m)	13.8 m
Average flow (m^3 / s)	24.5 m^3/s
Design flow (m^3 / s)	30 m^3/s
Load factor	74.4% (banking case), 80% (average of 4 years)
Number of physically displaced households	0
Power density (MW / m^2)	29 W/m^2, based on rough estimate of reservoir surface (pre-existing reservoir)
Emissions intensity (gCO_2e / kWh)	Not estimated (see Section 12)
Contacts / website	https://www.rehgroup.co.za/

Figure 1 – View from the Botterkloof Dam, with the Stortemelk powerhouse on the left and the Ash River flowing downstream. Note the architecturally distinct design of the powerhouse, the fencing around REH's property, the small storage building to the right, riprap for erosion protection along the riverbanks, the successful revegetation of the construction site, and the wetland on the left bank.

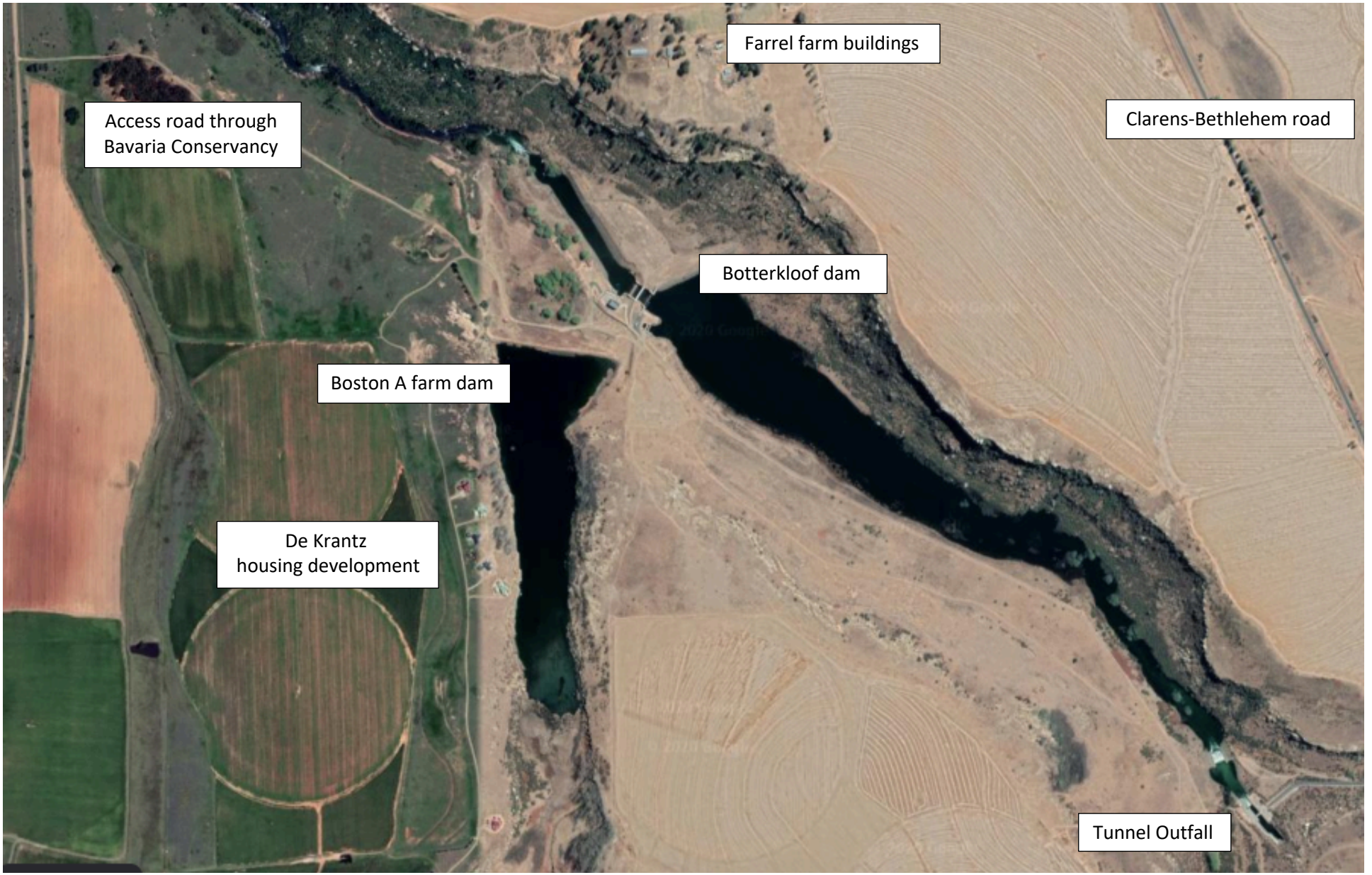
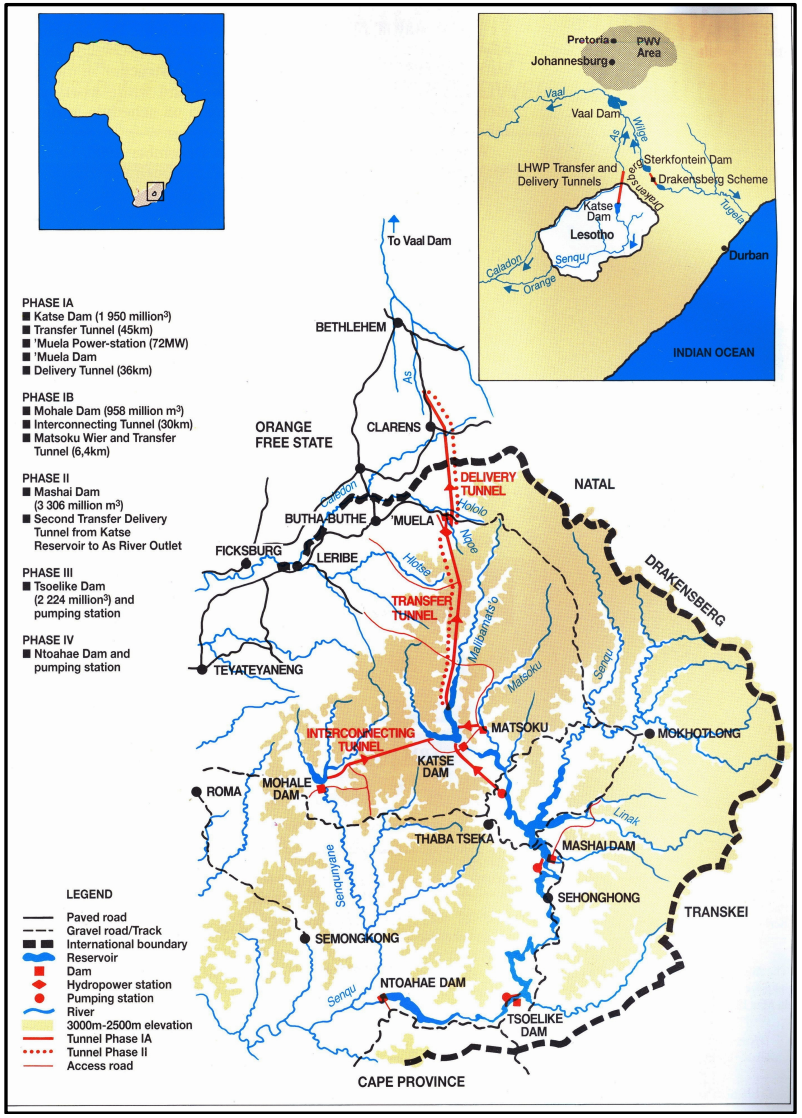


Figure 2 – Google Earth image of area around Stortemelk power station.



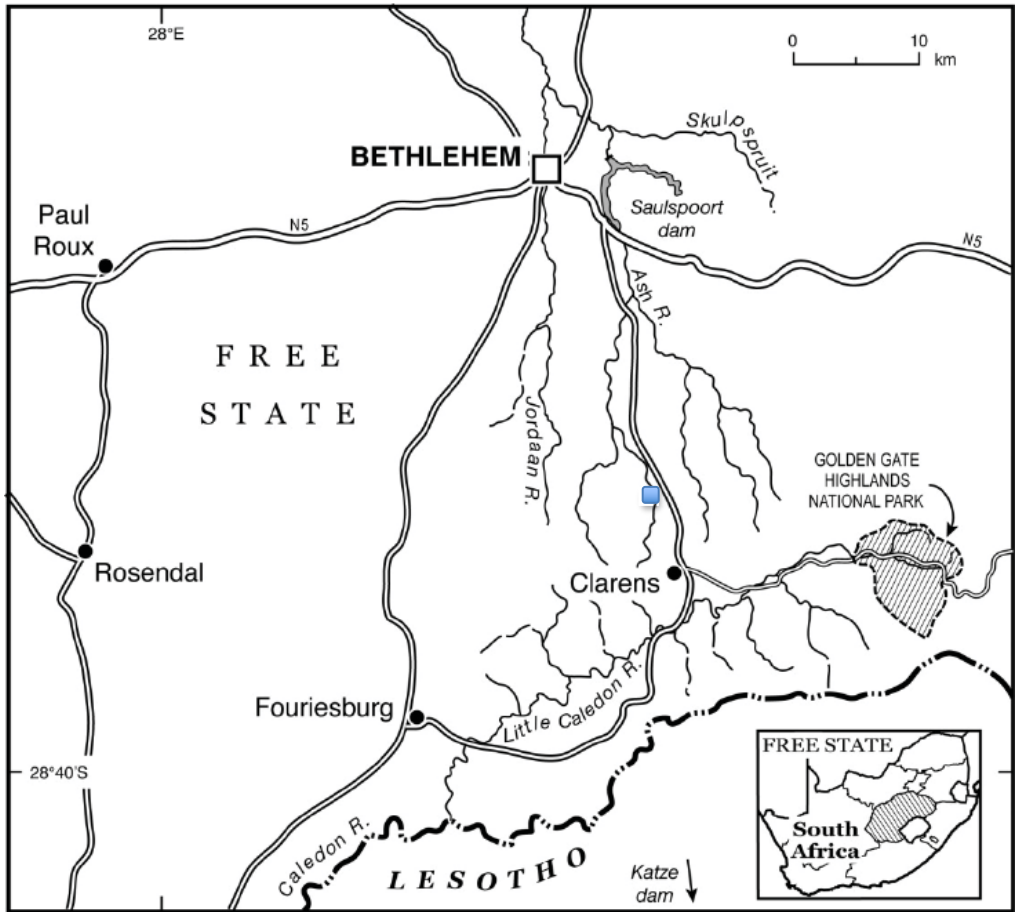
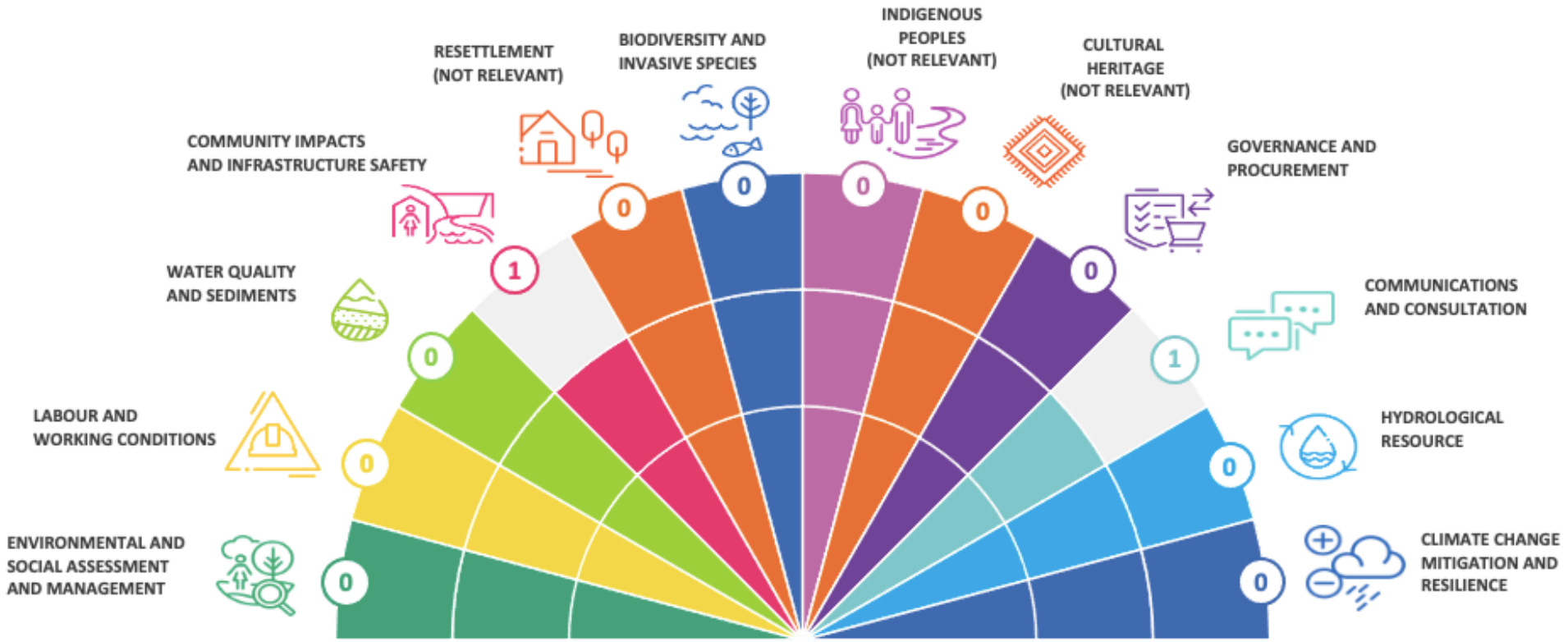


Figure 3 – Lesotho Highlands Water Project, with delivery tunnel outfall approximately 10 km north of Clarens.

Figure 4 – Regional map of the eastern Free State province, with Stortemelk project marked in blue.

