HydroNova

INNOVATING WATER PROSPERITY

Republic of Somaliland

Environmental and Social Impact Assessment for Deep Borehole in Cali Ciise

Prepared for:

WORLD BANK GROUP

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Acronyms

BoQ	Bill of Quantities
CIR	Construction Investment Report
CoC	Code of Conduct
DEP	Department of Environment
E&S	Environment and Social
EC	Electrical Conductivity
EHS	Environment, Health and Safety
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standard
FGD	Focus Group Discussion
FGM	Female Genital Mutilation
GBV	Gender Based Violence
GRM	Grievance Redress Mechanism
GW4R	Groundwater for Resilience Project
IDP	Internally Displaced Persons
IEC	Information, Education and Communication
km	kilometers
l/s	liters per second
LMP	Labor Management Plan
m	meters
m3	cubic meters
masl	meters above sea level
mm	millimeters
MoECC	Ministry of Environment and Climate Change
MoWRD	Ministry of Water Resources Development
NGO	Non-governmental Organization
OHS	Occupational Health and Safety
PIU	Project Implementation Unit
PPE	Personal Protective Equipment
PV	Photovoltaic
POM	Project Operational Manual
PWD	Persons with Disabilities
SEA/SH	Sexual Exploitation and Abuse/Sexual Harassment
SEP	Stakeholder Engagement Plan
SLSH	Somaliland Shillings

SWL	Static Water Level
VDC	Village Development Council
VES	Vertical Electrical Soundings
WB	World Bank
WUC	Water User Committee

Executive Summary

Introduction

The Environmental and Social Impact Assessment (ESIA) for the Cali Ciise deep borehole project has been conducted to evaluate potential environmental and social risks associated with the project and to propose mitigation measures that will ensure sustainability. The project is part of the broader Horn of Africa Groundwater for Resilience (GW4R) Program, which aims to enhance water security, improve climate resilience, and establish strong groundwater governance mechanisms across Somaliland. Given the ongoing challenges of water scarcity in semi-arid regions, the development of deep boreholes has been identified as a strategic intervention to improve access to clean and reliable water resources for communities that have traditionally relied on seasonal rain-fed sources.

The primary objective of the borehole project in Cali Ciise is to provide a sustainable water source, reducing reliance on unreliable water sources such as berkads, haffir dams, and expensive water trucking services. By improving water access, the project is expected to enhance public health, boost livestock productivity, and strengthen local water governance. However, the implementation of the project also presents several potential risks that need to be carefully managed. These include soil erosion due to land disturbance and social conflicts over water allocation. This ESIA aligns with Somaliland's environmental policies, particularly the Environment Management Act, and follows the World Bank Environmental and Social Framework (ESF) standards to ensure compliance with best practices in sustainable water management.

By identifying potential risks and integrating appropriate mitigation measures, this ESIA provides a comprehensive framework for responsible borehole development. The study highlights both the benefits and the challenges associated with the project and outlines strategies to maximize positive impacts while minimizing any adverse environmental or social consequences.

Project Description

The proposed borehole in Cali Ciise will be drilled to an estimated depth of approximately 450 meters, tapping into the Yesomma Sandstone aquifer, which has been identified as a viable water source based on hydrogeological surveys. The project will include key infrastructure components to ensure efficient water extraction, storage, and distribution. The borehole system will include a submersible pump, well casing, and gravel pack to ensure well integrity and long-term operational efficiency.

The water distribution system will include an elevated storage tank, strategically located water kiosks, and livestock watering troughs. These facilities will be designed to meet the needs of both resident households and nomadic pastoralists who rely on water for their livestock. The borehole will be powered by a hybrid solar-diesel system, minimizing dependence on fossil fuels while ensuring continuous operation during periods of low solar energy production.

Additional infrastructure will include an access road, fencing around the borehole site, and a shelter for the watchman responsible for overseeing borehole operations. The project location has been selected to optimize accessibility while ensuring minimal disruption to grazing lands and community settlements. The borehole site is located approximately 900 meters from the main residential area, striking a balance between ease of access and land use efficiency.

Baseline Environmental and Social Conditions

The environmental and social conditions in Cali Ciise present both challenges and opportunities for borehole development. The region is characterized by an arid climate, with annual rainfall averaging around 266 millimeters. This limited rainfall makes groundwater a critical resource for survival, as surface water sources are often unreliable or seasonal. Climate variability in the region has further exacerbated water scarcity, with prolonged droughts affecting both human populations and livestock.

The geology and hydrogeology of the area indicate that the Yesomma Sandstone aquifer can provide a sustainable water source. Desktop and field geophysical studies estimate the amount recharging the deep aquifer in the Togdheer region at approximately 26.5 million cubic meters per year. While this figure pertains to a broader area, it underscores the potential for significant recharge in the region.

Production from the borehole of this project will be less than 5 l/s and for only half of the year. This equates to about 54,000 cubic meters of water over a 150-day dry season, assuming 20 hours of pumping each day. Therefore, the likelihood of aquifer depletion is highly unlikely. That being said, because so little is known about the nature of the aquifer, only well tests and monitoring will reveal the sustainable abstraction rate and, ultimately, the well's potential. Water quality assessments suggest that while the borehole is expected to yield usable water, salinity levels may be elevated, necessitating appropriate treatment measures for human consumption.

Cali Ciise has an estimated population of 8,000 residents, primarily composed of pastoralist families who depend on livestock for their livelihood. The lack of reliable water sources has created economic challenges, as households must either purchase expensive trucked water or migrate seasonally in search of better grazing lands. The introduction of a permanent water source will significantly improve water access, but will also necessitate clear governance structures to manage resource allocation and prevent disputes.

Key Environmental and Social Impacts

The ESIA has identified both positive and negative impacts associated with the borehole project.

Positive Impacts:

- Increased water security for households, livestock, and small-scale farming.
- Reduced time spent fetching water, particularly benefiting women and girls.
- Improved hygiene and public health due to access to cleaner water.
- Enhanced climate resilience, helping the community withstand drought conditions.
- Economic benefits, including improved livestock productivity and market value.
- Reduced conflicts over water resources, provided governance structures are fair and inclusive.

Negative Impacts and Mitigation Measures:

- Potential water or land use conflicts, requiring community agreements and equitable water-sharing protocols.
- Water contamination risks from livestock waste, mitigated through controlled waste disposal and secure livestock watering points.
- Soil erosion from drilling and construction activities, requiring sediment control measures and replanting of native vegetation.
- Dust and noise pollution during construction, requiring dust suppression measures and noise control.
- Waste generation, including drilling mud, oil, and plastic, necessitating a waste management plan.
- Gender-based violence risks, particularly with an outside workforce, requiring worker Codes of Conduct and strict enforcement of grievance mechanisms.
- OHS risks such as entrapment in moving parts, manual handling of drilling equipment, traffic accidents during project mobilization, and working at height during construction of elevated water tank etc.

Environmental and Social Management Plan (ESMP)

A comprehensive Environmental and Social Management Plan (ESMP) has been developed to address identified risks. The ESMP includes specific mitigation actions, assigns responsibilities to relevant parties, and establishes monitoring protocols to ensure compliance with environmental and social safeguards.

Key elements of the ESMP include:

- Capacity-building initiatives to strengthen local water governance.
- Water quality monitoring and contamination prevention strategies.
- Social safeguards to protect community health and safety, including grievance mechanisms and GBV prevention.
- OHS provisions.
- Waste management and safe disposal practices.

- Erosion control and land restoration measures.

Conclusion and Recommendations

The Cali Ciise deep borehole project is environmentally and socially feasible, provided that mitigation measures and ESMP guidelines are fully implemented. The project offers an opportunity to improve water access, public health, and economic stability, but it requires careful management to prevent negative impacts.

Key recommendations include:

- Establishing a Water User Committee with broad community representation to manage water sharing and mediate any potential conflicts due to an influx of people or livestock.
- Implementing capacity-building programs for borehole operators and local governance structures.
- Conducting regular water quality and sustainability monitoring.

Through the integration of strong governance mechanisms, community engagement, and environmental safeguards, the borehole project can provide lasting benefits for the residents of Cali Ciise while ensuring sustainable resource management.

1. INTRODUCTION

1.1 Project Background and Rationale

The Horn of Africa Groundwater for Resilience (GW4R) Program is a multi-country initiative designed to increase the sustainable access and management of groundwater resources across the borderlands of the Horn of Africa. It aims to strengthen institutions and information systems related to groundwater, deliver inclusive water services, and reduce vulnerability to droughts and other climate shocks.

In Somaliland specifically, the program supports:

Infrastructure investments: Drilling and rehabilitating boreholes, installing or upgrading distribution systems, and ensuring that new or improved water points benefit both people and livestock.

Groundwater governance: Establishing or strengthening the government's capacity—particularly within the Ministry of Water Resources Development—to monitor, regulate, and plan groundwater use. This includes developing a groundwater office or unit, equipping it with technology and data-management tools, and training professional staff.

Community engagement: Working closely with village water committees and local stakeholders to ensure that new or rehabilitated water points are operated and maintained effectively, and that communities (including vulnerable groups) have a voice in how groundwater is shared.

Knowledge and learning: Generating up-to-date hydrogeological data and sharing it among local and regional agencies, enabling better, evidence-based decision-making for water investments and drought resilience.

Overall, in Somaliland the GW4R project aims to secure reliable, climate-resilient water supplies while building local institutions and capacities so that groundwater resources remain available, well-managed, and beneficial to communities in the long term.

1.2 Project Justification

Somaliland's climate is predominantly arid or semi-arid, with scarce and highly erratic rainfall. Prolonged droughts, limited surface water sources, and frequent climate shocks all intensify the region's water scarcity. Many rural communities rely on shallow, unprotected wells, berkads (surface cisterns), or trucked-in water—each of which is vulnerable to contamination, depletion, and high costs. These conditions not only threaten public health and hygiene but also undermine pastoral and agro-pastoral livelihoods, as livestock and small-scale farms depend on consistent water availability.

Establishing a deep borehole addresses these challenges by providing:

Drought Resilience: Tapping into deeper aquifers offers more reliable groundwater storage, reducing the impact of dry spells and strengthening community resilience to recurring climate shocks.

Livelihood Support: Reliable water points allow pastoralists and agro-pastoralists to water their livestock and irrigate small plots, stabilizing incomes and improving food security even during drought periods.

Overall, a deep borehole can greatly enhance water security in Somaliland, mitigating the risks of surface-water dependence and helping communities better cope with, and recover from, recurring droughts.

Beneficiaries

The estimation of beneficiaries for the newly constructed water infrastructure was derived by the socio-economic survey done by the PIU and satellite imagery, allowing for a detailed assessment of surrounding population densities. It was also possible to identify the predominant economic activities in the area, distinguishing between farming and nomadic practices based on visible land use patterns. An average number of livestock per household was considered to characterize the community water needs.[1]

The analysis considered the villages that would benefit from the new water point, home to approximately 800 households that rely mainly on pastoralism and approximately 250 nomadic families that rely on water availability at the site during the dry season. Livestock, including camels, goats, cattle and donkeys play a significant role in the local economy, with varying numbers in each category.

Table 1: Number of beneficiaries estimation

	Community households	Nomadic families	Camels	Sheep	Goats	Cattles	Donkeys
Beneficiaries	800	250	1,396	10,470	11,168	2,094	698

[1] The estimates of average livestock numbers per household were derived from the study "Impact of Climate Change on Agricultural Production in Marodijeh and Gabiley Regions (Somaliland)." The analysis synthesizes data from various local agricultural surveys and expert consultations to ensure accuracy in the context of regional livestock management practices.

Water Availability and Quality

The community's main water sources are berkads, balleys, and haffir dams, located near the villages. These sources rely on surface runoff during the rainy season to store water for use in the dry season. Although surface water generally has low electrical conductivity, it carries high contamination risks. The reliability of these sources depends on both rainfall and the amount of water stored.

When these sources are insufficient, communities rely on water trucking from distant boreholes, which often provides lower-quality water with high salinity.

Figure 1: Water structures in the area of interest: on the left, an existing haffir dam; on the right, several berkads

Water Demand

Daily consumption quantities are calculated based on the estimated number of liters for each consumer type[2] and are presented in the following three tables.

Table 2: Estimation of the water demands by villagers and nomadic pastoralists.

		Number of HH				
Type of Villager	HH Size	Share	Number	Total Number of People (H)	Unitary Water Consumption [L/D/H]	Total Water Consmption [MC/D]
Agro-Pastoralists (i.e. livestock and crop land)	12.0	5%	40	480	25	12.0
Farmers (i.e. crop land only)	8.8	5%	40	350	25	8.8
Nomadic Pastoralists	6.5	24%	250	1,625	25	40.6
Pastoralists (i.e. livestock only)	8.7	51%	408	3,563	25	89.1
Village Household	9.0	15%	120	1,081	25	27.0
					Total Water Need for Villagers	177.5

[2] These figures are estimated based on two main sources of literature: Coppock et al. 1988 and Erik Nissen-Petersen (2006): Water for Arid Land (Danida). Hofkes (1983) emphasized that livestock in semi-arid areas require approximately 20-30 liters per Tropical Livestock Unit (TLU), with each TLU having a live weight of 250 kg. Thus, camels have a TLU of 1.6, beef cattle (as opposed to dairy cattle) have a TLU of 0.8, and sheep and goats have a TLU of 0.1. The water demand figures have been rounded to the nearest multiple of 10 for ease of reference.

Table 3: Estimation of the water demand for livestock

Type of Livestock	Average Number of Livestock per HH	Total Current Number of Livestock	Total Additional Livestock that the Project can Support	Unitary Water Consumption [L/D/H]	Total Water Consmption [MC/D]
Camels	2.0	1,396	0	30	41.9
Sheep	15.0	10,470	0	5	52.4
Goats	16.0	11,168	0	3	33.5
Cows	3.0	2,094	0	24	50.3
Other	1.0	698	0	25	17.5
				Total Water Need for Livestock	**195.4**

Based on the above and the detailed calculations in the CIR (attached in the Annexes), the proposed borehole, with an extractable volume of 54,000m^3, will provide support to 97% of the total local needs (human + livestock) for a period of up to 150 days of dry season (when the storage water structures dry up).

1.3 Purpose and Objectives of the ESIA

The primary purpose of conducting an Environmental and Social Impact Assessment (ESIA) is to ensure that potential environmental and social risks and opportunities are systematically examined before project implementation begins. In this process, the ESIA will identify, predict, and evaluate the project's impacts over its entire lifecycle—covering construction, operation, and any eventual decommissioning. By doing so, it helps developers, regulators, and local stakeholders make informed decisions, select mitigation measures to address significant adverse impacts, and enhance potential benefits in a transparent and inclusive manner.

Additionally, in conducting this ESIA, the project will adhere strictly to Somaliland's legal and regulatory requirements, particularly the Environment Management Act LR 79/2018, which governs how development activities must safeguard natural and social environments. Further compliance with other relevant legislation—such as the national Water Act and solid waste management policies—ensures that environmental responsibilities are upheld at all stages of development. In parallel, the ESIA will follow the World Bank Environmental and Social Framework (ESF), applying its core standards on issues like community health and safety, labor and working conditions, and stakeholder engagement. By integrating both national regulations and the ESF, the assessment process helps maintain the highest possible environmental and social safeguards throughout the project's lifecycle.

1.4 Scope of the ESIA

The ESIA will cover all phases of the deep borehole project—pre-construction, construction, operation, and any eventual decommissioning. In line with mentioned above, the ESIA will evaluate the proposed well site, its associated facilities, and auxiliary services needed to ensure a reliable and climate-resilient water supply.

Location and Depth

- The borehole is planned for Cali Ciise, Togdheer Region (approx. 8.5425° N, 45.5196° E).
- The design depth is roughly 450 meters, targeting the Yesomma Sandstone aquifer to ensure a viable yield during extended dry seasons.

Area of Influence

1. **Hydrogeological Impact Zone:** Radius: 500 meters to 2 kilometers, depending on factors like pumping rate and drawdown patterns.
2. **Social & Community Impact Zone:** Radius: Often 1–5 kilometers, depending on population density and water access patterns.
3. **Environmental Impact Zone:** Radius: Usually up to 2–3 km, depending on proximity to sensitive habitats (there are no sensitive habitats within 3km of the project site)

Associated Infrastructure

- Pump and Power Supply: A submersible pump sized for up to 5 L/s will be installed; power will come from both a diesel generator and a solar photovoltaic (PV) array.
- Distribution System: An elevated water tank, communal water kiosks, and multiple animal troughs will be constructed to manage and distribute water effectively.
- Water Treatment: If required, small-scale treatment (e.g., reverse osmosis, UV disinfection) may be installed near the kiosk for human consumption.
- Monitoring and Control: Flow meters, piezometers, and water-level sensors will be included to track aquifer drawdown and usage.

Project Phases

- Pre-construction: Geological and geophysical surveys, final design, community consultations, procurement, and site mobilization.
- Construction: Drilling of the 450 m borehole; installation of casing, screens, and gravel pack; pump and pipeline setup; building of water kiosks and troughs; and establishment of the PV system and generator.
- Operation: Ongoing pumping, water quality monitoring, routine maintenance of the pump, generator, and solar panels; management of water allocations among communities, agro-pastoralists, and livestock.
- Decommissioning (if needed): Proper sealing of the borehole, dismantling of structures, and site restoration once the system is no longer required or must be replaced.

Auxiliary Facilities

- Access Roads: Grading or reconditioning existing tracks to accommodate drilling equipment and service vehicles.
- Storage Areas: Safe handling and storage of fuel, drilling fluid, cement, and construction materials will be reviewed to prevent soil and water contamination.
- Toilets: A male and female toilet will be constructed on site.

Overall, the ESIA's scope extends beyond the borehole itself, encompassing all directly related infrastructure and auxiliary services that may pose environmental or social risks. The assessment will focus on safeguarding groundwater resources, preventing land degradation, securing community health and safety, addressing any land acquisition requirements, and engaging local stakeholders, in full alignment with Somaliland regulations and the World Bank's ESF.

2. LEGAL AND INSTITUTIONAL FRAMEWORK

Below is an overview of the main legal frameworks and policies relevant to a deep borehole project under the GW4R Program. These instruments collectively govern how water resources are accessed, managed, and protected, and how environmental and social safeguards must be observed.

2.1 Somaliland

Constitution of the Republic of Somaliland (2001)

- Environmental Protection Mandate: The Constitution underscores the importance of safeguarding and preserving the environment. Article 18 specifies that the state and citizens must prioritize environmental conservation, providing a foundational basis for subsequent laws and policies.
- Implication for the Project: Any borehole development must be conducted in a way that upholds constitutional mandates around environmental sustainability and public welfare.

National Environmental Policy (2015)

- Strategic Environmental Management: This policy outlines Somaliland's broad objectives for biodiversity protection, pollution control, climate change adaptation, and sustainable resource use.
- Relevance for Borehole Project: It supports integrated water-resource management, requires environmental assessments for major water infrastructure, and emphasizes community involvement in natural resource decisions.

Environment Management Act LR 79/2018

- Core Environmental Framework: Often referred to as Somaliland's key environmental statute, it establishes the Ministry of Environment and Climate Change (MoECC) as the lead agency for environmental oversight.
- ESIA Requirements: The Act mandates Environmental and Social Impact Assessments for projects likely to have significant impacts. It details procedures for licensing, compliance monitoring, and penalties for environmental harm.
- Project Applicability: A deep borehole falls under the category of projects requiring an ESIA or equivalent study to demonstrate that resource extraction does not harm local ecosystems or communities.

Somaliland Water Act No. 49/2010 (Amended 2011)

- Groundwater Management: This law governs the ownership, allocation, and use of water resources. It outlines how permits and concessions are granted, stressing sustainable withdrawals and equitable distribution.

Other Relevant Legislation

- Solid Waste Management Act (No. 81/2018): Addresses waste disposal requirements, ensuring drilling byproducts (e.g., drilling muds, packaging) are managed properly.
- Private Sector Employment Law (No. 31/2020): Guides labor practices, worker rights, and occupational health and safety, complementing World Bank ESS2 for project workers.

2.2 Overview of the World Bank Environmental and Social Framework

The World Bank's Environmental and Social Framework (ESF) sets out the Bank's commitment to sustainable development through a comprehensive risk management approach. It comprises:

A Vision for Sustainable Development: Emphasizes balanced economic, social, and environmental outcomes.

Environmental and Social Policy: Outlines the Bank's responsibilities in screening, appraisal, and monitoring of projects.

Ten Environmental and Social Standards (ESS): Provide requirements for Borrowers to identify, assess, and mitigate a project's environmental and social risks.

How the ESF Applies to the Project

For a deep borehole project in Somaliland, the ESF guides how risks and impacts—both environmental and social—are managed throughout the project cycle (from planning and design to operation, maintenance, and decommissioning). It requires stakeholder engagement, adherence to good international industry practice, and ongoing monitoring and reporting to ensure that the project achieves positive outcomes while avoiding or minimizing harm.

Applicable World Bank Environmental and Social Standards

Several ESSs are generally relevant to groundwater or water supply projects, especially those involving borehole drilling and ancillary infrastructure:

ESS1 – Assessment and Management of Environmental and Social Risks and Impacts

- Requires a thorough Environmental and Social Impact Assessment (ESIA) and development of an Environmental and Social Management Plan (ESMP).
- For this deep borehole project, ESS1 underpins the entire risk analysis: site selection, drilling methods, water usage, potential land acquisition, and overall monitoring.

ESS2 – Labor and Working Conditions

- Covers workers' rights, fair pay, safe working conditions, and prohibition of child or forced labor.
- Drilling contracts, technician teams, and any local laborers must be managed in line with both ESS2 requirements and local labor laws.

ESS3 – Resource Efficiency and Pollution Prevention and Management

- Focuses on efficient resource use (water, energy) and minimizing pollution (e.g., safe disposal of drilling mud, control of noise and dust, management of wastewater).
- Directly applies to drilling and pumping operations, potential use of diesel generators, or chemical additives in drilling fluids.

ESS4 – Community Health and Safety

- Addresses traffic safety, security risks, hazardous materials, emergencies, and exposure to communicable diseases.
- Relevant for mitigating any construction hazards (noise, dust, movement of heavy trucks), as well as ensuring wellhead security and water-quality risks to nearby residents.

ESS5 – Land Acquisition, Restrictions on Land Use, and Involuntary Resettlement

- Activated if the project requires permanent or temporary acquisition of land, restricts access to communal areas, or leads to displacement (physical or economic).
- Even if land is community-owned or voluntarily donated, ESS5 procedures (e.g., voluntary land donation protocols) may apply.

ESS6 – Biodiversity Conservation and Sustainable Management of Living Natural Resources

- Applicable if the drilling site or pipeline routes potentially affect sensitive habitats, protected species, or unique ecosystems.
- Necessitates screening to ensure no critical habitats are adversely impacted.

ESS7 – Indigenous Peoples and Sub-Saharan African Historically Underserved Traditional Local Communities

- Requires the project to ensure the protection of the cultural identity, practices, and customary lands of indigenous people and specific traditional local communities in Sub-Saharan Africa.

- The screening by the World Bank determined that ESS7 does not apply to this sub-project.

ESS8 – Cultural Heritage

- Requires identification and protection of cultural heritage that may be impacted, directly or indirectly, by the project.
- “Chance finds” procedures must be in place if artifacts or sites of cultural significance are discovered during drilling or excavation.

ESS10 – Stakeholder Engagement and Information Disclosure

- Emphasizes meaningful engagement with affected communities and stakeholders, and the establishment of a functioning Grievance Redress Mechanism (GRM).
- Central to ensuring community acceptance, conflict mitigation, and transparency about water sharing arrangements.

2.3. Gap Analysis: Somaliland vs. World Bank ESS Requirements

The table below compares key aspects of Somaliland legal provisions with the World Bank standards, focusing on issues most relevant to a borehole project (e.g., environmental assessment, water regulation, labor, community engagement, and land acquisition).

Table 4 Gap Analysis between Somali law and ESF Standards

Thematic Area / WB ESS	Somaliland Laws & Policies	WB ESS Requirements	Identified Gaps & Implications for the Project
ESS1: Environmental & Social Impact Assessment (ESIA)	- **Environment Management Act LR 79/2018** mandates ESIA for projects with potential significant impacts. - Ministry of Environment & Climate Change (MoECC) issues ESIA guidelines and approvals. - **National Environmental Policy (2015)** calls for integrated water resource management and stakeholder input.	- Requires comprehensive ESIA covering direct, indirect, and cumulative impacts. - Stipulates an ESMP with mitigation measures, monitoring, reporting, and adaptive management.	- Somaliland framework is relatively clearer on mandatory ESIAs. - For cross-border or external donor-funded projects, the project must adhere to both local frameworks (Somaliland) and WB ESS1 for robust ESIA documentation.
ESS2: Labor & Working Conditions	- **Private Sector Employment Law No. 31/2020** addresses wages, working hours, and OHS but enforcement capacity may be limited in rural areas. - **Constitution** prohibits forced/child labor, but implementation relies on local labor offices and MoWRD for sector-specific projects.	- Workers' rights, safe working conditions, no child or forced labor. - Requires labor management procedures (LMP) and a worker GM.	- Somaliland has recognized labor rights but enforcement is variable. - Project must create a clear LMP that supplements local law with ESS2 standards (especially for child labor age limits, OHS protocols, and grievance channels for workers).
ESS3: Resource Efficiency & Pollution Prevention	- **Environment Management Act LR 79/2018** covers pollution control but does not	- Advocates efficient water usage, managing emissions, safe waste disposal (hazardous and nonhazardous).	- Need specific procedures for drilling byproducts, chemical usage, and potential brine disposal.

Thematic Area / WB ESS	Somaliland Laws & Policies	WB ESS Requirements	Identified Gaps & Implications for the Project
	provide detailed guidelines on drilling mud disposal or noise/dust emissions. - **Somaliland Water Act No. 49/2010** addresses sustainable abstraction, though detailed implementing rules can vary.	- Emphasizes resource efficiency measures (energy, water).	- Project ESMP must detail best-practice measures for well construction, waste handling, generator emissions, and possible solar PV use to reduce diesel consumption.
ESS4: Community Health & Safety	- No single "Community Safety" law; relevant elements found in **Environment Management Act** and local planning regulations. - Disaster risk management is decentralized.	- Manage traffic, construction hazards, security risks, and community exposure to communicable diseases. - Address potential infrastructure safety (e.g., water tank design).	- Gaps in cohesive community safety legislation. - Project must institute site-specific safety measures (fencing, signage, controlling dust/noise), emergency response plans, and coordinate with local authorities.
ESS5: Land Acquisition, Restrictions on Land Use & Involuntary Resettlement	- Land frequently under **customary tenure**. - **Somaliland Land Tenure Policy** (draft) outlines recognition of communal lands but not fully implemented. - **Environment Management Act** can require compensation if environmental damage or land confiscation occurs.	- Ensures fair compensation and resettlement for physically/economically displaced persons. - Encourages voluntary land donation protocols if relevant.	- Clear legislative gaps around formal land registration and compensation. - Project must document any land use agreement or donation carefully, following ESS5 steps (consultation, documentation, and grievance avenues), ensuring no involuntary displacement.
ESS6: Biodiversity & Sustainable Management of	- **Environment Management Act LR 79/2018** can protect	- Requires screening for impacts on critical habitats, endangered species, and	- Potentially insufficient local capacity for thorough biodiversity assessments.

Thematic Area / WB ESS	Somaliland Laws & Policies	WB ESS Requirements	Identified Gaps & Implications for the Project
Living Natural Resources	ecologically sensitive areas, but enforcement remains limited. - No specialized biodiversity law.	requiring offsets if critical habitat is affected.	- Borehole drilling must avoid or mitigate habitat fragmentation; ESMP should identify if rangeland or protected areas are impacted.
ESS8: Cultural Heritage	- **Constitution** references safeguarding Somali culture and heritage. - Implementation under the MoECC or Ministry of Tourism & Heritage is limited.	- Mandates identification, avoidance, and "chance finds" procedure for tangible or intangible cultural resources.	- Gaps in formal cultural heritage surveys or site registries. - ESIA must incorporate chance-find procedures and consult local elders/clan authorities about any known sacred or historical sites in the project area.
ESS10: Stakeholder Engagement & Information Disclosure	- **Environment Management Act LR 79/2018** requires some public consultation for ESIAs; though not always systematic. - **National Environmental Policy (2015)** emphasizes community involvement but lacks full procedural detail.	- Demands meaningful, inclusive consultation with project-affected parties. - Requires a functioning GRM accessible to communities.	- Limited local legislation on thorough stakeholder engagement. - Project must go beyond minimal legal requirements, ensuring ongoing consultation with local communities, including vulnerable groups, and establishing a culturally appropriate grievance procedure.

Key Observations from the Gap Analysis

ESIA Procedures: Somaliland's Environment Management Act LR 79/2018 requires ESIAs for major projects, aligning relatively well with ESS1. However, enforcement capacity and technical guidelines may need strengthening to match the depth of analysis prescribed by the World Bank.

Labor Protections: Both Somaliland and Federal Somali frameworks protect basic worker rights; however, ESS2 is more detailed and explicit about child labor prohibition, worker accommodation standards, and the need for dedicated grievance mechanisms for laborers.

Land and Resettlement: Formal land titling in Somaliland is still evolving, and usage rights frequently revolve around clan-based customary law. Under ESS5, the project team must document voluntary land donations or any partial land acquisition thoroughly to avoid disputes. The voluntary land donation form has been provided in Annex 11 following a meeting held with the community on 17 February 2025.

Stakeholder Engagement: Although local laws call for public input in ESIA, ESS10 requires a structured, continuous approach to community engagement, with special attention to minority groups and women, plus a robust Grievance Mechanism.

Implementation Capacity: Regardless of statutory alignment, limited capacity within government agencies could hamper enforcement. Project-level processes (e.g., robust ESMP, training local stakeholders, independent monitoring) will be essential to fill gaps.

2.4. World Bank EHS Guidelines

The World Bank General EHS Guidelines are directly applicable to the Cali Ciise borehole project and must be integrated into project planning, construction, and long-term water management. Adhering to these standards will minimize environmental damage, enhance worker and community safety, and ensure the sustainable use of groundwater resources.

EHS Guidelines on Water and Sanitation

Table 5 EHS Guidelines on Water and Sanitation

Project Component	Relevant EHS Guidelines (2007)	Key Requirements / Measures
Groundwater Abstraction	Protect recharge zones; identify and control contamination sources	Define the recharge area; assess vulnerability to contamination and overuse; implement land-use controls and monitoring programs near the abstraction point.

Project Component	Relevant EHS Guidelines (2007)	Key Requirements / Measures
Drilling & Construction	Address chemical exposure, noise, confined space hazards	Use PPE, establish confined space protocols, install barriers and noise controls; provide training and emergency procedures for chemical and physical hazards.
Wastewater / Drill Fluids	Treat waste fluids and brine; avoid discharge without treatment	Reuse or treat drilling wastewater on-site; avoid surface discharge; evaluate impacts on soil and groundwater if land application is used.
Sludge & Solids Handling	Analyze sludge content; avoid dumping in open areas	Determine whether sludge is hazardous or non-hazardous; store in lined, protected areas; dispose in accordance with local or WHO requirements.
Chemical Use & Storage	Manage chlorine, hypochlorite, and other disinfection chemicals safely	Store in ventilated, secure areas; separate incompatible chemicals; use corrosion-resistant containers; minimize storage volumes.
Sanitation at Campsites	Ensure safe septic system design and regular maintenance	Use sealed septic tanks or improved pit latrines; plan for periodic safe desludging; avoid raw discharge to environment.
Occupational Safety	Prevent injuries, exposure to pathogens, and hazardous gases	Train workers in hygiene and safety; implement fall protection, and emergency planning.
Community Health	Prevent contamination of drinking water sources; ensure secure wellhead protection	Monitor for potential leaks or backflow; design wellheads and pump houses to prevent tampering or contamination; coordinate with community health authorities.
Monitoring	Implement regular water quality, sludge, and emissions monitoring	Establish baseline and operational monitoring protocols; maintain calibrated instruments; report findings to regulators and stakeholders.

2.5. Institutional Roles and Responsibilities

Below is an overview of the main government and project-specific institutions involved in implementing and supervising the project, as well as the roles each entity plays in ensuring full compliance with both Somaliland regulations and World Bank standards.

Ministry of Environment and Climate Change (MoECC)

Created under Environment Management Act LR 79/2018, the MoECC is the primary authority responsible for environmental oversight and enforcement in Somaliland. It sets policy, develops guidelines, and approves (or rejects) the ESIAs of projects considered to have significant environmental impacts.

The Department of Environment Protection (DEP) within MoECC examines the submitted ESIA documentation for compliance with national regulations and the ministry's operational guidelines. Once satisfied with the ESIA findings, the ministry grants an environmental clearance, typically in the form of an Environmental Certificate or Approval Letter. Through site visits, document reviews, and audits, MoECC monitors compliance. If infractions are found—such as pollution breaches or unauthorized land use—MoECC can issue improvement orders or, in severe cases, suspend project activities.

MoECC regularly consults with other entities (e.g., Ministry of Water Resources Development, local authorities) for projects involving natural resources, such as water. It also collaborates with international partners, ensuring environmental standards remain consistent with best practices and donor requirements.

Ministry of Water Resources Development (MoWRD)

The MoWRD oversees Somaliland's water sector governance, including issuing water abstraction permits, managing water resource mapping, and coordinating with local districts on water infrastructure projects. The Somaliland Water Act No. 49/2010 provides the legal basis for regulating water usage, ensuring sustainable groundwater extraction and equitable distribution.