Operation

C. HESG Gap Analysis Diagram



0 - No Gaps
1 - One Gap
2 - Two or more gaps

D. Significant gaps

List of significant gaps:		Sections											
		1. Environmental and Social Assessment and Management	2. Labour and Working Conditions	3. Water Quality and Sediments	4. Community Impacts and Infrastructure Safety	5. Resettlement	6. Biodiversity and Invasive Species	7. Indigenous Peoples	8. Cultural Heritage	9. Governance and Procurement	10. Communications and Consultation	11. Hydrological Resource	12. Climate Change Mitigation and Resilience
1.	There is a lack of clarity regarding dam safety processes and responsibilities.				x								
2.	There is a lack of public disclosure of project information.									x	x		
NUMBER OF SIGNIFICANT GAPS BY SECTION:					1					1[1]	1		
TOTAL NUMBER OF SIGNIFICANT GAPS:		2											

E. Observations

- The Environmental and Social Management System (ESMS) could benefit from some consolidation.
- Stakeholder information could be consolidated into an up-to-date stakeholder map, and used to systematically determine communication requirements.
- There is some potential to follow up more proactively with stakeholders, for example by informing water agencies and river users of flow changes, by inviting neighbours who have expressed curiosity about the hydropower plant, and by communicating details about the contributions to CCIA.

[1] The gap identified under Section 9 is the same as the one under Section 10, and is counted only under Section 10 to avoid double-counting.

F. Environmental and Social Action Plan (ESAP)

The following actions are recommended to address and resolve the significant gaps.							
Section	Significant gaps	Action(s)	Responsibility	Indicator of achievement	Timeframe		
					<12 months	12-24 months	>24 months
4	There is a lack of clarity regarding dam safety processes and responsibilities.	It is recommended to meet with DWS (and perhaps with TCTA) to exchange relevant documents and agree on a coordinated approach to dam safety.	REH with DWS (perhaps also TCTA)	An agreed plan for monitoring, maintenance, emergency preparedness and response.	x		
9, 10	There is a lack of public disclosure of project information.	It is recommended to post existing documents or (preferably) non-technical summaries on the Stortemelk project (or on all projects along the Ash River) and regarding REH's processes and policies (primarily the E&S Policy) on REH's website. Additionally they could also be shared directly with an (updated) list of stakeholders.	REH	Documents posted on REH's website.	x		

1 Environmental and Social Assessment and Management

Scope and Intent
This section addresses the plans and processes for environmental and social issues management. The intent is that negative environmental and social impacts associated with the hydropower facility are managed; avoidance, minimisation, mitigation, compensation and enhancement measures are implemented; and environmental and social commitments are fulfilled.

Background	
Identify the main environmental and social issues during operation	Minor impacts on other river users, contributions to local socio-economic development
Identify the environmental regulator	DETEA (Department of Economic Development, Tourism and Environmental Affairs, Free State province) through environmental authorisation (later renamed to DESTEA)
Identify other regulators (e.g. on land, water use, Indigenous Peoples)	DWS (Department of Water and Sanitation) through water use license, NERSA (National Energy Regulator of South Africa) through generation license
Summarise the ESIA regulatory requirements	National Environment Management Act, 1998 (Act No. 107 of 1998) (NEMA) and subsequent regulations. At the time of the application for the Environmental Authorisation, projects of the size of Stortemelk only required a Basic Assessment. The Environmental Authorisation for the project (No. EMB/1K, 1M, 4/07/93) issued by DETEA, requires that an Environmental Management Plan (EMP) be implemented during the construction phase, supported by the appointment of an Environmental Control Officer to check on performance against EMP requirements. During operations, an Environmental Management System (EMS) must be implemented.
Describe the non-physical cultural heritage in the project area	The majority population of the Free State province (as in neighbouring Lesotho) are the Basotho, with their language Sesotho. In terms of land use, the eastern Free State is dominated by white commercial farms (wheat, corn, cattle). The Free State is the successor to the Orange Free State, one of the original Boer Republics, with Afrikaans as the primary language of the white population. Most black inhabitants either live in townships, including in the regional towns such as Bethlehem and Clarens, or in rural areas and work in agriculture.
Other relevant information	Before the 1st phase of the Lesotho Highlands water transfer scheme, the Ash River was a small creek. Since water deliveries began in 1999, the 40 km section of the river between the tunnel outfall and the Sol Plaatje reservoir (earlier named Saulspoort reservoir), with a drop of ~ 80 m, has been completely transformed. Rapid erosion and river degradation required a number of river training works such as the Botterkloof Dam (directly

	downstream of the outfall), weirs, gabions and riprap, which have stabilized the river channel. The Botterkloof dam is actually off-channel, i.e. on a small, intermittent tributary to the Ash River, which joins the main channel a few kms downstream. The additional water availability has led to significant interest from hydropower developers, recreational users (rafters, kayakers, trout fishermen) and irrigators.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
1.1 Assessment		
Systematic processes are in place to identify any ongoing or emerging environmental and social issues associated with the operating hydropower facility	✓	Identification of E&S issues has improved over time. The 2009 Basic Assessment report had a number of gaps, and for those operational impacts that were identified, somewhat superficial descriptions of impacts and mitigation measures. Subsequent work improved the understanding of E&S issues, including the 2014 Ecological Overview Report (Aurecon), the 2017 Assessment of Priority Ecosystem Services Report (Envital), and a series of internal and external E&S audit reports. Some of these reports were triggered by external partners, such as the project finance lender Rand Merchant Bank, who is an Equator Principles bank and had its Lender's Technical Advisor, an environmental law firm, and internal environmental team review the project.
The processes utilise appropriate expertise	✓	A number of reputable consulting firms have been engaged and have contributed appropriate expertise.
Monitoring programs are in place for identified issues	✓	During construction, the main focus of monitoring efforts by the appointed environmental supervisor was to keep activities within the designated footprint, and to ensure that proper procedures for the management of waste, topsoil, and invasive species were followed. During operations, the two key monitoring mechanisms are the periodic operations & maintenance reports from REH O&M (which focus on ongoing E&S management at the site level, as well as any incidents) and audits against the different license conditions, EMPs, lender's requirements etc. These reports are shared with some of the key stakeholders such as shareholders, regulators and lenders.
1.2 Management		
Environmental and social management system is in place to manage measures to	✓	The design and operations of the plant and the choice of equipment (e.g. an oil-free transformer) have simplified the scope of E&S management from the early stage.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
address identified environmental and social issues		An ESMS has been developed over time and now consists of a comprehensive suite of policies, management and monitoring plans, risk assessment methodologies, manuals and procedures, including regular team meetings and internal as well as external audits. There are a few uncertainties over the status and use of some of those documents, as there are multiple overlaps e.g. between the 2017 Environmental, Social, Health and Safety Management System Manual (Golder), the 2017 Operational Environmental and Social Management Plan (Envital), the 2017 Environmental and Social Monitoring Plan (Envital) and the more specific plans e.g. for waste management and chemical storage. The system could therefore benefit from some consolidation.
This management system is implemented utilising appropriate expertise (internal and external)	✓	While the small team of REH has no dedicated E&S staff, it has gained significant expertise over time and where necessary, has contracted reputable consultants for assessments, design of policies and procedures, and audits.
Measures in place to guide generation operations are based on social and environmental considerations	✓	The run-of-river generation operations cause limited additional variations on a highly disturbed river system (see Section 11).
1.3 Conformance and Compliance		
Processes and objectives in environmental and social management plans have been and are on track to be met with:		
• no major non-compliances	✓	Some minor non-compliances with regulatory and license requirements have been identified over time in the various environmental audits. Several of these are formalities (e.g. registration of name changes) and others do not appear material or have been closed out.
• no major non-conformances	✓	There are some minor non-conformances with internal policies and plans, but no indications of non-conformances with agreements with financiers.
Environmental and social commitments have been or are on track to be met	✓	Voluntary and contractual commitments in the local project area have been met.
Environmental and social funding commitments have been or are on track to be met	✓	Funding commitments (e.g. to CCIA Clarens, a local church-based NGO) have been met (see Section 4).
1.4 Outcomes		

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
Negative environmental and social impacts associated with hydropower facility operations are avoided, minimised and mitigated with no significant gaps	✓	The Stortemelk project is essentially a run-of-river project within a man-made water transfer scheme, with exceptionally low incremental E&S impacts, lower even than for the other hydropower projects downstream along the Ash River (which require a water diversion). It was able to make use of an existing dam and existing road access, thus minimizing impacts. The remaining impacts have been well managed.
Land disturbance associated with development of the hydropower project is rehabilitated or mitigated	✓	The project was implemented on a small parcel of land that had been previously disturbed, and land has been rehabilitated as required. The owner of the surrounding land mentioned that small amounts of construction debris have remained, but it is unclear whether this is from the earlier construction of the Botterkloof dam or from the later construction of the power station.
The operating hydropower facility or the corporate entity to which it belongs can pay for social and environmental commitments	✓	The revenues of Stortemelk Hydro have been stable and as least as high as expected, due to favourable hydrology and high plant availability; there are no issues with funding E&S commitments into the future.

Summary of Findings

Summary and other notable issues	List of significant gaps
The assessment and mitigation of the E&S impacts in the Stortemelk project has been relatively easy, due to the selection of a site with exceptionally low impacts during construction and operations. E&S management has been embedded in a corporate system for three operational plants and several planned projects, which is generally suitable although there is some potential for consolidation.	

2 Labour and Working Conditions

Scope and Intent
This section addresses labour and working conditions, including employee and contractor opportunity, equity, diversity, health and safety. The intent is that workers are treated fairly and protected.

Background	
Labour requirements during operation (full-time equivalent)	1 technician and 1 caretaker full-time; other REH staff part-time as required; occasional use of contractors and consultants
Applicable key human resources regulations	South Africa has a comprehensive set of labour legislation including the Labour Relations Act, Basic Conditions of Employment Act, Employment Equity Act, Skills Development Act, and Unemployment Insurance Act.
Applicable key occupational health and safety (OH&S) regulations	Key regulations include the Occupational Health & Safety Act and the Compensation for Occupational Injuries and Diseases Act.
Identify the regulator for labour law and OH&S	Department of Employment and Labour
Other relevant information	The REH Group has a total of 14 employees, 7 at the corporate headquarters in Cape Town and 7 at the REH O&M subsidiary based in Bethlehem, Free State.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
2.1 Assessment		
A periodically updated assessment has been undertaken of human resource and labour management requirements for the operating facility	✓	As a small facility, Stortemelk's operations are fully integrated into REH O&M and supported by headquarters staff. As REH O&M has matured and the first employees are close to retiring, increasing emphasis has been placed on the transfer of knowledge and training of the next generation of operators.
The assessment included project occupational health and safety issues, risks, and management measures	✓	OH&S issues were already considered in the design of the plant and the choice of equipment; for example by having almost all operational tasks located on the ground level while the lower floors only need to be accessed for checks. Safety is also regularly evaluated and monitored. External inspections of safety-relevant equipment such as cranes and fire extinguishers are conducted periodically. Stakeholders have confirmed a good safety culture within REH.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
Monitoring is being undertaken to assess if management measures are effective	✓	The HR function in REH tracks basic parameters such as employee retention and grievances. Although not required under the regulations for an operation of this scale, all member of the REH O&M team are also members of a Health and Safety Committee and have been supported by an independent consultant (Occupational Health and Safety Professional), for the last 7 years. They regularly discuss OH&S issues and track any incidents. Reported accidents have been mostly traffic accidents on the way to or from work, and cuts, bruises or similar injuries from work in the power station. There is an annual medical exam for all staff members.
Ongoing or emerging labour management issues have been identified	✓	REH is interested in retaining its committed, qualified and specialised staff and closely tracks their work satisfaction. It also follows any legal or regulatory developments, for example regarding anti-discrimination, employment equity and black empowerment codes.
2.2 Management		
Human resource and labour management policies, plans and processes are in place to address all labour management planning components	✓	REH offers comparatively good working conditions to attract and retain committed staff. For example, unskilled plant caretakers are paid approximately USD 600/month, about three times the national minimum wage, plus pension fund contributions and transport. Training and up-skilling are significant commitments by REH. Individual development plans are agreed for all staff and training needs identified. For example, caretakers on the operational team are paid for attending their final school year and obtaining formal technical qualifications. There has been an OH&S policy for REH O&M since 2014. The policy applies to staff, contractors and visitors. OH&S processes such as training requirements, safe operating procedures, control permits and risk assessments are regularly audited, reviewed and updated. All REH O&M staff have first aid and other relevant OH&S training. The regular staff meetings have a component called 'Policy Integration', during which E&S as well as health and safety policies and processes are discussed.
Human resource and labour management policies, plans and processes of contractors, subcontractors, and intermediaries, are in place	✓	Contractor selection is not based on sustainability criteria, but basic evidence such as payment of workers' compensation contributions and OH&S compliance certificates are required from contractors.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
2.3 Conformance and Compliance		
Processes and objectives relating to human resource and labour management have been and are on track to be met with:		
• no major non-compliances	✓	There is no evidence of any non-compliances. No official labour inspections have taken place, which also indicates that there are no reports of unfair labour relations or other non-compliances.
• no major non-conformances	✓	There is no evidence of any non-conformances.
Any labour related commitments have been or are on track to be met	✓	There is no evidence of any commitments that have not been met. Staff reported a high level of work satisfaction. There have been no labour disputes, strikes or any similar incidents during construction and operation. The formal grievance mechanism available to employees has not been used.
2.4 Outcomes		
There are no identified inconsistencies of labour management policies, plans and practices with internationally recognised labour rights	✓	South Africa has ratified all fundamental and most other ILO international labour conventions, and many labour rights are included in the Constitution. Labour law was among the first areas of law to be reformed after the end of Apartheid, and is considered to offer a significant degree of protection to employees in international comparison. There are no indications that the labour practices at Stortemelk are not consistent with internationally recognised labour rights.

Summary of Findings

Summary and other notable issues	List of significant gaps
REH is a small company with good labour relations and labour management practices. There have been few work safety incidents and no non-compliances, grievances or labour disputes.	

3 Water Quality and Sediments

Scope and Intent
This section addresses the management of water quality, erosion and sedimentation issues associated with the operating hydropower facility. The intent is that water quality in the vicinity of the operating hydropower facility is not adversely impacted by activities of the operator, that erosion and sedimentation caused by the project are managed responsibly and do not present problems with respect to other social, environmental and economic objectives, and that commitments to address water quality, erosion and sedimentation issues are fulfilled.