Through its engineering and hydrogeological departments, the ministry can advise on best drilling practices, coordinate design reviews, and give technical clearance for pump installation and distribution systems. MoWRD tracks water extractions (where feasible) to prevent over-abstraction. It may also impose quotas or limit pumping rates if aquifer depletion is likely.

The ministry works alongside local governments (district councils, water committees) to identify high-need areas, address water conflicts, and manage community-level water committees that often operate the distribution systems.

Relevant District Authorities

District authorities typically handle land-use planning, resolving minor disputes over communal or private land, and issuing local construction permits in line with broader MoECC and MoWRD guidelines. Where farmland or pastoral lands may be affected, district authorities help facilitate voluntary land donation or compensation discussions with landowners or clan elders.

District councils often host initial stakeholder meetings, mobilize communities, and contribute to local-level grievance resolution. If land acquisition or potential resettlement (physical or economic) is required, district authorities help ensure that ESS5 and national requirements on compensation or documentation are carried out.

They can conduct site inspections, especially to assess local labor usage and confirm compliance with safety or land-use regulations. Districts also act as liaisons between the community, the project, and national ministries when questions of enforcement arise.

Project Implementation Unit (PIU)

The PIU is embedded within the Ministry of Water Resources Development and ensures day-to-day project coordination, from feasibility and design to procurement, construction oversight, and capacity-building for local water user committees.

The PIU tracks project progress against E&S indicators, including GBV, compiles periodic reports for MoECC, MoWRD, the World Bank, and other stakeholders. If challenges arise—like community complaints, worker grievances, or environmental noncompliance—the PIU organizes appropriate mitigation or corrective actions and reports back to both ministries.

Contracts for drilling companies, civil works, or suppliers will define compliance obligations under the ESMP, including site safety, worker conditions, and waste management. The PIU ensures these standards are included in bidding documents and that contractors adhere to them.

Compliance Monitoring and Enforcement

Environmental Licensing

- Environmental Clearance: Granted by MoECC upon review of the ESIA and consultation feedback.

Compliance Monitoring

- Internal Monitoring (PIU): The PIU’s environmental and social staff conducts site checks, reviews contractor performance, and compiles internal compliance data.

External Monitoring (Government):

- MoECC: Periodic inspections to verify ESIA/ESMP implementation, pollution control, biodiversity protection.
- MoWRD: Monitors groundwater usage rates, checks well construction specs, ensures alignment with the Water Act.
- District Authorities: Oversee local-level labor usage, land-related issues, and minor grievances.

Enforcement Actions

- Improvement Orders or Warnings: If minor noncompliance is detected, MoECC or MoWRD can issue corrective orders with a clear timeline.
- Stop-Work Notices: For major violations—such as hazardous waste dumping or serious breach of safety—authorities can suspend operations until the issue is rectified.

Ongoing Collaboration

Ministries convene regular coordination meetings with the PIU to discuss progress, share monitoring results, and address any emergent challenges. The PIU also provides capacity-building and technical assistance to both district officials and community committees, helping to sustain compliance over the borehole's operational life.

3. PROJECT DESCRIPTION

3.1. Project Location and Layout

Below is a summary of the project's proposed location and layout for the deep borehole at Cali Ciise (often spelled "Cali Cise") village, including basic maps, coordinates, and an overview of sensitive sites (schools, clinics, etc.) within the broader project influence area.

Coordinates and Overview

Borehole Site Coordinates: Latitude: 8.5425° N, Longitude: 45.5196° E

Village & District: Cali Ciise, Togdheer Region, approximately 100–120 kilometers south of Burao.

Elevation: ~800–850 meters above sea level (based on field measurements).

Proximity to Village: The planned borehole sits roughly 900 meters from the main residential area of Cali Ciise.

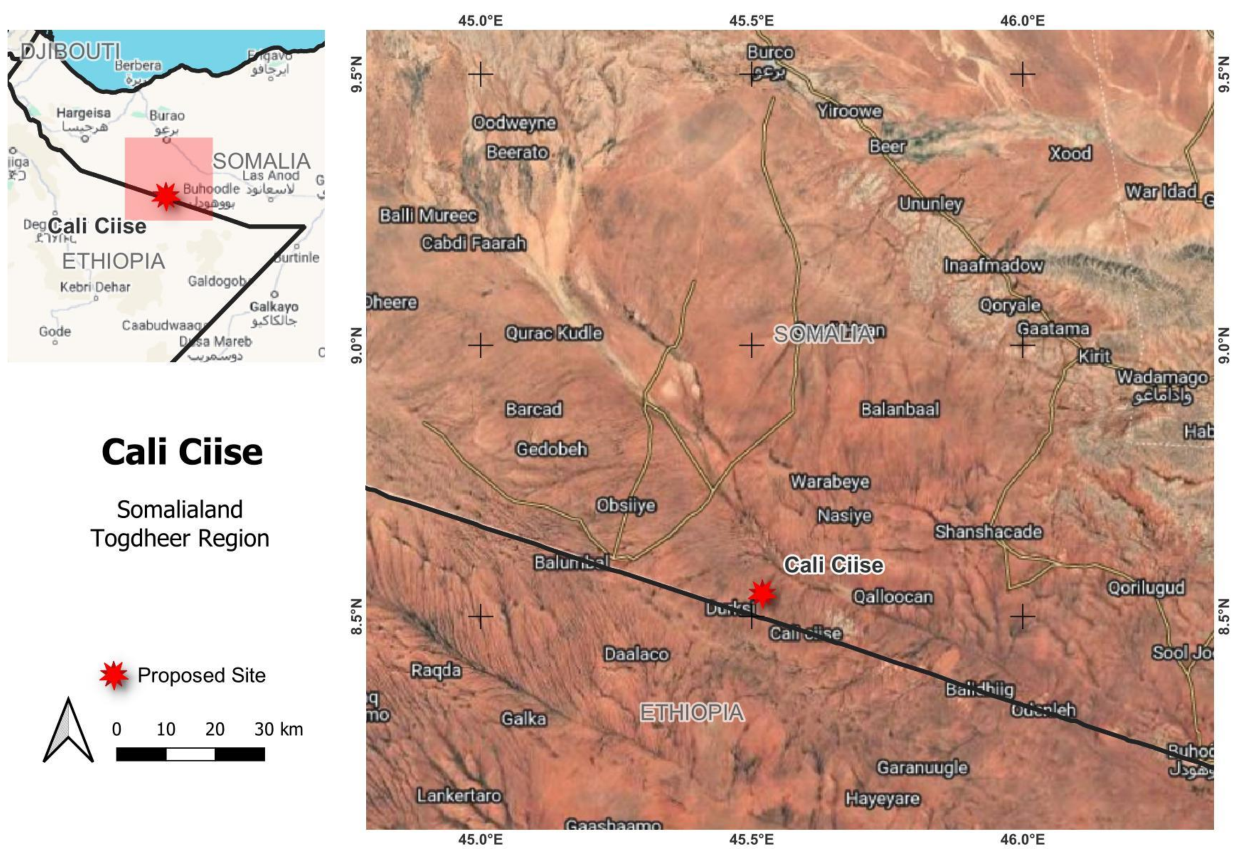


Figure 2 Location of Project

3.2. Sensitive Features within the Project Influence Area

Schools: *Primary and Elementary School*: Educates around 260 students (90 female, 170 male), *Boarding Secondary School*: Approximately 120 students enrolled. Both facilities are in the central village area (~300–400 meters from the main residential hub). Since the borehole is about 900 meters from the village center, these schools are well within a 1–1.5 km radius of the project site.

Health Facility: Cali Ciise has a small clinic located near the village core (no more than 400–500 meters from the main settlement). Provides basic medical services to local residents. This health post is also within ~1 km of the proposed borehole location.

Haffir Dam at Duruqsi: Found approximately 7 km away from Cali Ciise. Serves as a seasonal water reserve and critical backup for livestock watering when local berkad runs dry.

Residential Areas: The main village is home to roughly 800 households plus an additional 250 pastoralist families in the vicinity. The site is sufficiently removed (900 m) to minimize noise and dust impacts on residential dwellings during drilling and to keep livestock watering away from the village center.

Protected Areas or Key Biodiversity Hotspots: Field surveys and community discussions indicate no officially designated protected areas or ecologically sensitive sites in the immediate project zone. Vegetation includes *Acacia* species and grasslands used for grazing, but no unique or threatened habitats have been identified.

Other Potentially Sensitive Receptors: *Clinics/Local shops*: Additional small businesses and local shops cluster near the village center. *Livestock Corridors*: Pastoralists occasionally move herds near the site, but the main migration corridor is further out, linking Cali Ciise with seasonal grazing areas across the Ethiopia–Somaliland border. There are no cultural or historical sites in the project area, as detailed in the Baseline chapter of this report.

Other Potential Site Issues: The site has extremely low seismic and flooding risks. There is very low seismic risk, because the seismic genetic structure lay very far from the area. Regarding flooding, Cali Ciise is considered to have low flood risk. Cali Ciise is situated on an elevated plateau, characterized by arid and semi-arid conditions. This terrain inherently reduces the likelihood of significant flooding events. The area is located far from major river systems such as the Shabelle and Juba rivers, which are typically associated with seasonal flooding in Somalia. Finally, there is no documented history of significant flooding in Cali Ciise.

3.3. Layout and Key Components

Depth & Geological Target: Up to ~450 meters, tapping into the Yesomma Sandstone aquifer.

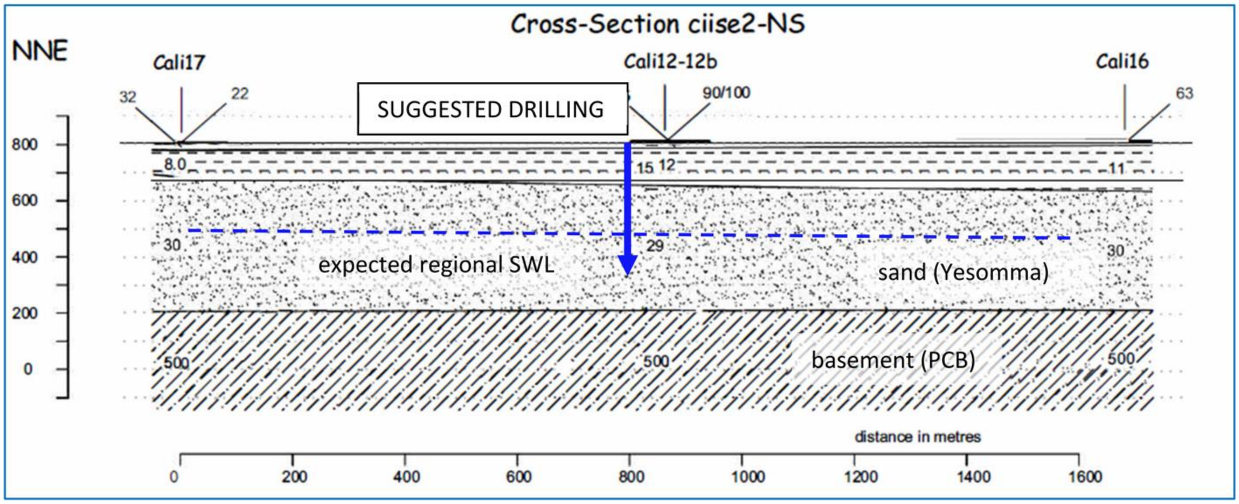
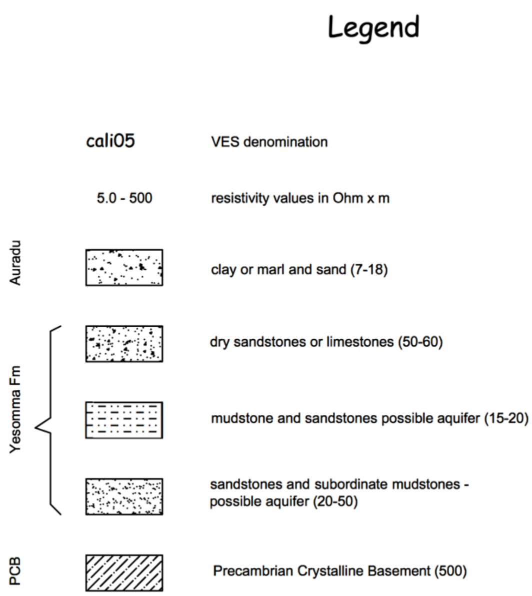


Figure 3 Geological cross section with borehole



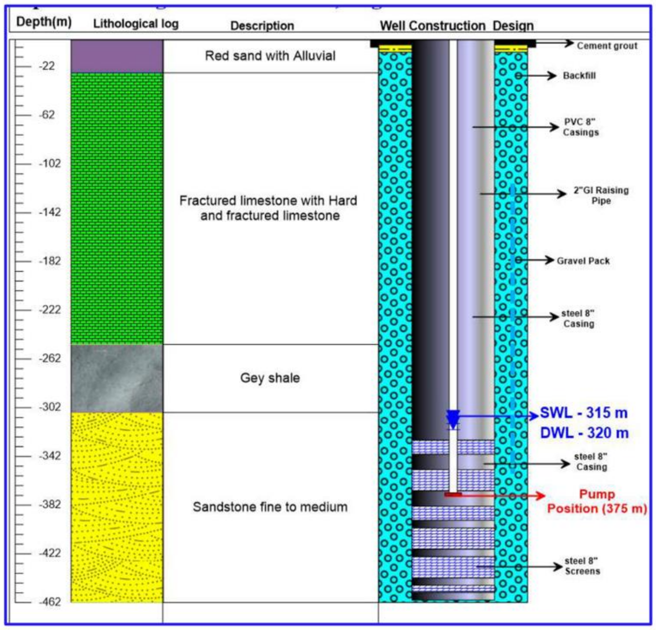


Figure 4 Borehole cross section

Casing: Typically 8-inch diameter PVC (or equivalent) with screened sections sized to match the predicted aquifer intervals. A gravel pack will surround the screened portion, helping to filter out fine sediments.

Pump Specifications: A submersible centrifugal pump (6-inch or smaller, as appropriate) designed for around 5 liters/second at a total head of approximately 400–450 meters. It will include:

- Riser Pipes (galvanized steel or heavy-duty plastic)
- Control Panel/Starter (with protective devices such as overload, phase-failure relays)
- Monitoring Equipment (flowmeter, dip tubes for water-level measurement, etc.)

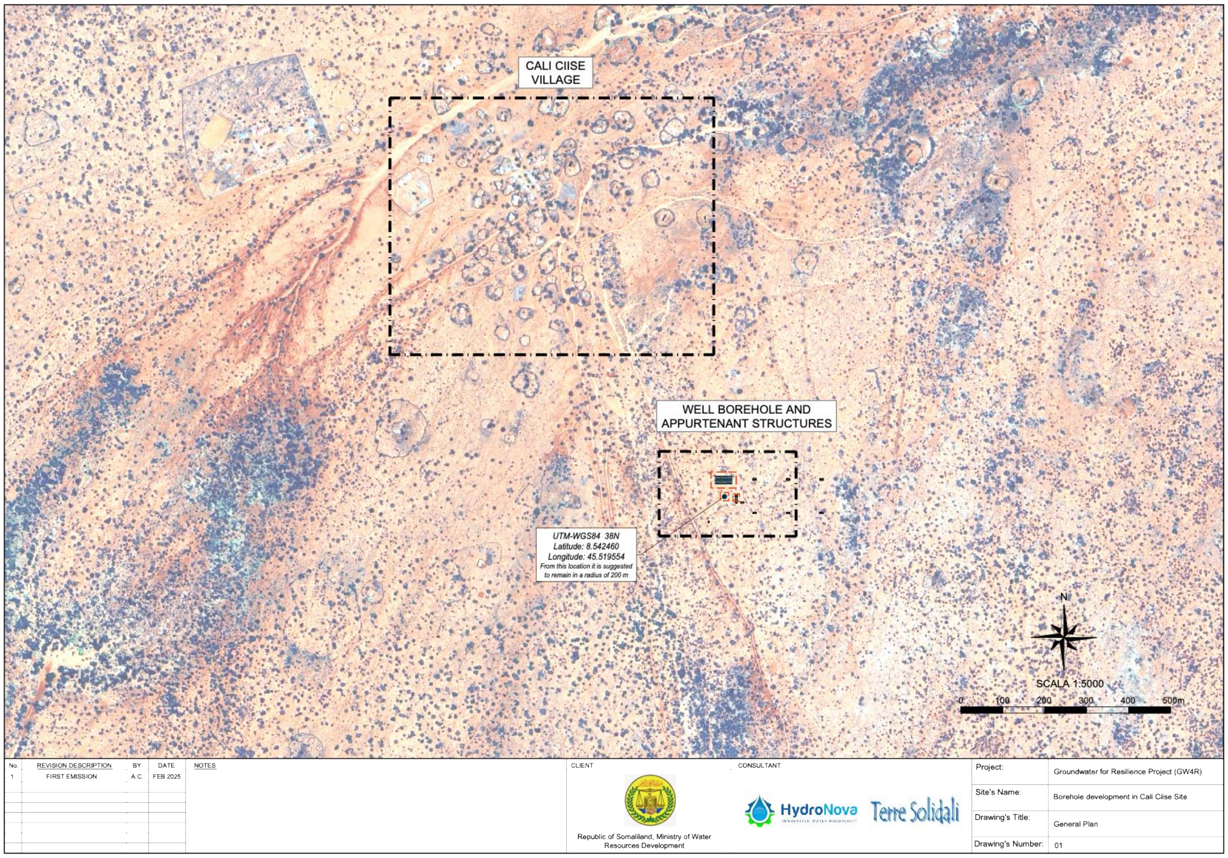


Figure 5 Location of Village and Project Site

Be

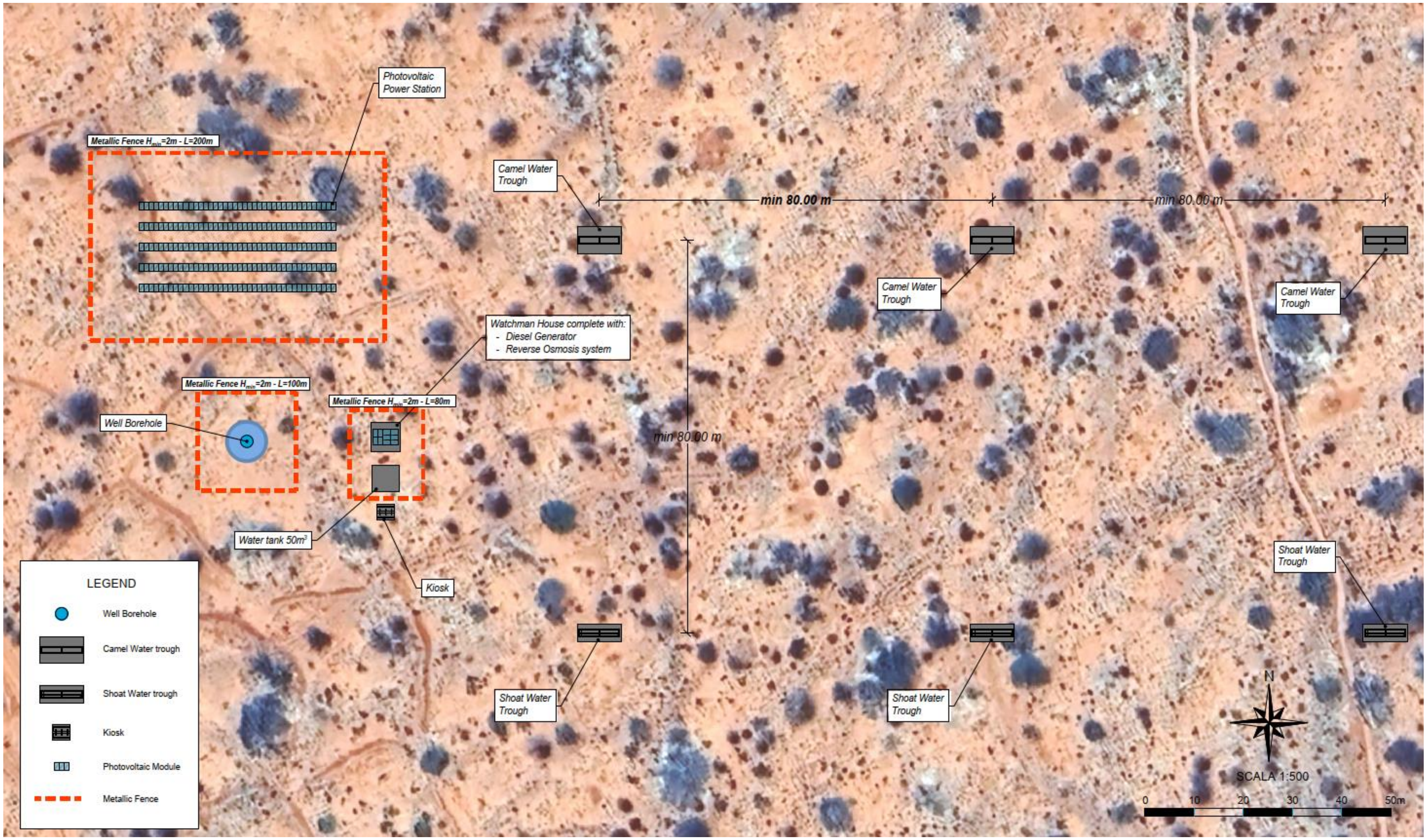


Figure 6 Project Layout

Water Distribution Infrastructure

Piping: Short transmission pipeline (up to ~100–200 m from the borehole) to reach storage or distribution points.

Community Water Kiosks: At least one kiosk located at a safe distance from the borehole (often 100–200 m) for domestic water collection. Fitted with taps or spigots and potentially small storage tanks or filtration systems (like RO/UV if needed).

Animal Troughs: Dedicated troughs constructed ~50–80 m from the kiosk to reduce contamination and crowding. May include separate troughs for small ruminants (sheep/goats) and larger stock (camels/cattle).

Storage Tanks: The water tank installed to regulate water supply, accommodate peak demand, and stabilize pump operation. Equipped with level indicators and protective fencing.

Energy Source

Hybrid Power System: Combines a diesel generator and a photovoltaic (PV) array, allowing flexibility:

- Generator for nighttime pumping or as a backup.
- Solar Panels (with battery storage or direct-feed to the pump) to reduce diesel costs, especially during peak sun hours.

Fuel Storage: A small, securely bunded area near the generator to store diesel, preventing accidental spills and contamination.

Fencing

Light fencing around the wellhead, generator, and any sensitive equipment will safeguard from vandalism or livestock intrusion.

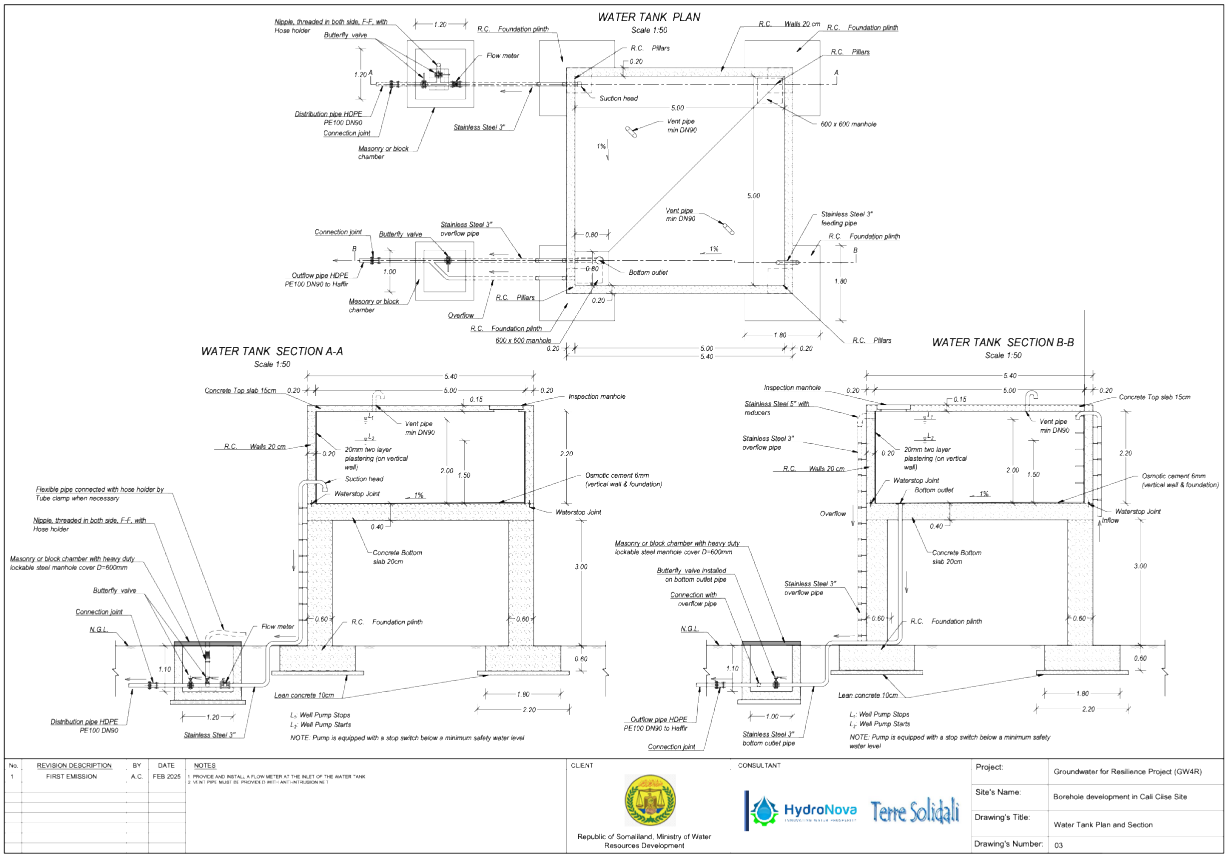


Figure 7 Schematic of Water Tank

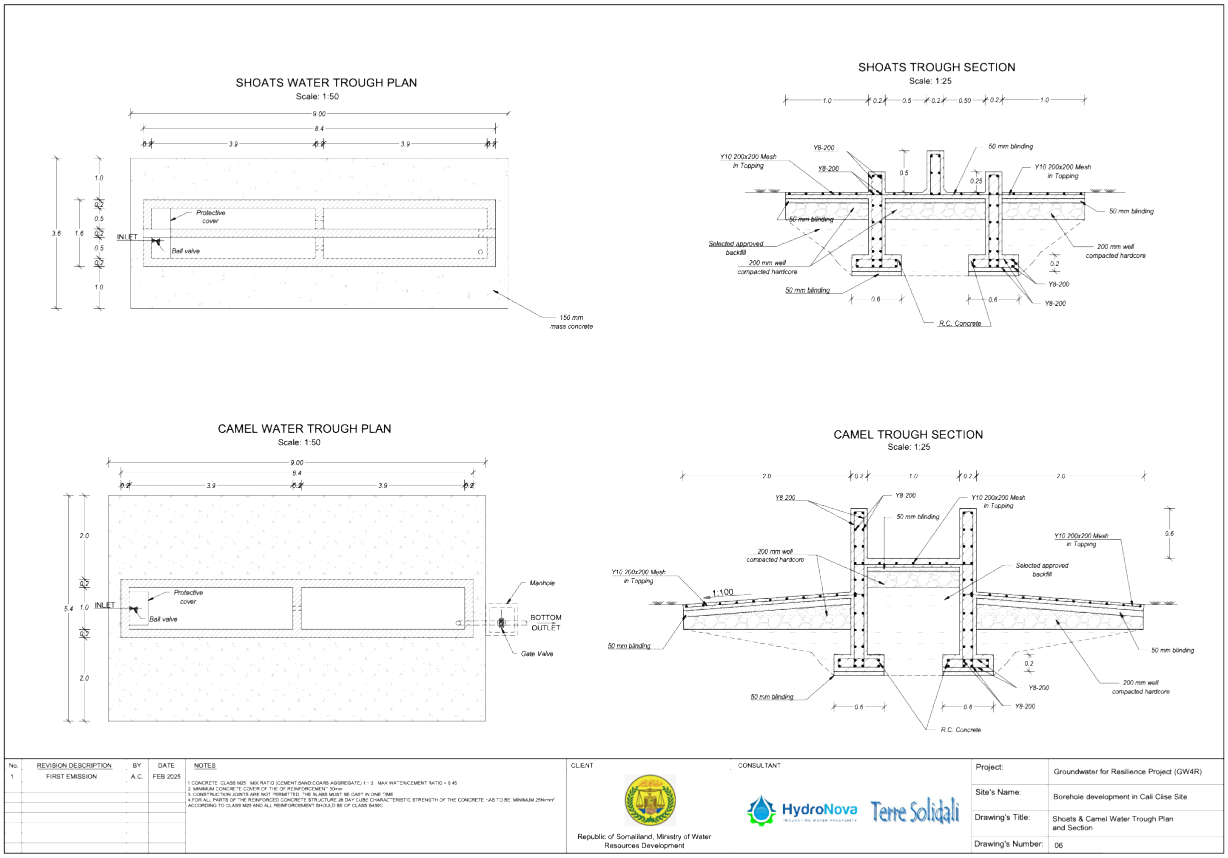


Figure 8 Schematic of Animal Troughs

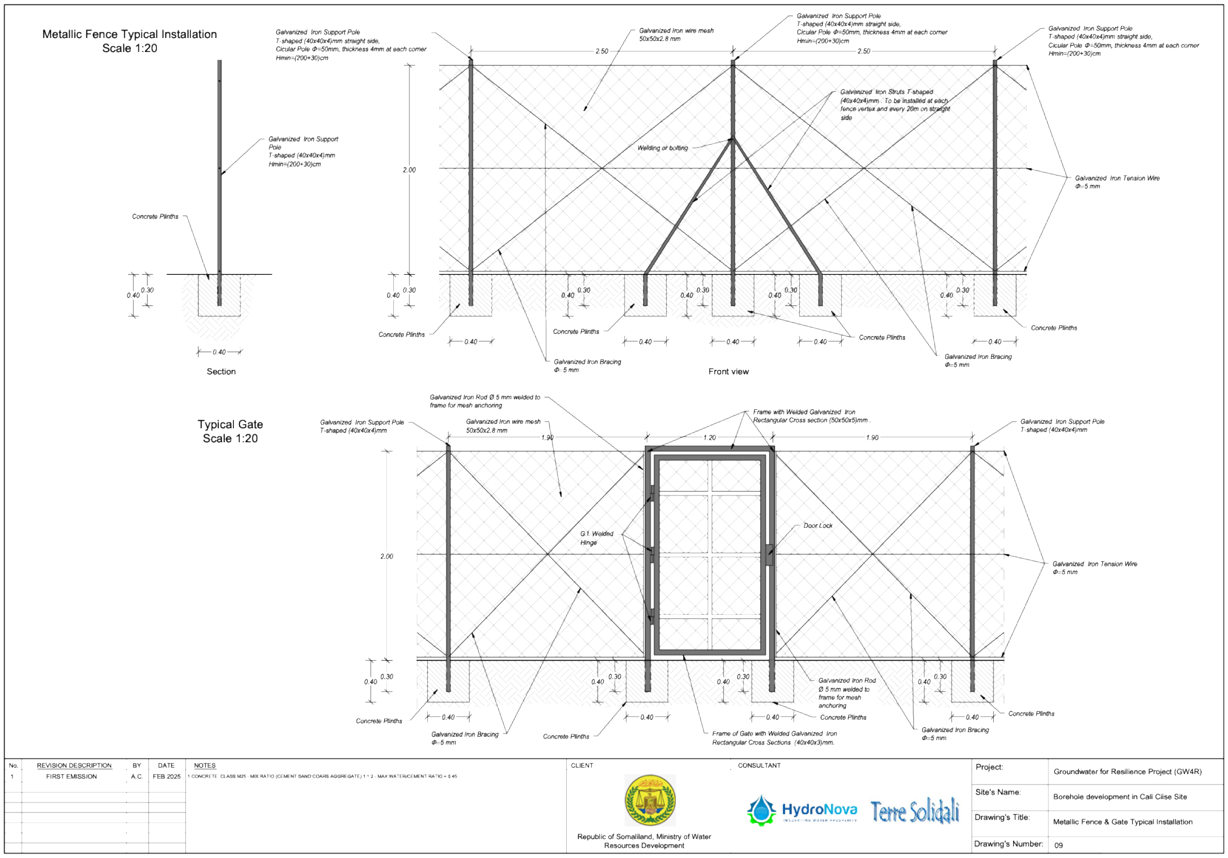


Figure 9 Schematic of Fencing

Access Roads and Laydown Areas

An existing unpaved road is in decent condition, allowing vehicles, drilling rigs, and herders to reach the site. The last ~120 meters may need grading or slight improvement.

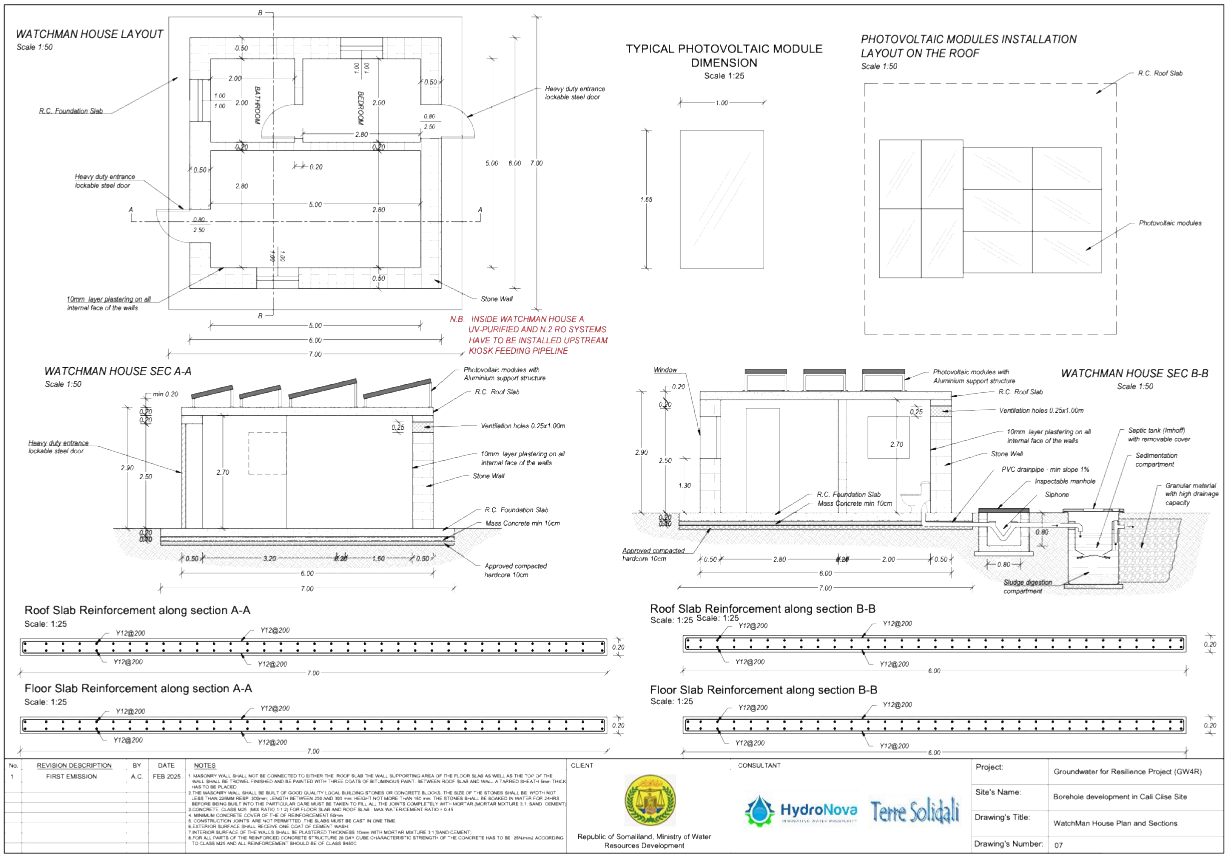
There will be a laydown area, which is a temporary site (often 20–30 m from the borehole) for drilling equipment, gravel, casing pipes, and other construction materials. It will be kept clear of residences and fenced to ensure safety. Post-construction, the area is typically cleared of debris, with any waste properly disposed.

Watchman House and Toilets

A small shelter will be built near the borehole/tank for security and routine maintenance. There will also be two toilets, one for men and one for women, built on site.

Figure 10 Drone view of project location, existing road on left

Figure 11 Project site with view of existing road


WATCHMAN HOUSE LAYOUT
Scale 1:50
BATHROOM
BEDROOM
R.C. Foundation Slab
Heavy duty entrance lockable steel door
10mm layer plastering on all internal face of the walls
Stone Wall
N.B. INSIDE WATCHMAN HOUSE A UV-PURIFIED AND N.2 RO SYSTEMS HAVE TO BE INSTALLED UPSTREAM KIOSK FEEDING PIPELINE
TYPICAL PHOTOVOLTAIC MODULE DIMENSION
Scale 1:25
PHOTOVOLTAIC MODULES INSTALLATION LAYOUT ON THE ROOF
Scale 1:50
R.C. Roof Slab
Photovoltaic modules
WATCHMAN HOUSE SEC A-A
Scale 1:50
Photovoltaic modules with Aluminium support structure
R.C. Roof Slab
Ventilation holes 0.25x1.00m
Mass Concrete min 10cm
Approved compacted hardcore 10cm
WATCHMAN HOUSE SEC B-B
Scale 1:50
Window
Septic tank (Imhoff) with removable cover
Sedimentation compartment
PVC drainpipe - min slope 1%
Inspectable manhole
Siphone
Granular material with high drainage capacity
Sludge digestion compartment
Roof Slab Reinforcement along section A-A
Scale: 1:25
Y12@200
Floor Slab Reinforcement along section A-A
Scale: 1:25
Roof Slab Reinforcement along section B-B
Scale: 1:25
Floor Slab Reinforcement along section B-B
Scale: 1:25
No.
REVISION DESCRIPTION
BY
DATE
NOTES
1
FIRST EMISSION
A.C.
FEB 2025
CLIENT
CONSULTANT
Republic of Somaliland, Ministry of Water Resources Development
HydroNova
Terre Solidali
Project:
Groundwater for Resilience Project (GW4R)
Site's Name:
Borehole development in Cali Ciise Site
Drawing's Title:
WatchMan House Plan and Sections
Drawing's Number:
07

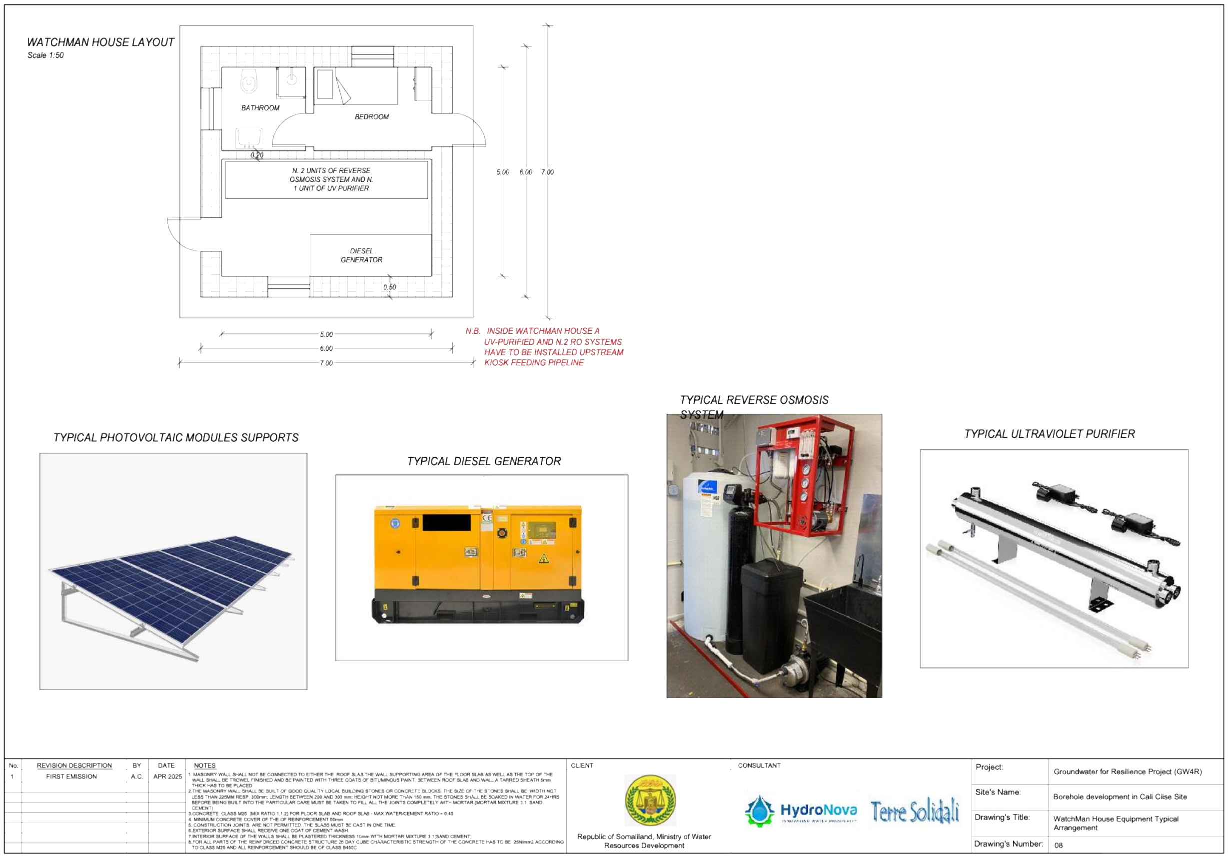


Figure 12 Schematic of Watchman House

Locating the borehole roughly 900 meters from the village core helps balance community proximity with the avoidance of major noise, dust, or land-use conflicts. Moreover, environmental and social mitigation measures—such as controlling runoff, siting livestock troughs away from the wellhead, and maintaining a protective buffer from community facilities—will ensure minimal disruption to sensitive features like schools and the health facility.

Drilling Mud

For this project, water-based drilling mud (WBM) will be utilized. This choice aligns with good international industry practice due to its lower environmental footprint compared to oil-based alternatives. Water-based muds are non-toxic, biodegradable, and pose minimal risk to groundwater quality or soil integrity. Their use reduces the risk of long-term contamination and simplifies handling, transport, and disposal procedures, which is especially beneficial in sensitive pastoral and agro-pastoral environments where communities depend heavily on natural resources. To mitigate any potential impacts associated with the disposal of WBM, the project will implement a suite of measures including the use of lined containment pits to prevent infiltration, careful monitoring of drilling fluids, and dewatering followed by safe disposal of residual solids in designated, approved locations.

Lifetime of the Well

The presumed lifespan of the borehole is 20 years, which is conservative. The typical life of a well-maintained deep borehole is 25 to 50 years. The optimistic scenario with proper management is 50+ years. With poor maintenance it can be less than 15 years. Factors that can shorten lifespan include inadequate data during drilling (especially in poorly mapped geologies), overuse or unmanaged abstraction, contamination from latrines, livestock, poor community management or vandalism and lack of maintenance culture.

Project Timeline

The following table outlines the general timeline and key activities involved in the development of a typical borehole.

Table 6 Project Timeline

Phase	Duration	Key Activities
Drilling and Construction Phase	2–3 Months	Site mobilization, equipment deployment, borehole construction/rehabilitation
Commissioning and Handover Phase	0.5–1 Month	System testing, community training, formal handover
Post-Implementation Monitoring	6–12 Months (Ongoing)	E&S audits, compliance checks, follow-up monitoring

3.4. Project Phases

Pre-construction: Surveys, design finalization, mobilization, worker campsite setup, stakeholder consultations.

The project will unfold in a series of distinct but overlapping phases, beginning with Pre-construction activities. During this initial stage, most of which has been completed, technical teams finalize site investigations, including geophysical surveys, while also conducting community consultations to share information and gather local input. Concurrently, procurement processes are carried out for equipment and materials, and local contractors are identified or shortlisted. Although these tasks are largely administrative and preparatory, they lay the groundwork for a smooth transition into the next phase. This phase will also include grading or reconditioning existing access road to accommodate drilling equipment and service vehicles and removal of vegetation such as grasses and shrubs to allow for commencement of construction activities.

Construction: Actual drilling, civil works, installation of pump, and water distribution system.

Construction starts once all permits are secured and the final design is approved. Drilling rigs are mobilized to the site, and a temporary laydown area is set up for storage of pipes, casings, and other supplies. The borehole is then drilled to the targeted depth, screened, and equipped with the submersible pump.

The drilling will be carried out up to a depth in the interval 400-450 m. However, the borehole can be stopped by the contracting authority and finalized also at a depth lower than 400 m. The contracting authority will appoint a supervisor for the drilling operations who will be responsible, on behalf of MoWRD, for all activities related to drilling, completion of works and subsequent pumping tests. At the end of the drilling operations, the supervisor will decide on the basis of the drilling logs, water quality etc., whether to finalize the borehole or to abandon it, thus cancelling all the remaining operations.

The contracting Authority supervisor should be a geologist or a person with wide experience of boreholes drilling supervision. The drilling site is near Cali Ciise village, Togdher region, the coordinates are: 8.542460° N and 45.519554° E. It is suggested to drill in a radius of 200 m from this location. The drilling shall be executed with the only methodology of rotary with water based mud circulation, to face hole wall collapses, frequently occurring in the area. Bentonite may be used depending on local conditions and will be determined on-site by the drilling engineer. The diameter of the drilling tools shall be suitable for the installation of 8” casing plus an annular space of 3” around the casing for the gravel pack installation, therefore no less than 14”.

Around the same time, distribution infrastructure is built, which may include laying short transmission pipelines, erecting an elevated tank, installing animal troughs and a communal kiosk. Parallel to these efforts, a small solar array or diesel generator (or a combination) is placed to power the new installation. Throughout this period, environmental and social safeguards—such as noise abatement, dust control, and community safety measures—are actively monitored and adapted as needed. Access to the site by local stakeholders will be restricted temporarily during this phase to safeguard the community from construction related injuries but given the small footprint of the project and the distance from the project site to the village (~1km), this is not anticipated to disrupt livelihoods.

Operation and Maintenance: Borehole pumping, water treatment (if needed), water user committees, maintenance schedules.

Before operation, there is a pumping test. The pumping test is performed with a pump suitable for yields up to 5 l/s with a head of 400 m and 6” of diameter. The contractor shall provide, beyond the pump and the generator, a gate valve, a flowmeter, a piezometric probe or diameter (up to 500 m of length) and a calibrated EC-meter for the measurement of electrical conductivity. The EC-meter is calibrated on a standard solution of known conductivity before the start of drilling operations. Field forms are supplied for each type of test. The test is followed by the drilling supervisor or by a person appointed by him/her.

The activity consists of 3 different tests, preceded by a test of one hour to verify the reasonable yield range of the borehole.

- **Step Test**: it is performed by 4 steps at growing yields, at ¼, ½, ¾ of the maximum expected yield. The last step is done at the maximum yield. The time of pumping for each step is 1 hour. The passage to each next step is done without intermediate recovery. After the last step is concluded, a recovery phase of 2 hours measurements is done. During the test, readings of the water level are taken in the time intervals indicated on the step test form. Flowmeter readings, EC and temperature are measured at the start of each step and in the last minute of the last step.
- **Constant rate test**: once the recovery from step test is completed at 100%, a constant rate test of 72 hours is performed. The yield is selected by the drilling supervisor, on the basis of the results of the step test and specifically at a yield of ¾ of the critical yield. During the test, readings of the water level, of the flowmeter, of EC and temperature are taken in the time intervals indicated on the step test form. It is recommended to verify the pump yield each 12 hours calculating the time necessary to fill a 200 litres drum by stopwatch. No generator stops are admitted, in case a stop occurs to the generator, the test shall restart from time 0, after a full recovery of the water level. Before the end of the test a sample of 5 litres of water is taken for chemical analyses.
- **Recovery**: as soon as the pump is shut the recovery measurements start following the timing of the recovery form. The recovery is followed for a maximum of 10 hours or up to 95% of the whole draw-down is recovered by the water level.

Following the completion of physical works and pumping tests, Operation of the borehole and its associated systems commences. Day-to-day running is typically handed over to a water committee or local authority trained in basic pump maintenance and administrative tasks. At this stage, the community begins drawing water directly from the kiosk, while pastoralists use the troughs. Operational considerations include periodic monitoring of pumping rates and water quality and simple inspections of the solar or generator setup. Meanwhile, authorities or project staff maintain oversight through periodic site checks and collaboration with local representatives.

Decommissioning/Closure (if/when relevant): Well Closure and Decommissioning Process for a Non-Productive Borehole

In the event that the borehole drilled at Cali Ciise is determined to be unsuccessful—either due to lack of sustainable water yield or adverse geological conditions—the borehole must be properly decommissioned and closed in accordance with good international industry practice (GIIP), national groundwater protection requirements, and World Bank safeguard expectations.

Decommissioning a failed borehole is essential to prevent the structure from becoming a physical hazard, a pathway for groundwater contamination, or a long-term liability to the community and environment. A poorly sealed well can act as a conduit for pollutants to enter otherwise protected aquifers or result in subsidence around the wellhead.

The closure procedure must be carried out by the drilling contractor under the supervision of the PIU and documented in full. The steps typically include:

- **Removal of all equipment and debris** from within the borehole;
- **Disinfection of the borehole** to eliminate any biological contamination;
- **Backfilling the borehole** with an appropriate sealing material such as neat cement, bentonite-cement slurry, or clean clay in stages to prevent settlement or water flow;
- **Cutting off the casing** at least 1 meter below ground level;
- **Placing a concrete cap or plug** over the sealed borehole to prevent intrusion;
- **Restoring the site** through removal of drilling infrastructure, backfilling of pits, and regrading to natural contours.

Where possible, the community should be notified and consulted prior to final closure, and signage should be posted during the process to ensure safety. The final location and closure status of the borehole should be reported to the national groundwater database and included in the project documentation.

Importantly, any drilling waste (e.g., spent muds, cuttings) generated during the failed drilling operation must still be managed and disposed of in accordance with the Site Waste Management Plan. Closure does not negate environmental responsibilities.

This precautionary protocol ensures that even if the exploratory effort fails to result in a viable water source, the site is returned to a safe and environmentally sound condition, and the integrity of the underlying aquifer is preserved for future use.

It should be noted the well will not be abandoned due to salinity. Instead, if the salinity exceeds 2,500 ms/cm, a desalination plant will be included to ensure water meets project standards.

Summary of Raw Materials and Inputs by Project Phase

General Items

- Construction camp setup materials (e.g., fencing, storage, temporary shelter)
- Water for worker consumption, hygiene, and light site use
- Electricity/Diesel generators to power site offices and lighting

Borehole Drilling

- Water-Based Drilling Mud (prepared using water and possibly bentonite)
- Steel casing pipes (203 mm, plain and slotted)
- Gravel pack and well screens
- Drilling rig fuel – primarily diesel
- Lubricants and coolants
- Water – large volumes (often >10,000 liters/day) needed for mud preparation and drilling circulation
- Electricity or diesel power for drilling rig, compressors, and control panels

Pumping and Purification

- Submersible electric pump
- Galvanized steel riser pipes
- Chlorine or other water treatment chemicals
- Electricity: either from the main grid, solar PV, or generator
- Water: small volumes for pump testing and calibration

Water Tank Installation

- Reinforced concrete (M20–M30) for foundations and support pads
- Pre-fabricated or welded steel water tanks
- Water for concrete curing

- Electricity or diesel-powered concrete mixer

Kiosk / Tap Stand Construction

- Concrete and cement blocks
- HDPE or galvanized pipes
- Clean water for mixing mortar and curing
- Electricity for small tools or lighting (if applicable)

Animal Troughs

- Masonry and concrete materials
- HDPE or steel piping
- Water for construction and cleaning

Watchman House

- Concrete, blockwork, roofing sheets, etc
- Water for mixing materials and domestic use
- Electricity for lighting and basic appliances (usually solar or generator-fed)

Diesel & Domestic PV Generators

- Diesel generator unit
- Fuel tanks and piping
- Inverters, circuit breakers, and grounding rods
- Diesel fuel
- Battery backups for domestic loads

Photovoltaic Field

- Photovoltaic panels (PV modules) and mounting structures
- Cabling, inverters, combiner boxes
- Battery bank and control systems (if off-grid)
- No ongoing fuel or water needed post-installation

3.5. Project Justification and Benefits

The project is driven by the pressing need to bolster water security in Cali Ciise, a village in Somaliland's Togdheer Region that faces prolonged droughts, limited freshwater sources, and the high cost of trucking water from distant locations. Currently, many households rely on shallow, often unprotected structures (berkad) or seasonal rain-fed reservoirs, leaving them vulnerable when these sources dry up. By tapping into a deeper and more reliable aquifer, the new borehole aims to mitigate the hardships families and pastoralists endure during extended dry seasons.

Project benefits are both immediate and long-term. Most notably, local residents gain a safer water supply, which reduces time spent fetching water—particularly for women and children—and improves overall community health. Livestock owners benefit by having a stable watering point for their animals, limiting losses and boosting productivity in the pastoral economy. Potential small-scale cultivators may also explore more consistent irrigation of home gardens or fodder plots, further diversifying incomes. Additionally, the project strengthens local capacity in overseeing a robust water management system. Finally, by integrating solar-based pumping (where possible) and a formal water user fee, the borehole stands as a more climate-smart, economically resilient solution for long-term water provision.

4. BASELINE ENVIRONMENTAL AND SOCIAL CONDITIONS

4.1. Physical Environment

Below is an overview of the physical environment in Cali Ciise. This section draws on desktop research, project documents, and the Construction Investment Report (CIR).

Rainfall Analysis

The assessment of precipitation in the area of interest is essential for identifying local rainfall patterns that may indicate the water availability and water needs of the population. For this analysis, data from ground weather stations provided by SWALIM and remotely sensed data from GPM (Global Precipitation Measurement) and TMPA (TRMM Multisatellite Precipitation Analysis) using TRMM (Tropical Rainfall Measurement Mission) data will be utilized. The available ground monitoring network alone cannot be expected to fully represent the area's diverse precipitation patterns, so remotely sensed data will complement these observations. GPM and TRMM, a joint mission of NASA and the Japan Aerospace Exploration Agency launched in 1997 to monitor rainfall for weather and climate studies, offer precipitation data at a 3-hour interval with a 0.25° x 0.25° spatial resolution. This dataset was analyzed to assess its capability to accurately represent local precipitation compared to data from weather stations.

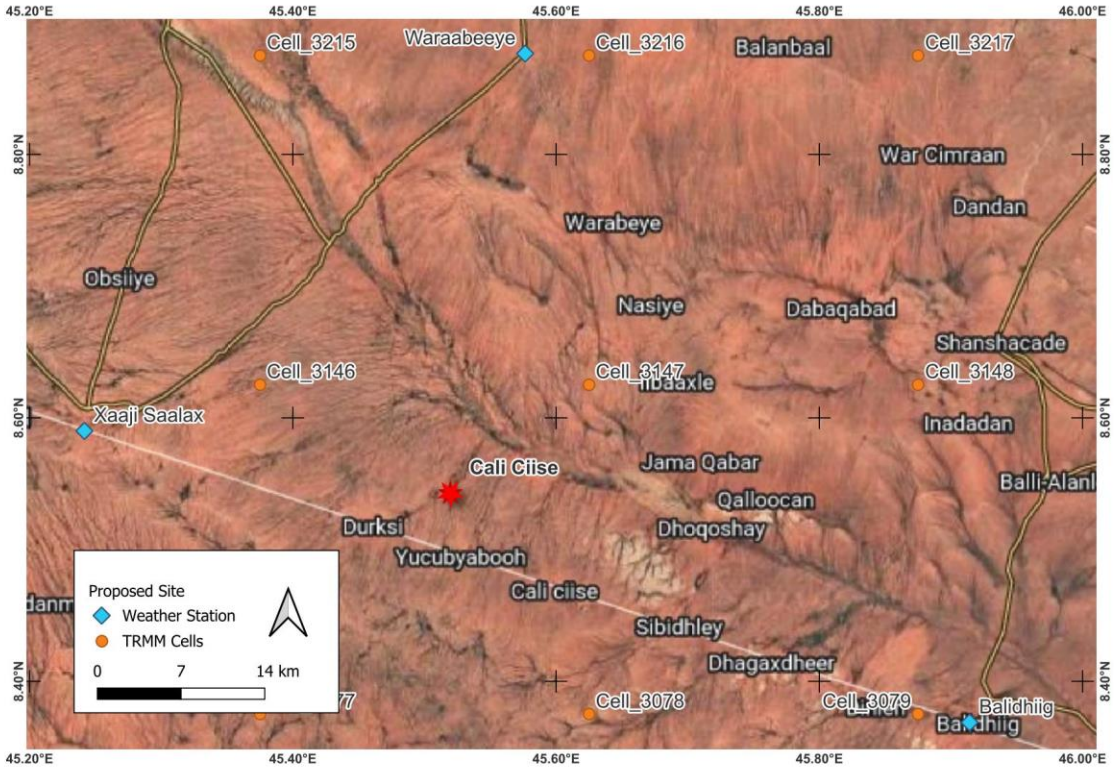


Figure 13: Location of the closest weather station and TRMM cell compared to the location of the site

An analysis was performed on the TRMM dataset, comparing the Waraabeeye station (the closest with the longest series of data) with the closest TRMM cell available (3216 in the map above). The comparison of the two datasets considered both the monthly pattern and the average yearly values. As shown below, the analysis demonstrates a quite good correlation between the two records, with similar monthly patterns and a ratio between the average annual rainfall of the two-time series of 1.4 (this means that, on average, there is less than 40% difference between the recorded data and those provided by TRMM).

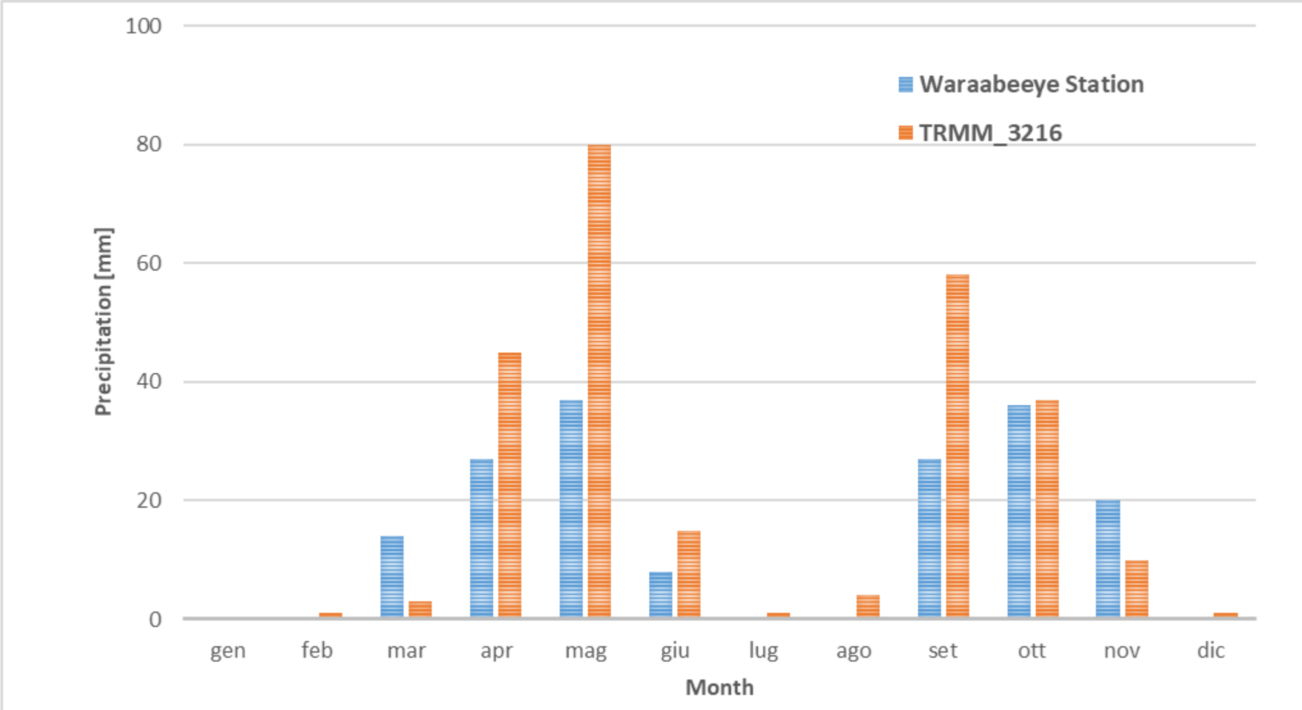


Figure 14: Average cumulative monthly rainfall data comparison between the Waraabeeye weather station and the closest TRMM cell

Table 7 Comparison between the average cumulative annual rainfall between the Waraabeeye weather station and the closest TRMM cell in mm

Weather Station	TRMM	Ratio
169	245	1.4

Given the distance between Waraabeeye weather station and the location of the proposed site (about 37 km) and the satisfactory match between TRMM data and ground observed data, the TRMM dataset can be employed since it is assumed to be more representative of the rainfall in the area of interest, it provides data every 3 hours and has a longer series of data.

TRMM dataset is available for a total of 22 years. According to such records, average rainfall precipitation is 266 mm/year. The following figure shows the extent of the annual precipitation records.

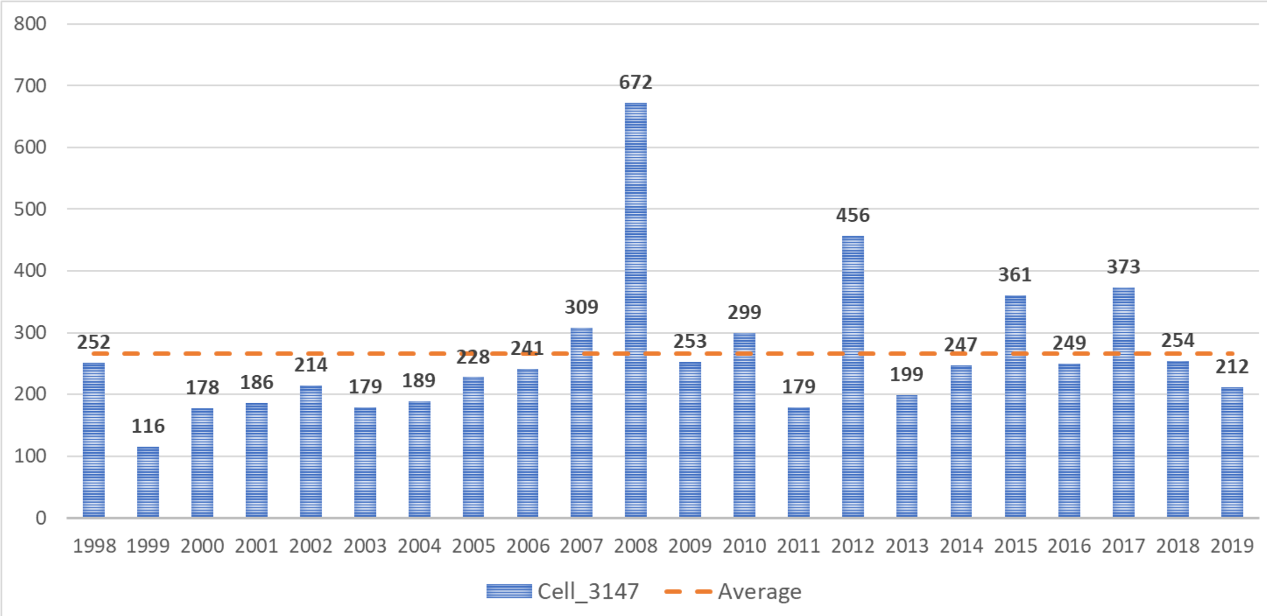


Figure 15: Cumulative yearly rainfall data of the cell 3147 of TRMM database

From the data available the average cumulative monthly was calculated and the average trend is presented below.

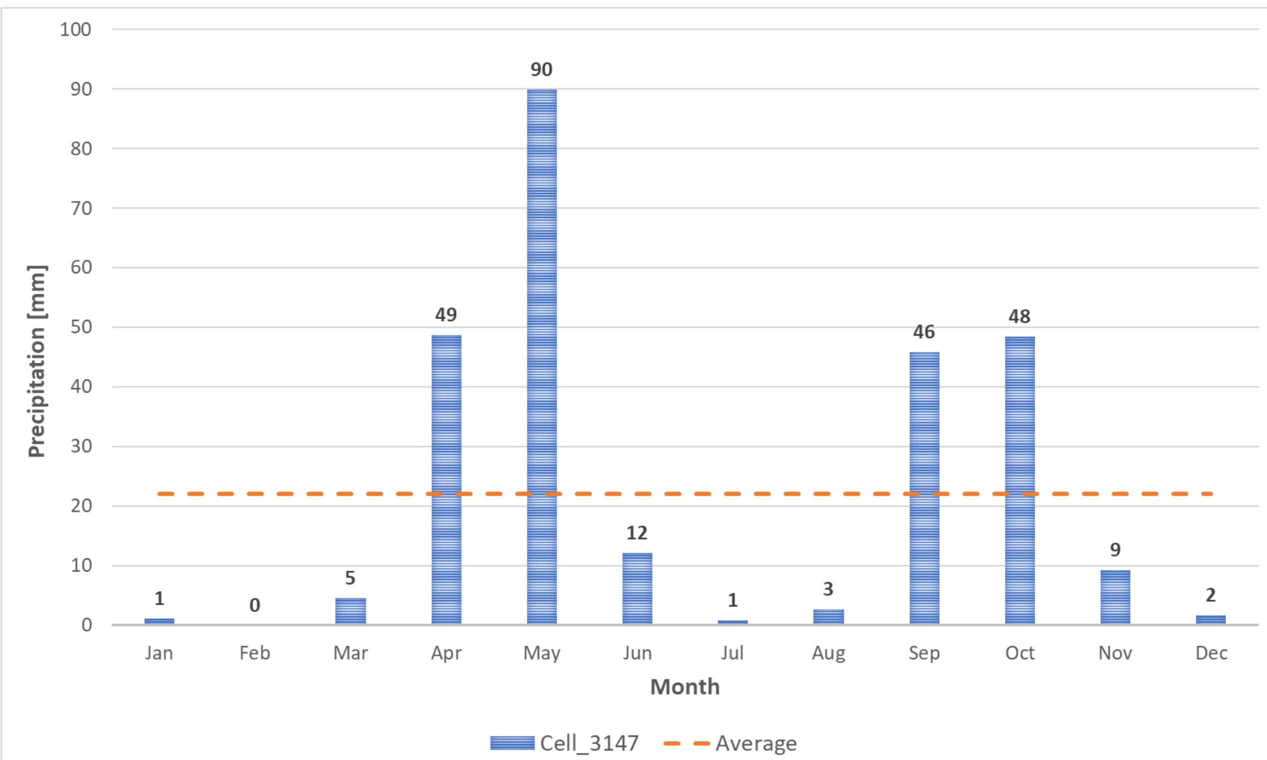


Figure 16: Average cumulative monthly rainfall data of the cell 3147 of the TRMM database (1998-2019)

According to the data, the rainfall peaks usually occur during the months of April/May and during September/October. The very dry period extends from November to March.