Background	
Sedimentology	
Key sediment issues	Lesotho has relatively high rates of soil erosion, but the water transferred from Lesotho has low sediment content, as sediment is deposited in the various reservoirs along the transfer scheme (including Katse 1,950 million m^3, Muela 5-6 million m^3, and Botterkloof 600,000 m^3). Turbidity at the project site is therefore generally low, with the exception of the onset of the rainy season. It increases towards the downstream, because the high and variable volumes of additional water caused major scouring and channel degradation problems, especially in the first years after the water transfers started. An 'Ash River Rehabilitation Program' included various works (including the Botterkloof dam) to dissipate erosive energy and protect the riverbanks. This program was implemented by TCTA (which is responsible for the river reach down to the Sol Plaatje dam) and then handed over to DWS for operations.
Sediment load (tonnes/year)	There are no data for the current sediment load in the Ash River system. According to the LHWP Phase 1B environmental impact assessment (1997), historic sediment yields were estimated to range from 800t/km^2/year from the upper end of the Ash River catchment to 150t/km^2/year further downstream.
Catchment area at the dam	The local catchment of the small, unnamed tributary of the Ash River has an area of 23.2 km^2. Additionally, the dam is connected to the LHWP catchments through the delivery tunnel.
Water Quality	
Description of water quality	Water quality in the Ash River is described as good or even pristine by most users, especially in the upper reaches and on the small tributary that has the tunnel outfall and Botterkloof Dam.
Key water quality issues	DWS and Rand Water (as the downstream water utility) are most concerned about pollution caused by wastewater from settlements, which decrease water quality further downstream from the project site.
Main influences on water quality	Most of the water in the Ash River is transferred from Lesotho, where the Katse reservoir is a large, deep, cool, high-elevation, oligotrophic waterbody. The local catchment is small and rural in character, with no significant pollution sources.
Other information	

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
3.1 Assessment		
Ongoing or emerging issues have been identified, in the following areas:		
• erosion and sedimentation	✓	The original rationale for the Botterkloof Dam was erosion control, which was identified as a necessity after the LHWP had started operations. By comparison, erosion from the small physical footprint of the construction camp and power station construction site was a minor issue.
• water quality	✓	No water quality issues have been identified, beyond the standard need to prevent pollution from the power station.
In these areas, if management measures are required then monitoring is being undertaken to assess if management measures are effective for:		
• erosion and sedimentation	✓	Erosion downstream was last surveyed in 2019 when the LHWP delivery tunnel was shut down for maintenance. The works under the 'Ash River Rehabilitation Program' have slowed down the degradation of the channel. Erosion from land disturbance around the construction site was visually monitored during and after construction. There has been no monitoring of sedimentation of the Botterkloof reservoir, which might reduce storage capacity in the long term. Due to the low sediment content of the water transfers from Lesotho, the relatively low human pressure on the small catchment, the fact that there is another dam upstream on the small tributary of the Ash River (Miemiesrust dam) that would trap most sediments, and the lack of any visual evidence of sedimentation, this is not seen as a gap.
• water quality	✓	Water quality monitoring is regularly undertaken by DWS (monthly sampling) and Rand Water, with the results presented to stakeholders. There are no known water quality issues associated with the Botterkloof Dam (with its short water retention time) or the Stortemelk power station. An environmental audit has recommended replacing the pesticides used by REH for weed control by less toxic alternatives.
3.2 Management		
Measures are in place to manage the following identified issues:		
• erosion and sedimentation	✓	Erosion from land disturbance during and after construction was controlled appropriately, and the site is now revegetated.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
• water quality	✓	Pollution from the power station is prevented through appropriate handling and disposal of oils, fuels and other chemicals (which are partly stored at the neighbouring Merino power station), and storage and disposal of wastewater. Stortemelk contributes to controlling floating debris and garbage on the Ash River, which are extracted from the trashrack. Organic material is disposed of in a disused quarry on the Farrel farm property, while other material is taken to the municipal dump, jointly with domestic solid waste from the power station, with a register kept. Used oil and other hazardous waste (in small quantities) is disposed of through a licensed contractor, with a manifest issued.
3.3 Conformance and Compliance		
Processes and objectives in place to manage each of the following have been and are on track to be met:		
• erosion and sedimentation, with no major non-compliances	✓	There are no indications for any non-compliances.
• erosion and sedimentation, with no major non-conformances	✓	There are no indications for any non-conformances.
• water quality, with no major non-compliances	✓	There are no indications for any non-compliances.
• water quality, with no major non-conformances	✓	There are no indications for any non-conformances.
Commitments related to the following have been or are on track to be met:		
• erosion and sedimentation	✓	No specific commitments have been made.
• water quality	✓	No specific commitments have been made.
3.4 Outcomes		
Erosion and sedimentation issues are avoided, minimised and mitigated with no significant gaps	✓	The Stortemelk project has minimal incremental impacts on erosion and turbidity downstream during operations, through unavoidable land disturbance and minor additional downstream flow fluctuations. The installation of hydropower plants along the river has further contributed to energy dissipation, adding to the 'Ash River Rehabilitation Program' works.
Negative water quality impacts arising from activities of the operating hydropower facility	✓	The Stortemelk project has had no relevant water quality impacts, is following good practices in pollution prevention, and is extracting floating debris from the Ash River.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
are avoided, minimised and mitigated with no significant gaps		

Summary of Findings

Summary and other notable issues	List of significant gaps
There are no relevant impacts and risks from erosion, sediment or water quality on the Stortemelk power station, and neither are there relevant impacts from the Stortemelk power station on erosion, sedimentation or water quality.	

4 Community Impacts and Infrastructure Safety

Scope and Intent
This section addresses how impacts of development of the hydropower facility on project-affected communities have been addressed, in cases where these commitments are well-documented against a pre-project baseline. These impacts include economic displacement, impacts on livelihoods and living standards, public health impacts, impacts to rights, risks and opportunities of those affected by the project, infrastructure safety risks and additional benefits that can arise from a hydropower facility. The intent is that livelihoods and living standards impacted by the project have been improved relative to pre-project conditions for project-affected communities, that commitments to project-affected communities have been fulfilled, and that life, property and community assets and resources are protected from the consequences of dam failure and other infrastructure safety risks. This section does not address particular subsets of the community, which are addressed in Sections 5 and 7. Other interested parties and groups are addressed in Section 10.

Background	
In the case of older projects, are there well-documented commitments in relation to project-affected communities and/or projects benefits made at the time of project approval and/or data on the pre-project baseline against which to compare post-project?	
Yes, all scoring statements are relevant	There are commitments for mitigation of local impacts as well as for contributions to local economic development; hence all statements in this section are relevant.
No, scoring statements on project affected communities and/or project benefits are not relevant (in this case, issues in relation to these topics should be taken into consideration under Section 1 – Environmental and Social Issues Management)	

Project-affected communities	
Description of project-affected communities and how they are affected (distinguish between directly affected vs economically displaced vs other affected communities and include number of people and households)	The project did not require resettlement (see Section 5) and only required a change in land use on a small, previously disturbed portion of the Farrel farm, which did not affect the viability of the farm and in fact, led to a considerable payment for land acquisition. There are a small number of farm households, guesthouses, and private residences within a radius of ~1.5 km, most of which belong to (or are on land sold by) the Farrel family. Some servitudes are registered by DWS, REH and Eskom for the related infrastructure (dam, access roads, transmission lines). Recreation on the Ash River makes a contribution to the local economy (for example, Clarens Xtreme Adventure Company employs 24 people) and is being affected by the hydropower projects, although less so by the Stortemelk project. There are relatively small benefits from local procurement and

	employment during operations. No direct local taxes are paid by Stortemelk Hydro or REH, since limited taxation applies in South Africa for property outside of urban developments.
Description of key public health issues	Key public health issues in the Free State Province are a dual HIV-TB epidemic, high maternal and child mortality, high levels of violence and injuries, increasing non-communicable diseases, and mental health issues. Most South Africans rely on public clinics and hospitals. The Covid-19 pandemic has added to the challenges, with more than 20,000 deaths in South Africa to date.
Agencies relevant to land acquisition	The Deeds Office processes voluntary land transactions and maintains a deeds register.
Agencies relevant to livelihood restoration and project benefits	The IPP office (established by agreement between the Department of Energy, the Treasury and the Development Bank of South Africa) is responsible for the Renewable Energy IPP Procurement Programme (REIPPPP), with economic development targets and criteria formulated for each bidding round. Criteria have included job creation, local content, black ownership and management control, preferential procurement, enterprise development, and local socio-economic development.
Agencies relevant to public health	Ministry of Health for policy and coordination, provincial health departments for service delivery
Infrastructure safety	
Type of dam	RCC dam and spillway, with earth embankment dam flanks on left and right bank
Dam height (m)	16 m
Probable maximum flood (m^3 / s)	South Africa generally uses the regional maximum flood (RMF) as a design criterion, which was determined as 455 m^3/s in the design of the Botterkloof Dam. This method uses observed extreme floods in a region to determine a regional value that relates catchment area to maximum flood discharge. With a relatively small local watershed of 23 km^2, potential flood flows at the Botterkloof dam are also limited. The RMF and SEF (Safety Evaluation Flood) were updated to 480 m^3/s in 2016.
Design flood (expressed as estimated flood with return period)	Floods for different return periods have been estimated, including a 1:100-year flood of 82 m^3/s. See above for design flood.
Spillway capacity (m^3 / s)	470 m^3/s; additionally up to 35 m^3/s can be released through the power house.
Spillway height (masl)	1,731.5 masl
Headrace length (m)	55 m square concrete penstock, 6 m square-to-round transition, 2 m long circular section before the turbine intake
Headrace width (m)	3.6 m x 3.6 m square concrete penstock
Headrace capacity (m^3 / s)	35 m^3/s rated (maximum) capacity
Seismicity	South Africa has experienced few major earthquakes, and seismic hazard maps show low to moderate seismic activity in the project area.
Geology	The power station was constructed through the earth embankment dam and by excavating backfill and underlying weak sand-, silt- and mudstone.

Dam safety regulatory authorities	Dam Safety Office (DSO) of the Department of Water and Sanitation (DWS)
Local presence/capacity of emergency services	Regular medical, fire and other emergency services based in Bethlehem and Clarens; as well as provincial and national institutions such as the National Disaster Management Centre (NDMC)
Potential safety risks in this context	Safety from dam break downstream, and safety on water (reservoir and downstream). There has been one fatality at the upstream TCTA tunnel outfall, about 2 years ago.
Degree of risk of dam failure and in what way	The Botterkloof dam is categorized as a 'medium' size class dam with a 'significant' hazard rating. The key failure mode would be overtopping of the embankment sections, potentially also seepage leading to piping.
Population at risk of dam break (locations, numbers)	A 'significant' hazard rating implies a potential loss of life of less than 10 persons. There are generally few people present along the downstream section of the Ash River. Whitewater rafting groups typically approach from the upstream tunnel outfall, portage around the right side of the dam, and continue downriver.
Dam safety standards followed	South African dam safety regulations prescribe safety management processes, but leave the choice of appropriate standards largely to the dam designer, who can follow a number of applicable guidelines. As the country with the 7th most dams in the world, South Africa has significant dam safety experience. DWS owns more dams than any other organization in the country.
Agencies relevant to dam safety	The DSO is supported by a cadre of professionals approved by the Engineering Council of South Africa (Approved Professional Persons - APPs).
Other infrastructure safety issues	The power station and access road are on private property and are fenced or gated. The transmission line crosses a number of roads and private farms on its way to the substation.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
4.1 Assessment		
Monitoring is being undertaken to assess if the following commitments have been delivered and if management measures are effective:		
• commitments to project-affected communities	✓	There are very few impacts on local communities and consequently, very few formal commitments and requirements for monitoring. These are monitored through personal interactions with local farmers, residents and other stakeholders.
• commitments to project benefits	✓	Because of a lack of in-house capacity, project benefits are delivered through a local partner. CCIA (Combined Churches in Action) is a Clarens-based NGO with 11 staff, dedicated to support vulnerable children and other community needs. Some ad-hoc support was provided to CCIA even before the begin of a formal relationship. The delivery

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
		of commitments to CCIA and the effectiveness of CCIA programs are now regularly monitored, including reporting to the IPP Office.
Ongoing or emerging issues relating to the following have been identified:		
• issues that affect project-affected communities	✓	Although significant effort has gone into the design of the power station (which has won an architectural award, is very compact and is well integrated into the landscape), some of the residents in the De Krantz development alongside the Boston A farm reservoir have expressed that they can see the power plant building and requested the planting of trees to shield the view. Two rafting companies that were established after the LHWP transfer and Botterkloof Dam, and use the river primarily in the warm season, have complained about water level fluctuations and water diversions related to hydropower development. However, these complaints are primarily related to LHWP operations and the construction of downstream hydropower projects, and not the Stortemelk project. One of these companies no longer operates after the 2-month water outage in 2019 due to planned TCTA tunnel maintenance.
• delivery of project benefits	✓	CCIA and Stortemelk Hydro have discussed the need to make CCIA more sustainable and less reliant on Stortemelk Hydro's contributions over time. In 2019, CCIA achieved the interim target of relying on Stortemelk for less than 60% of its revenue, with the 2020 figure closer to 50%, by mobilizing other donors. It is Stortemelk Hydro's intention to renew the MoU in 2021 for another 3 years. The hydropower plants along the Ash River have contributed to regional grid stability and reduced power losses.
• public health issues associated with the operating hydropower facility	✓	No public health issues related to the Stortemelk project have been identified. Regarding occupational health issues, see Section 2.
• dam and other infrastructure safety	✓	Ongoing and emerging issues related to the safety of the Botterkloof Dam, which have been identified since its construction, include: - safe passage of floods, without overtopping the right and left embankment sections; - small cracks and seepage in the central concrete spillway; - minor seepage on left flank downstream, near powerhouse; - vegetation control; - need for access to dam through access road and power station gates;