4.2. Hydrogeological Investigations

Geological Frame

A geophysical survey was conducted in an area near the border where the Auradu Limestone Formation outcrops. The regional geology is characterized by three main geological units, which are mostly covered by a thin layer of Quaternary alluvial-aeolian deposits:

- Auradu Limestone Formation (Ea, Middle-Early Eocene): This unit consists of nodular limestones, abundant marls, and sandy limestones. Its composition and thickness vary by location, ranging from a few dozen meters in the hills south of Hargeisa to over 400–500 meters along the northern escarpment of the plateau near Laas Canood. The closest data to the study site come from Balidhiig, about 50 km ESE, where the Auradu Formation was found at depths of up to 300 meters, and from the Shanshacade borehole (50 km ENE), where the unit was present up to the bottom of the drilling at 400 meters. The Auradu is the first post-Cretaceous marine unit and lies unconformably on the Yesomma Formation.
- Yesomma Sandstone Formation (Cretaceous): The Yesomma Formation (Ky) is a continental unit composed of variegated quartzose sandstones and siltstones, primarily of fluvial and/or lacustrine origin. It extends across much of the Haud Plateau, with thicknesses typically exceeding 400 meters. In some tectonic trenches, such as the Nugal Valley and Xood Trench, this formation unconformably overlies Jurassic limestones. However, no data from the nearby border area confirm the presence of Jurassic limestones, so it is assumed that in the study area, the Yesomma Formation lies directly and unconformably on the basement.
- PCB (Precambrian Undifferentiated Basement): This is a complex of crystalline rocks of intrusive and metamorphic origin, forming part of the ancient African Shield. It outcrops at the border between the Awdal and Marodijeex regions and along the northern edge of the Haud Plateau. It has likely been encountered in most drillings in the Marodijeex region, with depths ranging from less than 100 meters at Tog Wajale to over 350 meters in the Salaxley-Balli Gubadle area. In the study area, it is expected to be at depths of no less than 500 meters. However, drilling logs are completely absent in the area from Balli Gubadle toward the southeast. At Balidhiig, the PCB was not encountered, indicating a depth of more than 460 meters.

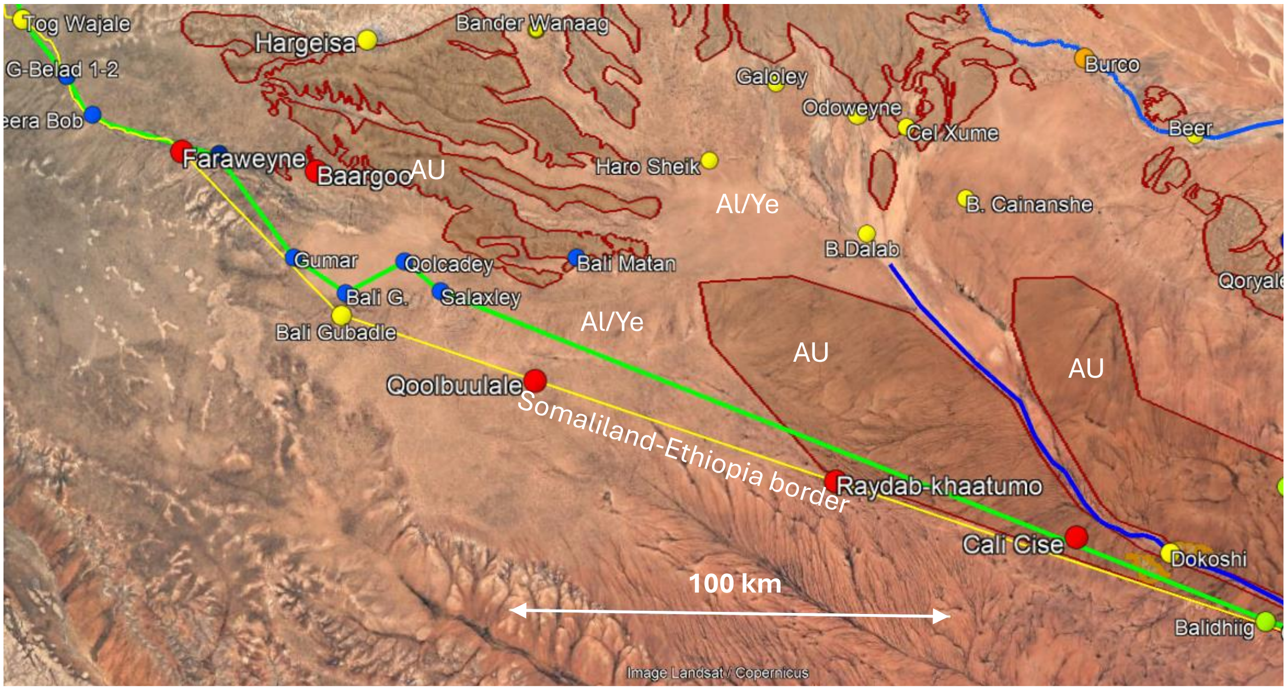


Figure 17: Geological map of South Somaliland with boreholes location – Al/Ye: Yesomma Sandstone, with alluvial cover – AU: Auradu Limestones – yellow line: international border – green line: cross-section in Figure 18 below – blue/green points: boreholes – red points: project proposed sites – map modified by Abate et Al (1994)

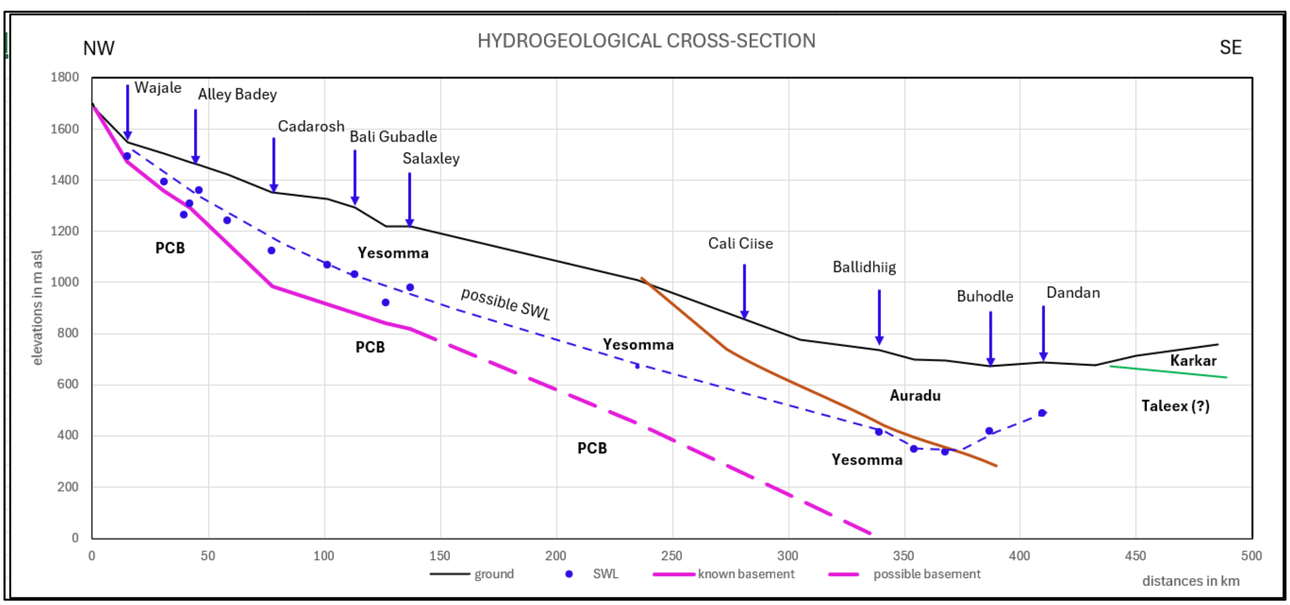


Figure 18: Hydrogeological cross-section along the Somaliland Ethiopia border

Hydrogeology

Along the border, from Tog Wajale to Balidhiig, the aquifer is located in the sandy deposits of the Yesomma Formation. In the Marodijeex region, up to Salaxley, the static water level (SWL) is typically close to the top of the basement, and in most cases, the saturated section of the Yesomma rarely exceeds 50 meters. As a result, the yields of drilled boreholes are generally low, rarely exceeding 10 m^3/hour. This scarcity of yield can be attributed to several factors, including the abundance of fine deposits in the Yesomma Formation, the challenges of drilling, poorly completed boreholes, and the limited capacity of submersible pumps, which require significant power to raise water from depths of 200–300 meters.

In Togdheer, the saturated section of the Yesomma Formation is expected to be much thicker. Data reported by SWALIM and measured during pumping tests show yields of nearly 10 to 20 m^3/hour, even at SWL depths greater than 300 meters, as seen in Balidhiig.

At Buhodle, the aquifer appears to be partly located in the Auradu Formation, likely due to the presence of thicker limestone intervals and a lesser amount of marly-shale components. Eastward from Buhodle, the water table begins to rise, likely due to the presence of the Taleex evaporites, which host aquifers at shallow depths in the Laas Canood area (Nugal Valley).

Water quality, measured using an EC meter in July, was found to be moderate in the area between Geed Belad and Wadabarish and in the Bali Gubadle borehole (2,300–3,000 µS/cm). However, water quality was poor in Gumar, Salaxley, and Shanshacade (3,600–5,000 µS/cm). At Balidhiig, the borehole was non-functional, so no measurements were taken, although testing during pumping indicated poor quality at the end of drilling.

Based on this information, in the study area, the aquifer is likely to be found in the Yesomma Formation, where sandy deposits dominate. The SWL is expected to be between 250 and 350 meters, with potential yields of 12–18 m^3/hour. The water quality, however, remains unknown.

A summary of borehole data provided by the Ministry of Water Resources Development (MoWRD), extracted from the SWALIM database, and gathered during a field mission in July 2024 is shown below. The mission visited boreholes near the border from Tog Wajale, where three new boreholes have been drilled, up to Shanshacade and Balidhiig in Togdheer. Unfortunately, many boreholes were temporarily closed due to heavy rains that filled the valleys, providing the population with fresh and affordable water. In some cases, there was no personnel available to provide information on yield, daily pumping times, or other data, and it was not possible to obtain water samples for EC measurement. However, during the field mission, the geologist confirmed the presence of Precambrian basement (PCB) fragments near the boreholes, indicating that the basement had been reached during drilling.

Table 8: Boreholes location and hydraulic parameters – PVB: Precambrian Basement

name	Latitude	Longitude	Depth	SWL	DWL	pump depth	Yield	pump time	Yield	EC	Status	Lithology
	decimal degree		m	m bgl	m bgl	m	m3/hr	hours	m3/day	µS/cm		
Tog-wajale 1	9.63330	43.36373	180	68.7		abandoned					not working	
Tog-wajale 2	9.63736	43.35383	180	67		155	12	3	36	3700	Active	
Tog-wajale 3	9.64334	43.40393	180	66.5		138	14	new		4650	new	PCB frag.
Tog-wajale 4	9.63769	43.38407	218	65	72	145	27	new		4500	new	PCB frag.
Tog-wajale 5	9.63481	43.37925	210	65	70	148	26	new		5457	new	PCB frag.
Geed Belad 1	9.48774	43.42720	144	sealed		232	3.5	0-23		2550	Active	
Geed Belad 2	9.48531	43.42803	160	sealed		146	2.5	0-23	10	2620	Active	
Walixdoor	9.42022	43.46156	216	174		210	10	0-18		2370	Active	PCB frag.
Dameera Bob	9.40679	43.48204	250	sealed		180	15	0-23			Active	PCB frag.
Cadaroosh	9.32703	43.74477	377	sealed		310	13.5	18		2800	Active	PCB frag.
Wadabarish	9.20625	43.79685	326	sealed		305	4			3020	not working	PCB frag.
Gumar	9.11774	43.90090	340	sealed	260	280	3	3	10	3600	Active	PCB frag.
Baligubadle	9.04583	44.00847	360	sealed		300	13	3	50	2790	Active	
Qolcadey	9.11047	44.12960	360	sealed		damage					not working	
Salaxley	9.05532	44.20271	400	300		362	11	5	55	4080	Active	
Salaxley new	9.06256	44.19918	400	borehole under completion. Drilling samples label (depth) not readable								
Balidhiig	8.37452	45.90854	462	320	No	370	11				not working	PCB frag.
Shanshacade	8.64969	45.95254	360	182		315	15	3	45	5010	Active	

Table 9: Location and hydraulic parameters of the boreholes along Somalia-Ethiopia border

name	Latitude	Longitude	Elevation	Depth (m)	SWL	Pump depth	Yield	pump time	Draw-Down	DWL	AqH//SCL	T	K	EC	Recovery 90%	Ye/PCB depth		Main Aquifer	Year	Agency	Region
	decimal degree		m asl	m	m bgl	m	m^3/hr	hours	m	m bgl	m	m^2/day	m/day	µS/cm	min	m					
Tog Wajale	9.60065	43.33477	1555	84	57		2.5	dried up								77	PCB	YE	2003	Africa 70	
Wado Godka	9.54815	43.42520	1530					abandoned for water salinity										YE	2005	Africa 70	
Geed Belad 1	9.48531	43.42803	1508	160	130		8.7	23						2450				YE	2005	Africa 70	
Geed Belad 2	9.48774	43.42720	1505	162	112		12.9	12	13.35	129	33	1.2E+02	3.6E+00		50	148	PCB	YE	2006	COSOB Co.	
Walixdoor	9.42010	43.46150	1480	216	150													YE	2019	SWALIM	
Dameera Bob 1	9.40679	43.48204	1471	200/212	>150/80	188	12/7							2870				YE	2005/14	A70/SWALIM	
Dameera Bob 2	9.40650	43.48180	1467	230	200				22									YE	2019	SWALIM	
Alley Badey	9.38700	43.51370	1459	180	100		7											YE	2014	SWALIM	
Wado Makail	9.35944	43.61015	1422	265	180		4											YE	2019	SWALIM	Marodijeex
Fararweyne	9.33240	43.66869	1401	270	245		4		12					2570	3			YE	2019	SWALIM	
Cadaroosh	9.32800	43.74579	1374	377	232.5	300	16	24	23	46.65	242	1.4E+02	2.4E+01		10	368	PCB	YE	2021	MoWRD	
Wadabarish	9.20602	43.79650	1384	300	225		16							3020				YE	2019	SWALIM	
Gumar	9.11774	43.90090	1327	340	257	300	9	72	3.45	260.5	41			1730	40			YE	2018	MoWRD	
Qolcadey 2	9.11047	44.12960	1223	376	300-330		4	7	2					3170	4			YE	2017	TS/SWALIM	
Qolcadey 1	9.08800	44.19152	1198	340	300			abandoned for low yield										YE	2019	TS/SWALIM	
Salaxley	9.05014	44.20447	1200	390	240		12	8						3300				YE	2022	SWALIM	
Bali Matan	9.11882	44.48454	1426	460	430		5	20						3160				YE	2022	SWALIM	
Balidhiig	8.37452	45.90854	736	462	320	370	18	24	3	323	80	4.2E+02	2.9E+00		10	306	YE	YE	2022	MoWRD	
Shanshacade	8.64969	45.95254	784	395	183	370	12	24	122	305	146	3.1E+00	1.5E-02		70			AU	2022	MoWRD	
Coodanle	8.33506	46.04233	700	350	320		8	5						1670					2022	SWALIM	
Xadhadhanka	8.29970	46.15640	696	360	333		16	24	not working in 2019 for problem to pump										2019	SWALIM	
Qori Lugud	8.56011	46.23796	741	354	176		16	12						1360					2022	SWALIM	
Shangalli	8.28255	46.31196	656	398	239		18	12						3830					2022	SWALIM	Togdheer
Buhodle 3	8.25550	46.31960	672	350	270	12	16	24											2022	SWALIM	
Buhodle 2	8.24664	46.32216	672	400	252	380	14.4	24	47	298.55	75.4	1.6E+01	1.04E-01	n.a.	240	397	YE	AU +YE	2021	MoWRD	
Qararrooyin	8.22000	46.35600	660	360	270																
Dandan	8.25140	46.52950	683	370	200	200	16	12						4280					2019	SWALIM	

data source	MoWRD	SWALIM	COSOB Co.	Africa 70	TS
red color	dried or abandoned or temporarily not working				

AqH//SCL	aquifer thickness/filters lenght
Ye/PCB	Yesomma/Precambrian basement

VES Survey

The survey was conducted using 15 Vertical Electrical Soundings (VES) with a maximum AB/2 spacing of 1,000 meters during the first phase, which took place from August 24th to 28th, 2024. An additional five VES were completed in the second phase, from September 18th to 21st. The VES layout was generally oriented at 280–300° E, with a few exceptions due to accessibility constraints.

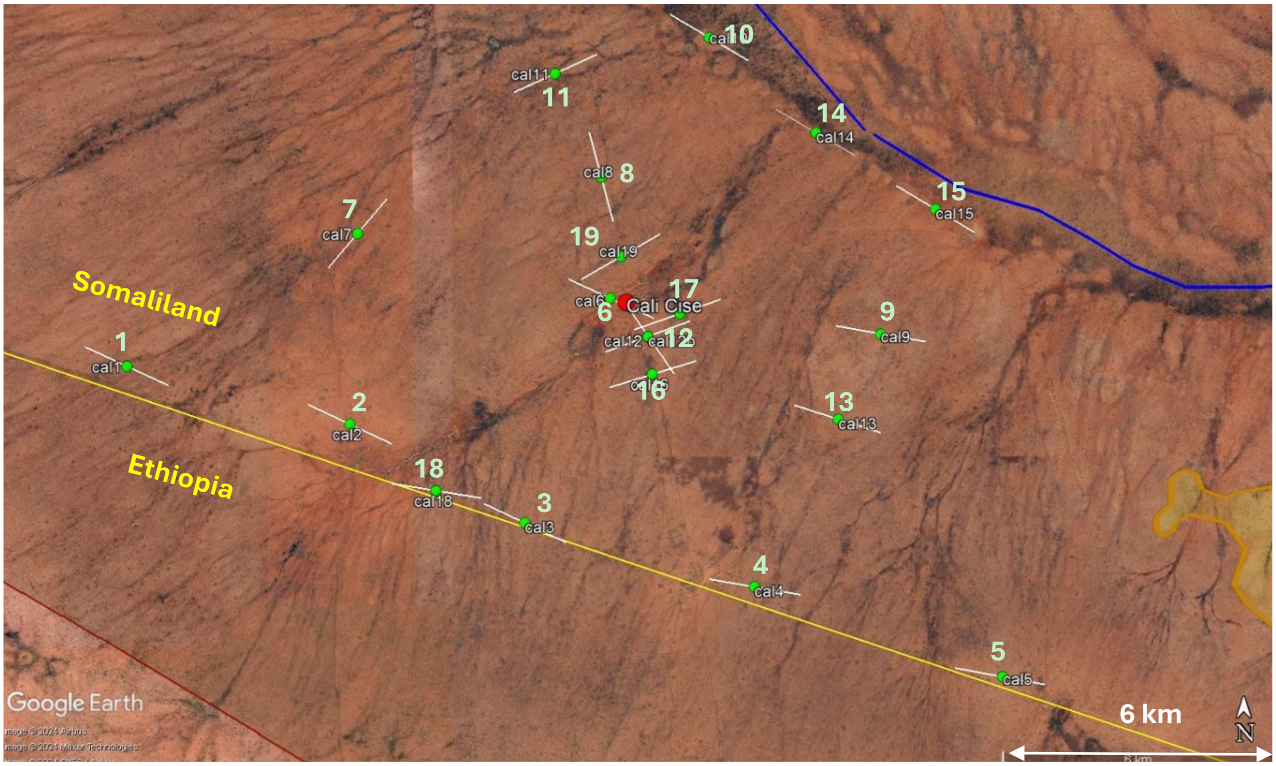


Figure 19: VES locations (green points), denomination and azimuth (white lines) – green numbers: VES denomination – red point: village – yellow line: border – blue line: main area drainage

The VES data were interpreted using the NEW-VES program, which also generated cross-sections whose positions and orientations are shown below. After the initial interpretation, the resistivity models were subjected to mathematical control to verify their compatibility with field data. For nearly all VES, a second (or more) model was built and validated, as it is common in this type of subsoil for multiple numerical (and thus geological) interpretations to be consistent with the field resistivity data.

The ground's response in terms of resistivity (Rho) to different geological configurations is not unique, as it depends on the ratios between resistivity and thickness of the layers. The main challenge in the study area is the presence of predominantly fine deposits (such as marls, shale, and silt) from the Auradu Formation, underlain by sandy-silty deposits of the Yesomma Formation, and at greater depths by the Precambrian Undifferentiated Crystalline Basement (PCB). The resistivity ratios between these three units increase with depth, and the VES curves show a gradual rise.

When the thickness of the Yesomma sands exceeds 300 meters, the boundary between this formation and the PCB is well detectable. However, when the thickness is less, the boundary can be harder to define due to the depth range, and multiple resistivity models can be consistent with the field data.

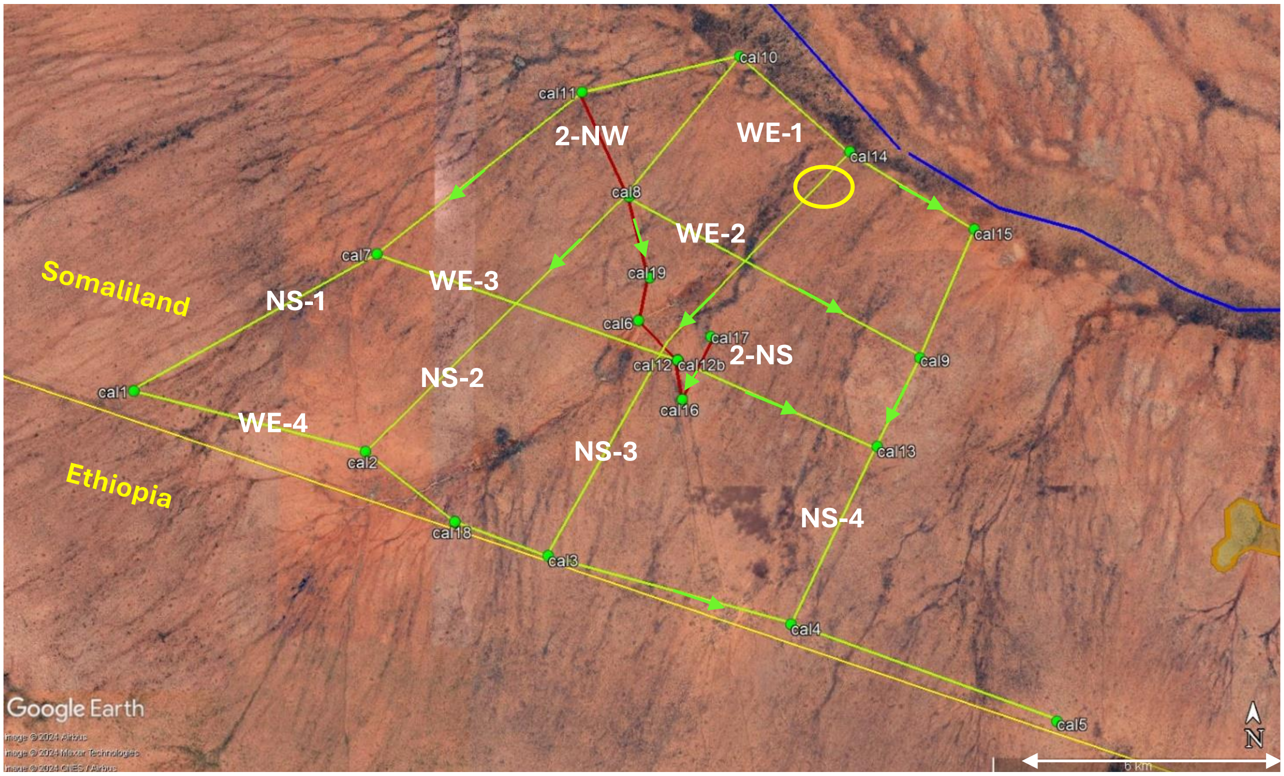


Figure 20: VES and cross-sections positions (green points and lines) – green arrows: cross-section direction – white letters: cross-section name – yellow ellipse: previously failed borehole (probable collapse) – yellow line: Ethiopia – Somaliland border

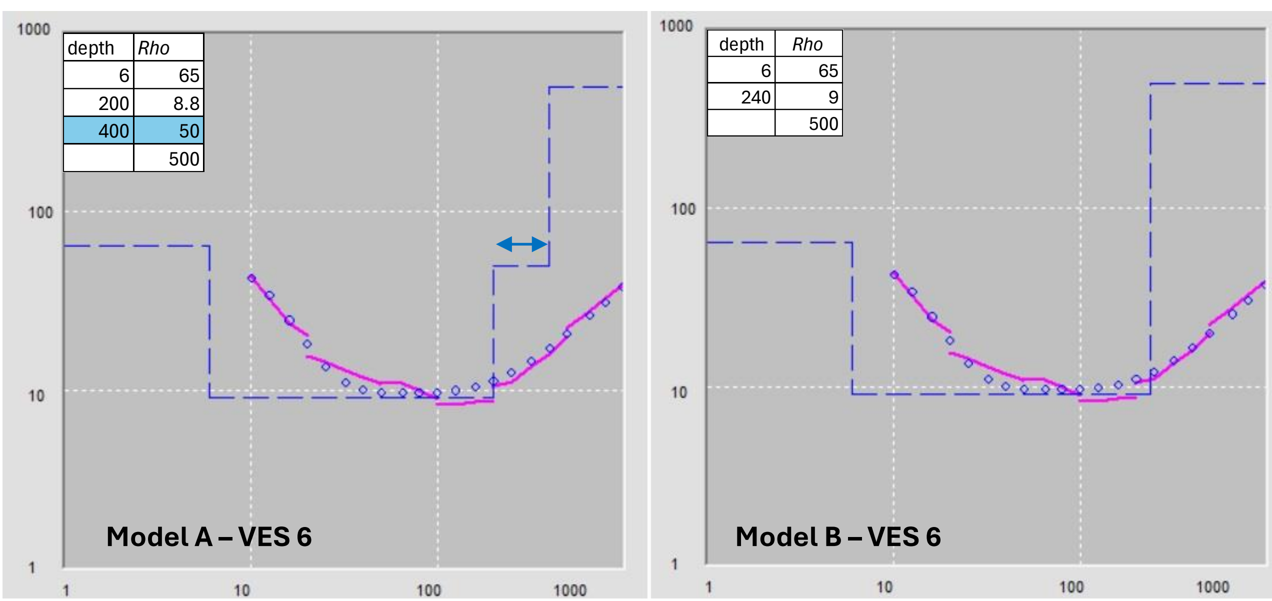
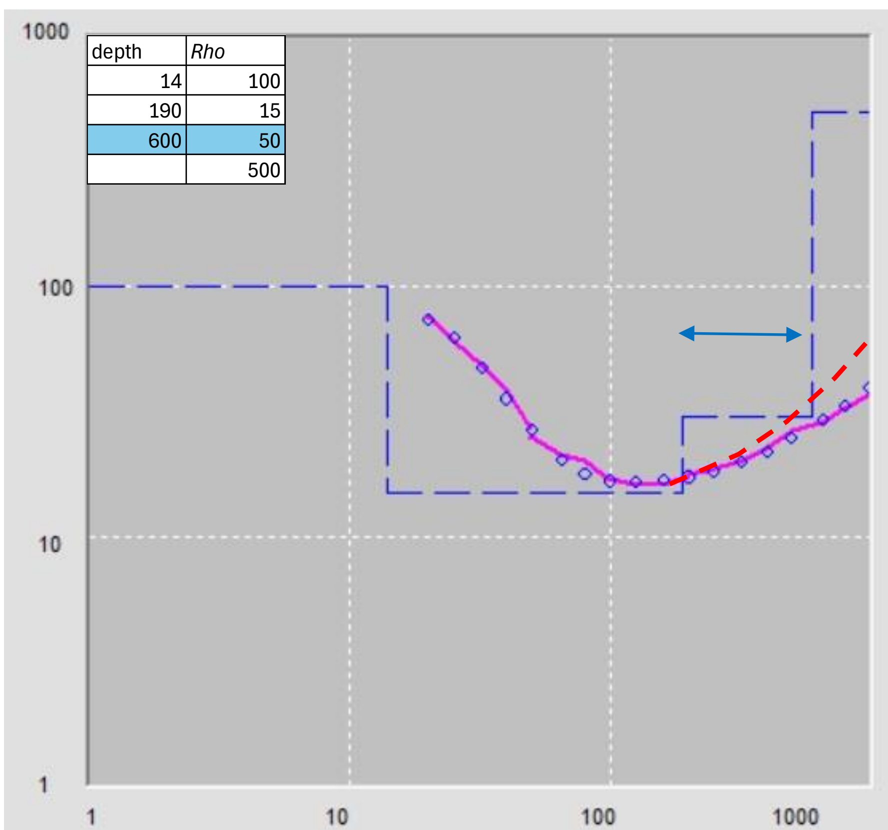


Figure 21: *Comparison between different resistivity models (dashed blue lines and blue circles) and field resistivity data (violet lines). The blue double arrow shows the layer missing in the model B.*

In **Figure 21**, two different resistivity models (represented by blue dashed lines) that were subjected to mathematical control produced nearly identical results (small blue circles), with a difference of only 0–0.2% from the field data (violet lines). Although the mathematical difference between the two models is negligible, the hydrogeological implications are significant: in Model B, the deep sandy fraction of the Yesomma Formation, which could potentially host the aquifer, is absent. In contrast, Model A shows a possible sandy layer extending from 200 to 400 meters deep, providing a higher likelihood of aquifer presence.

Performing multiple interpretations of the VES curves helps to identify locations where the margin for multiple interpretations is very narrow, indicating areas where favorable groundwater conditions are more likely. For example, **Figure 22** illustrates (with the red dashed line) how the VES curve would differ if the potential aquifer layer were reduced from 600 meters to 350 meters deep. In this case, we can be reasonably confident that the aquifer likely extends to a depth of no less than 400–500 meters. This particular VES location is one of the sites considered suitable for groundwater exploration, and, along with a few others, it became the focus of further surveys conducted during the second phase.



depth	Rho
14	100
190	15
600	50
	500

Figure 22: Impact of a reduction of depth/thickness of the possible aquifer (double blue arrow) on the field resistivity data in the curve of VES 12. The red dashed line shows the deep impact on the VES curve of a minor depth (350 against 600 m) of the bottom of the possible

Different VES shapes and interpretations may result from lateral variations in resistivity along the VES layout. This effect can be more pronounced with longer layouts, such as the present survey, which used an AB spacing of 2,000 meters. For this reason, one of the promising areas, around VES 12, was further investigated during the second phase with additional VES (12b, 16, and 17) aligned along a different azimuth. This was done to verify that the interpretative model did not change with the direction and to confirm the area's suitability. These three VES confirmed that the selected area is favorable for the deep extension of a possible aquifer. Additionally, VES 18 confirmed the potential of the area between VES 2 and 3, while VES 19 indicated a probable reduction in aquifer depth near the previously conducted VES 6, located northwest of the village.

Based on the field data interpretation, four main resistivity units were identified:

- *Top Unit*: This is a thin unit, typically less than 15 meters thick, with highly variable resistivity values, indicating the presence of loose alluvial and aeolian deposits, ranging from sands to clayey materials. In some cases, where the resistivity exceeds 100 Ωm, it may include limited layers of Auradu limestones. The resistivity (Rho) values range between 5 and 500 Ωm.
- *Conductive Unit*: The second unit is a conductive layer with Rho values between 10 and 20 Ωm. It can extend, overlain by the Top Unit, to depths of 150–300 meters, and in some areas, mostly in the northern part of the study area, it reaches beyond 500 meters. This unit consists mainly of marly deposits from the Auradu Formation and is considered unsuitable for groundwater, especially where Rho values are ≤10 Ωm, even when found deeper than 350 meters, the potential maximum depth of the regional water table. Where this unit extends deeper, it may transition into the Yesomma Formation, dominated by finer sediments.
- *Deep Semi-Resistive*: This third formation has Rho values between 30 and 50 Ωm, though in some cases, the values are lower (below 20 Ωm), making it difficult to distinguish from the Conductive Unit. As explained earlier, this unit is not always clearly detectable because it may be obscured by the deeper layers. It likely occurs throughout the study area, though its thickness may vary. VES with Rho values around 50 Ωm exhibit this uncertainty. This unit is attributed to the Yesomma Formation, which has a wide range of resistivity due to its composition of sandstones and mudstones, and it may extend to depths ranging from 300 to 800 meters.
- *Bottom Resistive*: This is the deepest unit detected, but when its top lies beyond 500 meters, it becomes difficult to define. Its resistivity is approximated at 500 Ωm, though the high depth makes precise calculation challenging from the VES curves. The nature of this unit remains unclear: it could represent the Yesomma Formation or the Precambrian Basement (PCB). However, the PCB is unlikely to be found at depths shallower than 500 meters, as the combined thickness of the Auradu and Yesomma Formations should be at least 500–600 meters. Furthermore, since the aquifer is expected at depths of 350–400 meters, the sandy deposits of the Yesomma Formation at these depths should not exhibit Rho values above 50 Ωm. It is also uncertain whether Jurassic limestones might exist between the Yesomma sandstones and the basement in this area.