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
		- ability to lower water levels through gated culvert in spillway and/or through powerhouse; and - the stability of the Boston A farm dam, whose spillway is located directly next to Botterkloof Dam and the power station. The only other public safety issue raised by stakeholders is the portage around the dam, where rafters and other recreational users have to navigate large riprap.
If public health issues require management measures then monitoring is being undertaken to assess if management measures are effective	✓	No public health issues related to the Stortemelk project have been identified.
Routine monitoring of dam and infrastructure safety is being undertaken to identify risks and assess the effectiveness of management measures	✓	There is no instrumentation on the dam, and inspections are primarily visual. DWS' operational divisions are expected to regularly visit the dam and keep a logbook of observations, but it is uncertain how systematically this is done. DSO undertook annual inspections in 2016 and 2017, leading up to the second major dam safety evaluation in 2018 (after the first one in 2008). In practice, while there is no formal agreement or allocation of responsibility between parties, ongoing monitoring of dam safety is left largely to REH staff.
4.2 Management		
Measures are in place to deliver commitments:		
• to project-affected communities	✓	A number of informal arrangements are in place with the Farrel family and the De Krantz homeowners, e.g. regarding access road maintenance or planting of trees to limit the visibility of the powerhouse. Residents report positive relationships with the project.
• to project benefits	✓	CCIA has annually received contributions of 1% of the gross revenue of the project as well as, starting in 2020, dividends from its 2.5% shareholding in Stortemelk Hydro.
Measures are in place to manage any identified issues relating to these commitments:		
• to project-affected communities	✓	There is a general commitment of Stortemelk Hydro and the local landowners to cooperate pragmatically and rectify any issues that might arise. Attempts to negotiate between hydropower developers, farmers along the river and rafting companies have been partially successful (e.g. rafters have paid a contribution to a farmer's group in return for providing security), but rafters are maintaining their opposition

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
		against further hydropower developments, which have gradually reduced the number of rapids in the river.
• to project benefits	✓	REH maintains contact with CCIA and contributes to the planning and governance of the program and its funding, for example by attending CCIA's annual general meeting, reviewing periodic reports, and ensuring that CCIA adheres to the annual Socio-Economic Development Plans.
• to public health	✓	There are no related commitments or identified issues.
If there are any formal agreements with project-affected communities, these are publicly disclosed	✓	The only formal agreements are regarding the purchase of the land as well as servitudes on private land for different infrastructure components. These are with private individuals, not with the community, and are only disclosed through the deeds register.
Commitments to project benefits are publicly disclosed	✓	The commitment to support CCIA was part of the procurement process during the second round of the REIPPPP and has been discussed publicly since. Details of the contribution such as the amounts transferred are not publicly disclosed either through CCIA and REH, but only reported to the IPP Office. This could be an opportunity for improved transparency.
Dam and other infrastructure safety management plans and processes have been developed in conjunction with relevant regulatory and local authorities	✗	While there are no concerns over the design and current condition of the Botterkloof dam, plans and processes for its safety management have some shortcomings, some of which were also highlighted during the 2018 Dam Safety Evaluation: - Responsibilities for maintenance are divided and unclear. For example, REH staff control some of the vegetation growing on the dam, and REH has added a number of safety-relevant features to the dam (e.g. a 20 cm-high concrete buffer along the embankment dam crest), but there appears to be no formal agreement on the division of labour for maintenance. - Access to the dam is restricted, and DWS has no keys for gates and needs to contact REH for access. Also, the handle for the spillway sluice gate is stored in the power station. These could be issues in emergencies. - REH did not have access to relevant documents such as the O&M Manual and Emergency Preparedness Plan for the dam, and only received the 2018 Dam Safety Evaluation Report upon request during this assessment. - It is unclear if the monitoring recommendations from 2018 have been followed up by DWS' operational divisions and/or REH, and whether observations have been documented and shared. The DWS operational division was not present during the

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
		2016 and 2017 site visits, but REH was. TCTA also appears to have a remaining role in monitoring, although it has turned over the dam to DWS. - There appears to be limited interaction with local stakeholders and authorities on dam safety issues such as emergency preparedness and response. The lack of clarity regarding dam safety processes and responsibilities is a **significant gap** against basic good practice.
These plans and processes provide for communication of public safety measures	✓	While there is limited coordination between DWS, REH and local authorities, the communication of safety measures towards the general public appears adequate. The few visitors to the area (most of them recreational users with experienced guides) are informed through signage and diverted from critical areas such as the intake and spillway, through access restrictions.
Emergency response plans and processes include awareness and training programs and emergency response simulations	✗	While REH staff are well aware and trained regarding safety considerations around the area, they are mostly focused on occupational safety. There have been no systematic public safety programs or emergency response simulations, jointly with the dam owner. This is another aspect of the significant gap identified above.
4.3 Conformance and Compliance		
Processes and objectives in place to manage the following have been and are on track to be met:		
• delivery of commitments to project-affected communities, with no major non-compliances	✓	There are no indications for any non-compliances.
• delivery of commitments to project-affected communities, with no major non-conformances	✓	There are no indications for any non-conformances.
• project benefits, with no major non-compliances	✓	There are no indications for any non-compliances.
• project benefits, with no major non-conformances	✓	There are no indications for any non-conformances.
• public health issues, with no major non-compliances	✓	There are no indications for any non-compliances.
• public health issues, with no major non-conformances	✓	There are no indications for any non-conformances.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
• dam and other infrastructure safety, with no major non-compliances	✓	There are no indications for any non-compliances. DWS has obtained approvals and undertaken dam safety evaluations as required under the regulations.
• dam and other infrastructure safety, with no major non-conformances	×	There may be some non-conformances with monitoring and other plans, which are another aspect of the significant gap listed above.
Commitments have been or are on track to be met in relation to:		
• project-affected communities	✓	There are no indications for any commitments that have not been met.
• project benefits	✓	There are no indications for any commitments that have not been met.
• public health	✓	There are no indications for any commitments that have not been met.
• dam and other infrastructure safety	✓	There are no indications for any commitments that have not been met.
4.4 Outcomes		
Livelihoods and living standards impacted by the project have been or are on track to be improved	✓	There are very few households whose livelihoods or living standards could be impacted by the project at all. The most directly affected family has benefitted from the revenue of the land sale as well as through contracts during construction (e.g. concrete deliveries) and road maintenance.
Economic displacement has been fairly compensated, preferably through provision of comparable goods, property or services	✓	A small portion of the Farrel farm has been acquired and converted to a different land use, which has been fairly compensated through a willing-seller/willing-buyer transaction. There appears to be no significant economic displacement through the servitudes, either.
Communities directly affected by the development of the hydropower facility and any other identified beneficiary of the facility have received or are on track to receive benefits	✓	Benefit sharing has sensibly focused on vulnerable communities in nearby Clarens instead of the neighbours of the project. These have received significant benefits for early childhood development, nutrition and skills development. Because part of the benefits delivery mechanism is through dividends from the 2.5% shareholding in the project, those benefits arrive relatively late, after the project starts breaking even and the loan to acquire the shares is repaid.
Negative public health impacts arising from activities of the operating hydropower facility are avoided, minimised and mitigated with no significant gaps	✓	There are no negative public health impacts.
Safety risks have been avoided, minimised and mitigated with no significant gaps	✓	There are very few people exposed to any safety risks from this project. The original design of the dam as well as the retrofitting of the hydropower project have been planned, supervised and evaluated by qualified engineers (Approved Professional Person (APP), as required for this dam category under South African dam safety regulations). The design

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
		flood has been established using a conservative method, and the condition of the dam has been recently reviewed. There are no indications of any unsafe conditions in the vicinity of the project, although there is room for improvement in the coordination of safety-relevant processes.

Summary of Findings

Summary and other notable issues	List of significant gaps
The Stortemelk project has minor community impacts which have generally been well handled. There is an ongoing issue with recreational use of the Ash River, but this is more related to other downstream hydropower projects. Significant benefits have been provided in the town of Clarens, where Stortemelk is the most important donor to the main charity. The Botterkloof Dam, which is not owned by Stortemelk Hydro but by the Department of Water and Sanitation, is considered to be safe and in compliance with applicable regulations, but there is potential for improvement in the coordination of safety-relevant operations, maintenance, monitoring, and emergency preparedness and response.	● There is a lack of clarity regarding dam safety processes and responsibilities.

5 Resettlement

Scope and Intent
This section addresses how the physical displacement arising from development of the hydropower facility has been addressed, in cases where resettlement occurred and commitments are well-documented against a pre-project baseline. The intent is that the dignity and human rights of those physically displaced have been respected; that these matters have been dealt with in a fair and equitable manner; that livelihoods and standards of living for resettlees and host communities have been improved; and that commitments made to resettlees and host communities have been fully fulfilled. This section does not address those that are only economically displaced, who are addressed in Section 4.

Background	
Did the project require or result in any physical displacement of people? Please state the evidence on which this determination is made.	
Yes, this section is relevant (for older projects, move on to the next question)	
No, this section is not relevant	Due to the small footprint of the project, directly downstream of two existing dams, no physical resettlement was necessary. The land was acquired from a commercial farmer for whom this was a minor part of his landholdings. This farmer was interviewed, and the purchase agreement was viewed. Likewise, the transmission line goes across open agricultural land (with servitudes registered on behalf of ESKOM) and did not require resettlement.

6 Biodiversity and Invasive Species

Scope and Intent
This section addresses ecosystem values, habitat and specific issues such as threatened species and fish passage in the catchment, reservoir and downstream areas, as well as potential impacts arising from pest and invasive species associated with the operating hydropower facility. The intent is that there are healthy, functional and viable aquatic and terrestrial ecosystems in the area that are sustainable over the long-term; that biodiversity impacts arising from the operating hydropower facility are managed responsibly; that ongoing or emerging biodiversity issues are identified and addressed as required; and that commitments to implement biodiversity and invasive species measures are fulfilled.

Background	
Short description of the ecological region in the project area	Free State province: natural vegetation - mostly grasslands, open forests and some riparian wetlands; elevation -1,000-2,000 masl; climate - continental (warm to hot summers, cool to cold winters); rainfall - ~ 600-700 mm/a
Protected areas (national parks and reserves etc) and their distance from the project	The Golden Gate Highlands National Park boundary is approximately 20 km from the project site.
Critical habitats in the project area, including important bird areas, hotspots of endemism etc.	The south-eastern part of the Free State, where the grasslands meet the Drakensberg escarpment, is generally considered to have the highest conservation values in the province. The project site is within the 450,000 ha Rooiberge–Riemland Important Bird and Biodiversity Area (IBA), which is unprotected except for some small municipal and private conservation areas, with several endemic species of insects, reptiles, birds and mammals.
# threatened species in the directly affected area: terrestrial	None known
# threatened species: aquatic	None known.
Any other species of conservation importance	None known.
Migratory pathways	None affected. Any migration patterns that may have existed historically were already interrupted by previous hydraulic works, fences etc.
Invasive species: terrestrial	A number of non-native plant species which are widespread in South Africa and are often found in disturbed soils are also found at the site. It is expected that these can be controlled and will eventually be replaced by native vegetation.
Invasive species: aquatic	Non-native trout which are better adapted to the cold and high-flow conditions in the Ash River appear to have replaced the native fish species.
Key threats to biodiversity	Much of the grassland and wetlands in the area have been converted to farming.
Agencies involved in biodiversity conservation	Department of Environment, Forestry and Fisheries and associated bodies such as the South African National Biodiversity Institute (SANBI) and South African National Parks

	(SANParks), as well as provincial-level agencies (Free State Department of Economic Development, Tourism and Environmental Affairs)
Other relevant information	

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
6.1 Assessment		
Ongoing or emerging biodiversity issues have been identified	✓	The wetland area directly downstream on the left bank was identified as valuable. The landowners around the project established a 180 ha private game reserve (Bavaria Conservancy) with several antelope and other species (protected by a 2.4 m high fence) that surrounds the project site and access road; no significant impacts on those species are expected. Although the physical footprint of the project's temporary construction activities and permanent installations is small, land rehabilitation was identified as a priority. No impact on aquatic ecology, which is already highly modified, is expected.
If management measures are required, then monitoring is being undertaken to assess if management measures are effective	✓	Visual monitoring of invasive weeds is undertaken periodically.
6.2 Management		
Measures are in place to manage identified biodiversity issues	✓	The downstream wetland area has been fenced off and not been affected by project construction or operations. There is good cooperation with the owners of the conservancy; for example, Stortemelk Hydro has assisted with recovering an animal that escaped through the access road gate. Land rehabilitation has followed a rehabilitation plan filed with the authorities, has included spreading of stockpiled topsoil, and seeding and jute mats on steeper slopes, and has been carried out successfully. Non-native weeds (some of which have to be removed when found) are also being successfully controlled.
6.3 Conformance and Compliance		
Processes and objectives in place to manage biodiversity issues have been and are on track to be met with:		
• no major non-compliances	✓	No major non-compliances are apparent. Two conditions in the original license regarding aquatic studies and wetland bio-monitoring have been dropped through license amendments.
• no major non-conformances	✓	No non-conformances are apparent.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
Biodiversity related commitments have been or are on track to be met	✓	Commitments have been met.
6.4 Outcomes		
Negative biodiversity impacts arising from activities of the operating facility are avoided, minimised, mitigated, and compensated with no significant gaps	✓	There are no indications of any negative impacts from the project, which is located on land and along a river which have been significantly disturbed and modified by previous human activities. The project makes no positive contributions to biodiversity either. Higher water tables due to higher flows in Ash River may be benefitting riparian wetlands, but this has not been investigated in detail and would not be due to the Stortemelk project.

Summary of Findings

Summary and other notable issues	List of significant gaps
While the wider area has a relatively high conservation value and the power station is located within a private protected game reserve, the direct footprint of the project is very small and has no implications for biodiversity conservation.	

7 Indigenous Peoples

Scope and Intent
This section addresses the rights at risk and opportunities of Indigenous Peoples with respect to the hydropower facility, recognising that as social groups with identities distinct from dominant groups in national societies, they are often the most marginalized and vulnerable segments of the population. The intent is that the operating facility respects the dignity, human rights, aspirations, culture, lands, knowledge, practices and natural resource-based livelihoods of Indigenous Peoples in an ongoing manner throughout the project life.

Background	
Are any of the affected people Indigenous Peoples? Please state the evidence on which this determination is made.	
Yes, this section is relevant	
No, this section is not relevant	In South Africa, only the Khoisan (or non-Bantu) ethnic groups who make up ~1% of the population are generally considered as indigenous people. Their traditional leadership was recognised through the 2019 Traditional and Khoisan Leadership Act, and South Africa adopted the United Nations Declaration on the Rights of Indigenous People (UNDRIP) in 2016. There are no indications for any indigenous groups in the vicinity of the Stortemelk project. The National Khoi & San Council indicates that most of their members reside in the western part of the country, with Bloemfontein as the closest area represented.