However, even if present, Rho values should remain below 50 Ωm in an aquifer environment. The most plausible explanation is that this Bottom Resistive Unit represents the Precambrian Basement, potentially displaced by tectonic thrusts.

In conclusion, the first phase of the survey identified several locations (VES 2, 3, 8, 11, and 12) where the Yesomma Formation exhibits high resistivity values (Rho > 20–35 Ωm), consistent with the presence of sandy layers extending to depths greater than 350–400 meters, which is considered the possible depth of the regional water table. In these VES, the margin of error for defining the aquifer depth interval is minimal. However, where Rho values approach 50 Ωm, there is greater uncertainty regarding the extent of the Yesomma Formation. The second phase confirmed the existence of three positive areas, with suitable Rho values and depths exceeding 500 meters, as shown in **Figure 23**.

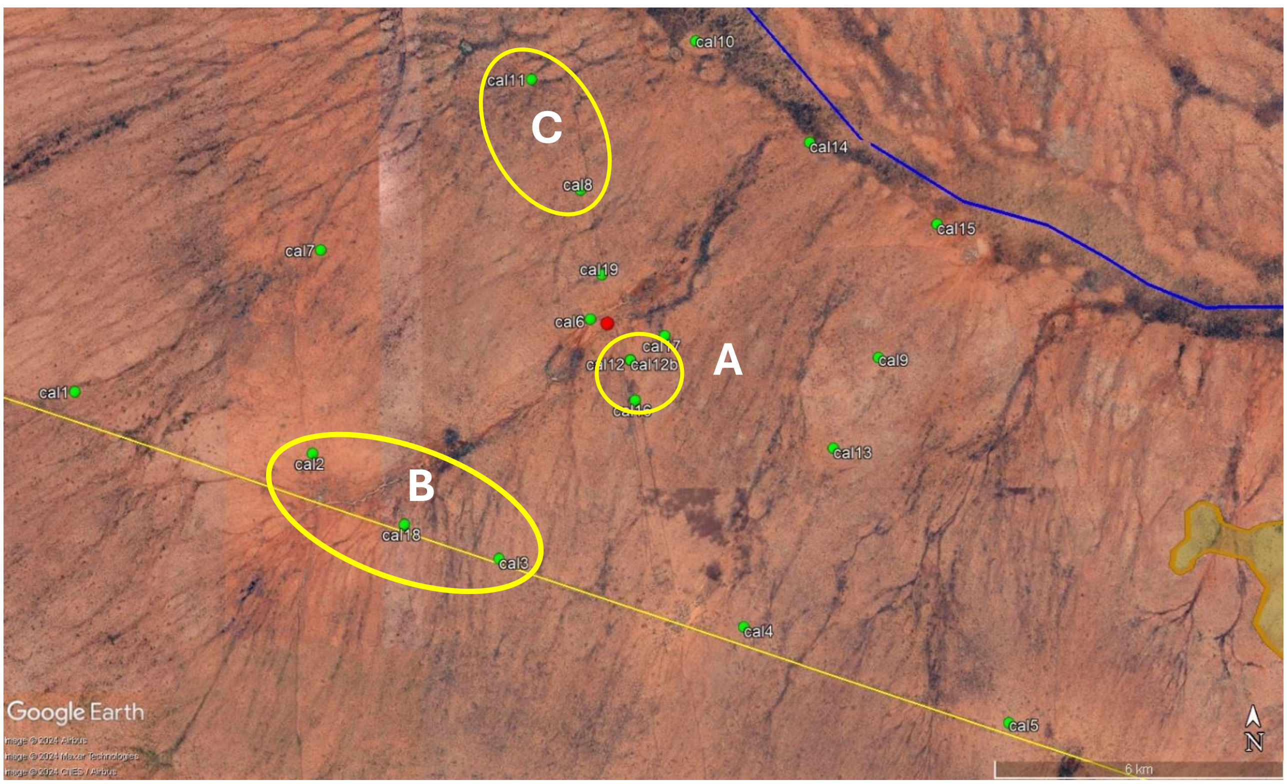


Figure 23: VES locations (green points) - red point: village – yellow line: border – yellow ellipses: areas suitable for groundwater research - blue line: main area drainage

From the interpretation of the survey it is possible to conclude that:

- In the study area around the Cali Ciise village, the probable subsoil configuration is made by 3 geological units:
  - Auradu limestones, present at shallow depth and locally outcropping, mostly made by marly clayey deposits.

- Yesomma sandstones, made by alternances of sandstones and mudstones. This unit can reach up to 600-700 m of depth and is the only possible aquifer.
- PCB (Precambrian Undifferentiated Basement), made by crystalline rocks, overlain by the Yesomma Fm.

- These units are roughly represented by three resistivity units, identified by the geophysical survey and described in the chapter 3 as ***Conductive Unit***, ***Deep Semi-Resistive***, ***Bottom Resistive***.
- The possible aquifer is expected in the formation of the Yesomma Sandstones, at depth starting from 350-400 m and extending up to the PCB (***Bottom Resistive***), at depth of 300-700 m. The SWL is expected between 250 and 350 m, the water quality can range from slightly brackish (2,500 µS/cm) up to strongly brackish (>4,000 µS/cm).
- All the deposits above the regional water level are dry. For this reason, the suitable locations for groundwater research are those where the depth of the Yesomma Fm is beyond 450 m. Given the normal uncertainty of the VES interpretation, suitable locations are considered those where the depth of Yesomma is expected beyond 500 m.
- The locations where the sandy component is abundant are the more suitable, once the condition of the depth is respected. The higher percentage of sand (or higher ratio of coarse/fine deposits) are indicated by the resistivity interval 20-35 Ωm.
- The VES survey detected 3 suitable areas, where the last 2 conditions (PCB depth > 500 m and resistivity of 20-30 Ωm) are respected. These areas are indicated by the yellow ellipses, named A, B and C in **Figure 23**. The areas A and B are considered the more suitable, and the final suggestion is the area A for the nearness to the village. We indicate specifically the location of the VES 12 as the site to make a drilling. The coordinates are: 8.542460° N and 45.519554° E. From this location it is suggested to remain in a radius of 200 m. The suggested minimum depth is 400 m and maximum is 500 m. The drilling director is in charge to decide at which depth to stop drilling operations. For the VES survey details, please see the Annexes.

4.3. Aquifer Recharge and Sustainability

The recharge area for the borehole has uncertain borders. It is estimated to about 15,000 km2 wide in Somaliland territory, and it is unknown in Ethiopia. In Somaliland, it covers the section of the Yesomma Sandstones-Auradu limestone outcrop, from NW to NNE of Cali Ciise. According to desktop research, in northern Somaliland, including areas like Cali Ciise, aquifer recharge primarily occurs through:

- **Seasonal Rainfall**: Recharge is mainly during the Gu (April–June) and Deyr (October–November) rainy seasons.

- **Infiltration from Toggas**: Ephemeral streams, known as toggas, facilitate infiltration into the aquifers during rainfall events.

- Karstic and Fractured Formations: The presence of karstic limestones and fractured rocks enhances the aquifer's ability to receive recharge through percolation.

The FAO SWALIM report titled *"Hydrogeological Survey and Assessment of Selected Areas in Somaliland and Puntland"* (Technical Report No. W-20, 2012) provides information on the aquifer recharge in the Cali Ciise area. It references a 1977 study (by GWK, Gesellschaft für Kläranlagen und Wasserversorgung, a German Institution), which estimated the amount recharging the deep aquifer in the Togdheer region at approximately 26.5 million cubic meters per year. While this figure pertains to a broader area, it underscores the potential for significant recharge in the region.

Production from the borehole of this project will be less than 5 l/s and for only half of the year. This equates to about 54,000 m^3 of water over a 150-day dry season, assuming 20 hours of pumping each day. Therefore, the likelihood of aquifer depletion is highly unlikely. That being said, only the well tests and monitoring will reveal the sustainable abstraction rate and, ultimately, the well's potential.

4.4. Biological Environment

Below is an overview of the biological environment in Cali Ciise, with attention to the flora, fauna, possible biodiversity hotspots, and predominant land-use practices. The information derives from field observations, the Construction Investment Report (CIR), and inputs from community members in the village.

Flora and Habitats

Much of the project area features scattered stands of acacia species (e.g., *Acacia tortilis*), complemented by short grasses and shrubs that are adapted to seasonal rainfall. These hardy plants tend to thrive in semi-arid conditions, providing both ground cover and forage for livestock.

Common acacias include Qudhac (*Acacia tortilis*), Bilcil (*Acacia melifera*), Qansax (*Acacia reficiens*), and Sarmaan (*Acacia horrida*). In addition, *Commiphora hodai* (locally known as Xoday) appears in some spots. Although these species are not flagged as threatened, they are crucial for stabilizing soils and offering shade.

The village does not report any ecologically unique habitats—such as wetlands or dense forest—that would demand special protective measures. The area's vegetation is generally characterized by an open rangeland ecosystem rather than specialized or fragile habitats.

No officially recognized protected or medicinal plant species have been identified or were reported by locals. While some acacia species may have traditional uses, they are not subject to formal conservation status locally.

Fauna

Although wildlife populations are limited, local residents report sightings of small game such as rabbits, dik-dik (often referred to as “salt dik dik”), and hyenas that pass near the village perimeter. These animals rely on the sparse vegetation for both food and shelter. These animals are not listed as endangered or threatened as per the list of endangered species in Somalia according to the IUCN Red List[3] and according to both community feedback and available desk studies. Scarcity of large predators or specialized fauna suggests low risks of severe human-wildlife conflicts. There are no protected or critical habitat areas within the area of impact. Most of the wildlife is believed to move through the region opportunistically, correlating with the brief rainy seasons and availability of forage.

Biodiversity Hotspots and Protected Areas

Neither the desk research nor community consultations indicate any key biodiversity hotspots, critical habitats, or habitats supporting endangered species within the project site.

There is no record of official nature reserves or wildlife sanctuaries in the vicinity of Cali Ciise. Moreover, local regulations do not identify any portion of the village rangeland as protected land.

Existing Land Use

Rangeland usage dominates in Cali Ciise, where livestock rearing—particularly goats, sheep, and camels—forms the economic backbone. Communal land-tenure norms allow herders to use vast tracts freely, with no recent history of land disputes over grazing rights.

Crop cultivation is minimal and generally occurs in small household plots for subsistence gardening. Occasional attempts at growing cereals or vegetables rely on seasonal rainfall; reliable irrigation practices are limited due to water scarcity.

The surrounding territory is mostly communal rangeland interspersed with acacia stands. Although charcoal-making is an issue in some parts of Somaliland, the village indicates minimal deforestation or charcoal trade in Cali Ciise itself, helping preserve a stable though modest tree cover.

The biological environment at Cali Ciise is relatively straightforward: hardy, semi-arid vegetation and modest wildlife populations underscore the importance of sustainably managing rangeland resources. Given that no sensitive ecosystems or threatened species are identified, typical best-practice mitigation—such as limiting unnecessary land

[3] For the list of endangered species in Somalia, see https://worldrainforests.com/biodiversity/en/somalia/EN.html.

clearing, protecting acacia stands near the borehole site, and avoiding contamination from livestock waste—should suffice to preserve the local natural habitat and biodiversity.

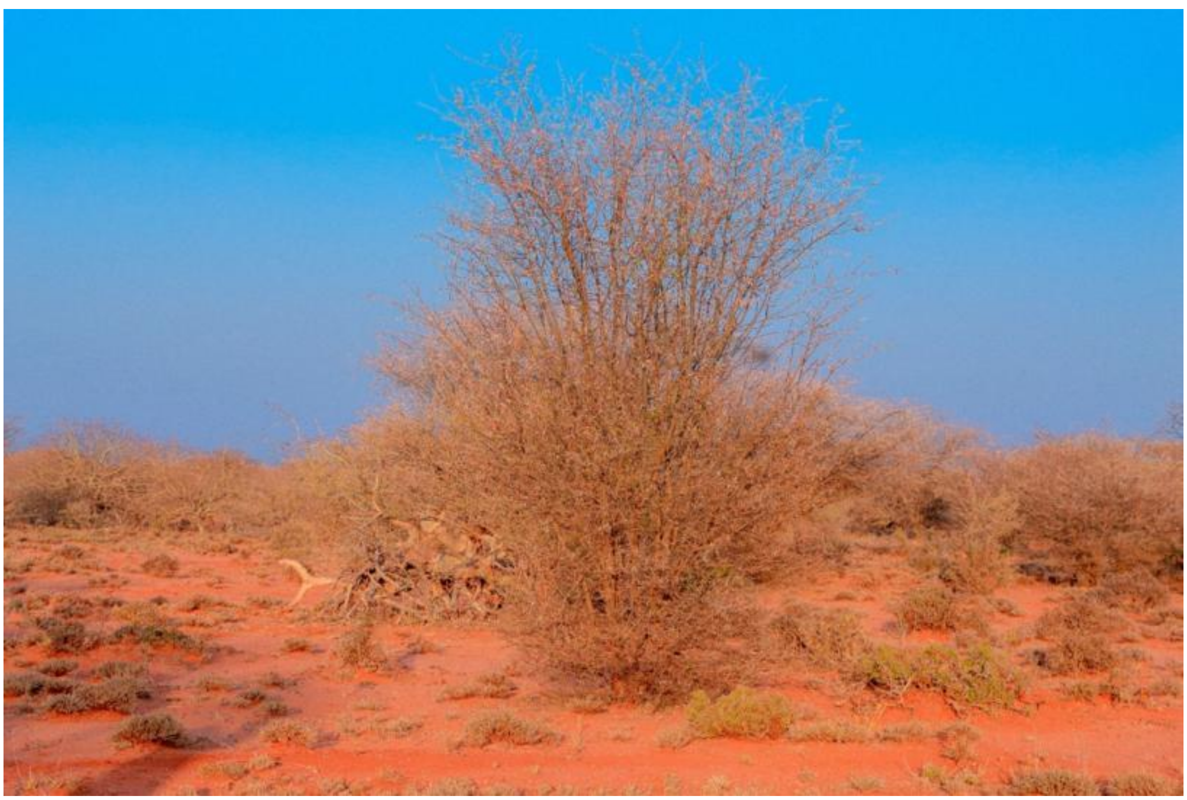


Figure 24 Pictures of the project area, depicting trees and shrubs

4.5. Socio-Economic and Cultural Environment

Below is an overview of Cali Ciise's socio-economic and cultural environment. The information is based on interviews with local community members, field observations, and project documents relevant to the GW4R effort in the Togdheer Region.

Demographics

Cali Cise is located approximately 119 km from Burao and about 70 km from Balidhiig. There are no operational boreholes in the vicinity, making water access particularly difficult. The village and its outlying areas have a combined population of about 8,000 people; the average household contains around 7 members. Residents indicate gradual population increases over the last five years due to natural growth and occasional in-migration. Most inhabitants belong to a single clan, fostering a shared cultural identity and unified social structures. Village elders and a development council form the backbone of local governance.

Although large-scale internally displaced persons (IDP) settlements are not currently reported in Cali Ciise itself, pastoralists and nomadic families periodically migrate into the area during severe droughts. This can temporarily increase village numbers and strain resources.

Livelihoods

Livestock rearing (goats, sheep, camels) is the principal economic activity. Households depend on rainfall patterns for grazing and small berkad (water reservoirs), making them highly vulnerable to drought. Small-scale farming tends to be rain-fed and limited to subsistence crops or small gardens. Weather fluctuations significantly affect yields.

A number of families run shops (e.g., small groceries or tea stalls) near the village center, providing everyday goods. Such micro-enterprises also benefit from diaspora remittances, supplementing pastoral incomes.

Land Tenure

Grazing land around the village is not formally demarcated; it is traditionally open-access under customary clan-based arrangements overseen by the elders. Residents collectively decide on livestock movement to avoid overgrazing.

Individual families privately own house plots and berkeds. Water from these private berkad may be sold or shared freely, depending on household preference. Formal land titling is rare in rural zones like Cali Ciise. Instead, village committees and local elders apply customary norms to settle boundary disputes or mediate resource use.

Figure 25 Picture of Cali Ciise land use

Figure 26 Another view of village

Community Facilities

The village has a free primary/elementary school serving ~260 students (about 90 girls, 170 boys) and a boarding secondary school with around 120 boys. A small clinic provides basic medical care. Although modest, it helps reduce the need for long-distance travel in emergencies.

Basic consumer goods are available in local shops. Larger markets or specialized goods typically require traveling to Burao or other bigger towns. An unpaved but serviceable road connects Cali Ciise to Burao (~100–120 km away). It also provides access for livestock movements and small vehicles.

Gender Dynamics

Women and girls often bear the brunt of fetching water from berkad or distant sources, particularly in dry seasons. A new borehole could substantially reduce their workload. The official village committee comprises male elders, but women's informal networks—such as weekly money-pooling groups—give them influence over community initiatives. Even so, female-headed households can face greater economic stress during water shortages.

Reliable water access would free up women's time for income-generating activities or education, but project planning must include them in water governance for equitable outcomes.

Figure 27 The Women's Group Meeting at Cali Ciise

Vulnerable and Marginalized Groups

While the village has no distinct minority clan subgroups, individuals with disabilities may be present, though not formally enumerated. Their access to services or water points can be limited by distance or social stigmas.

Younger residents often shoulder herding duties. They may also migrate seasonally or seek education in boarding schools. Involving youth in training for well maintenance fosters local ownership and skill-building.

Migrant pastoralist families from across the Ethiopia–Somaliland border occasionally settle temporarily around Cali Ciise if rangeland conditions are favorable, complicating resource management. This needs to be managed by elders supported by the district government through bylaws and discussions with elders/community representatives from other areas including cross border.

Figure 28 Elders and youth at the community stakeholder meeting

Cultural Heritage

The community has not identified formal sacred groves, shrines, or archaeological remnants in the immediate project area. Oral traditions and clan customs, however, shape local dispute resolution and grazing rules.

Neither the desk review nor local elders' reports indicate the presence of recognized historical landmarks. There is a central "main tree" used for public gatherings and dispute settlement, but it is 900m from the borehole site and therefore not going to be impacted by project activities.

Figure 29 Speaking with Elders from the Village at the Project Site

Current Water Sources and Usage

Community members rely heavily on small, privately owned berkads. Some berkad owners sell water, while others provide it free of charge. The nearest major water point is a haffir dam in Duruqsi (~7 km away). Water trucking from Burao or Balidhiig involves a journey of 70 km or more.

Each person requires roughly 10–15 L/day. Livestock watering intervals vary: sheep/goats need water every 4 days, while camels can last up to 7 days.

According to local interviews, a new borehole situated ~900 m from the village center may significantly reduce the burden of fetching water, especially during droughts. The community anticipates that 300–500 additional households could be drawn to the area if a reliable supply is established.

Figure 30: A private water structure near the site

Potential for Conflict and Institutional Arrangements

The community reports minimal land-use or water-related conflict, largely due to strong traditions of mutual aid and resource sharing. Grazing areas remain open-access, and no formal range boundaries exist.

Though individuals own berkad, the community mobilizes collectively under a six-person Village Development Council (all male). This council coordinates drought responses—negotiating with berkad owners or seeking external assistance. If disagreements arise, the council attempts to settle them; unresolved cases escalate to community elders and, ultimately, the district committee. The village also relies on clan-level structures (present on both sides of the border) for cross-border disputes.

For new infrastructure like a borehole, the community plans to create a mixed-gender water committee. They are willing to collect small fees (500–1,000 Somaliland Shillings) for water usage to fund ongoing maintenance, reflecting broad support for sustainable cost recovery.

Conclusion

The socio-economic and cultural context in Cali Ciise revolves around pastoral livelihoods, clan-based communal norms, and village-level governance that influences how water resources are allocated. Vulnerabilities stem from frequent droughts, limited infrastructure, and the strain placed on women in managing water duties. By incorporating inclusive decision-making and capacity-building programs, a new borehole can yield wide-ranging benefits, from easing the labor burden on women to bolstering local resilience against climatic extremes.

The following should be considered in for the long-term sustainability of the borehole:

Capacity Building Needs: Local leaders recognize the importance of training to manage pump operations, routine repairs, and water-sharing rules effectively.

Environmental Sustainability: While overgrazing is not yet a critical problem, an influx of people and livestock underscores the need for pasture management. The project needs to liaise with MoECC or environmental NGOs to support this or ensure that the elders/community can manage this on their own.

Conflict Potential: The community's tradition of collaboration makes large-scale conflict unlikely. Still, greater in-migration or uneven benefit-sharing could challenge existing communal norms, highlighting the importance of inclusive decision-making on water access and fees.

5. STAKEHOLDER ENGAGEMENT AND PUBLIC DISCLOSURE

5.1. Objectives

Stakeholder engagement and public consultation are critical components of the borehole project, ensuring transparency, inclusivity, and alignment with both World Bank Environmental and Social Standard 10 (ESS10), Somaliland's Ministry of Environment and Climate Change (MoECC) guidelines, and the project approach as outlined in the community engagement guidelines. The engagement process aims to:

Ensure Transparency and Inclusivity

- Provide timely and accessible information to all affected and interested parties.
- Engage key community members, including women, pastoralists, and vulnerable groups, ensuring their voices are heard.

Promote Participatory Decision-Making

- Strengthen community ownership by involving them in discussions about borehole placement, usage fees (if applicable), and maintenance responsibilities.
- Address concerns and incorporate feedback into the ESIA and project design.

Minimize Conflicts and Enhance Social Cohesion

- Identify potential disputes over land use, water-sharing mechanisms, and livestock access.
- Establish local grievance redress mechanisms to handle complaints before they escalate into conflicts.

Align with Local and International Safeguards

- Meet ESS10 requirements by ensuring ongoing, meaningful engagement throughout the project lifecycle.
- Comply with MoECC's Environmental Management Act, which mandates public involvement in ESIA processes.

5.2. Alignment with GW4R SEP

Stakeholder engagement for the project has been conducted in full alignment with the Stakeholder Engagement Plan (SEP) prepared for the GW4R Project in Somaliland. The approach adopted reflects the SEP's core principles of inclusivity, cultural appropriateness, and continuous engagement. Communities have been consulted throughout the planning process using participatory methods adapted to the local context, and special efforts have been made to ensure that traditionally underserved groups—such as nomadic pastoralists, women-headed households, and internally displaced persons—have had meaningful opportunities to contribute to decision-making. The engagement process has also incorporated the SEP's provisions for grievance redress, feedback loops, and coordination with local governance structures, thereby ensuring that stakeholder voices inform both project design and mitigation planning.

Key Areas of the SEP

The GW4R SEP establishes a comprehensive framework for how stakeholder engagement should be structured across all components of the project. It emphasizes that effective engagement is not a one-time exercise but a continuous, adaptive process.

In line with the SEP, stakeholder engagement for the borehole project has included activities appropriate to each phase:

- During planning, community meetings and focus groups were held in accessible locations.
- Information has been disseminated via oral communication and local leaders, ensuring inclusivity for low-literacy populations.
- Village Development Committees (VDCs) have served as trusted intermediaries, helping to coordinate feedback and convey community concerns to the project team.

Inclusion of Vulnerable Groups

The SEP places a strong emphasis on the active inclusion of marginalized and underserved groups. In the sub-project, this has been achieved by:

- Holding separate consultations with women, minority clans, and nomadic households;
- Ensuring that vulnerable groups have input into project decisions.

Grievance Redress Mechanism (GRM)

Consistent with the SEP, a multi-tier grievance redress mechanism has been operationalized for the borehole project. Stakeholders can submit complaints or suggestions through:

- Local focal points and suggestion boxes;
- SMS, telephone, or in-person reporting to project staff;
- Escalation channels leading to the PIU and Ministry of Water Resource Development (MoWRD) if needed.

In cases of Gender-Based Violence (GBV) or Sexual Exploitation, Abuse, or Harassment (SEAH), the grievance system ensures survivor confidentiality and referral to appropriate services, in accordance with the SEP's safeguards.

Monitoring, Reporting, and Resources

The stakeholder engagement process is being continuously monitored to ensure it remains effective and inclusive. Indicators include the number and diversity of participants, grievance resolution rates, and community satisfaction with consultation processes. Dedicated staff—including a social specialist and communications officer—are responsible for implementation, and a defined budget has been allocated to support engagement activities, outreach, and grievance handling.

This alignment with the GW4R SEP has not only fulfilled safeguard requirements but also contributed to greater community ownership, reduced risk of conflict, and enhanced sustainability of the borehole investment.

5.3. Alignment with ESS10 and MoECC Guidelines

ESS10: Stakeholder Engagement and Information Disclosure requires that:

- Consultations are meaningful, inclusive, and continuous throughout the project.
- A formal Stakeholder Engagement Plan (SEP) is developed and implemented.
- A Grievance Redress Mechanism (GRM) is in place, accessible to all affected people.

MoECC Guidelines similarly emphasize:

- The importance of early community involvement in ESIA preparation.
- Clear disclosure of environmental and social risks before project approval.
- Inclusion of marginalized groups in decision-making.

The Cali Ciise project follows these principles by involving the Village Development Council (VDC), the district government and broader community in key discussions regarding site selection, water distribution, and potential land-use concerns.

Evidence of Open, Inclusive, and Participatory Consultation

The stakeholder engagement field reports indicate the following:

Village Development Council (VDC) Meetings

- The six-member VDC (all male) was consulted at multiple stages to discuss land allocation and community expectations.

- Elders provided input on the borehole's exact placement to ensure accessibility while avoiding encroachment on grazing areas.

Community Gatherings and Informal Discussions

- Public meetings were held under the "main tree", a traditional gathering point.
- Women's financial cooperatives were consulted separately to discuss the their needs in terms of siting, design and management and E&S risks..
- Residents expressed willingness to pay (500–1,000 Somaliland Shillings) for borehole maintenance, showing awareness of long-term sustainability needs.

Consultation with Pastoralist Groups

- Seasonal migration routes were discussed to ensure livestock could access water without disrupting existing communal grazing practices.
- Local pastoralists indicated that a separate livestock trough (~50–80 meters from the main kiosk) would prevent congestion at the main water point.

Grievance Redress Mechanism (GRM) Development

- A mechanism was proposed through the VDC and clan elders, who traditionally mediate disputes.
- Issues related to water pricing, livestock access, or overuse will be handled at the village level before escalation to district authorities.

5.4. Stakeholder Identification

Below is a structured stakeholder identification and mapping process that categorizes key groups based on their influence, interest, and role in the project.

Local Authorities and Government Entities

These stakeholders provide governance, technical expertise, and regulatory oversight.

Table 10 Local Authorities

Stakeholder	Role/Interest in Project	Level of Influence
Ministry of Water Resources Development (MoWRD)	Grants water abstraction permits, ensures technical standards, and monitors sustainable water use.	High
Ministry of Environment and Climate Change (MoECC)	Regulates environmental impact assessment (ESIA) approvals, oversees compliance with environmental safeguards.	High
Togdheer Regional Administration & District Authorities	Oversees local governance, land use planning, and dispute resolution related to water access.	Medium

Community-Based Stakeholders

These groups represent those directly affected by the borehole project, including decision-makers, water users, and marginalized groups.

Table 11 Community based stakeholders

Stakeholder	Role/Interest in Project	Level of Influence
Village Development Council (VDC)	Coordinates local decision-making on water access, resolves disputes, and ensures fair distribution of water.	High
Elders and Clan Leaders	Provide traditional dispute resolution, ensure fair access for different households, and help implement project agreements.	High
Religious Leaders (Sheikhs & Imams)	Influence community behavior regarding water use, advocate for equity and sustainability.	Medium
Water User Committees (Planned)	Expected to be formed to manage or oversee borehole operation, fee collection, and basic maintenance.	Medium to High
Women’s Groups & Informal Savings Cooperatives	Women are primary water collectors and are directly impacted by water availability; they manage household water use and economic activities.	Medium

Stakeholder	Role/Interest in Project	Level of Influence
Youth Groups	Often responsible for herding livestock and carrying out water-fetching duties; can play a role in borehole maintenance.	Medium

Water-Dependent Livelihood Groups

These stakeholders rely on the borehole for economic sustainability and improved livelihoods.

Table 12 Water dependent livelihood groups

Stakeholder	Role/Interest in Project	Level of Influence
Pastoralists	Largest group reliant on borehole for livestock watering, concerned about trough placement and potential overuse.	High
Farmers (Small-scale, seasonal)	Small plots near the village depend on reliable water sources for irrigation; water quality concerns may arise.	Medium
Nomadic Pastoralists (Seasonal Migrants)	Cross-border movement between Somaliland and Ethiopia, may require negotiated water access rights.	Medium
Livestock Traders	Interested in better water access improving animal health and market value.	Medium

Vulnerable and Marginalized Groups

Special attention must be given to these groups to ensure equitable access and inclusion.

Table 13 Vulnerable and marginalized groups

Stakeholder	Role/Interest in Project	Level of Influence
Internally Displaced Persons (IDPs)	May temporarily settle near the borehole during droughts; need fair access to water resources.	Low to Medium
Persons with Disabilities (PWDs)	Require accessible water points and inclusive management policies to prevent exclusion.	Low
Female-Headed Households	More dependent on community-managed water schemes, risk being left out of decision-making.	Medium

External Stakeholders and Development Partners

These groups provide funding, technical assistance, or advocacy for the project.

Table 14 External stakeholders

Stakeholder	Role/Interest in Project	Level of Influence
World Bank (GW4R Program)	Provides funding and applies ESS10 standards for stakeholder engagement.	High
Non-Governmental Organizations (NGOs) & Humanitarian Agencies	May provide capacity building, water governance training, or emergency water trucking in crises.	Medium
Private Contractors and Service Providers	Drill the borehole, install pumps, and construct water kiosks; must comply with environmental and labor laws.	High

Stakeholder Prioritization Matrix

To ensure effective engagement, stakeholders can be classified into four levels of priority:

High Influence, High Interest (Primary Decision-Makers)

- Ministry of Water Resources Development (MoWRD)
- Village Development Council (VDC)
- District authorities
- Pastoralists & Livestock Owners
- Water User Committees (once formed)

High Influence, Low Interest (Regulators and Funders)

- Ministry of Environment and Climate Change (MoECC)
- World Bank (GW4R)

Low Influence, High Interest (Affected Groups)

- Women's Groups & Female-Headed Households
- Internally Displaced Persons (IDPs)
- Small-Scale Farmers

Low Influence, Low Interest (Supporting Actors)

- Youth Groups
- Local NGOs

The stakeholder mapping reveals a complex but structured local governance framework, where clan elders, the Village Development Council, and pastoralist groups hold the greatest influence over water resource management. The proposed borehole must integrate concerns from water-dependent livelihoods (pastoralists, traders, farmers) while ensuring fair access for women, IDPs, and vulnerable households. To maintain compliance with ESS10, a grievance redress mechanism (GRM) must be accessible to all groups to enable resolution of any complaints during construction.

5.5. Consultation Approach

Based on the SEP for the GW4R project**,** the consultation approach for the Cali Ciise borehole project is detailed below.

Consultation Methods

Below is a suggested multi-pronged approach to ensure timely, inclusive, and culturally appropriate engagement with key stakeholders. The actual engagement strategy will be decided by the PIU in consultation with the World Bank in accordance with the GW4R SEP.

Engagement Strategies:

Table 15 Engagement Strategies

Method	Purpose	Participants	Timing
Focus Group Discussions (FGDs)	Gain detailed perspectives from key demographic groups (pastoralists, women, youth, elders).	Women's groups, youth, pastoralists, local businesses.	Before project approval and periodically throughout.
Community Meetings (Barazas)	Facilitate collective feedback, project updates, and discussion of grievances.	Entire community, VDC, religious leaders, elders, pastoralists, IDPs.	Held at traditional meeting places at key milestones.
One-on-One Interviews	Gather input from marginalized groups and individuals who may not speak openly in large forums.	Female-headed households, disabled persons, IDP families.	Conducted during ESIA preparation and throughout.
Local Radio Announcements	Inform wider populations, particularly nomadic groups, about project milestones and water-sharing rules.	General public, mobile pastoralists, borderland communities.	Before drilling, during implementation, and post-completion.

Method	Purpose	Participants	Timing
Official Notices & Posters	Publicly disclose project updates, environmental/social safeguards, and land use agreements.	VDC, district government, elders, and community members.	Displayed in schools, mosques, health centers, and community hubs.
Feedback Forms & Suggestion Boxes	Allow literate individuals to submit anonymous concerns.	Water users, traders, school representatives, health workers.	Placed at health posts, village councils, and water kiosks.

This structure ensures maximum reach and accessibility, while also maintaining cultural appropriateness for the local context.

Special Measures for Women, Youth, and Vulnerable Groups

Women's Inclusion

Separate Women's Meetings: Because women are primary water collectors but often excluded from decision-making, dedicated consultations specifically for women ensure their concerns are heard.

Participation in Water Committees: The SEP mandates at least 30% representation of women in water management committees.

Economic Empowerment Considerations: Women's savings groups were consulted about borehole operation-related income generation, particularly regarding potential small-scale water vending.

Youth Engagement

Youth FGDs focused on their role in water-fetching and livestock care, ensuring their perspectives on borehole management are included.

Training in Borehole Maintenance: Young men from the community should receive technical training on pump repairs and system upkeep.

Vulnerable Groups (Nomadic Pastoralists, IDPs, PWDs)

Mobile Pastoralists: Special discussions were held with cross-border herders about maintaining access without causing overcrowding.

Accessibility Measures: To support Persons with Disabilities (PWDs), recommendations include lowered taps and designated access zones at water kiosks.

5.6. Summary of Stakeholder Concerns

The feedback received from community members, pastoralists, and local leaders directly informed the project. Here is a table summarizing the key stakeholder concerns and how they were addressed in the project design and ESMP.

Table 16 Summary of Stakeholder Concerns and Project Responses

Stakeholder Concerns	Details	Project Adjustments & ESMP Integration
Water Access Priorities	- No nearby boreholes (closest is 70–119 km away). - Heavy reliance on privately owned berkad, which dry up during droughts. - High cost of water during droughts (up to $17 per cubic meter). - Concerns about water salinity.	✓ Borehole placed ~900m from the village center for accessibility & land-use balance. ✓ Separate livestock & human water points (80m apart) to prevent contamination. ✓ Water treatment measures (Reverse Osmosis/UV) will be installed if salinity is too high. ✓ Water cost lowered to $1.20/m³, reducing financial burden.
Potential Conflicts Over Water Usage	- Concern that pastoralists & village residents may compete for water. - Nomadic herders from Ethiopia may increase demand. - Water access may encourage more households to settle in the area.	✓ Rotational access system for pastoralists to prevent overcrowding. ✓ Water User Committee (WUC) to manage disputes, ensuring equitable access. ✓ Existing clan conflict resolution system will mediate cross-border issues.
Land Acquisition & Infrastructure Concerns	- Who owns the land for the borehole & infrastructure? - Will infrastructure reduce grazing land? - Will the borehole cause unplanned settlements nearby?	✓ Village Development Council (VDC) confirmed land is communal—no private ownership issues. ✓ Livestock troughs placed away from grazing routes to minimize disruption. ✓ No new settlements allowed near borehole—village boundaries remain unchanged.
Community Management & Financial Contributions	- Who will maintain the borehole? - Will households afford water fees? - How will financial transparency be ensured?	✓ Water User Committee (WUC) with 30% women will manage operations & finances.

Stakeholder Concerns	Details	Project Adjustments & ESMP Integration
		✔ Households will contribute 500–1,000 Somaliland Shillings (SLSH) per month, far lower than trucking costs. ✔ Capacity-building training for the committee on maintenance & financial tracking.
Environmental & Social Safeguards	- Overgrazing risks if livestock numbers increase. - Worker conduct concerns—risk of SEA/SH incidents.	✔ Piezometer installed to track groundwater levels & prevent over-extraction. ✔ SEA/SH risk mitigation measures: - Worker Code of Conduct (CoC) signed by all contractors. - Women's consultations before & after construction. - Confidential reporting system for SEA/SH complaints.

Figure 31 Village meeting at Cali Ciise

5.7. Stakeholder Engagement Plan

The project Stakeholder Engagement Plan outlines a suggested schedule for community consultations, ongoing engagement throughout construction and operation, and the disclosure strategy for ESIA findings in accordance with World Bank ESS10 and Somaliland's MoECC guidelines. This is the suggested plan; the actual engagement will be determined by the PIU, in coordination with its World Bank partners.

Consultation Schedule Throughout Construction and Operation

Table 17 Suggested consultation schedule

Phase	Engagement Activities	Stakeholders Involved	Method of Engagement	Timing
Pre-Construction (Planning & ESIA Completion)	- Finalize site selection and confirm land use. - Consult on borehole management structure. - Address environmental and social concerns (e.g., grazing areas, SEA/SH risks).	- Village Development Council (VDC) - Women's Groups-Pastoralist Representatives - Local Government (District Office, MoWRD, MoECC)	- Community Meetings under village tree. - Focus Group Discussions (FGDs) for women and youth. - Radio Announcements to reach wider community. - Door-to-Door Awareness for Vulnerable Groups.	2 months before drilling starts
Early Construction (Drilling & Infrastructure Setup)	- Inform residents about project timeline, noise, and safety measures. - Provide clear grievance mechanism (GRM) information. - Ensure labor Code of Conduct (CoC) is followed to prevent SEA/SH.	- Community Members (Households, Traders, Farmers). - Contractors & Drilling Teams. - Local Government (MoECC, MoWRD).	- Posters and Notices at Key Locations (Mosque, Health Clinic, School). - Mobile Announcements via Loudspeakers. - Grievance Mechanism (GRM) Sensitization Meetings.	1 week before drilling begins
Mid-Construction (Installation & Testing Phase)	- Monitor community concerns (e.g., noise, dust, land use). - Conduct first water quality tests. - Update residents on borehole progress.	- Local Households. - Women & Youth - Village Development Council. - MoECC Inspectors.	- Site Visits & Open Feedback Forums. - Suggestion Boxes at Community Centers. - Local Radio Updates.	Monthly during construction

Phase	Engagement Activities	Stakeholders Involved	Method of Engagement	Timing
Post-Construction (Handover & Operation Start)	- Train Water User Committee (WUC) in maintenance and financial management. - Establish fee collection and operational rules. - Final community consultation to confirm satisfaction & concerns.	- Water User Committee (WUC). - MoWRD & District Water Office. - Pastoralist Representatives. - Women's Groups.	- Workshops on Borehole Management & Fees. - Radio & Poster Campaign for Final Guidelines. - Public Meeting for Final Feedback.	1 month after construction is complete
Ongoing Operation & Monitoring	- Monthly water quality testing. - Quarterly community check-ins for grievances. - Annual review of borehole function & sustainability.	- WUC. - MoWRD/MoECC. - Community Members. - External Auditors.	- Quarterly Public Meetings at Village Tree. - Annual Satisfaction Survey. - Water Quality Reports Shared via Posters.	Ongoing for 5+ years

5.8. Disclosure of ESIA Findings

To ensure transparency and accessibility, the ESIA findings should be disclosed in multiple formats and local languages (Somali and Arabic, where applicable). The ESIA will be disclosed on the Ministry of Water website, with the exec summary in Somali and given to the VDC and district. Other potential disclosure methods will be agreed upon by the PIU, in coordination World Bank.

Disclosure Methods

Table 18 Potential Disclosure Methods

Format	Location & Access Points	Target Audience
Printed Reports in Somali	- Village Office - Health Center - Local School	Village Development Council (VDC), Educated Residents
Simplified Summaries (Posters & Flyers)	- Mosque Bulletin Boards	General Community (Low-Literacy Groups)

Format	Location & Access Points	Target Audience
	- Water Kiosks - Livestock Trough Areas	
Community Meetings (Public Readings of ESIA Findings)	- Village Meeting Area (Main Tree) - Women's Group Meetings	Non-Literate Residents, Women, Elders
Online & Government Archives (if applicable)	- MoECC & MoWRD Websites	NGOs, Researchers, Development Partners

Culturally Appropriate Adjustments for Inclusion

Women-Specific Sessions: To accommodate cultural norms, separate consultation meetings for women should be organized, ensuring their feedback is heard and integrated.

Mobile Outreach for Pastoralists: Because some nomadic herders travel seasonally, ESIA findings and borehole updates should be announced via radio and mosque loudspeakers.

Youth & School Engagement: To involve younger generations, the project should introduce school-based awareness sessions about sustainable water use and borehole management.

6. ANALYSIS OF PROJECT ALTERNATIVES

6.1. No-Project Alternative

The no-project alternative would leave Cali Ciise in a state of persistent water insecurity, with significant socio-economic consequences. Without the borehole, the community will continue relying on distant and unreliable water sources. The nearest boreholes are located 70 to 119 kilometers away, making access difficult, particularly during droughts. Households currently depend on privately owned berkad, which dry up during the dry season, forcing them to either buy expensive trucked water or travel long distances to collect it. The cost of water trucking can reach as high as $17 per cubic meter, an amount that many households struggle to afford. In the absence of a sustainable water source, families will continue to experience severe shortages, forcing them to use contaminated sources that increase the risk of waterborne diseases.

Health outcomes in the community will deteriorate if the borehole is not developed. Many households already consume well below the international minimum water requirement, affecting hygiene and increasing vulnerability to diseases such as diarrhea, cholera, and dysentery. Poor sanitation conditions in schools and health centers will persist, leading to increased absenteeism among students and greater health risks for pregnant women and newborns. Without reliable water, women and children will continue spending long hours fetching water, reducing time available for education, income generation, and household responsibilities. Women will remain particularly vulnerable to gender-based violence, as they will have to walk long distances in isolated areas to access water sources.

The local economy will also suffer from continued water scarcity. Cali Ciise depends primarily on livestock rearing, and without sufficient water, animal health and productivity will decline. During severe droughts, pastoralists experience high livestock mortality, leading to financial losses and increased food insecurity. Small businesses, particularly those that rely on water for food preparation and other services, will struggle to remain operational. The high cost and limited availability of water will increase the cost of running shops and restaurants, reducing profitability and limiting economic opportunities. Farming, which already faces significant challenges due to unreliable rainfall, will continue to be unviable, leaving families without options for diversifying their livelihoods.

The absence of a reliable water source will deepen existing social inequalities, particularly for women and children. The burden of water collection will continue to fall disproportionately on women, keeping them from engaging in productive economic activities. Young girls, who are often responsible for collecting water for their families, will remain at risk of dropping out of school due to the time required for fetching water and the lack of adequate sanitation facilities in schools. Women will continue to be excluded from decision-making processes related to water governance, reinforcing existing gender disparities in the community.

Cali Ciise is also likely to experience greater displacement and resource conflicts in the absence of the borehole. The village has a growing population of over 8,000 people, with many pastoralist families migrating seasonally in search of water and pasture. If the water crisis persists, families may be forced to leave the area in search of better conditions in urban centers or IDP camps, increasing urban poverty and straining limited government resources. Competition for water between resident households and nomadic pastoralists will intensify, increasing the likelihood of disputes. While traditional conflict resolution mechanisms have been effective in managing water-sharing agreements, escalating scarcity could strain these systems, potentially leading to tensions and instability.

The no-project alternative would ultimately have far-reaching consequences for the health, livelihoods, and stability of Cali Ciise. Water scarcity will worsen, forcing residents to rely on expensive and unsafe alternatives. Health conditions will continue to decline, increasing the burden of disease and mortality. The local economy will weaken as livestock losses and declining small businesses reduce income-generating opportunities. Women and girls will remain disproportionately affected by the water crisis, limiting their opportunities for education and participation in economic activities. With the potential for displacement and increased competition over water resources, the long-term sustainability of the village will be at risk. Given these realities, the development of the borehole is essential to ensuring a stable, healthy, and economically viable future for the community.

6.2. Location Alternatives

The selection of the final drilling site for the proposed borehole was informed by an extensive technical and participatory process, in line with World Bank ESF and national requirements. The GW4R Project conducted a multi-phase investigation, which included geological and geophysical surveys, community consultations, and environmental analysis.

Initial Site Screening

An initial scan of the broader Cali Ciise area near the Somaliland–Ethiopia border identified several general zones of interest. The key criteria for screening included:

- Proximity to underserved communities
- Distance from existing boreholes (the nearest being over 50 km away)
- Evidence of suitable hydrostratigraphy and aquifer depth
- Safe distance from flood-prone or environmentally sensitive zones

Geophysical and Hydrogeological Analysis

A total of 20 Vertical Electrical Soundings (VES) were conducted in two phases. The analysis identified three distinct geological formations:

- **Auradu Limestone Formation** (generally not suitable for groundwater)
- **Yesomma Sandstone Formation** (primary target aquifer)
- **Precambrian Basement** (non-aquifer bedrock)

VES interpretations allowed delineation of potential aquifer zones based on resistivity signatures indicating sandy, water-bearing strata at depths of 350–500+ meters.

Preferred Sites Identified

Three primary candidate zones—Areas A, B, and C—were delineated based on two key criteria:

1. **Depth to Precambrian basement >500 m**, ensuring ample aquifer thickness
2. **Resistivity of 20–30 Ωm**, indicative of favorable sandy layers

Among these, Area A emerged as the preferred option due to:

- Its **high probability of a viable aquifer** (sufficient depth and sandy lithology)
- Its **close proximity to Cali Ciise village**, minimizing pipeline costs and improving accessibility
- Community acceptability and reduced land tenure conflicts

Final Site Selection

The exact coordinates of the recommended drilling point are:

- **Latitude**: 8.542460° N
- **Longitude**: 45.519554° E

Drilling is to occur within a 200-meter radius of this point to maintain optimal geological and logistical conditions. The selected site lies within the Yesomma Sandstone formation, expected to yield 12–18 m^3/h with brackish water quality (EC 2,500–4,000 µS/cm)—acceptable for livestock and non-potable domestic use, especially during dry periods.

This structured assessment ensured the borehole's location optimizes hydrogeological yield, accessibility, and socio-economic impact, while minimizing environmental risks and technical uncertainties.

6.3. Design Alternatives

Drilling Methods

The selection of the drilling method depends on geological conditions, borehole depth, water yield requirements, and cost considerations. The two primary options are rotary drilling and percussion drilling.

Rotary Drilling (Mud or Air Rotary)

Rotary drilling is the most common method used for deep boreholes in arid regions like Cali Ciise. This technique employs a rotating drill bit to cut through rock formations, while drilling fluid (mud or compressed air) carries cuttings to the surface.

- Advantages:
  - Suitable for deep boreholes (up to 450m as planned in Cali Ciise)
  - Faster drilling speeds than percussion methods.
  - Works well in consolidated formations like sandstone, which is present in the Yesomma Formation.
- Disadvantages:
  - Higher costs due to the need for drilling mud or air compressors.
  - Complex operation and maintenance, requiring skilled labor.
  - Environmental concerns related to disposal of drilling fluids.

Percussion Drilling (Cable Tool)

Percussion drilling involves raising and dropping a heavy bit to crush rock and create a borehole. It is effective in hard rock formations and requires no drilling fluids.

- Advantages:
  - Lower initial equipment costs.
  - Suitable for hard rock formations and areas where groundwater is relatively shallow.
  - No need for drilling fluid disposal.
- Disadvantages:
  - Slower than rotary drilling, making it unsuitable for deep boreholes.
  - Less effective in unconsolidated formations like sand and gravel.
  - Higher labor costs due to extended drilling time.

Recommended Option for Cali Ciise

Considering the 450m target depth and Yesomma Sandstone Formation, mud rotary drilling is the preferred option due to its efficiency, speed, and ability to handle varying geological conditions.

Drilling Muds

Drilling muds, also referred to as drilling fluids, are essential in the borehole drilling process to stabilize the borehole wall, cool the drill bit, remove cuttings, and maintain hydrostatic pressure. The choice of mud affects both drilling efficiency and the environmental and social footprint of the project.

Water-Based Mud:

Water-based muds are the most common type of drilling fluids and use freshwater or brine as a base, mixed with bentonite clay (if needed). They are generally regarded as the most environmentally acceptable option.

- **Advantages**:
  - Lower environmental impact compared to oil-based systems
  - Easier to dispose of and manage with simple lined pits
  - Readily available materials and additives
  - Lower cost and simpler logistics
  - Safer for handling by workers and less hazardous to nearby communities
- **Disadvantages**:
  - Less effective in highly reactive or unstable formations
  - May require additives to control clay swelling and hole stability
  - Potential for bacterial growth in stagnant pits if not managed properly

Synthetic-Based Mud

Synthetic-based muds use synthetic oils (e.g., esters, olefins) as a base fluid, offering better lubricity and thermal stability while being less toxic than traditional oil-based muds. They are commonly used in challenging geologies or deeper wells.

- **Advantages**:

- Excellent lubricity for deep or deviated wells
- Reduced bit wear and improved rate of penetration
- Lower toxicity than traditional oil-based systems

- **Disadvantages**:
  - More expensive than WBM
  - Requires specialized waste handling and disposal procedures
  - Can still pose groundwater contamination risks if improperly managed
  - Not widely available in Somaliland and may involve importation delays

Oil-Based Mud

Oil-based muds use diesel or mineral oil as the base fluid and are known for their superior performance in reactive shales, high-pressure zones, and complex formations. However, their environmental risks are significant.

- **Advantages**:
  - Superior wellbore stability in difficult geological conditions
  - Excellent thermal resistance and lubricity
  - Lower fluid loss compared to WBM
- **Disadvantages**:
  - High environmental risk if spilled (especially near aquifers)
  - Toxic to flora, fauna, and human health if not carefully contained
  - Requires advanced equipment and trained personnel
  - Expensive and difficult to dispose of in Somaliland due to lack of hazardous waste infrastructure

Recommendation

Given the depth and location of the borehole, Water-Based Mud is recommended as the most appropriate drilling fluid. It offers an acceptable balance of performance, cost, safety, and environmental protection for the Somaliland context. However, the formulation of the WBM must include additives that improve borehole stability and reduce environmental risks from cuttings and mud disposal.

Pump Technologies: Diesel vs. Solar

The choice of pump technology is a crucial decision that affects operating costs, reliability, and sustainability. The two primary options considered are diesel-powered pumps and solar-powered pumps.

Diesel-Powered Pumps

Diesel submersible pumps are widely used in deep boreholes where electrical or solar options are limited. They use a diesel generator to power the pump, drawing water from the aquifer.

- Advantages:
    - Can operate 24/7, providing a constant supply of water.
    - Higher lifting capacity, making them suitable for deep boreholes.
    - More affordable initial costs than a full solar setup.
- Disadvantages:
    - High operational costs due to rising fuel prices.
    - Requires regular maintenance and fuel storage.
    - Environmental concerns from CO_2 emissions and fuel spills.

Solar-Powered Pumps

Solar-powered submersible pumps convert solar energy into electricity, eliminating the need for fuel. These systems are becoming more cost-effective and widely used in remote areas.

- Advantages:
    - Zero fuel costs, reducing long-term operational expenses.
    - Low maintenance, as there are no fuel filters or moving engine parts.
    - Environmentally sustainable, reducing carbon footprint.
- Disadvantages:
    - Higher upfront investment in solar panels and battery storage.
    - Limited pumping during cloudy periods, unless combined with storage.
    - Requires battery backup or hybrid integration for 24-hour operation.

Recommended Option for Cali Ciise

A hybrid solar-diesel system offers the best balance of cost, efficiency, and sustainability.

- Solar panels will be used as the primary power source, covering daytime pumping needs.

- A diesel generator will serve as a backup, ensuring 24-hour operation when necessary.
- This approach reduces fuel dependency while maintaining reliability during low-sunlight conditions.

Water Distribution Layouts

The borehole water must be distributed efficiently to households, livestock, and community facilities. There are three main design options:

Centralized Water Kiosk System

In this system, water is pumped from the borehole into an elevated storage tank, which then feeds a single public kiosk.

- **Advantages:**
  - Simple and cost-effective for operation and maintenance.
  - Minimizes pipeline costs and leak risks.
- **Disadvantages:**
  - Crowding issues, as all users must fetch water from one location.
  - Longer waiting times during peak usage hours.

Piped Distribution Network

A pipeline network delivers water from the borehole to multiple kiosks, livestock troughs, and institutions (schools, clinics) across the village.

- **Advantages:**
  - Reduces congestion, allowing multiple collection points.
  - More convenient for residents and livestock herders.
- **Disadvantages:**
  - Higher installation and maintenance costs due to extended pipelines.
  - Potential for leaks and pressure loss over long distances.

Hybrid System (Recommended Option)

A hybrid approach balances accessibility and cost.

- Water will be pumped into an elevated tank, ensuring consistent pressure.
- A primary kiosk near the borehole will serve the main village residents.
- Additional troughs (~50-80m away) will prevent livestock congestion.
- A pipeline extension may be added later if demand grows.

Trade-Offs in Cost, Efficiency, Reliability, and Environmental Impact

Table 19 Trade-Offs in Cost, Efficiency, Reliability, and Environmental Impact

Design Aspect	Cost	Efficiency	Reliability	Environmental Impact
Mud Rotary Drilling	High upfront	High	High	Moderate waste from drilling fluids
Percussion Drilling	Lower upfront	Lower	Medium	Lower environmental impact
Diesel Pump	Lower upfront, high fuel costs	High	High	High carbon footprint
Solar Pump	Higher upfront, no fuel costs	Moderate (weather-dependent)	High (low maintenance)	Low carbon footprint
Hybrid Solar-Diesel Pump	Medium upfront, reduced fuel use	High	High	Lower emissions than full diesel
Centralized Kiosk System	Low	Medium	High	Low impact
Piped Distribution	High	High	Medium	Potential leaks & pressure loss
Hybrid Distribution System	Medium	High	High	Balanced impact

Conclusion: Recommended Design for Cali Ciise

Based on cost, efficiency, reliability, and environmental impact, the optimal design choice for the borehole system in Cali Ciise is:

Mud Rotary Drilling for deep penetration and stable well construction.

A Hybrid Solar-Diesel Pumping System to ensure energy efficiency and long-term cost savings.

A Hybrid Distribution Network with a primary kiosk and separate livestock troughs, with the option for future pipeline extensions if demand increases.

7. ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

7.1. Impact Assessment Methodology

The impact assessment follows a structured methodology to determine the significance of each environmental and social impact, based on its magnitude, duration, and type. This approach enables a transparent and consistent evaluation of both positive and adverse impacts and informs the appropriate design of mitigation or enhancement measures.

Impact Significance

Impact significance is a function of:

- **Magnitude** (extent and severity of the impact),
- **Receptor sensitivity** (social or ecological),
- **Probability of occurrence**, and
- **Reversibility or persistence**.

Impacts are categorized as follows:

Table 20 Impact Significance

Category	Definition
High	The impact is expected to cause major, long-term or irreversible changes to sensitive social receptors. Likely to require significant mitigation or design changes.
Moderate	The impact may cause appreciable but manageable changes to physical, biological, or social environments. Can be reduced through well-defined mitigation.
Low	The impact is minor, short-term, reversible, or occurs in a context of low sensitivity. Requires standard mitigation or monitoring.

Note: Both positive and negative impacts are rated using the same scale. For example, a *High positive* impact may significantly enhance water access or health outcomes.

Duration

The duration refers to the length of time the impact is expected to persist:

Table 21 Duration

Category	Definition
Temporary	Impact occurs only during the construction or short-term operational phase and dissipates shortly after the activity ends. Typically <2 years.
Permanent	Impact continues throughout the project life cycle or has long-lasting effects that persist beyond project closure (e.g., groundwater depletion, land use change).

Type of Impact

Impact type describes the relationship between the project activity and the effect:

Table 22 Type of Impact

Category	Definition
Direct	The impact results immediately from a project activity (e.g., noise from drilling, contamination from fuel spills). Causality is immediate and traceable.
Indirect	The impact occurs as a secondary or downstream effect of the project (e.g., population influx leading to resource competition, rangeland degradation from increased access). These impacts may be delayed or mediated by other factors.

Assessment Procedure

Each identified impact is assessed using the following steps:

1. **Identification** of the source (project activity) and the receptor (environmental or social system).

2. **Evaluation of magnitude**, sensitivity of the receptor, and potential cumulative effects.

3. **Assignment of significance** based on predefined criteria (High, Moderate, Low).

4. **Characterization of duration and type** (Temporary/Permanent; Direct/Indirect).

5. **Documentation** of rationale, including any assumptions or uncertainty.

Example

Table 23 Impact Evaluation Examples

Impact	Significance	Duration	Type	Rationale
Dust from construction	Low	Temporary	Direct	Localized and reversible, easily mitigated through spraying
Conflict over resource access	Moderate to High	Permanent	Indirect	May emerge gradually from population influx or exclusion

Non-Significant Impacts

For non-significant impacts—those categorized as "low" or "negligible" in terms of their severity, duration, extent, or reversibility—are acknowledged but do not require detailed mitigation planning. This aligns with international best practice and is consistent with both ESF guidelines and national ESIA procedures.

While non-significant impacts do not trigger standalone mitigation measures, they are still subject to general good practice measures embedded in the project's design, operational protocols, and ESMP. For example, minor dust generation or temporary noise in an uninhabited area are not significant enough to warrant a bespoke mitigation plan, but will still be managed through routine measures such as use of water sprays or maintenance of equipment.

7.2. Positive Impacts

The borehole project will bring significant benefits to the community, improving water security, public health, economic stability, and social cohesion. By providing a reliable water source, the project will address long-standing challenges related to water scarcity, high costs, and dependence on unsafe sources.

Enhanced Water Availability for Domestic Use, Livestock, and Small-Scale Irrigation

The borehole will provide a stable, year-round water supply, replacing the community's reliance on seasonal, unprotected sources such as berkads and haffir dams. Currently, residents must travel long distances to access water, and during drought periods, many depend on expensive water trucking. With the borehole, households will have access to clean, locally available water, significantly reducing water shortages and lowering household expenditures on water.

For pastoralists, the borehole will ensure consistent access to water for livestock, reducing mortality rates and improving overall herd health. With healthier animals, pastoralist households will benefit from higher milk and meat production, increasing food security and economic resilience. While irrigation is not the primary focus of the project, reliable water access may support small-scale household gardening, diversifying diets and providing additional income opportunities for families.

Reduced Time and Distance Spent Fetching Water

The borehole will significantly reduce the time and physical burden of collecting water, particularly for women and girls, who are primarily responsible for this task. At present, women walk long distances multiple times a day, carrying heavy containers of water for household use. This daily burden prevents them from engaging in economic activities, caring for children, or participating in community affairs.

With the borehole located close to the village center, the time required for water collection will be dramatically reduced, allowing women to invest their time in small businesses, livestock rearing, and household responsibilities. For young girls, access to water will increase school attendance, as they will no longer need to miss classes to fetch water for their families or migrate during the dry season. The reduction in travel distances will also decrease their exposure to gender-based violence (GBV), a risk associated with walking to distant, isolated water sources.

Improved Hygiene, Public Health, and Livelihoods

Access to clean water will lead to better hygiene and sanitation, reducing the spread of waterborne diseases such as cholera, diarrhea, and dysentery. Many current water sources in Cali Ciise are unprotected and highly vulnerable to contamination, particularly berkads, which often contain animal waste, bacteria, and other pollutants. By providing a protected, regularly monitored water source, the borehole will significantly improve public health outcomes.

The availability of clean water will particularly benefit health facilities and schools, which currently struggle with poor sanitation and hygiene due to inadequate water supplies. In health centers, medical staff will have access to clean water for sterilization, handwashing, and patient care, reducing the risk of infections. In schools, improved access to water will enable better hygiene practices among students, reducing absenteeism caused by preventable illnesses.

For pregnant women and young children, access to safe drinking water will lower the risk of waterborne infections, leading to better maternal and infant health outcomes.

Potential for Conflict Reduction Over Scarce Water Resources

During periods of scarcity, disputes over access to limited water supplies can lead to resource-based conflicts and displacement. The introduction of a regulated, equitably managed borehole will reduce competition over water, fostering greater cooperation and stability within the community.

The project includes the establishment of a Water User Committee (WUC), which will oversee water allocation, fee collection, and dispute resolution mechanisms. The committee will include representatives from different user groups, ensuring fair water distribution and preventing the marginalization of certain groups, including pastoralists and women. Additionally, traditional governance structures, such as clan-based mediation, will be incorporated to ensure that conflicts are resolved in a culturally appropriate manner. By reducing water scarcity-related tensions, the borehole project will help strengthen social cohesion, improve security, and support long-term community resilience.

Increased Climate Resilience and Sustainable Water Management

Groundwater resources are generally more resilient to climate fluctuations than surface water sources, making them a more reliable solution for long-term water security. By tapping into a deep, sustainable aquifer, the borehole will help Cali Ciise withstand future droughts and climate-related shocks, reducing the community's vulnerability to erratic rainfall patterns and extreme weather events.

The project will also strengthen local water management institutions, ensuring that the borehole is sustainably operated and maintained. The Water User Committee will receive technical training on pump maintenance, financial record-keeping, and water conservation strategies, ensuring that the borehole remains functional for years to come. Additionally, regular groundwater monitoring will be conducted to track water levels and prevent over-extraction, preserving the resource for future generations.

7.3. Negative Impacts on the Physical Environment

Adverse Impacts on Soil and Land Degradation

The construction and operation of the borehole could lead to soil degradation if not properly managed. The main risks include erosion from construction activities, improper disposal of drilling cuttings, and potential soil contamination from project-related activities.

Erosion from Construction Activities

- Land clearing and excavation for borehole installation, access roads, and water distribution infrastructure will disturb the natural soil structure.

- Removal of vegetation will expose the topsoil, increasing vulnerability to wind and water erosion, particularly in the semi-arid environment of Cali Ciise.
- Heavy machinery and drilling equipment will compact the soil, making it harder for water to infiltrate, increasing runoff, and accelerating gully formation.
- Seasonal rains, though infrequent, can cause localized flash floods, washing away exposed soil and contributing to land degradation.
- Livestock concentration near the borehole will cause soil compaction and trampling, leading to decreased vegetation cover and increasing erosion risk in frequently used areas.

Potential Soil Contamination

- Fuel will need to be transported and stored onsite, which could result in spills. Fuel spills may introduce hydrocarbons into the soil, leading to localized pollution and degradation.
- Improper disposal of lubricants and machine fluids could leach into the soil, contaminating grazing lands and reducing vegetation growth.
- Overuse of livestock watering points will result in nutrient overloading from animal waste, leading to soil degradation and the formation of unsanitary, muddy areas.
- Poor drainage management at water collection sites could result in standing water, increasing soil salinization and degrading land productivity over time.

Mitigation Measures

Erosion from Construction Activities

- Limit vegetation clearing strictly to the footprint of the borehole, pipelines, and necessary access roads.
- Clearly demarcate construction boundaries to avoid unnecessary site disturbance.
- Design and enforce controlled livestock routes and resting areas near troughs to reduce trampling.
- Use gravel or concrete bases at watering points to minimize soil damage and erosion.
- Install shallow diversion channels or berms around cleared areas to redirect stormwater.

Potential Soil Contamination

- Store fuel, oil, and lubricants in clearly marked, bunded areas with impermeable flooring.
- Refuel and maintain machinery only in designated containment zones.
- Equip construction sites with spill kits (absorbent materials, gloves, disposal bags).
- Train all workers in spill prevention, containment, and clean-up procedures.
- Collect used oils, lubricants, and filters in sealed containers and dispose of them through approved handlers or in lined pits approved by MoECC.
- Prohibit dumping of any liquids or waste on bare soil.

Adverse Impacts on Water Quality

The construction and operation of the borehole introduce several potential risks to water quality that could impact both human consumption and livestock use. These risks stem from chemical contamination, improper well construction, and inadequate wastewater management.

Potential Contamination from Chemical Use

- Drilling fluids and lubricants used during the borehole drilling process may contain chemical additives that, if not properly managed, could leach into the groundwater.
- Improper disposal of drilling fluids on the surface may allow contaminants to seep into the borehole's recharge zone, affecting water quality.
- Fuel and oil spills from diesel generators, pumps, and storage tanks could introduce hydrocarbons into the soil, eventually contaminating groundwater if spills are not contained.

Improper Well-Casing and Seal Installation

- Faulty or inadequate well casing could allow surface contaminants, bacteria, and agricultural runoff to infiltrate the well.
- Inadequate sanitary sealing around the borehole may enable wastewater, animal waste, and other pollutants to enter the aquifer, leading to bacterial contamination.
- Well integrity failures due to poor construction or material defects could lead to mixing of saline and fresh water zones, worsening water quality.

Wastewater and Livestock-Related Contamination

- Livestock concentration around the borehole and water troughs will generate animal waste, which can leach into the groundwater if the area lacks proper drainage.
- Wastewater runoff from overuse at communal water kiosks can create stagnant water pools, which increase bacterial growth and potential contamination.
- Improperly managed waste from borehole operations could result in nitrate contamination, affecting water quality and posing health risks, particularly for infants and pregnant women.

Mitigation Measures

Potential Contamination from Chemical Use

- Use non-toxic or biodegradable drilling fluids whenever possible.
- Store all chemicals, fuels, and lubricants in bunded, covered areas with impermeable surfaces, away from the borehole site.
- Avoid surface discharge of drilling fluids—dispose of them in lined waste pits or other method approved by MoECC.

Improper Well-Casing and Seal Installation

- Use high-quality, corrosion-resistant casing materials that meet national and international borehole standards.
- There will be pressure and integrity testing of casing and sealing before final commissioning.
- Avoid over-pumping, which can draw saline water into freshwater zones—follow extraction limits based on aquifer tests.

Wastewater and Livestock-Related Contamination

- Construct drainage channels around the water kiosk and livestock troughs to divert runoff to lined soak pits or gravel infiltration beds.
- The livestock and human water access points have been designed to be 80 meters apart, with fencing to avoid co-use and crowding.
- Rotate livestock access to prevent overuse of any single trough area; consider vegetation buffer zones.