8 Cultural Heritage

Scope and Intent
This section addresses cultural heritage, with specific reference to physical cultural resources, associated with the hydropower facility. The intent is that physical cultural resources are identified, their importance is understood, and measures are in place to address those identified to be of high importance. This section does not address non-physical cultural resources, which are addressed in Section 1 and/or in Sections 5 and 7 when relevant.

Background	
Does the project affect any physical cultural resources? Please state the evidence on which this determination is made.	
Yes, this section is relevant	
No, this section is not relevant	The physical footprint of the hydropower station is only 0.4 ha, in an area that was previously disturbed during construction of the Botterkloof and Boston A dams. Similarly, the adjacent construction camp site was previously used and has been rehabilitated. No borrow pit was necessary. The closest listed sites are historical building in the town of Clarens, 10 km to the south. In the vicinity of Clarens, rock paintings and dinosaur fossils have been discovered in recent years, but these are again at a considerable distance from the project site. Regarding paleontology, the publicly available GIS database SAHRIS (https://sahris.sahra.org.za/) of the South African Heritage Resources Agency (SAHRA) shows the project site and the Ash River with 'moderate sensitivity' (i.e. desktop studies required for new projects). SAHRA was not consulted during the ESIA for the Stortemelk hydro project, as the regulatory threshold was not met, but was notified by ESKOM regarding the transmission line. No further action was deemed necessary, and no heritage resources were identified during construction and operation. In 2017, the REH Group instituted a modern Chance Finds Procedure that applies to all projects and to contractors and consultants. However, since no further excavations are likely at Stortemelk, this is very unlikely to be triggered.

9 Governance and Procurement

Scope and Intent
This section addresses corporate and external governance considerations for the operating hydropower facility. The intent is that the owner/operator has sound corporate business structures, policies and practices; addresses transparency, integrity and accountability issues; can manage external governance issues (e.g. institutional capacity shortfalls, political risks including transboundary issues, public sector corruption risks); and can ensure compliance.

Background	
Key information on political context and public sector risks	South Africa is a parliamentary democracy. It is ranked 84th out of 190 countries on the World Bank's Doing Business Index, and 70th out of 190 countries on Transparency International's Corruption Perceptions Index, indicating a complex environment for private businesses, particularly for those interacting with public entities (e.g. for contracting and permitting). The power generation sector in South Africa has been criticized for its operational performance and costs, leading to a risk of non-payment by the offtaker Eskom (although there is a back-up provision with government), or political interventions that affect PPAs.
Key information on corporate ownership and governance	The REH Group is owned by its founder Anton-Louis Olivier, responsAbility Renewable Energy Holding (majority-held by KfW, Norfund, the Nordic Development Fund), and the Mergon/Mertech Group. REH Group is overseen by a Board of Directors representing the main shareholders, and is organised into a holding and two subsidiaries for project development and for O&M. It owns 70% of the special purpose vehicle Stortemelk Hydro, while the remaining 30% are owned by the investment vehicle Vapotouch, qualifying as a Broad-based Black Economic Empowerment (BBBEE) entity with shares held by the black industrialist group H1 Capital and the local NGO CCIA.
Details of the concession, if applicable	Generation License granted 2012/2013 PPA concluded 2013
Key licenses or permits	Environmental Authorisation granted 2009 Water Use License granted 2011
Other relevant information	

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
9.1 Assessment		
Ongoing or emerging political and public sector governance issues have been identified	✓	Between the shareholders, there is substantial experience with political and public sector governance issues, and these are constantly followed and if required, discussed in the REH Board and with the co-owners in the special purpose vehicles, such as Stortemelk Hydro. One example is that the Department of Energy is aiming to reduce tariffs in existing PPAs with IPPs, by refinancing of debt and extension of PPAs, on a voluntary basis. The tariffs that were achieved by projects like Stortemelk in the 2nd round of REIPPPP bidding (based on audited financial models) are higher than could be achieved today, after a general drop in renewables costs.
Corporate governance requirements and issues have been identified	✓	There have been frequent discussions with shareholders and external experts on corporate governance issues. Mergon as an experienced impact investor contributed a number of corporate governance principles. ERM was contracted in 2017 for a review by against IFC Performance Standards and Equator Principles, which resulted in some corporate policy and management system improvements.
Monitoring is being undertaken to assess if corporate governance measures are effective	✓	Monitoring is undertaken through the board of REH and the other shareholders of Stortemelk Hydro.
9.2 Management		
Processes are in place to manage the following:		
• corporate, political and public sector risks	✓	All interactions with government entities such as the REIPPPP bidding, permitting, power sales etc. appear to have followed the correct processes. For example, REH submitted all required documents to successfully participate in the 2nd round of REIPPPP program, and the capacity of the Stortemelk plant was confirmed by an independent engineer (AECOM) as the basis for the PPA. The risks of the Stortemelk project during the operation stage, including its exposure to adverse political and public sector developments, are considered to be relatively low. There is a formal Service Level Agreement with the REH O&M subsidiary, with a performance bonus for plant availability. There is no formal risk register, but this is not seen as a gap.
• compliance	✓	Regulators and minority shareholders confirm compliance of the Stortemelk project and more generally, a good culture of compliance within REH. The legal counsel of the REH Group has primary responsibility for tracking compliance requirements. There are also

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
		periodic reviews of all licenses and other documents relevant for compliance, to make sure all requirements are met and to reflect any material changes.
• social and environmental responsibility	✓	The REH Group's Environmental and Social Policy, which is supported by a suite of management and monitoring plans, risk assessment methodologies, manuals and procedures, ensures responsible behaviour. The group does not make major financial contributions to E&S causes beyond those required by regulations and contracts (see Section 4) but strives to be a good neighbour locally and contribute to sustainable development nationally. It also participates in initiatives such as Nation Builder, which aim to foster positive E&S impacts from private businesses.
• procurement of goods and services	✓	There is board-level oversight for major procurement decisions. There are no formal procurement policies for Stortemelk, where most purchasing is for small operational expenses under the authority of REH O&M. Under the Economic Development agreements, procurement from BBBEE, small, women-owned, disabled people-owned, and youth-owned is being reported.
• grievance mechanisms	✓	Grievance mechanisms are available both for external and for internal stakeholders.
• ethical business practices	✓	Staff enter commitments for ethical behaviour through their employment contracts. Tender documents also contain relevant requirements.
• transparency	✗	The commitments towards public disclosure in the E&S Policy and Grievance Mechanism are currently not met. This is discussed in Section 10, and this gap is not double-counted here.
Policies and processes are communicated internally and externally as appropriate	✓	As REH is a small organisation, internal communication of policies and processes is functioning relatively smoothly, although there could be more clarity about the applicability of some aspects of the procedures. Externally, there is some information on the projects and policies available on the REH website, but only the grievance mechanism can be downloaded; see Section 10.
In case of capacity shortfalls, appropriate external expertise is contracted for additional support	✓	It is standard practice in REH to contract external expertise.
9.3 Conformance and Compliance		
The project has no major non-compliances	✓	Regulators have confirmed that Stortemelk Hydro has no non-compliances. Eskom has also complied with payment obligations under the PPA.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
9.4 Outcomes		
There are no significant unresolved corporate and external governance issues identified	✓	There are currently no significant unresolved external governance issues, but there is an opportunity to participate in a revision of the PPA. There may be further shifts in the ownership structure, although these would not be expected to fundamentally affect the Stortemelk project. There are some opportunities to streamline and formalize some corporate policies and processes, but these are not considered as significant unresolved internal governance issues.

Summary of Findings

Summary and other notable issues	List of significant gaps
South Africa presents some governance challenges for private businesses, but the Stortemelk project has been able to avoid and mitigate these to date. The REH Group and its subsidiary Stortemelk Hydro generally have well-developed corporate governance structures and processes, although there is some scope for consolidation.	

10 Communications and Consultation

Scope and Intent
This section addresses ongoing engagement with project stakeholders, both within the company as well as between the company and external stakeholders (e.g. affected communities, governments, key institutions, partners, contractors, catchment residents, etc). The intent is that stakeholders are identified and engaged in the issues of interest to them, and communication and consultation processes maintain good stakeholder relations throughout the project life. Communications and consultation requirements unique to physically displaced communities and Indigenous Peoples are found in Sections 5 and 7, respectively.

Background	
Directly affected community-level stakeholders	Neighbouring farmers and residents, Ash river users
Directly affected institutional-level stakeholders	Eskom, TCTA and regulators
Other relevant information	

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
10.1 Assessment		
Ongoing or emerging issues relating to hydropower facility communications and consultation have been identified	✓	Communication needs have been identified from an early stage in project development, and the Basic Assessment process in 2009 involved some stakeholder consultations. Informal communication with local stakeholders has been maintained over the years. Local stakeholders are sometimes unclear about the exact responsibilities e.g. for management of river flows, between the Stortemelk project, DWS and TCTA. TCTA is generally taking care of communications about longer-term shutdowns (due to tunnel maintenance). Rafting companies and other recreational river users have limited information about short-term operations, and may be surprised about hydropower plant shutdowns that reduce river flows for short periods of time (<10min), after which flows increase for a short period of time above average levels. However, many of these shutdowns are unplanned (due to grid instabilities), in which case there is no way to inform affected stakeholders in advance. No incidents related to these short-term variations have been reported since the plant was commissioned.
Requirements and approaches are determined through a periodically updated	✓	There is an initial stakeholder database in the draft Stakeholder Engagement Plan, resulting from the EIAs for REH's three hydropower projects, as well as a generic database of the

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
assessment process involving stakeholder mapping		typical stakeholders that would be expected and need to be identified in detail. There is also a map and list of farms and farmers along the Ash River with contact information, and there are informal stakeholder maps resulting from interactions of REH staff (and in particular the O&M manager) with stakeholders over the years. These have not been consolidated into an up-to-date stakeholder map, and have not been used to systematically determine communication requirements. While this is a gap, it is not considered significant because no stakeholders have complained about a lack of communication or access to information.
Effectiveness is monitored	✓	Communication effectiveness is informally monitored by REH staff, who have not seen a need to formalize communications procedures.
10.2 Management		
Communications and consultation plans and processes are in place to manage communications and engagement with stakeholders	✓	There is a draft Stakeholder Engagement Plan from 2017 which has been partially implemented. Communications with regulators and authorities follow appropriate channels. The Stortemelk project is generally known among stakeholders, and staff are seen as easily approachable and responsive. While the formal grievance process has not been used, any complaints and suggestions from local stakeholders are discussed at the monthly staff meetings, and documented in the minutes of those meetings. There have been activities like schoolchildren visits to the project, organised jointly with CCIA, that have fostered considerable goodwill.
These plans and process include an appropriate grievance mechanism	✓	Grievance mechanism instructions have been posted to REH's website, but to date have not been used. There is also a formal internal grievance mechanism, with instructions in each staff member's employment contract, which also has not been used.
These plans and processes outline communication and consultation needs and approaches for various stakeholder groups and topics	✓	The draft Stakeholder Engagement Plan has some limited information on appropriate communication methods; in practice this has been handled informally, with REH staff members reaching stakeholders more on an ad-hoc basis. Contact information for REH staff is displayed at various locations such as the gates on access roads.
10.3 Stakeholder Engagement		
The project operation stage involves engagement with directly affected stakeholders	✓	As described above, there has been engagement although it has largely been ad-hoc and reactive with local stakeholders, and driven by formal reporting and monitoring issues with regulators.
Engagement is:		

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
• appropriately timed and scoped	✓	Stakeholders confirm that they generally have access to timely and relevant information when they request it.
• often two-way	✓	Stakeholders confirm that engagement is often two-way and Stortemelk staff is responsive to their suggestions and requests.
• undertaken in good faith	✓	Stakeholders confirm that they are treated respectfully and that Stortemelk staff engage in good faith.
The business interacts with a range of directly affected stakeholders to understand issues of interest to them	✓	Stortemelk Hydro often reacts to information requests und thus understands well which issues are of interest to stakeholders. There is some potential to follow up more proactively with stakeholders, for example by informing rafters and perhaps other river users of operational changes. If this is of interest, a simple group text arrangement could involve operators from TCTA, DWS and Stortemelk, local authorities and river users, and could help stakeholders plan and coordinate activities, and contribute to public safety. Some neighbours have expressed curiosity about the hydropower plant, and could be invited for a visit.
Ongoing processes are in place for stakeholders to raise issues and get feedback:		
• in general	✓	There are adequate processes in place.
• environmental and social issues	✓	There are adequate processes in place.
• project-affected communities	✓	There are adequate processes in place.
• resettlees and host communities	✓	Not relevant.
• Indigenous Peoples	✓	Not relevant.
• employees and contractors on human resources and labour management issues	✓	There are adequate processes in place.
• management of climate risks	✓	There are adequate processes in place.
Public disclosure:		
• the business makes significant project reports publicly available	✗	Significant project reports like the basic assessment report, feasibility study, environmental authorization and other permits, audit or monitoring reports are not made publicly available, and nor are summaries or non-technical versions. Some of these can be found online, such as the Basic Assessment Report on the EIB's website, but this is not a replacement for publication through the project owner. This is seen as a **significant gap** against basic good practice.
• the business publicly reports on project performance, in some sustainability areas	✗	While there are some reports to shareholders, lenders and regulators e.g. on E&S issues such as incidents, there is no publicly available information and no materiality process to

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
		determine what sustainability areas stakeholders are interested in. This is another aspect of the significant gap identified above.
• power density calculations, estimated GHG emissions, and / or the results of a site-specific assessment are publicly disclosed	✓	Not relevant (see Section 12).
10.4 Conformance and Compliance		
Processes and objectives relating to communications and consultation have been and are on track to be met with:		
• no major non-compliances	✓	Stortemelk Hydro and REH appear to be in compliance with all communications and consultation requirements.
• no major non-conformances	✗	The E&S Policy, draft Stakeholder Engagement Plan and external Grievance Mechanism all prescribe mechanisms for public access to information which have not been followed in practice. This is another aspect of the significant gap identified above.
Communications related commitments have been or are on track to be met	✓	There do not appear to be any voluntary communications commitments to stakeholders, that have not been met.

Summary of Findings

Summary and other notable issues	List of significant gaps
Like many small hydropower projects, Stortemelk is well embedded within the local community with many informal communication channels, and stakeholders see project staff as open and responsive. There are some formal communications plans and processes, but these are not as effective as they could be. In particular, some public disclosure plans have not been implemented.	● There is a lack of public disclosure of project information.

11 Hydrological Resource

Scope and Intent
This section addresses the hydrological resource availability and reliability to the operating facility, reservoir planning and downstream flow regimes in relation to operating hydropower facility. The intent is that power generation planning and operations take into account hydrological resource availability and reliability in the short- and long-term, that issues with respect to downstream flow regimes are identified and addressed, and that the reservoir is well managed taking into account power generation operations, environmental and social management requirements, and multi-purpose uses where relevant.

Background	
Hydrology and flows	
Average flow at dam (m^3 / s)	24.5 m^3/s
Minimum monthly average flow (m^3 / s) Maximum monthly average flow (m^3 / s) Lowest observed flow (m^3 / s) Highest observed flow (m^3 / s)	The flow varies between ~ 14 m^3/s in summer and ~ 32 m^3/s in winter. Flows are higher in winter because of higher water demand in South Africa and higher power demand in Lesotho. Phase 2 of the LHWP will further increase the flow rate to ~ 40 m^3/s over a period of about 25 years. The LHWP delivery tunnel is restricted to 42-44 m^3/s. When the upstream Muela power plant and/or the delivery tunnel are shut down, inflows into the Botterkloof reservoir are reduced to the natural flow rate in the small tributary to the Ash River. This flow is very small, intermittent and not sufficient to operate the power station, which requires a minimum flow of 8.5 m^3/s.
Design flow (m^3 / s)	30 m^3/s (flow at maximum efficiency; the maximum intake capacity is 35 m^3/s)
Affected river reaches (start/end and how affected)	Because of limited capacity, the upstream Muela reservoir or 'tail pond' can only partially re-regulate the Muela power station peaking operations. Variations in deliveries cause major Botterkloof reservoir level and downstream flow variations. In addition, the delivery tunnel needs to be periodically shut down for longer periods, for revisions and repairs. By comparison, the Stortemelk power plant has minor impacts on the water level in the reservoir and on downstream flow rates and water levels. The reservoir water level is generally maintained at ~ 5 cm below the spillway crest (considered as FSL) to maximize the head. When inflows are higher than 35 m^3/s or the power plant is shut down, the reservoir begins to spill over the ungated spillway after a short period. When the power plant resumes operations while the reservoir is still spilling, for a short period the flow below the dam is higher than the inflow into the reservoir. If the reservoir level drops below 30 cm below FSL, the power plant shuts down.

Proposed downstream flow regimes for environmental or social objectives	The environmental reserve flow for the Ash River has been determined as only 50 l/s. This does not apply to the small tributary reach of the Ash River on which the Botterkloof dam is located. The Botterkloof dam was built and is still operated to buffer inflow variations. No other downstream flow rules have been imposed.
Reservoir	
Reservoir length (km)	roughly 1.5 km, as measured from map
Minimum operating level MOL (masl)	Unknown
Normal operating level (masl)	~ 5 cm under FSL (1,731.5 masl)
Full supply level FSL (masl)	1,731.5 masl
Reservoir area at FSL (km^2)	20 ha
Reservoir area at MOL (km^2)	Unknown
Volume at FSL (million m^3)	600,000 m^3
Volume at MOL (million m^3)	The minimum operating level is determined either by the lower level of one gated culvert in the spillway, or the lower level of the power plant intake. Below that level is the 'dead storage' volume of the dam. While there are no data on the dead storage volume, the live storage has been estimated at ~ 2 hours of operations.
Average retention time in days	At an average inflow of 24.5 m^3/s, the retention time for the full water volume is ~ 7 hours.
Number of days for filling	Approximately 7 hours
Other relevant information	

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
11.1 Assessment		
Ongoing or emerging issues have been identified, in the following areas:		
• hydrological resource availability and reliability	✓	Hydrological resource availability and reliability largely depends on Lesotho's compliance with water delivery obligations to South Africa, under their bilateral treaty, as well as the scheduling of operations and maintenance of Lesotho's water infrastructure. These have been compliant and predictable to date, and in fact flows have been higher than in the projections before construction of Stortemelk. The continuity of flows, further enhanced by the buffering in the Botterkloof reservoir, has been a major argument for building the Stortemelk project, as it leads to a high capacity factor which will further increase with Phase 2 of the LHWP.
• reservoir management	✓	The reservoir is largely managed passively on an inflow = outflow basis. The retrofitting of the Stortemelk hydropower plant has added small variations to reservoir water levels when

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
		the plant is shut down and restarted. While this has not been formally analysed, it is not considered a gap, as there are no significant issues resulting from these minor variations, which are within the range of the variations that would be experienced with Stortemelk. Also, the plant is designed so that for most of the shut-downs, which are caused by short Eskom grid instabilities that last less than 3 minutes, the turbine will automatically re-synchronize and restart, without the need for operator intervention.
• downstream flow regimes	✓	An environmental reserve flow for the Ash River has been established, but does not apply to the small tributary on which the Botterkloof dam is located. This tributary has always been intermittent and hence, short interruptions in flows from Stortemelk operations are not considered as relevant. The need to reduce impacts from the ramping up or ramping down of flows has also been established.
In these areas, if management measures are required then monitoring is being undertaken to assess if management measures are effective:		
• reservoir management	✓	Reservoir levels are monitored continuously, as they determine the power station intake flows.
• downstream flow regimes	✓	Downstream flows are not gauged, but anecdotal information is that flow variations are usually minor except in the case of forced, unplanned shutdowns (when there is no ability to gradually ramp down flows). Rafting operators have complained about water level variations.
Monitoring is being undertaken of hydrological resource availability and reliability	✓	Because of the large importance of reliable supplies from the LHWP for Lesotho's and South Africa's economies, there is significant attention on hydrological monitoring, forecasting and management, both by the Lesotho authorities and by downstream agencies such as Rand Water. There are also annual coordination meetings in Pretoria for the major stakeholders in the upper Vaal catchment, where medium- and longer-term developments are discussed. The Stortemelk project itself does not conduct hydrological monitoring, as a) its small storage capacity and operating rules do not allow meaningful active storage management, b) there is no incentive (for example, in the form of time-of-day tariffs) to manage water inflows for peaking, and c) the overriding objective of the Botterkloof dam is to reduce downstream variability, and hence peaking is not likely be welcomed by the dam owner and downstream river users. There is some illegal water abstraction along the Ash River, and the DWS is trying to enforce water use license conditions. However, almost all of these are downstream of the Botterkloof Dam.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
Inputs include:		
• field measurements	✓	There are a number of gauging stations where flows are monitored, including at the tunnel outfall just upstream of the power station.
• appropriate statistical indicators	✓	As mentioned above, flow data are constantly monitored and analysed.
• issues which may impact on water availability or reliability	✓	See the discussion of climate change resilience in Section 12.
• a hydrological model	✓	Hydrological models have been used in conjunction with climatological and water management models to project and assess Lesotho's options.
11.2 Management		
Measures are in place to manage identified reservoir management issues	✓	Reservoir levels are automatically regulated through sensors and regulation of the turbine intake. The Department of Water and Sanitation as the owner of the dam can make use of a sluice gate, which controls the one remaining culvert in the spillway (originally there were three, two of which were closed in the process of constructing the power station). The sluice gate could be used to lower the level of the reservoir, for example for dam inspections or repairs. Since commissioning of the power plant, this has not been necessary. The reservoir level can also be lowered through the power station. Grass, garbage and other debris that collects in front of the trash racks is extracted by Stortemelk hydro and disposed of (see Section 3).
In the case of a need to address downstream flow regimes, measures are in place to address identified downstream flow issues	✓	There is no environmental minimum flow required for the small tributary of the Ash River. However, flows are provided almost continuously due to the operating procedures which provide for spilling after a short while. Ramp-up and -down procedures have been discussed with the turbine manufacturer and are implemented when possible.
Where formal commitments have been made to downstream flow regimes, these are publicly disclosed	✓	Reserve requirements are publicly available for all South African rivers, including the Ash River a few km downstream of the project, which receives a natural base flow.
Measures are in place to guide generation operations that are based on:		
• analysis of the hydrological resource availability	✓	Resource availability has been analysed in the project feasibility study and has been the basis for project design and operations.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
• a range of technical considerations	✓	A number of alternatives have been considered, although the options were narrowly constrained by the design and objectives of the existing infrastructure.
• an understanding of power system opportunities and constraints	✓	Stortemelk is not a very significant component of South Africa's generation fleet of more than 51 GW installed capacity, is locked into a long-term PPA, and has limited ability to actively schedule the timing of its generation. Therefore, the fact that there are limited efforts to analyse power system opportunities and constraints is not seen as a gap.
• social, environmental and economic considerations	✓	Social and environmental considerations are incorporated by operating Stortemelk as a run-of-river station with small impacts on downstream flows. Economic considerations are incorporated by choosing a site where generation equipment is used efficiently, with a high load factor, and the usefulness of pre-existing infrastructure like the Lesotho transfer scheme and the Botterkloof dam are enhanced.
11.3 Conformance and Compliance		
Processes and objectives in place to manage each of the following have been and are on track to be met:		
• reservoir management, with no major non-compliances	✓	There are no indications for any major non-compliances regarding reservoir management.
• reservoir management, with no major non-conformances	✓	There are no indications for any major non-conformances regarding reservoir management.
• in the case of a need to address downstream flow regimes, with no major non-compliances	✓	There are no indications for any major non-compliances regarding downstream flows.
• in the case of a need to address downstream flow regimes, with no major non-conformances	✓	There are no indications for any major non-conformances regarding downstream flows.
Commitments related to the following have been or are on track to be met:		
• reservoir management	✓	There are no relevant commitments to any stakeholders.
• downstream flow regimes	✓	There are no relevant commitments to any stakeholders.
11.4 Outcomes		
In the case of a need to address downstream flow regimes and commitments to downstream flow regimes have been made,	✓	There are no formal requirements to address downstream flow regimes and no associated commitments, but the operations take a range of objectives into account.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
these take into account environmental, social and economic objectives		
Downstream flow regimes take agreed transboundary objectives into account, where relevant	✓	Not relevant regarding Stortemelk's operations; however, the overall flow regime in the Ash River is determined by objectives that are bilaterally agreed between Lesotho and South Africa.

Summary of Findings

Summary and other notable issues	List of significant gaps
Reservoir and downstream conditions are almost completely determined by water deliveries from the LHWP. The Stortemelk project has limited influence, and there are few relevant impacts and objectives, and no formal requirements other than power generation to consider.	

12 Climate Change Mitigation and Resilience

Scope and Intent
This section addresses the estimation and management of the project's greenhouse gas (GHG) emissions, analysis and management of the risks of climate change for the project, and the project's role in climate change adaptation. The intent is that the project's GHG emissions are consistent with low carbon power generation, the project is resilient to the effects of climate change, and the project contributes to wider adaptation to climate change.

Background	
Climate Change Mitigation	
Capacity (MW) (or additional capacity in case of expansion/ rehabilitation projects)	4.3 MW
Average reservoir area (representing area of flooded land, net of pre-impoundment water body) (km^2) (or additional reservoir area if any, for expansion/rehabilitation projects)	20 ha
Power density (W / m^2)	29 W/m^2, based on rough estimate of reservoir surface
Emissions intensity (gCO_2e / kWh)	Not calculated, because a) reservoir emissions from Botterkloof Dam could only be partially allocated to the Stortemelk hydro plant as the reservoir was established earlier and the hydro plant does not materially change reservoir operations, b) emissions from construction of the compact structures and from operations are negligible, if divided by the amount of power generated over the lifetime of the plant.
National and regional policies, plans and commitments relevant to mitigation	South Africa is the world's 14th largest emitter of GHGs, largely due to a heavy reliance on coal in power generation. Its Nationally Determined Contributions (NDC) under the Paris Agreement and its 2019 Integrated Resource Plan for the power sector project a relatively slow transition away from coal. A carbon tax will come into effect from 2020.
Climate Change Resilience	
Hydrological data available for the project site and the basin, and observed climate trends	Hydrology for the site is almost entirely determined by releases from the Lesotho Highlands Water Project (LHWP). If and when completed, the 2nd phase of that scheme will further increase flows in the Ash River. In the longer term, climate change in the water source areas may affect LHWP water deliveries, if average precipitation declines or if it becomes more irregular and storage capacities are insufficient.
Regional and basin-level climate models relevant to the project location, if any	The World Bank Climate Knowledge Portal provides easy access to a range of climate models. See projections below.

Any climate change predictions for the project location, and degree of consistency	Temperature projections for Lesotho: • The northern areas are projected to see annual temperatures increase between 0.4-4.7°C while the southern regions will experience temperature increases between 0.2-3.8° C by 2100. • The number of 'frost' days is projected to decrease by mid century (2046-2065) and late century (2081-2100) under all emissions scenarios. The largest projected change in the number 'frost' days is over northeastern Lesotho in the Mountain livelihood zone. • The number of 'warm' days and nights is projected to increase by mid and late 21st century under low, medium, and high emissions scenarios. Northwestern Lesotho is projected to see the largest increase. Precipitation projections for Lesotho: • Projections suggest a late onset of summer rains and a change in rainfall patterns that will become more erratic. • Mean annual precipitation is projected to increase slightly by middle (2046-2065) and late 21st century (2081-2100), under all emissions scenarios. Southern Lesotho is projected to see average to below average precipitation in summer. • Projections indicate an increase in the intensity and frequency of floods and droughts. Downscaled projections for South Africa and Lesotho are also available at https://pta-gis-2-web1.csir.co.za/portal/apps/GBCascade/index.html?appid=b161b2f892194ed5938374fe2192e537.
National policies, plans and commitments relevant to adaptation and resilience	South Africa's National Climate Change Adaptation Strategy was approved in August 2020, with the water sector as a key area for adaptation, but no specific implications and actions for the hydropower sector or the region dependent on the LHWP.
Other relevant information	The Stortemelk project feeds directly into the South African grid. The grid's emissions intensity is ~ 900 g CO_2eq/kWh, which is very high by international comparison. Despite its small size, generation from Stortemelk thus displaces a significant amount of emissions.