Adverse Impacts on Air Quality and Noise Pollution

The construction and operation of the borehole will generate air pollution and noise disturbances, particularly during the drilling phase and ongoing operation of pumps and generators. These impacts are negligible and not anticipated to affect human health, disrupt daily life, or contribute to environmental degradation. This is due to both the nature of the project and the fact that the proposed site is sufficiently removed (900 m) from the settlement area to minimize noise and dust impacts.

Dust and Particulate Pollution During Construction

- Drilling activities will generate dust, especially in dry conditions, where loose soil is easily disturbed by excavation and heavy machinery.
- Vehicle movement on unpaved roads will raise dust clouds, reducing air quality and causing respiratory irritation for workers and nearby residents.
- Stockpiling of drilling materials, gravel, and cuttings may result in airborne particulates, particularly if left uncovered and exposed to wind.
- Strong winds common in arid environments can spread fine dust particles over a wider area, affecting visibility and air quality for both workers and livestock.

Noise and Emissions from Drilling Rigs and Generators

- Drilling operations will generate high noise levels, particularly from rotary drilling rigs, compressors, and hammering tools.
- Diesel generators used for pumping operations can produce constant low-frequency noise, which may disturb residents if operated near homes or at night.

- Heavy machinery, including transport trucks and excavation equipment, will add to noise pollution, particularly during site preparation and material transport.
- Diesel generators and heavy machinery will produce emissions.
- Sensitive receptors such as schools, health centers, and residential areas may experience temporary noise disruptions, affecting learning and patient care.

Mitigation Measures

Dust and Particulate Pollution During Construction

- Spray water on unpaved access roads, drill pads, and cleared areas at least twice per day during dry, windy periods.
- Store drilling cuttings, sand, gravel, and other materials under tarpaulins or shade netting to prevent wind dispersion.
- Limit vehicle speeds on-site and along access roads to a maximum of 20 km/h to reduce dust emissions.
- Use well-maintained, fuel-efficient equipment and limit engine idling to reduce diesel emissions from generators and heavy machinery.
- Provide masks or respirators to all workers exposed to dust and conduct regular training on respiratory protection.

Noise from Drilling Rigs and Generators

- Restrict high-noise activities (e.g., drilling, hammering, generator operation) to daylight hours (e.g., 7:00 a.m.–6:00 p.m.) to avoid nighttime disturbance.
- Provide ear protection (earplugs or earmuffs) to workers near high-decibel equipment and rotate tasks to limit prolonged exposure.

Adverse Impacts of Waste Generation

The borehole construction and operation will generate various types of solid and liquid waste, including drilling mud, packaging materials, and hazardous waste such as oil and lubricants. If not properly managed, these waste materials could contaminate soil and water, create health hazards, and contribute to environmental degradation.

Expected Waste Generation and Management

1. Non-Hazardous Wastes

a. Construction and Inert Waste

Types: Concrete debris, surplus aggregates, broken masonry, excess pipe segments, and packaging (plastic, wood, cardboard).

Estimated Quantity: 1–2 tons

Management:

- Segregated at source.
- Reused for site backfilling or landscaping where feasible.
- Remainder disposed at designated municipal disposal sites.

b. Domestic Waste

Types: Food remnants, plastic bottles, general refuse from workers.

Management:

- Sorted into biodegradable and recyclable fractions.
- Biodegradable waste composted or disposed via municipal routes.
- Plastics and cans sent to recycling points or collected for off-site disposal.

2. Hazardous Wastes

a. Waste Oils and Lubricants

Sources: Equipment servicing (generators, compressors, drill rigs).

Management:

- Stored in marked, sealed drums.
- Transferred to approved waste oil handlers or incinerated at approved facilities.

b. Obsolete Electrical and Solar Equipment

Types: Broken panels, cables, connectors, batteries.

Management:

- Stored in secure enclosures.
- Transferred to e-waste recycling handlers in accordance with MoECC and international guidelines.

c. Chemical Containers (e.g. chlorine, biocides)

Management:

- Triple-rinsed and punctured prior to disposal.
- Stored in ventilated, locked enclosures until safe off-site disposal.

3. Drilling Waste: Cuttings and Water-Based Mud (WBM)

a. Drilling Cuttings

Quantity: Estimated 9–15 m^3, depending on lithology and borehole diameter.

Composition: Crushed rock fragments carried to the surface by drilling fluid.

b. Water-Based Drilling Mud (WBM)

Quantity: Estimated 10–20 m^3 active volume, with additional volumes lost to borehole seepage or discarded after contamination.

Additives: Usually include bentonite. No polymers or other additives are expected for this project.

Storage and Disposal Measures:

Table 24 Drilling Mud Management

Aspect	Management Measure
Initial Containment	Drilling mud and cuttings will be collected in a lined waste pit (HDPE or compacted clay) located at least 50 m from any watercourse or well.
Separation	Solids allowed to settle and decant clear water for reuse in circulation
Drying and Stabilization	Settled solids will be allowed to dry and stabilized using lime or cement if required.
Reuse/Disposal of Cuttings	Dried cuttings can be reused as fill material. Otherwise, they will be removed to an approved disposal or encapsulation site.

Final Pit Closure	After completion, the waste pit will be dewatered, backfilled with clean soil, and compacted to prevent erosion or water collection.

4. General Waste Management and Compliance Measures

All waste handling and disposal activities must align with:

- World Bank ESS3 on Resource Efficiency and Pollution Prevention,
- Somaliland Environmental Management Act LR 79/2018, and
- Approved site-specific Environmental and Social Management Plans (ESMPs).

Implementation Procedures

- On-site waste segregation, labeling, and secure storage.
- Availability of Waste Management Plans (WMP) approved by the Ministry of Environment and Climate Change (MoECC).
- Training of all site workers in proper waste handling and safety.
- Use of personal protective equipment (PPE) during drilling and waste handling.
- Regular audits by PIU and environmental specialists to verify compliance.

Drilling Mud and Cuttings

- Large volumes of drilling mud and cuttings will be produced during borehole excavation. These materials contain a mix of soil, rock fragments, and drilling fluids, some of which may contain chemical additives used for lubrication and borehole stability.
- Improper disposal of drilling mud can clog drainage systems, contaminate groundwater, and degrade soil quality by altering pH levels and nutrient balance.
- Uncontrolled disposal of drilling waste without settling ponds or designated pits can lead to surface runoff and seepage.

Use of Bentonite

- During transport, storage, and mixing, fine bentonite particles can become airborne. Inhalation of this dust may pose health risks to workers. Although workers in this project will only be exposed for a few weeks and therefore unlikely to experience health impacts, all workers should be provided with appropriate PPE, as detailed in the Mitigation Measures below.

- Because bentonite is a type of clay (that swells and becomes pliable when wet), if bentonite slurry is improperly disposed of, it can clog soil pores and interfere with natural percolation of water.
- The use of bentonite will be determined on-site by the drilling engineer.

Packaging Waste from Construction Materials

- Borehole construction will require cement, pipes, metal fittings, and electrical components, generating significant packaging waste such as plastic wraps, wooden pallets, cardboard boxes, and metal scraps.
- Uncontrolled disposal of plastic and non-biodegradable waste can lead to landscape degradation and pose risks to livestock and wildlife that may ingest or become entangled in waste materials.
- Recycling and proper disposal measures should be implemented, ensuring that reusable materials are collected and hazardous waste is handled safely.

Oil, Lubricants, and Fuel Waste

- Diesel-powered generators and drilling rigs will require regular lubrication and fuel refills, leading to potential spills and leaks.
- Used engine oil and hydraulic fluids are classified as hazardous waste and, if improperly disposed of, can contaminate soil and groundwater.
- Proper containment measures, such as spill-proof storage and designated disposal areas, must be implemented to prevent environmental contamination.

Mitigation Measures

Drilling Mud and Cuttings

- Construct lined waste pits or other disposal area at the drilling site to collect and contain drilling mud and cuttings. To meet World Bank EHS Guidelines and Somaliland protocols, ensure these are at least 50 meters from the borehole.
- Prohibit the dumping of drilling fluids directly onto the ground.
- After drilling, backfill and seal waste pits to prevent seepage or accidental reuse.
- Coordinate with MoECC or local authorities for any required permits or inspections of waste handling procedures.

Use of Bentonite

- Equip workers with masks and gloves and implement dust suppression measures.
- Use lined containment pits for bentonite waste and dispose of them at designated sites.

Packaging Waste from Construction Materials

- Deliver training to workers on proper sorting and disposal procedures.

- Ensure regular waste collection and transport to approved local waste disposal or recycling facilities.
- Reuse wooden pallets and crates where possible; otherwise, dispose of them through approved channels or offer them for local repurposing.
- Prevent wind-blown litter by using covered bins or containers at all work areas.

Oil, Lubricants, and Fuel Waste

- Designate a fuel handling and equipment maintenance zone, at least 100 meters from the borehole, with a concrete or impermeable surface and bunding (containment walls).
- Store oil, lubricants, and fuel in labeled, leak-proof containers, in shaded and ventilated locations with secondary containment (bunds or trays).
- Use drip trays under generators and fuel-dispensing areas to catch accidental leaks.
- Collect used oil and lubricants in sealed, labeled drums and store them in a covered hazardous waste area until collected by approved waste handlers.
- Train all staff in spill response procedures, and keep spill response kits (absorbent pads, gloves, disposal bags) at fuel handling locations.

Adverse Impacts of Resource Depletion

The development of a borehole presents a potential risk of groundwater depletion if pumping rates exceed the sustainable yield of the aquifer. Over-extraction can lead to declining water levels, reduced recharge rates, and long-term damage to the groundwater system, threatening the availability of water for future generations.

Declining Water Table and Reduced Aquifer Recharge

- Excessive pumping can lower the water table, making it more difficult and costly to extract water over time.
- The Yesomma Sandstone Aquifer, which is the target formation for this borehole, has limited natural recharge due to low rainfall and high evaporation rates.
- If the rate of water withdrawal surpasses recharge rates, the aquifer could experience permanent depletion, reducing its long-term viability.

Impact on Other Water Users

- Neighboring villages and nomadic pastoralists that rely on the same aquifer may experience reduced water availability, increasing competition and the potential for resource conflicts.
- If the borehole is over-utilized, existing hand-dug wells and shallow wells may dry up, forcing communities to seek alternative and often less safe water sources.

Land Subsidence and Ecosystem Disruption

- Over-extraction of groundwater can lead to land subsidence, where the ground compacts due to the loss of underground water support, potentially damaging infrastructure.
- Depletion of groundwater can affect vegetation growth, reducing grazing quality for livestock and impacting pastoralist livelihoods.
- Drying aquifers can alter surface water dynamics, leading to increased desertification and reduced biodiversity in the surrounding ecosystem.

Mitigation Measures

Declining Water Table and Reduced Aquifer Recharge

- Set an extraction rate based on hydrogeological test results to ensure it remains below the estimated sustainable yield of the Yesomma Sandstone aquifer.
- If possible, equip the borehole with a calibrated flow meter to monitor daily water abstraction in real-time.
- If possible, conduct monthly or quarterly measurements of static water levels to detect drawdown trends.
- Implement fixed operating hours for the pump, aligned with seasonal demand and recharge patterns.

Impact on Other Water Users

- The WUC, VDC or other appointed entity should clearly define and communicate allowable volumes for different user groups (e.g., households, livestock, institutional).

  Strengthen the WUC with fair representation of vulnerable and mobile groups and train them on water equity principles.
- Set up a system to flag low water levels or signs of pressure from users in nearby zones, with protocols to reduce pumping if needed.

Land Subsidence and Ecosystem Disruption

- If possible, combine well metering with groundwater monitoring to ensure that withdrawals remain within safe yield limits.
- Track changes in grazing areas and vegetation health, using visual assessments or drone mapping if feasible.
- Use flexible or reinforced materials for surface infrastructure (e.g., tank stands, pipe joints) in case of minor subsidence.
- Implement rotational grazing and limit livestock congregation near the borehole to avoid localized land degradation.

7.4. Negative Impacts on the Biological Environment

The construction and operation of the borehole may have negative impacts on local vegetation and wildlife habitats. Although the region is semi-arid with relatively sparse vegetation, the introduction of a permanent water source and increased human and livestock activity could disturb natural ecosystems, degrade vegetation, and disrupt wildlife patterns.

Adverse Impacts of Habitat Disturbance

Loss of Vegetation and Habitat Disturbance

- Land clearing for drilling and infrastructure (e.g., access roads, water kiosks, and livestock troughs) will result in the removal of native vegetation, including hardy acacia species and grasslands that are critical for soil stabilization and grazing.
- Trampling by increased livestock populations will lead to soil compaction, which may reduce the ability of native plants to regenerate, resulting in land degradation.
- Wastewater runoff from watering points could alter soil moisture levels, potentially leading to localized plant die-off or the proliferation of invasive plant species.
- If overgrazing occurs near the water point, it could accelerate desertification, reducing the availability of pasture for future livestock use.

Disturbance to Wildlife

- The presence of a permanent water source will attract larger numbers of livestock, people, and potential predators, which could disrupt natural wildlife patterns.
- Wildlife species that traditionally rely on seasonal water sources may alter their habits, leading to increased human-wildlife interactions or competition for resources.
- Noise from drilling operations and increased human presence may cause wildlife displacement, particularly for small mammals, birds, and reptiles.
- Artificial lighting and human activity near the borehole at night may interfere with nocturnal species, affecting their feeding and breeding behaviors.

Mitigation Measures

Loss of Vegetation and Habitat Disturbance

- Restrict clearing to the exact footprint needed for infrastructure. Avoid clearing buffer zones or grazing areas unnecessarily.
- Install fencing or barriers to guide livestock to designated watering points, preventing free roaming and trampling in sensitive zones.

- Work with the community to implement seasonal rotation of livestock access around the borehole, allowing vegetation recovery.

Disturbance to Wildlife

- Schedule noisy construction activities (e.g., drilling) during daylight hours only.
- Avoid nighttime lighting around the borehole. If lighting is necessary for security, use low-intensity, downward-facing, motion-activated lights.
- Educate residents and the Water User Committee on the importance of wildlife conservation and how to avoid behaviors that provoke wildlife (e.g., leaving waste or chasing animals).

7.5. Negative Impacts on the Social Environment

The borehole project will bring significant benefits to the community, but it also presents social risks and challenges that must be managed to ensure equitable access, community safety, and sustainable resource use. These negative impacts include land acquisition concerns, community health and safety risks, labor issues, cultural heritage disturbances, gender-based violence risks, and potential conflicts over water usage.

Access Restriction

- Fencing of the borehole site to protect community members during construction works or to protect water quality could restrict pastoralist movement. Given the small footprint of the project site, the restricted area will be limited and there is no anticipated impact to livelihoods.

Mitigation Measures

- The PIU has facilitated voluntary, documented agreements for all land areas affected by the project, including pipeline routes, water kiosks, and livestock infrastructure.
- All agreements have been negotiated transparently with landowners, elders, women's representatives, and local authorities, in accordance with customary and statutory frameworks.
- The project has been designed to avoid siting infrastructure in areas that may provoke conflict or disrupt livelihoods.
- The project has been designed to utilize existing access roads, minimizing disruption to productive land.
- Ensure that any complaints about land use restrictions or unfair treatment are addressed through the project's grievance mechanism, with attention to marginalized and vulnerable groups.
- Include land-related grievances as a specific category in grievance tracking.

Community Health and Safety Risks

- Influx of workers from outside the village during construction may introduce health and security risks, especially if workers do not follow local norms and customs.
- Increased vehicle traffic on unpaved roads could pose road safety hazards, particularly for children and livestock, including during mobilization of the drilling rig to the site.
- Unsanitary conditions or lack of proper drainage near water collection points may create breeding grounds for mosquitoes, increasing the risk of vector-borne diseases such as malaria.
- Poorly managed wastewater runoff from the borehole site could lead to contaminated drinking water, increasing the risk of diarrheal diseases and bacterial infections.

Mitigation Measures

- Prioritize local hiring to reduce the influx of outside workers and minimize the potential for social disruption.
- There will be a code of conduct for all workers, covering behavioral expectations, including respect for local cultures, gender equality, and avoiding alcohol or substance abuse.
- A GM has been established for the community to report any security or behavioral concerns related to workers.
- Implement speed limits (e.g., 20 km/h) on unpaved access roads to reduce the risk of accidents.
- Design and implement proper drainage systems at the water collection points, especially at kiosks and livestock troughs, to prevent the formation of stagnant water pools that could act as breeding grounds for mosquitoes.
- Install lined soak pits and drainage channels at the borehole site to manage wastewater runoff safely, preventing it from contaminating drinking water sources. This should be done during the construction phase.

Long-Term Maintenance and Sustainability Risks

- If spare parts or servicing equipment for the pump system are not easily available, breakdowns could leave the borehole unusable for extended periods.
- Community payment models for water use need to be well-managed to avoid disputes or mismanagement of funds.

Mitigation Measures

- Select pumps, solar components, and piping systems that use non-proprietary, easily sourced parts available in regional markets (e.g., Hargeisa, Berbera).
- Provide a simple maintenance manual in Somali and train two or more community members on routine servicing and early fault detection. Basic O&M measures were included in the CIR, for example, which could be translated and used for this purpose.

- Develop a clear, transparent community water payment system (e.g., per jerrycan, per household, or livestock-based contributions) that reflects community preferences and ability to pay.
- Train the WUC on basic bookkeeping, transparent recordkeeping, and budgeting for preventive and corrective maintenance.

Labor and Working Conditions

- Workers must be provided fair wages and safe working conditions, in compliance with national labor laws and World Bank ESS2.
- Risk of child labor or exploitation may arise if contractors fail to enforce labor protections, particularly in low-wage informal labor sectors.
- Temporary worker accommodations may lack sanitary facilities, increasing risks of unsanitary living conditions and health hazards.

Mitigation Measures

- Require all contractors and subcontractors to sign and comply with a Labor Management Procedure (LMP) aligned with national laws and World Bank ESS2.
- Ensure that all workers—skilled and unskilled—receive at least the national minimum wage, with equal pay for equal work and no wage discrimination based on gender, clan, or status.
- Provide workers with written contracts in Somali, clearly stating wages, work hours, job duties, duration of employment, and grievance procedures.
- Enforce limits on working hours, rest breaks, and provide access to paid sick leave and weekly rest, in line with Somaliland labor regulations.
- Establish and enforce procedures to verify the minimum age of all workers (typically 18 years) before employment. Require identity documents at hiring.
- Include explicit anti-child labor clauses in all contracts, and conduct spot checks on subcontractor laborers.
- Make first-aid kits available on-site and train workers in basic health and safety. Link to a nearby health clinic for emergencies.
- All employees should sign a code of conduct addressing behavior expectations, health and safety, GBV/SEA/SH prevention, and respect for community norms.
- There is a confidential, accessible grievance mechanism for workers to raise concerns about wages, conditions, discrimination, or misconduct.
- Ensure that grievances are investigated promptly and resolved within a set timeframe.
- Communicate the grievance procedure during worker onboarding and display it at the worksite in Somali.

OHS Risks

- Risk of entanglement, crushing injuries, or falls associated with moving machinery and drilling equipment.
- Injuries from machinery (e.g., trucks, cranes) due to poor handling, blind spots, or lack of operator training.
- Potential for injury from dropped tools, pipe sections, or rig components.
- Musculoskeletal injuries from carrying heavy materials or improper lifting techniques.
- Contact with drilling muds, lubricants, fuel, or cleaning agents without proper handling or PPE.
- Prolonged exposure to high temperatures, especially in outdoor work with inadequate hydration or shade.
- Trips and falls from uneven surfaces, open pits, and unmarked hazards at the construction site.
- Injuries from mechanical parts or electrical faults during servicing.
- Increased risk of injury or exposure due to lack of or non-use of personal protective equipment.

Mitigation Measures

- All workers operating or working near heavy machinery (e.g., drilling rigs, trucks, cranes) must undergo certified health and safety training before starting work.
- Only certified and experienced operators should be permitted to use machinery and power tools.
- Secure tools, pipes, and materials at elevation. Use tool lanyards or restraints when working at height.
- Enforce the use of hard hats, steel-toed boots, and gloves on all construction sites. Provide and enforce the use of gloves, goggles, overalls, and respirators when handling hazardous substances.
- Store all lubricants, fuel, and chemicals in designated, ventilated, bunded areas with secondary containment.
- Implement shift rotation and mandatory rest breaks, especially during the hottest hours (11:00 a.m. to 3:00 p.m.).
- Ensure constant access to clean drinking water and encourage hydration breaks.

Cultural Heritage Risks

- Accidental disturbance of cultural sites that were not identified during the ESIA process may occur during drilling, excavation and pipeline installation.

Mitigation Measures

- In the event of accidental finds, implement a Chance Find Procedure as provided for in Appendix 3.
- Train workers to be aware of the potential of a chance find and what to do

Behavioral and Social Adaptation to a Permanent Water Source

- The transition from traditional water sources (berkads and haffir dams) to a borehole system could change social dynamics, particularly regarding clan-based water-sharing traditions.

- The borehole might encourage new settlements, leading to land-use pressures, increased demand for resources, and possible social tensions.

Mitigation Measures

- Form or strengthen the WUC with equitable representation from all clans, genders, youth, elders, and IDPs to reflect traditional and current stakeholders.
- Incorporate customary water rights and conflict mediation practices into new water management rules where appropriate, in consultation with elders.
- Strengthen conflict prevention measures, such as incorporating rotational access for mobile pastoralist groups and setting rules for resource use in dry vs. wet seasons.
- Conduct outreach on sustainable borehole usage, livestock rotation, and water conservation**,** targeting both established and new residents.

Gender-Based Violence and SEA/SH Risks

- The presence of an outside workforce may increase risks of sexual exploitation, abuse, and harassment, particularly for women and girls.
- Women collecting water may face harassment if borehole areas are poorly monitored or lack secure access pathways.
- Women's participation in water governance may be limited, reinforcing existing gender inequalities in decision-making.
- If female workers are hired, they may face discrimination, unsafe working conditions, or lack of gender-sensitive facilities at the worksite.

Mitigation Measures

- Require all contractors and laborers to sign and comply with a code of conduct that explicitly prohibits SEA/SH, GBV, and any form of harassment or discrimination.
- Conduct mandatory induction training for all workers on appropriate behavior, local cultural norms, and SEA/SH prevention.
- Position water kiosks and troughs in visible, well-used public areas with adequate lighting (if nighttime use is expected).
- The village has stated that at least 30% of Water User Committee (WUC) members will be women.
- There were women-only consultation meetings during stakeholder engagement to capture concerns that may not be voiced in mixed settings.
- Enforce policies requiring equal pay for equal work and zero tolerance for discrimination in hiring or task assignments.

- The project GM has a confidential and survivor-centered SEA/SH reporting system, ensuring anonymity, appropriate referral services, and non-retaliation guarantees.

Conflict Over Water or Land Usage

- Increased demand for water or land may lead to competition between pastoralists, settled residents, and seasonal migrant groups.
- Nomadic herders crossing from Ethiopia or neighboring areas may seek access, creating cross-border tensions over resource allocation.
- If livestock owners overuse the borehole, household users may face water shortages, increasing grievances between different community groups.
- The influx of livestock may bring disease.
- Unequal distribution of water access points could favor certain clans or social groups, leading to perceptions of unfair treatment and local disputes.

Mitigation Measures

- Ensure the WUC includes fair representation from:
  - Settled residents
  - Pastoralists (including seasonal migrants)
  - Women
  - Marginalized clans or groups
- Develop and publicly share agreed water access guidelines, including:
  - Time-of-day schedules for different user groups
  - Livestock versus household usage allocation
  - Rotation schedules for pastoralist groups
- Equip the WUC with training on mediation and dispute resolution, supported by traditional elders and local authorities.
- Develop flexible arrangements for seasonal or emergency access by mobile groups, balanced against local needs and sustainability limits.
- The project design has designated specific areas for livestock watering that are separated from human water access points.
- Encourage herders to access veterinary checks before using communal troughs during high-risk periods.
- Periodically clean and disinfect troughs to prevent disease transmission.
- Inform users about risks of disease spread and the importance of rotational grazing and livestock control.
- Allow any community member to submit grievances about water access, favoritism, or disputes through the project's GM.

Influx of People to the Area

- Conflict between host and incoming populations over water access, land use, and grazing rights.
- Disruption of traditional land tenure systems as informal settlers claim communal or reserved land.
- Breakdown of customary governance and water-sharing arrangements.
- Increased gender-based violence (GBV) and protection risks, particularly for women and girls in poorly regulated areas.
- Strain on social services and infrastructure (schools, health posts) if influx leads to spontaneous settlement.
- Rangeland degradation from increased livestock pressure on already fragile ecosystems.
- Soil erosion and loss of vegetation cover due to unplanned settlements and movement of people and animals.
- Pollution of water sources from human waste, livestock, and informal waste dumping.

Mitigation Measures

- Establish a Community Water Committee or strengthen existing customary institutions. Ensure the committee includes local elders, women, youth, and marginalized groups.
- Define and enforce rules for water access, prioritizing existing local needs.
- Support local authorities and communities to draft and adopt customary bylaws or local regulations that:
    - Define who has the right to access the water point.
    - Restrict permanent settlement of non-residents without community consent.
    - Set seasonal or rotational use if the borehole is in a grazing area.
- Map and register grazing routes and seasonal use zones to avoid overlapping claims.
- Fence off areas around the borehole to prevent spontaneous settlement.
- Hold early and repeated discussions with the host community on the risks of influx.
- Develop community-endorsed messages about seasonal access, migration norms, and land use boundaries.
- Establish a monitoring mechanism (possibly through the Grievance Redress Mechanism or a local committee) to:
    - Track new arrivals.
    - Resolve disputes between residents and migrants.
    - Flag early signs of land encroachment or tension.

7.6. Significance Ranking

Below is a classification table that organizes the positive and negative impacts of the borehole project based on their significance (High/Moderate/Low) and whether they are temporary or permanent, direct or indirect.

Impact Classification Table

Table 25 Impact Classification

Impact	Phase	Significance (High/Moderate/Low)	Duration (Temporary/Permanent)	Type (Direct/Indirect)
	Positive Impacts			
Enhanced water availability for domestic use, livestock, and small-scale irrigation	Operation	High	Permanent	Direct
Reduced time and distance spent fetching water, especially for women and girls	Operation	High	Permanent	Direct
Improved hygiene, public health, and sanitation	Operation	High	Permanent	Direct
Increased climate resilience and sustainable water management	Operation	High	Permanent	Indirect
Economic stability and livelihood improvements (livestock, trade, and small businesses)	Operation	Moderate to High	Permanent	Indirect
Potential for conflict reduction over scarce water resources	Operation	Moderate to High	Permanent	Indirect

Impact	Phase	Significance (High/Moderate/Low)	Duration (Temporary/Permanent)	Type (Direct/Indirect)
Strengthening of local water governance institutions	Operation	Moderate	Permanent	Indirect
Employment opportunities during construction	Construction	Low to Moderate	Temporary	Direct
Increased investment opportunities in the area	Operation	Moderate	Permanent	Indirect
	Negative Impacts on the Physical Environment			
Erosion from construction activities	Construction	Moderate	Temporary	Direct
Disposal of drilling cuttings and wastewater	Construction	Low	Temporary	Direct
Soil compaction and degradation near the borehole and water access points	Construction and Operation	Moderate	Permanent	Direct
Potential soil contamination from fuel spills and drilling fluids	Construction	Moderate	Temporary	Direct
Waste accumulation (packaging, oil, and lubricants)	Construction	Moderate	Temorary	Direct
	Negative Impacts on Water Quality			
Contamination from improper well casing or sealing	Construction	High	Permanent	Direct
Pollution from livestock waste at watering points	Operation	Moderate	Permanent	Direct

Impact	Phase	Significance (High/Moderate/Low)	Duration (Temporary/Permanent)	Type (Direct/Indirect)
Chemical contamination from drilling fluids and fuel spills	Construction	Moderate	Temporary	Direct
Poor wastewater management leading to stagnant water	Construction	Moderate	Temporary	Direct
	Negative Impacts on Air Quality and Noise			
Dust and particulate pollution during construction	Construction	Low	Temporary	Direct
Noise from drilling rigs and generators	Construction	Low	Temporary	Direct
	Negative Impacts on the Biological Environment			
Loss of vegetation from land clearing and overgrazing	Construction and Operation	Moderate	Permanent	Direct
Disruption of wildlife habitats	Construction and Operation	Moderate	Permanent	Indirect
Increased human and livestock activity leading to biodiversity loss or rangeland degradation	Construction and Operation	Moderate	Permanent	Indirect
	Negative Impacts on the Social Environment			
Community health and safety risks (accidents, influx of people, spread of diseases)	Operation	High	Temporary	Direct
Labor and working conditions risks (fair wages, worker safety)	Construction	Moderate	Temporary	Direct

Impact	Phase	Significance (High/Moderate/Low)	Duration (Temporary/Permanent)	Type (Direct/Indirect)
Gender-based violence and SEA/SH risks from external workforce	Construction	High	Temporary	Indirect
Conflict over water or land usage (including people and livestock influx)	Operation	Moderate to High	Permanent	Indirect
Long-term maintenance and sustainability risks	Operation	High	Permanent	Indirect

Key Observations from the Classification

- High-significance impacts include water availability, health improvements, and potential resource conflicts, which require strong management and governance measures.
- Most positive impacts are permanent, directly benefiting the community in terms of health, economic growth, and climate resilience.
- Most negative environmental impacts are direct and require mitigation, especially regarding soil degradation, water contamination, and resource depletion.
- Social and governance-related impacts are largely indirect but high-risk, such as gender-based violence risks, governance challenges, and potential disputes over water use.

7.7. Risk Assessment of Drilling Activities

Below is a qualitative risk assessment of drilling activities. This assessment categorizes environmental and occupational risks by likelihood, consequence, and risk level. Each risk is followed by recommended mitigation or control measures. The focus is on activities during the site preparation, drilling, and well development phases.

Risk Category	Potential Hazard	Receptor	Likelihood	Consequence	Risk Level	Key Controls / Mitigation Measures
Fuel Spill	Diesel spill from storage or refueling	Soil, shallow groundwater	Unlikely	Moderate (localized)	**Moderate**	Use secondary containment for fuel; limit storage (<1,000 L); train staff; spill kits onsite

Risk Category	Potential Hazard	Receptor	Likelihood	Consequence	Risk Level	Key Controls / Mitigation Measures
Fire or Explosion	Ignition of diesel from spark, cigarette, or equipment	Workers, nearby materials	Very unlikely	Severe (injury, damage)	Moderate	No-smoking policy; firefighting equipment; proper grounding; safe fuel handling practices
Drilling Mud Spill	Mud overflow or improper disposal	Soil, vegetation	Possible	Low (non-toxic WBM)	Low	Line mud pits with plastic; manage fluid levels; dry and bury spent cuttings
Fall or Crush Injury	Equipment movement, lifting heavy items, or slips	Workers	Possible	Severe	High	Site safety training; PPE; edge protection at pits; equipment maintenance
Exposure to Chemicals	Cement, lubricants, degreasers used in minor quantities	Workers	Possible	Low	Low	PPE; safe storage in locked containers; MSDS available
Injury from Equipment	Rotating machinery, entanglement risk	Workers	Likely	Moderate	High	Guards on equipment; job hazard briefings; enforce lock-out/tag-out procedures
Unauthorized Access	Community entry into drilling site	Local residents	Possible	Moderate	Moderate	Temporary fencing; signage in Somali; community awareness outreach

Summary of Risk Levels:

- Low Risk: Manageable with good standard practices
- Moderate Risk: Requires active mitigation and site-level supervision
- High Risk: Requires pre-planning, trained staff, and continuous monitoring

Notes:

- Catastrophic scenarios such as a full-scale diesel fire or chemical explosion are highly improbable due to the small fuel quantities and low chemical inventory expected at the site. However, even small-scale events (e.g., a 50-liter diesel spill) can cause localized harm and must be prevented through proactive risk management.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1. Introduction and Objectives

The Environmental and Social Management Plan (ESMP) is a core component of this Environmental and Social Impact Assessment (ESIA), outlining the specific measures required to mitigate, manage, and monitor the potential environmental and social risks and impacts associated with the construction and operation of the proposed deep borehole. The ESMP serves as a practical implementation framework that translates the findings of the impact assessment into actionable commitments, ensuring that adverse impacts are minimized and project benefits are maximized in a socially inclusive and environmentally sustainable manner.

This ESMP is designed in accordance with the requirements of the Somaliland Environmental Management Law No. 79/2018, as well as the World Bank Environmental and Social Framework (ESF), particularly ESS1 on Assessment and Management of Environmental and Social Risks and Impacts. It includes detailed mitigation measures for all identified significant impacts, defines institutional responsibilities, establishes monitoring protocols, and sets out capacity-building needs and reporting mechanisms. The plan is intended to guide contractors, the Project Implementation Unit (PIU), regulatory authorities, and other stakeholders throughout the project lifecycle—from pre-construction and drilling to operational handover—ensuring that environmental and social safeguards are fully integrated into project implementation.

The ESMP objectives include:

- Serve as a guiding document for the environmental and social monitoring activities for the supervising consultant, contractor and the client management including requisite progress reports.
- Provide detailed specifications for the management and mitigation of activities that have the potential to negatively affect the environment and social milieu.
- Provide instructions to relevant project personnel regarding procedures for protecting the environment and minimizing environmental effects.
- Document environmental concerns and appropriate protection measures; while ensuring that corrective actions are completed in a timely manner.