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
12.1 Assessment		
Climate Change Mitigation		
If power density is below 5 W/m^2, net GHG emissions (gCO_2e) of electricity generation	✓	Not relevant. Power density is higher than 5 W/m^2. No new reservoir was created for the Stortemelk project and the existing reservoir is not primarily operated for hydropower, so

Requirement	Requirement is met: yes (✓) or no (✗)	**Findings and Observations**
are calculated, independently verified and periodically updated		in any case, only a small share of any emissions would be allocated to the hydropower project.
If power density is below 5 W/m^2 and estimated emissions are above 100 gCO_2e/kWh, a site-specific assessment of GHG emissions is undertaken and periodically updated	✓	Not relevant.
Climate Change Resilience		
An assessment of the project's resilience to climate change is undertaken and periodically updated	✓	No assessment specific to the project has been undertaken, but this gap is not seen as significant because a) hydrology at the site is completely dominated by large-scale investment and operational decisions between Lesotho and South Africa regarding the LHWP, b) due to the significant exposure of South Africa to climate change, research into the resilience of regional water systems and specifically, the LHWP, is already being undertaken and will likely be periodically updated.
The assessment:		
• incorporates an assessment of plausible climate change at the project site	✓	Local climate change projections and risk profiles for South African municipalities such as Dihlabeng are available at https://greenbook.co.za/.
• identifies a range of climatological and hydrological conditions at the project site	✓	These identify a range of climatological and hydrological conditions.
• applies these conditions in a documented risk assessment or stress test	✓	No stress test specifically for the Stortemelk hydropower project has been conducted, but this is not seen as a gap given the small size of the project and the projected water deliveries under Phase II of the LHWP, which will increase the capacity factor even further. See additional reasons for non-significance below.
The risk assessment or stress test encompasses:		
• dam safety	✓	(See also Section 4.) Maximum deliveries from the LHWP depend on the limited tunnel capacity of ~ 40 m^3/s, which is close to the Stortemelk hydropower station's rated (maximum) intake capacity of 35 m^3/s. With a relatively small local watershed of 23 km^2, potential flood flows at the Botterkloof dam are also limited. The DWS used a 1:100-year flood of 82 m^3/s and a regional maximum flood (RMF) of 455 m^3/s in the design of the Botterkloof dam. The RMF and SEF (Safety Evaluation Flood) were updated to 480 m^3/s in 2016. The spillway capacity is 470 m^3, and the dam crest has been raised with a concrete buffer.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
• other infrastructural resilience	✓	The resilience of other components (such as the powerhouse, transmission line and access roads) is not expected to be significantly affected. Ventilation of the power station (and in particular, the transformer room) may have to be increased in hotter conditions, which can be easily done.
• environmental and social risks	✓	Social and environmental risks of the Stortemelk hydropower station are limited and are not expected to be significantly modified by climate change.
• power generation availability	✓	Risks and opportunities for generation availability from climate change are expected to be insignificant, compared to those resulting from LHWP investments and operations. When intermittent renewables start playing a much larger role in the region, there might be incentives to operate the upstream Muela power station in a more variable manner, but this will be constrained by treaty obligations and existing infrastructure.
12.2 Management		
Climate Change Mitigation		
If GHG emissions estimates assume design and management measures, these measures are in place	✓	No specific design or management measures required. The current arrangements minimize emissions.
Climate Change Resilience		
Measures are in place to avoid or reduce identified climate risks	✓	No specific design or management measures required, as no significant climate risks are apparent.
12.3 Conformance and Compliance		
Climate Change Mitigation		
Processes and objectives relating to mitigation have been and are on track to be met with:		
• no major non-compliances	✓	Not relevant.
• no major non-conformances	✓	Not relevant, beyond REH's conformance with generation plans and objectives, which have been consistently met.
Mitigation-related commitments have been or are on track to be met	✓	Not relevant, beyond REH's strategic objective to expand low-carbon generation, which is being pursued consistently.
Climate Change Resilience		
Processes and objectives relating to resilience have been and are on track to be met with:		
• no major non-compliances	✓	Not relevant.

Requirement	Requirement is met: yes (✓) or no (✗)	Findings and Observations
• no major non-conformances	✓	Not relevant.
Resilience-related commitments have been or are on track to be met	✓	Not relevant.
12.4 Outcomes		
Climate Change Mitigation		
The project's GHG emissions are demonstrated to be consistent with low carbon power generation	✓	While there has been no specific assessment of reservoir GHG emissions, it is plausible that the project has very low emissions and displaces some high-carbon generation. The project is registered under UNFCCC (CPA 7887) but no trading of certificates has taken place, as by the time of commissioning the price of certificates had dropped significantly.
Climate Change Resilience		
Findings of the climate change assessment indicate that the project is resilient to climate change	✓	While there has been no specific assessment of climate change, it is highly plausible that the project is resilient.

Summary of Findings

Summary and other notable issues	List of significant gaps
The Stortemelk project makes a small but significant contribution to reducing emissions in South Africa's power sector, produces almost no incremental emissions, and has no major exposure to climate change.	

Appendix 1 – Interviews

Ref	Interviewee/s, Position	Organisation	Date and Time (MST)
1	Anton-Louis Olivier, Managing Director	REH Group	Nov 9, 8am and Nov 20, 6am
2	Reyburn Hendricks, CEO	H1 Holdings	Nov 19, 7:30am
3	Almero Strauss, Group Director	Mergon (also Non-Executive Director, REH Group)	Nov 10, 9am
4	Hugh Hawarden, Infrastructure Finance Transactor	Rand Merchant Bank	Nov 18, 8:45am
5	Hendrik (Henk) Hattingh, General Manager	REH Operations & Maintenance	Nov 12, 8am
6	Arnold Moloi, Stortemelk Plant Caretaker	REH Operations & Maintenance	Nov 12, 7:30am
7	Jaco Farrel, Landowner	Independent Farmer	Nov 12, 9:30am
8	Bernie Platt (Treasurer) and Thomas Thaele (Manager)	Combined Churches in Action (CCIA), Clarens	Nov 10, 8am
9	Themba Ngomane, O&M Engineer	Trans-Caledon Tunnel Authority	Nov 11, 8am
10	Strafford Harris, Financial and HR Manager	REH Group	Nov 18, 5:45am
11	Phillimon Khwinana and Florah Mamabolo	Department of Water and Sanitation (DWS)	Nov 11, 7am
12	Mike Muller, former Director General (1994-2005)	Department of Water Affairs and Forestry (DWAF)	Nov 12, 8:30am
13	Oliver Esplin, Owner	Clarensxtreme rafting company	Nov 10, 9am
14	Bertrand Collet, Technical Director	Zutari (formerly Aurecon)	Nov 9, 9am
15	Reuben Heydenrych, Manager, Environment and Planning	Zutari (formerly Aurecon)	Nov 16, 9:30am
16	Mahlabela Comfort, Dam Safety Office	Department of Water and Sanitation (DWS)	per email
17	Heather Bellew and Corné van Rooyen, Home Owners	De Krantz development	per email
18	Charmaine Rowland, Programme Manager	IPP Office	Nov 19, 6:30am
19	Bongi Masemola and Sandile Jacobs, Compliance Engineers	National Energy Regulator of South Africa (NERSA)	per email
20	Lucky Galo, Network Optimisation Engineer	ESKOM	per email
21		DESTEA, Free State Province	per email (no response)
22		Dihlabeng Municipality	per email (no response)

Appendix 2 – Documents

Ref	Author	Year	Title	Notes / links / language
1	AURECON	2011	Technical Feasibility Study of Botterkloof & Merino II Hydropower Project	Covering three small hydro projects
2	Ninham Shand	2009	Application for Authorisation and Basic Assessment Report	https://www.eib.org/attachments/pipeline/20070446_eia_en.pdf
3	Aurecon	2014	Environmental Management Plan for the Stortemelk Hydro Project, Rev. 2	
4	Department of Economic Development, Tourism and Environmental Affairs, Free State Province	2009	Environmental Authorization (amended in 2011 and 2014)	Including licence conditions
5	NERSA	2012	Generation Licence (amended in 2013)	http://www.nersa.org.za/Admin/DocumentUpload/UploadFiles/Stortmelk%20Hydro%20(Pty)%20Ltd5019262014041911.pdf
6	Department of Water Affairs	2011	Water Use Licence (amended in 2014)	Including licence conditions
7	ESKOM and Stortemelk Hydro	2013	Power Purchase Agreement	Including side agreement with Department of Energy
8	LMV Consulting Engineers	2010	Ash River Farms map	Map showing landowners affected by three small hydro projects
9	--	--	Ash River farms and farmers list	List including contact information
10	Paul Johannes Farrell and Cannistraro Investments	2010	Deed of Sale	For 4 ha required for Stortemelk power station
11	LMV Consulting Engineers	2012	Map of Botterkloof 541 farm with subdivision 3 (4 ha)	For purposes of permit application with municipality for land use change
12	Stortemelk Hydro	2016	Construction Period Economic Development report	Excel sheet covering data on job creation, local content, ownership, top management and procurement
13	Stortemelk Hydro	2020	Socio-Economic Development (SED) & Enterprise Development (ED) Plan for the period 1 April 2020 to 31 March 2021	Report on CCIA funding and activities; submitted to IPP Office

14	Stortemelk Hydro	2020	Economic Development Monitoring report for July-Sept 2020	Annexures A and B
15	Aurecon	2017	External Annual Water Use License Audit Report for the Stortemelk Hydro Power Plant, Free State	
16	Stortemelk Hydro	2019	Results of Internal Audit of Stortemelk Hydro Water Use License, for the period 1 January 2018 to 31 January 2019	
17	ERM	2017	Review of three 'run-of–river' hydropower projects against the requirements of the International Finance Corporation (IFC) and Equator Principles	Report for REH; high-level review of Sol Plaatje, Merino and Stortemelk projects
18	NERSA	2017	Compliance Audit Report for Stortemelk Hydro (Pty) Ltd	
19	Enviroworks	2019	Environmental Compliance Audit Report	Report forwarded to Department of Small Business Development, Tourism and Environmental Affairs Free State Province
20	REH Operations & Maintenance	2020	Stortemelk Hydro: Annual Operations and Maintenance Report 2019	
21	REH Operations & Maintenance	2020	Monthly Monitoring Report for September 2020	
22	REH Group	2017	Environmental and Social Policy of The REH Group	not signed
23	REH Group	2017	Chemical Storage Policy of The REH Group	
24	REH Group	2017	Chance Find Procedure of The REH Group	
25	Envital	2017	Assessment of Priority Ecosystem Services	Prepared for REH Group (Pty) Ltd
26	Envital	2017	Environmental and Social Risk Assessment Methodology	Prepared for REH Group (Pty) Ltd
27	Envital	2017	Environmental and Social Monitoring Plan	Prepared for REH Group (Pty) Ltd
28	Envital	2017	Operational Environmental Audit Report; Stortemelk Hydro	Prepared for REH Group (Pty) Ltd
29	Envital	2017	Operational Environmental and Social Management Plan	Prepared for REH Group (Pty) Ltd
30	REH Group	2017	Stakeholder Engagement Plan of The REH Group	draft
31	REH Group	2015	REH Group's External Communications and Grievance Mechanism	https://www.rehgroup.co.za/wp-content/uploads/2018/01/REH-Grievance-Mechanism.pdf
32	NuPlanet clean energy	2014	New Hydro Project Commences Construction South Africa	Press Release Nov 3 2014
33	Johann Geringer	--	The Application of RCC in South Africa	http://www.ibracon.org.br/eventos/50cbc/RCC/Geringer-%20Application%20%20RCC%20in%20South%20Africa.pdf
34	Minister of Water and Sanitation	2018	List of Dams in South Africa	https://pmg.org.za/committee-question/8633/

35	Hattingh & Segers	2018	Dam Safety Regulation in South Africa: 32 Years Down the Line	http://rnd.zednet.co.za/Training/B_learning_material/knowledge/5%20Dam%20Safety%20Hattingh/Literature/ICOLD%202018%20Dam%20Safety%20Regulation%20in%20South%20Africa%2018-03-10%20final.pdf
36	responsAbility	2019	responsAbility teams up with leading Southern African hydropower developer REH	https://www.responsability.com/en/responsability-teams-leading-southern-african-hydropower-developer-reh
37	REH Group	2020	Stortemelk Hydro	https://www.rehgroup.co.za/project/stortemelk-hydro/
38	Creamer	2017	South African IPP pioneer laments the 'dampening effect' of Eskom's refusal to sign PPAs	https://www.polity.org.za/article/south-african-ipp-pioneer-laments-the-dampening-effect-of-Eskoms-refusal-to-sign-ppas-2016-10-28
39	Rand Merchant Bank	2020	RMB – New thinking for NuPlanet	https://www.rmb.co.za/historic-deal/new-thinking-for-nuplanet
40	Norfund	2020	Renewable Energy Holdings Pty Ltd	https://www.norfund.no/investment/renewable-energy-holdings-pty-ltd/
41	Ginster et al	2010	Views on unlawful water abstractions along the Liebenbergsvlei River, South Africa	https://www.researchgate.net/publication/45509606_Views_on_unlawful_water_abstractions_along_the_Liebenbergsvlei_River_South_Africa
42	Beck & Basson	2003	The hydraulics of the impacts of dam development on the river morphology. Report to the Water Research Commission	http://www.wrc.org.za/wp-content/uploads/mdocs/1102-1-031.pdf
43	McKay	2014	White water adventure tourism on the Ash River, South Africa	African Journal for Physical, Health Education, Recreation and Dance (AJPHERD) Volume 20(1), March 2014, pp. 52-75

44	Aurecon	2017	African Hydropower Project receives 2017 Award for Architecture	https://www.aurecongroup.com/about/latest-news/2017/november/african-hydropower-project-receives-2017-award-for-architecture#:~:text=15%20November%202017%20%2D%20The%20Stortemelk,for%20the%20Free%20State%20Region.
45	Eberhard & Naude	2017	The South African Renewable Energy IPP Procurement Programme: Review, Lessons Learnt & Proposals to Reduce Transaction Costs	https://www.gsb.uct.ac.za/files/EberhardNaude_REIPPPPReview_2017_1_1.pdf
46	Dihlabeng Municipality	2020	Draft 2020-2021 Integrated Development Plan	http://www.dihlabeng.gov.za/StrategicDocuments/IDP/DRAFT%202020-2021%20INTEGRATED%20DEVELOPMENT%20PLAN.pdf
47	Combined Churches in Action	2020	CCIA website	http://ccia.co.za/
48	Department of Energy	2012	CDM Host Country Approval / Project Design Document. See additional materials related to CDM at https://cdm.unfccc.int/ProgrammeOfActivities/cpa_db/M5P0CL47IN9FGEKASJOYX832R1WDHQ/view	http://www.energy.gov.za/files/esources/kyoto/2012/2012-07-31NuPlanet20PoA20RSA20Host20Country20Approval[1].pdf
48	Collet & Olivier	2015	Design Considerations for the Stortemelk Hydropower Station, South Africa	https://www.ich.no/Opplastet/Dokumenter/Hydropower15/Rochecouste%20Collet%20&%20Olivier_South%20Africa.pdf
50	Kotzé	2011	The potential of small hydropower plants in South Africa	The Water Wheel November/ December 2011
51	Department of Energy	2019	Integrated Resource Plan (IRP 2019)	http://www.energy.gov.za/files/docs/IRP%202019.pdf
52	Muller	2017	Lesotho Highlands Water Project's happy spin-off	http://www.waterafrica.co.za/index.php/contributors/66-helgard-muller/42-lesotho-highlands-water-project-s-happy-spin-off
53	Taylor et al	2011	The Drakensberg Escarpment as the Great Supplier of Water to South Africa	In: Greenwood & Shroder (eds.) Mountain Ice and Water,

				Developments in Earth Surface Processes, Volume 21.
54	van Wyk & du Preez	2004	The Environmental Impacts of Releases from Katse Dam on the Ash and Liebenbergsvlei Rivers	Proceedings of the 2004 Water Institute of Southern Africa (WISA) Biennial Conference
55	Wright		The Impact of Katse Dam Water on Water Quality in the Ash, Liebenbergsvlei and Wilge Rivers and the Vaal Dam	https://ujcontent.uj.ac.za/vital/access/manager/Repository/uj:9762?site_name=GlobalView&view=null&f0=sm_identifier%3A%22http%3A%2F%2Fhdl.handle.net%2F10210%2F716%22&sort=null
56	Huber-Lee et al	2016	Lesotho: Tackling water insecurity in a changing climate. Stockholm Environment Institute and World Bank Group	https://www.sei.org/publications/lesotho-water-insecurity/
57	Aurecon	2014	Stortemelk Mini Hydro Plant: Ecological Overview Report	Baseline report before construction start
58	Aurecon	2016	Stortemelk Hydropower Station on the Ash River: Monthly ECO Monitoring Reports January - May 2016	
59	Aurecon	2017	Stortemelk Hydropower Station on the Ash River: ECO Close-out Report September 2017	
60	Republic of South Africa	1998	National Water Act	https://www.gov.za/sites/default/files/gcis_document/201409/a36-98.pdf
61	REH	2020	Ownership Structure of REH Group and of REH O&M	
62	ESKOM	2013	Map Transmission Line Node Substation-Stortemelk	https://sahris.sahra.org.za/sites/default/files/additionaldocs/NODE_STORTERMELK.pdf
63	ESKOM	2013	SAHRA Notification regarding Transmission Line	https://sahris.sahra.org.za/sites/default/files/additionaldocs/SAHRA_9.pdf
64	SAHRA	2013	Response to ESKOM regarding Notification	https://sahris.sahra.org.za/sites/default/files/casedecisions/sahra%20letter%20Node%20Stotemelk%20FS%20sept2013.pdf
65	Carbon Brief	2018	South Africa Profile	https://www.carbonbrief.org/the-carbon-brief-profile-south-africa

66	World Bank	2020	Historic climate trends and future projections for Lesotho	https://climateknowledgeportal.worldbank.org/country/lesotho
67	Republic of South Africa	2019	National Climate Change Adaptation Strategy	https://www.environment.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf
68	CSIR & IDRC	2019	Green Book – Adapting Settlements for the Future	https://greenbook.co.za/
69	DWS	2018	Botterkloof Dam: Report on Second Dam Safety Evaluation	including Flood Frequency Analysis and original Dam Design Report
70	REH	2015	Contract of Employment (sample)	with payslip, tax and social security contributions
71	REH O&M	2014	Occupational Health & Safety Policy	
72	REH O&M		Stortemelk Hydro Safety Reports (2018, 2019, 2020)	
73	REH O&M (Golder)	2017	Environmental, Social, Health and Safety Management System Manual	Version 2
74	Birdlife South Africa	2015	Important Bird and Biodiversity Areas of South Africa	https://www.birdlife.org.za/what-we-do/regional-conservation-programme/media-and-resources/documents-and-downloads/
75	PWC	2020	Labour Legislation in South Africa	https://www.pwc.com/jp/en/japan-desk/south-africa/assets/labour-legislation-in-south-africa-en.pdf

Appendix 3a – Photographs from site visit, Nov. 12, 2020

Photo 1: Botterkloof Reservoir with warning buoys

Photo 2: Intake with reservoir and Maluti Mountains in background

Photo 3: Intake and spillway from upstream, with walkway to sluice gate

Photo 4: Intake gate structure with view to right bank

Photo 5: Fine trashrack with cleaning machine

Photo 6: Spillway from upstream, with energy dissipators

Photo 7: Powerhouse from northwest, with generator on left and transformer on right

Photo 8: Intake gate controls, with Boston A farm dam in background

Photo 9: Spillway from downstream, with tailrace in foreground

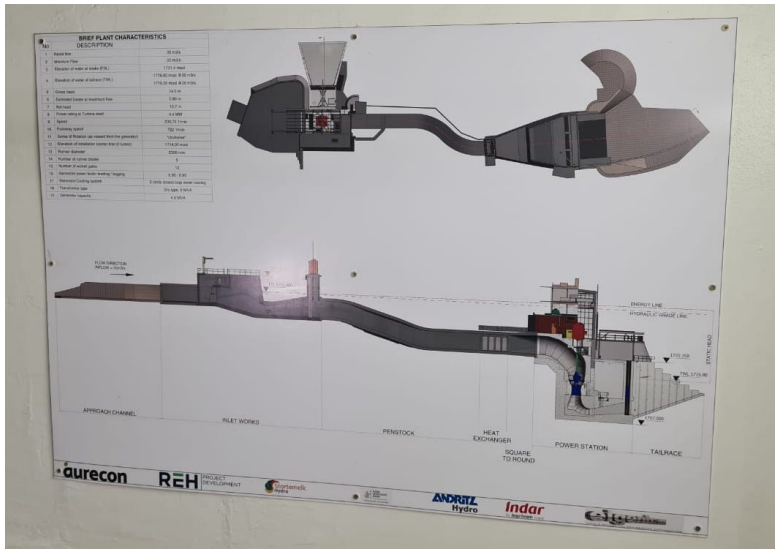


Photo 10: Profile and top-down schematics

Photo 11: Power station drawing with construction pictures

Photo 12: Penstock entering powerhouse

Photo 13: Panels in control room

Photo 14: Housekeeping on ground floor

Photo 15: Gate on access road through Bavaria Conservancy to power station

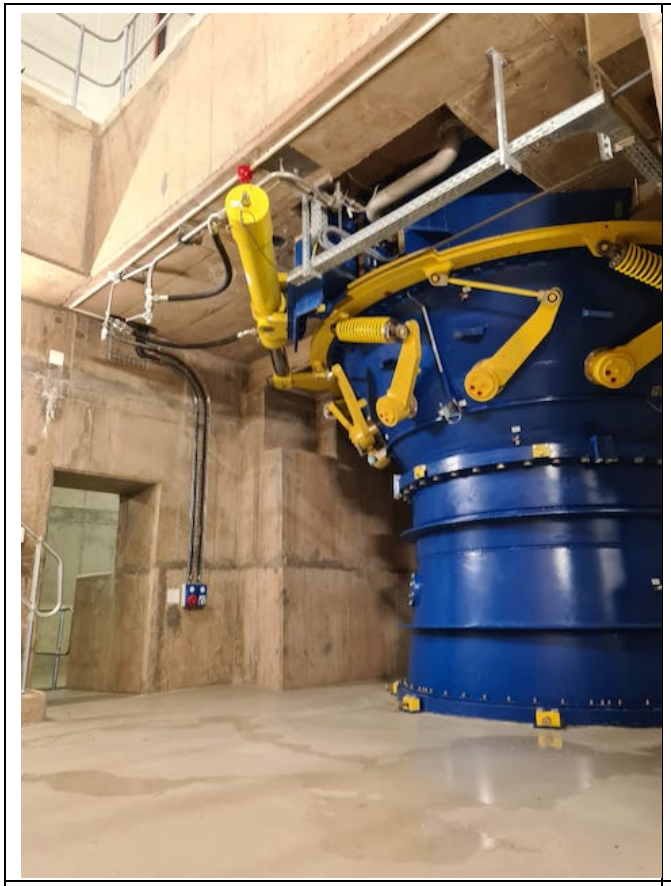


Photo 16: Guide vane controls

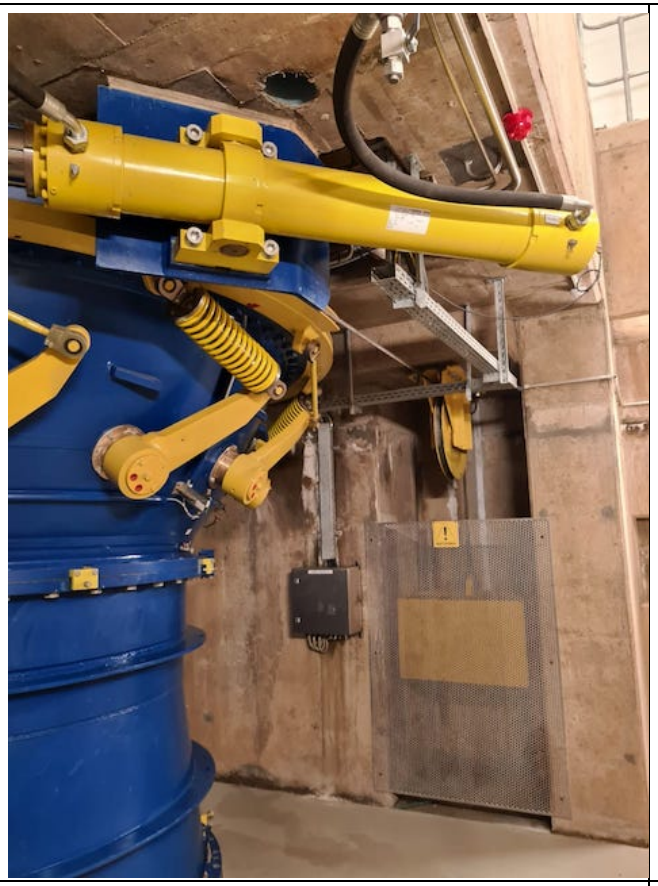


Photo 17: Weight for turbine shutdown

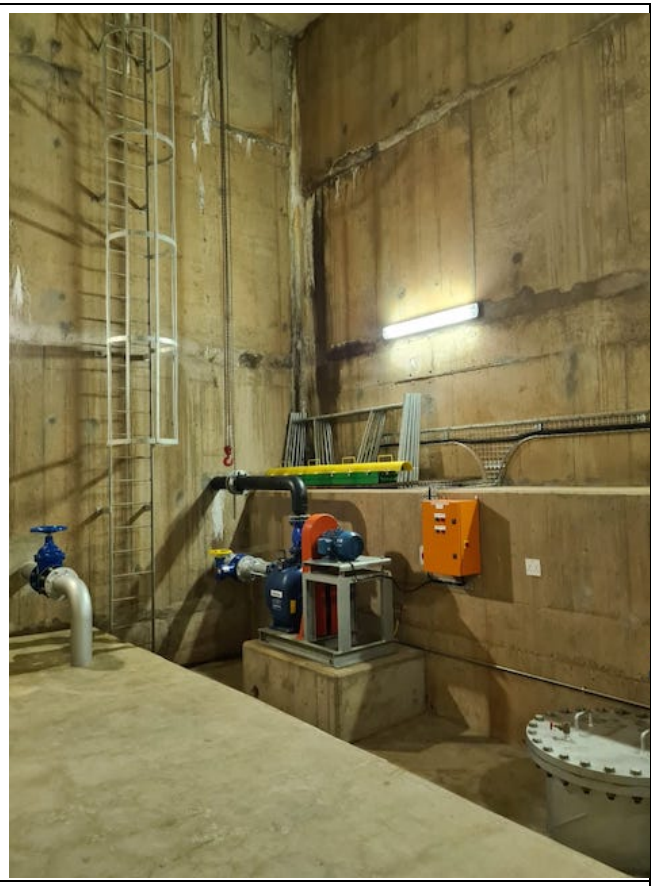


Photo 18: Sump pump and escape hatch ladder

Photo 19: Generator with door to control room

Photo 20: Transformer

Photo 21: Cooling system on ground floor

Appendix 3b – Photographs from other sources

Photo 1: Outfall of LHWP delivery tunnel on Ash River, just upstream of Botterkloof Reservoir (https://en.wikipedia.org/wiki/As_River)

Photo 2: Ash River rafting (Outrageous Adventures, Clarens)

Photo 3: View of Botterkloof spillway, Stortemelk power station and transmission line from right bank (https://www.zutari.com/project/stortemelk-hydropower/)

Photo 4: Planned Boston hydropower project site, just downstream of Stortemelk (https://www.rehgroup.co.za/project/boston-hydro/)

Photo 5: Operational Merino hydropower project (https://www.rehgroup.co.za/project/merino/)

Photo 6: Ash River near Sol Plaatje reservoir (https://en.wikipedia.org/wiki/As_River)

Photo 7: Operational Sol Plaatje hydropower project, next to Sol Plaatje dam (https://www.rehgroup.co.za/project/sol-plaatje/)