8.2. Environmental and Social Management Plan (ESMP) Summary

The table below presents mitigation measures, responsibilities, monitoring programs, reporting requirements, capacity-building needs, and budget estimates for the borehole project.

Mitigation Measures

Mitigation measures are essential as they ensure that negative environmental and social impacts are minimized while maximizing the project's long-term benefits. Without proper safeguards, the project could lead to groundwater depletion, land degradation, conflicts over water access, contamination risks, and social tensions. Implementing mitigation measures, such as erosion control, well-casing integrity, sustainable water governance, and community safety protocols, helps to protect natural resources, prevent harm to local populations, and maintain the project's sustainability.

Following the mitigation hierarchy is crucial for prioritizing how environmental and social risks are addressed. The hierarchy consists of four key steps: avoidance, minimization, restoration, and compensation. Avoidance is the most effective approach, ensuring that project activities are planned to eliminate environmental harm before it occurs, such as selecting a borehole site that does not interfere with critical habitats. Where impacts cannot be entirely avoided, they must be minimized through measures like controlled drilling waste disposal, well-sealing techniques, and safe water abstraction rates. If negative impacts still occur, restoration efforts, such as replanting vegetation and rehabilitating disturbed land, help recover affected ecosystems. As a last resort, if residual impacts remain, compensation strategies, such as supporting alternative grazing lands or investing in additional community infrastructure, can offset the harm. By adhering to this hierarchy, the project ensures that environmental and social risks are proactively managed, making the borehole a reliable and sustainable water source for the community.

8.3. Audits

The PIU, the contractor and other concerned parties should conduct regular audits of the ESMP to ensure that the system for implementation of the ESMP is operating effectively. The audit should ensure that:

- The ESMP being used is the up-to-date version;
- Variations to the ESMP and non-compliance and corrective action are documented;
- Appropriate environmental training of personnel is undertaken;
- Emergency procedures are in place and effectively communicated to personnel;

- A register of major incidents (spills, injuries, complaints) is in place and other documentation related to the ESMP; and
- Appropriate corrective and preventive action is taken by the contractor(s) once instructions have been issued.

These audits are also used to ensure compliance with environmental standards, and to facilitate any needed project design or operational changes. A monitoring program, backed up by agencies or other groups that can ensure corrective action when the monitoring results show it necessary, is a proven way to ensure effective implementation of mitigation measures. By tracking the sub-project's actual impacts, monitoring reduces the environmental and social risks associated with the project, and allows for project modifications to be made where required.

8.4. Management of Change in the ESMP

The Management of Change process ensures that the ESMP remains relevant and effective throughout the project lifecycle. It enables the Project Implementation Unit (PIU), in collaboration with contractors, supervising engineers, and regulatory bodies, to make informed updates to the ESMP based on:

- Monitoring results,
- Incident investigations,
- Stakeholder feedback,
- Emerging risks or non-compliance issues,
- Technical or design changes.

This process supports continuous improvement and compliance with the World Bank ESF and Somaliland environmental regulations.

Change Triggers

Modifications to the ESMP may be triggered by:

- Monitoring data showing that mitigation measures are ineffective or insufficient,
- Environmental or social incidents (e.g., contamination, grievances, near misses),
- Changes in project scope or design,

- Regulatory updates or new environmental permits,
- Feedback from communities, Village Development Committees (VDCs), or regulators.

Roles and Responsibilities

Table 26 Management of Change Roles and Responsibilities

Actor	Responsibilities
MoWRD Project Implementation Unit (PIU)	Lead the ESMP change process; assess proposed modifications; coordinate with stakeholders; submit to regulator and WB, if required.
Environmental & Social Specialists (PIU)	Identify deficiencies during monitoring; draft revised mitigation measures or monitoring protocols.
Contractor's ESHS Officer	Report on-ground challenges and suggest practical improvements to mitigation measures; implement revised C-ESMP.
Supervising Engineer	Confirm need for technical changes; review potential environmental and social consequences of design or construction changes.
World Bank (if applicable)	Review and clear substantial changes, especially those affecting ESF classification or introducing new risks.

Change Management Procedure

1. Identification and Documentation

A non-conformity, change request, or improvement need is identified during:

- Monitoring,
- Incident reporting,
- Community engagement,
- Contractor reporting.

2. Evaluation of Proposed Change

The PIU's Environmental and Social Specialists assess the environmental and social implications of the proposed change, including:

- Effectiveness of current measures,
- Feasibility of alternatives,
- Impact on compliance, budget, or schedule.

3. **Consultation and Coordination**

For significant changes, consultation is carried out with:

- Contractors and supervising engineers,
- Local authorities and VDCs,
- Regulators like MoECC.

4. **Approval and Documentation**

- Minor changes (e.g., improved fencing or dust suppression methods) are documented internally by the PIU and implemented via C-ESMP updates.
- Major changes (e.g., new waste handling methods, relocation of components) may require approval from regulators like MoECC, or require review by World Bank.

5. **Implementation and Training**

- Revised measures are integrated into updated site protocols, contractor instructions, and training materials.
- Contractors receive briefings on new requirements, and the PIU monitors compliance.

6. **Recordkeeping**

- All ESMP modifications are logged in a Change Register maintained by the PIU.
- The updated ESMP is reissued with a version number and date, and shared with relevant stakeholders.

Transparency and Accountability

- All changes to the ESMP will be communicated to affected stakeholders through the Stakeholder Engagement Plan (SEP) mechanisms.

- Where relevant, changes will be summarized in quarterly environmental and social monitoring reports submitted to the World Bank.

8.5. ESMP Roles and Responsibilities

The successful implementation of the ESMP depends on the coordinated efforts of several institutions, each with distinct roles and responsibilities. These include entities at the national, regional, and community levels, as well as the contractors and supervisory consultants engaged during project execution. The structure reflects both Somaliland's national legal frameworks and the World Bank's safeguard policies.

1. Ministry of Water Resources Development (MoWRD) – Project Implementation Unit (PIU)

The MoWRD, through its designated Project Implementation Unit (PIU) for the GW4R project, holds overall responsibility for ensuring that the ESMP is effectively implemented throughout the project lifecycle.

Responsibilities:

- Incorporate ESMP requirements into bidding documents and contractor contracts.
- Supervise contractor compliance with environmental, social, health and safety (ESHS) obligations.
- Assign dedicated Environmental and Social Specialists within the PIU to oversee safeguards.
- Coordinate with relevant ministries and local authorities for permitting, inspections, and land-related issues.
- Maintain documentation of monitoring reports, grievance records, and incidents.
- Report ESMP implementation status to the World Bank and the National Environmental Authority.

2. Contractor(s)

The construction contractor selected through competitive procurement will be contractually obligated to implement the ESMP on-site. This includes preparation of a Contractor's Environmental and Social Management Plan (C-ESMP) consistent with the project ESMP.

Responsibilities:

- Implement mitigation measures identified in the ESMP and C-ESMP.
- Maintain daily records of environmental and safety performance.
- Appoint an on-site ESHS Officer responsible for compliance and reporting.
- Train workers on health, safety, environmental, and social protocols.

- Comply with all national laws and permit conditions related to waste, emissions, and labor.

3. Supervision Consultant (or Independent Engineer)

If a supervising engineering consultant is engaged, they will play a critical role in monitoring contractor performance with respect to ESMP implementation.

Responsibilities:

- Conduct regular site inspections and verify contractor compliance.
- Support the PIU in issuing non-compliance notices and corrective action plans.
- Review and approve contractor reports, including C-ESMP updates and health & safety logs.
- Document and escalate any environmental or social incidents.

4. Ministry of Environment and Climate Change (MoECC)

The MoECC is the national regulatory authority responsible for environmental compliance and permitting. It also plays a key role in external monitoring.

Responsibilities:

- Review and approve the ESIA and ESMP documents.
- Issue the Environmental Clearance Certificate (ECC).
- Conduct periodic inspections of project activities for regulatory compliance.
- Participate in public consultations and respond to grievances when applicable.
- Collaborate with the MoWRD PIU in monitoring high-risk environmental aspects.

5. Local Government (Togdheer Regional Administration and Burao District Authorities)

Local authorities serve as key facilitators and liaisons between the community and project implementers.

Responsibilities:

- Facilitate access to land, local permits, and security coordination.

- Participate in site inspections and stakeholder engagement events.
- Support resolution of local grievances and social conflicts.
- Coordinate with Village Development Committees on community issues.

6. Community Institutions and Village Development Committees (VDCs)

Community participation is essential for long-term sustainability and social acceptance of the project.

Responsibilities:

- Support local monitoring of environmental and social impacts (e.g., waste disposal, influx, safety).
- Participate in grievance resolution at the community level.
- Mobilize community members for awareness-raising and participatory planning activities.
- Communicate concerns to the PIU via the project's Grievance Redress Mechanism (GRM).

7. World Bank

As the project financier, the World Bank provides oversight to ensure compliance with the Environmental and Social Framework (ESF).

Responsibilities:

- Review and clear the ESIA/ESMP and associated safeguard instruments.
- Conduct supervision missions and desk reviews of implementation progress.
- Provide technical guidance on corrective actions and capacity building.
- Monitor high-risk incidents and responses, particularly those involving ESS2 (Labor), ESS4 (Community Health and Safety), and ESS10 (Stakeholder Engagement).

E&S Experts

Below is a detailed description of the Environmental and Social (E&S) experts who should be stationed at the borehole project site during the site preparation and drilling phases.

1. Environmental Safeguards Officer (Site-Based)

Role & Responsibilities:

- Oversee daily implementation of environmental mitigation measures outlined in the ESMP and C-ESMP.
- Monitor and document key environmental parameters, including:
    - Waste generation and disposal (e.g., drilling mud, cuttings, fuel/oil containers),
    - Dust and noise levels,
    - Erosion and sediment control,
    - Spill prevention and response.
    - Ensure compliance with national environmental regulations and site-specific conditions in the Environmental Clearance Certificate.
    - Maintain the site's Environmental Monitoring Logbook with records of inspections, non-compliance, and corrective actions.
    - Coordinate environmental incident reporting to the PIU and Ministry of Environment and Climate Change (MoECC).
    - Supervise environmental induction training for contractor personnel.

Qualifications:

While the specific qualifications will be determined by the PIU, the following are generally expected:

- Minimum Bachelor's degree in Environmental Science, Environmental Engineering, or related field.
- At least 5 years of experience in construction-related environmental supervision, preferably with donor-funded projects.
- Demonstrated knowledge of ESMP implementation, waste handling, and water protection in arid or semi-arid contexts.
- Familiarity with World Bank Environmental and Social Standards, particularly ESS1 and ESS3.

2. Social Safeguards Officer (Site-Based)

Role & Responsibilities:

- Monitor and manage social risks and community interactions at the project site.
- Ensure implementation of social mitigation measures related to:
    - Labor and working conditions (ESS2),
    - Community health and safety (ESS4),
    - Gender-based violence (GBV) and SEA/SH risk mitigation (ESS4/ESS10),
    - Stakeholder engagement and grievance redress (ESS10).
- Serve as the primary point of contact for community liaison, grievance intake, and resolution coordination.
- Ensure compliance with Labor Management Procedures, including worker code of conduct enforcement.
- Lead daily briefings and toolbox talks on GBV, cultural sensitivity, and safety protocol for both local and external workers.

Qualifications:

- Minimum Bachelor's degree in Sociology, Social Work, Community Development, or a related field.
- At least 5 years of field-based experience in social safeguards implementation or community development.
- Proven ability to work in culturally sensitive settings with pastoral and rural communities.
- Knowledge of World Bank ESS2, ESS4, and ESS10, including grievance mechanisms and SEA/SH protocols.

3. Optional (Recommended): Gender or SEA/SH Focal Point

The Social Safeguards Officer may also serve as the Gender Focal Point.

Role:

- Conduct awareness sessions on GBV and SEA/SH.
- Act as a confidential reporting contact for community members and workers.
- Coordinate survivor referrals through the project's GBV service provider network.

Qualifications:

- Background in gender studies, public health, or social work.
- Experience in community-based GBV programming or case management preferred.

Staffing and Logistics Notes:

- These staff may be contracted by the contractor (with PIU approval) or directly embedded within the supervising consultant's team.
- They must be present full-time during the site preparation and drilling period, with reporting lines to both the Contractor's Site Manager and the PIU E&S Specialists.
- All must complete induction training on the project's ESMP, GRM, and World Bank safeguard requirements before mobilization.

Table 27 ESMP

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
ESS 1: Assessment and Management						
Environmental and social risks and impacts must be fully evaluated and accounted for	• Preparation of this ESIA Report; • Stakeholder engagement to understand and capture the potential social and environment risks and impacts, including community concerns • Site visits to both the village and project area • Engineering design takes into account potential E&S impacts, to avoid when possible and mitigate when avoidance is not possible	• ESIA Report cleared by WB • Documentation of E&S tools (E&S checklist, etc) • Records of stakeholder engagement • Photographs of site visits • CIR and other engineering reports	As necessary	PIU	PIU	TBD
ESS 2: Labor and Working Conditions						
OHS Risks	• All workers operating or working near heavy machinery (e.g., drilling rigs, trucks, cranes) must undergo certified health and safety training before starting work. • Only certified and experienced operators should be permitted to use machinery and power tools. • Secure tools, pipes, and materials at elevation. Use tool lanyards or restraints when working at height. • Enforce the use of appropriate PPE, including hard hats, steel-toed boots, and gloves on all construction sites. Provide and enforce the use of gloves, goggles, overalls, and respirators when handling hazardous substances or materials that generate fine particles.	• Safety risk assessment and management plan and implementation record • Training of workers on OHS including safe handling of equipment, traffic safety, security measures and use of PPEs • Toolbox meetings reinforce key safety protocols • All incidents recorded • PPE issuance register • Monitoring reports	Daily by the contractor site supervisor/ Weekly visits from PIU	Contractor/PIU	Contractor/PIU	TBD

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	• Store all lubricants, fuel, and chemicals in designated, ventilated, bunded areas with secondary containment. • Implement shift rotation and mandatory rest breaks, especially during the hottest hours (11:00 a.m. to 3:00 p.m.) • Ensure constant access to clean drinking water and encourage hydration breaks.	• Pictures of posters displayed				
Traffic accidents cause injury or death of workers	• All drivers undergo safe driving checks. • Traffic safety protocols are closely adhered to.	• Checks on drivers' documentation (qualifications and driving licenses) • Traffic safety awareness raising and monitoring are documented.	Monthly	Contractor/PIU	Contractor/PIU	No additional cost
Risks of child and forced labour	• Strict age verification process and documentation for all workers • Ensure that all contracts have contractual provisions to comply with the minimum age requirements including penalties for non-compliance • Include minimum age (18 years) in procurement documents. • Raise awareness on child protection with contractors and in the communities. • Posters prohibiting child labor at all sites	• Labor register showing age and sex of persons engaged • Worker's GRM in place • Provisions in the contracts • Records of awareness sessions • Pictures of posters displayed	Monthly	PIU	PIU	No additional cost

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
Labor and Working Conditions	• Require all contractors and subcontractors to sign and comply with a Labor Management Procedure (LMP) aligned with national laws and World Bank ESS2. • Ensure that all workers—skilled and unskilled—receive at least the national minimum wage, with equal pay for equal work and no wage discrimination based on gender, clan, or status. • Provide workers with written contracts in Somali, clearly stating wages, work hours, job duties, duration of employment, and grievance procedures. • Enforce limits on working hours, rest breaks, and provide access to paid sick leave and weekly rest, in line with Somaliland labor regulations. • Establish and enforce procedures to verify the minimum age of all workers (typically 18 years) before employment. Require identity documents at hiring. • Include explicit anti-child labor clauses in all contracts, and conduct spot checks on subcontractor laborers. • Make first-aid kits available on-site and train workers in basic health and safety. Link to a nearby health clinic for emergencies. • All employees should sign a code of conduct addressing behavior	• Records of workers and recruitment processes and criteria. • All employment related grievances and resolution times are logged.	Monthly	Contractor/PIU	PIU	No additional cost

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	expectations, health and safety, GBV/SEA/SH prevention, and respect for community norms. • There is a confidential, accessible grievance mechanism for workers to raise concerns about wages, conditions, discrimination, or misconduct. • Ensure that grievances are investigated promptly and resolved within a set timeframe. • Communicate the grievance procedure during worker onboarding and display it at the worksite in Somali.					
Workers are not observing safety requirements	• Sensitize workers on importance of adherence to site safety protocols • All workers sign a code of conduct including responsibilities and rights regarding GBV, Grievances, observing OHS and security protocols etc.	• Proper records of all signed forms • Training records	Daily by the contractor site supervisor/ Weekly visits from PIU	Contractor/PIU	Contractor/PIU	No additional cost
ESS 3: Resource Efficiency and Pollution Prevention Management						
Potential soil contamination	• Store fuel, oil, and lubricants in clearly marked, bunded areas with impermeable flooring. • Refuel and maintain machinery only in designated containment zones. • Equip construction sites with spill kits (absorbent materials, gloves, disposal bags). • Train all workers in spill prevention, containment, and clean-up procedures.	• Proper records of oil & lubricant change and disposal	Monthly	Contractor	Contractor/PIU	TBD

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	• Collect used oils, lubricants, and filters in sealed containers and dispose of them through approved handlers or in lined pits approved by MoECC. • Prohibit dumping of any liquids or waste on bare soil.					
Impacts of waste generation (drilling mud and cuttings, packaging waste, oil and fuel waste)	• Construct lined waste pits or other disposal area at the drilling site to collect and contain drilling mud and cuttings. Ensure these are at least 50 meters from the borehole. • Prohibit the dumping of drilling fluids directly onto the ground. • After drilling, backfill and seal waste pits to prevent seepage or accidental reuse. • Coordinate with MoECC or local authorities for any required permits or inspections of waste handling procedures. • Deliver training to workers on proper sorting and disposal procedures. • Ensure regular waste collection and transport to approved local waste disposal or recycling facilities. • Reuse wooden pallets and crates where possible; otherwise, dispose of them through approved channels or offer them for local repurposing. • Prevent wind-blown litter by using covered bins or containers at all work areas.	• Waste management plan • Records of amount of solid waste re-used, recycled, and disposed of	Monthly	Contractor	Contractor/PIU	TBD

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	• Designate a fuel handling and equipment maintenance zone, at least 100 meters from the borehole, with a concrete or impermeable surface and bunding (containment walls). • Store oil, lubricants, and fuel in labeled, leak-proof containers, in shaded and ventilated locations with secondary containment (bunds or trays). • Use drip trays under generators and fuel-dispensing areas to catch accidental leaks. • Collect used oil and lubricants in sealed, labeled drums and store them in a covered hazardous waste area until collected by approved waste handlers. • Train all staff in spill response procedures, and keep spill response kits (absorbent pads, gloves, disposal bags) at fuel handling locations					

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
Impacts on water quality (contamination from chemicals, improper well casing, wastewater and livestock contamination)	• Use non-toxic or biodegradable drilling fluids whenever possible. • Store all chemicals, fuels, and lubricants in bunded, covered areas with impermeable surfaces, away from the borehole site. • Avoid surface discharge of drilling fluids—dispose of them in lined waste pits or other method approved by MoECC. • Use high-quality, corrosion-resistant casing materials that meet national and international borehole standards. • There will be pressure and integrity testing of casing and sealing before final commissioning. • Avoid over-pumping, which can draw saline water into freshwater zones—follow extraction limits based on aquifer tests. • Construct drainage channels around the water kiosk and livestock troughs to divert runoff to lined soak pits or gravel infiltration beds. • The livestock and human water access points have been designed to be 80 meters apart, with fencing to avoid co-use and crowding. • Rotate livestock access to prevent overuse of any single trough area; consider vegetation buffer zones.	• Waste management plan • Records of amount of solid waste re-used, recycled, and disposed of	Monthly	Contractor	Contractor/PIU	TBD

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
Impact on air quality (dust and noise)	• Spray water on unpaved access roads, drill pads, and cleared areas at least twice per day during dry, windy periods. • Store drilling cuttings, sand, gravel, and other materials under tarpaulins or shade netting to prevent wind dispersion. • Limit vehicle speeds on-site and along access roads to a maximum of 20 km/h to reduce dust emissions. • Provide masks or respirators to all workers exposed to dust and conduct regular training on respiratory protection. • Restrict high-noise activities (e.g., drilling, hammering, generator operation) to daylight hours (e.g., 7:00 a.m.–6:00 p.m.) to avoid nighttime disturbance. • Provide ear protection (earplugs or earmuffs) to workers near high-decibel equipment and rotate tasks to limit prolonged exposure.	• Number of sound machinery and equipment • Frequency of watering of surfaces to reduce dust • Frequency & maintenance plan	Monthly	Contractor	Contractor/PIU	No additional cost
Resource Depletion (declining water table and reduced aquifer recharge)	• Set an extraction rate based on hydrogeological test results to ensure it remains below the estimated sustainable yield of the Yesomma Sandstone aquifer. • If possible, equip the borehole with a calibrated flow meter to monitor daily water abstraction in real-time. • If possible, conduct monthly or quarterly measurements of static	• Flow meter readings and static water readings • GM complaints related to water levels	Monthly	PIU	PIU	TBD

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	water levels to detect drawdown trends. • Implement fixed operating hours for the pump, aligned with seasonal demand and recharge patterns. • The WUC, VDC or other appointed entity should clearly define and communicate allowable volumes for different user groups (e.g., households, livestock, institutional). • Strengthen the WUC with fair representation of vulnerable and mobile groups and train them on water equity principles. • Set up a system to flag low water levels or signs of pressure from users in nearby zones, with protocols to reduce pumping if needed. • If possible, combine well metering with groundwater monitoring to ensure that withdrawals remain within safe yield limits. • Track changes in grazing areas and vegetation health, using visual assessments or drone mapping if feasible. • Use flexible or reinforced materials for surface infrastructure (e.g., tank stands, pipe joints) in case of minor subsidence. • Implement rotational grazing and limit livestock congregation near the borehole to avoid localized land degradation.					
ESS 4: Community Health and Safety						

<table>
<tr><th rowspan="2">E&S Risks and Impacts</th><th rowspan="2">Mitigation Measures</th><th rowspan="2">Monitoring Indicators</th><th rowspan="2">Monitoring Frequency</th><th colspan="2">Responsibility</th><th rowspan="2">Cost</th></tr>
<tr><th>Mitigation</th><th>Monitoring</th></tr>
<tr><td>Conflict over water usage</td><td>• Ensure the WUC includes fair representation from:
  ○ Settled residents
  ○ Pastoralists (including seasonal migrants)
  ○ Women
  ○ Marginalized clans or groups
• Develop and publicly share agreed water access guidelines, including:
  ○ Time-of-day schedules for different user groups
  ○ Livestock versus household usage allocation
  ○ Rotation schedules for pastoralist groups
• Equip the WUC with training on mediation and dispute resolution, supported by traditional elders and local authorities.
• Develop flexible arrangements for seasonal or emergency access by mobile groups, balanced against local needs and sustainability limits.
• The project design has designated specific areas for livestock watering that are separated from human water access points.
• Encourage herders to access veterinary checks before using communal troughs during high-risk periods.
• Periodically clean and disinfect troughs to prevent disease transmission.</td><td>• GM complaints related to water usage
• Documentation of trainings to WUC/VDC
• Documentation of any water access guidelines developed</td><td>Monthly</td><td>PIU</td><td>PIU</td><td>TBD</td></tr>
</table>

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	• Inform users about risks of disease spread and the importance of rotational grazing and livestock control. • Allow any community member to submit grievances about water access, favoritism, or disputes through the project's GM.					
Increased GBV/SEAH cases	• Require all contractors and laborers to sign and comply with a code of conduct that explicitly prohibits SEA/SH, GBV, and any form of harassment or discrimination. • Conduct mandatory induction training for all workers on appropriate behavior, local cultural norms, and SEA/SH prevention. • Position water kiosks and troughs in visible, well-used public areas with adequate lighting (if nighttime use is expected). • The village has stated that at least 30% of Water User Committee (WUC) members will be women. • There were women-only consultation meetings during stakeholder engagement to capture concerns that may not be voiced in mixed settings. • Enforce policies requiring equal pay for equal work and zero tolerance for discrimination in hiring or task assignments. • The project GM has a confidential and survivor-centered SEA/SH	• Audit report in place • Records in place	Monthly	Contractor / PIU/ SPTs/ MDAs	PIU	No additional cost

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	reporting system, ensuring anonymity, appropriate referral services, and non-retaliation guarantees.					
Health and safety risks from an influx of workers	• Prioritize local hiring to reduce the influx of outside workers and minimize the potential for social disruption. • There will be a code of conduct for all workers, covering behavioral expectations, including respect for local cultures, gender equality, and avoiding alcohol or substance abuse. • A GM has been established for the community to report any security or behavioral concerns related to workers.	• GM complaints related to workers • Number of security or other incidents reported	Monthly	Contractor	PIU	No additional cost
The transition to a borehole system could change social dynamics; borehole might encourage new settlements, leading to land-use pressures, increased demand for resources, and possible social tensions.	• Form or strengthen the WUC with equitable representation from all clans, genders, youth, elders, and IDPs to reflect traditional and current stakeholders. • Incorporate customary water rights and conflict mediation practices into new water management rules where appropriate, in consultation with elders. • Strengthen conflict prevention measures, such as incorporating rotational access for mobile pastoralist groups and setting rules for resource use in dry vs. wet seasons.	• GM complaints related to the project • Site visits to confirm if there are new settlements • Documentation of any outreach for awareness raising	Monthly	PIU	PIU	No additional cost

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	• Conduct outreach on sustainable borehole usage, livestock rotation, and water conservation, targeting both established and new residents.					
Exposure of community members to physical/biological hazards on the project site (vehicular accidents, stagnant water pools, etc)	• Implement speed limits (e.g., 20 km/h) on unpaved access roads to reduce the risk of accidents. • Design and implement proper drainage systems at the water collection points, especially at kiosks and livestock troughs, to prevent the formation of stagnant water pools that could act as breeding grounds for mosquitoes.	• Records to show community sensitization on safety	Monthly	Contractor	PIU	No additional cost
Breakdowns could leave the borehole unusable; community payment model may not function properly.	• Select pumps, solar components, and piping systems that use non-proprietary, easily sourced parts available in regional markets (e.g., Hargeisa, Berbera). • Provide a simple maintenance manual in Somali and train two or more community members on routine servicing and early fault detection. Basic O&M measures were included in the CIR, for example, which could be translated and used for this purpose. • Develop a clear, transparent community water payment system (e.g., per jerrycan, per household, or livestock-based contributions) that reflects community preferences and ability to pay. • Train the VDC/WUC on basic bookkeeping, transparent	• Documentation of O&M manual • Documentation of a water payment system • Records of training	As necessary	Contractor/PIU	PIU	TBD

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	recordkeeping, and budgeting for preventive and corrective maintenance.					
ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement						
Physical or economic displacement of legal and illegal residents or traders in or around the construction sites	• The PIU has facilitated voluntary, documented agreements for all land areas affected by the project, including pipeline routes, water kiosks, and livestock infrastructure. • All agreements have been negotiated transparently with landowners, elders, women's representatives, and local authorities, in accordance with customary and statutory frameworks and in line with ESS5.The Community Engagement Report, Social Summary Report and voluntary land donation form are provided in Annex 4, 10 and 11 respectively. • The project has been designed to avoid siting infrastructure in areas that may provoke conflict or disrupt essential livelihoods.	• Documentation by social specialist	Monthly	PIU	PIU	No additional cost
Blocked access to people in the area	• Ensure that the local routes, drainage and community access are not blocked by construction. The project has been designed to utilize existing access roads, minimizing disruption to productive land.	• GM complaints related to blocked access	Monthly	Contractor/PIU	PIU	No additional cost
Conflict over land	• Before signing land agreements, consult all owners (private land) or users and residents (community	• Land agreements and certificates. • Records of consultations with	As necessary	PIU	PIU	No additional cost

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	land) and ensure that agreements and certificates are in place. • Ensure that any complaints about land use restrictions or unfair treatment are addressed through the project's grievance mechanism, with attention to marginalized and vulnerable groups. • Include land-related grievances as a specific category in grievance tracking.	land owners and users				
ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources						
Erosion from construction activities	• Limit vegetation clearing strictly to the footprint of the borehole, pipelines, and necessary access roads. • Clearly demarcate construction boundaries to avoid unnecessary site disturbance. • Design and enforce controlled livestock routes and resting areas near troughs to reduce trampling. • Use gravel or concrete bases at watering points to minimize soil damage and erosion. • Install shallow diversion channels or berms around cleared areas to redirect stormwater.	• Record of appropriate measures taken	Monthly	Contractor	Contractor/PIU	No additional cost
Habitat Disturbance (loss of vegetation and disturbance to wildlife)	• Restrict clearing to the exact footprint needed for infrastructure. Avoid clearing buffer zones or grazing areas unnecessarily. • Install fencing or barriers to guide livestock to designated watering	• Record of appropriate measures taken	Monthly	Contractor	Contractor/PIU	No additional cost

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
	points, preventing free roaming and trampling in sensitive zones. • Work with the community to implement seasonal rotation of livestock access around the borehole, allowing vegetation recovery. • Schedule noisy construction activities (e.g., drilling) during daylight hours only. • Avoid nighttime lighting around the borehole. If lighting is necessary for security, use low-intensity, downward-facing, motion-activated lights. • Educate residents and the Water User Committee on the importance of wildlife conservation and how to avoid behaviors that provoke wildlife (e.g., leaving waste or chasing animals).					
ESS8: Cultural Heritage						
Risk of damage to as-yet undiscovered items/areas of cultural significance	• Have a "Chance Find" procedure in place • Train workers to be aware of the potential of a chance find and what to do	• Chance Find Procedure in place	As necessary	Contractor	Contractor	No additional cost
ESS10: Stakeholder Engagement and Information Disclosure						

E&S Risks and Impacts	Mitigation Measures	Monitoring Indicators	Monitoring Frequency	Responsibility		Cost
				Mitigation	Monitoring	
Inadequate, ineffective, and inappropriate stakeholder and community engagements and disclosure of information	• Keep community leaders informed of progress/delays or activities that may impact community. • Conduct regular community consultations as necessary • Consultation to be held in culturally appropriate means and language	• Stakeholder engagement documentation • Records of meetings	Monthly	PIU	PIU	No additional cost
Poor access or low trust in GM	• Poster of GM and contacts always displayed outside project sites. • All complaints are logged and resolved within 7 days • Undertake consultations on the effectiveness of the GM	• Posters and displays in place • Records of consultation meetings	Monthly	PIU	PIU	No additional cost

Reporting Plan

Table 28 Reporting Plan

Report Type	Submitted To	Frequency	Responsible Entity
Environmental and Social Compliance Report	WB, MoECC, PIU	Quarterly	PIU Environmental Specialist
Water Quality and Usage Report	MoWRD, Water User Committee	Biannual	MoWRD, Local Authorities
Community Health and Safety Report	Health Ministry, Local Authorities	Quarterly	PIU Social Specialist
Labor Conditions and GBV Prevention Report	PIU, World Bank	Annually	PIU Social and Gender Specialists
Grievance Redress Mechanism (GRM) Report	PIU, Community Leaders	Continuous	PIU, Water User Committee

Contractor Requirements

To ensure compliance with Somaliland national law and World Bank Environmental and Social Framework (ESF) standards, the appointed contractor for the deep borehole development project will be required to meet comprehensive Environmental, Social, Health, and Safety (ESHS) obligations. These requirements will be clearly defined in the Request for Proposals (RFP) and will form a core component of the contract. They aim to ensure environmentally and socially responsible project implementation and safeguard the health, safety, and rights of both workers and local communities.

General Compliance Obligations

All contractors must operate in full compliance with applicable national legislation, including the Somaliland Environmental Management Law No. 79/2018, the Solid Waste Management Act, and the Private Sector Employment Law. Equally, they are expected to align with the World Bank's Environmental and Social Standards, particularly ESS1 (Assessment and Management of Environmental and Social Risks and Impacts), ESS2 (Labor and Working Conditions), ESS3 (Resource Efficiency and Pollution Prevention), ESS4 (Community Health and Safety), and ESS10 (Stakeholder Engagement).

Contractors will be contractually obligated to implement the mitigation measures defined in the project's Environmental and Social Management Plan (ESMP), including those specific to each borehole site.

Construction Environmental and Social Management Plan (C-ESMP)

A key requirement is the development of a **Construction Environmental and Social Management Plan (C-ESMP)**. This plan must operationalize the ESMP provisions and tailor them to the contractor's scope of work. It must be submitted to the

Project Implementation Unit (PIU) prior to site mobilization and approved by the project's Environmental and Social Safeguards Specialists.

The C-ESMP shall include, at minimum:

- A site-specific mitigation plan covering all environmental and social risks;
- A waste management plan detailing the handling, storage, and disposal of drilling mud, rock cuttings, oils, domestic refuse, and hazardous substances;
- Measures for dust suppression, noise control, erosion prevention, and spill response;
- Water abstraction plans, identifying sources and usage volumes;
- Site layout maps indicating fencing, waste pits, access roads, and environmental features.

The plan must also include a strategy for minimizing community impacts, such as maintaining safe distances between drilling operations and settlements or sensitive areas, and implementing buffer zones to reduce environmental disturbance.

Health and Safety Plan

The contractor must prepare a detailed Occupational Health and Safety Plan as part of the C-ESMP. This plan must conform to both Somaliland labor law and the World Bank Group Environmental, Health, and Safety Guidelines. It must include the following core elements:

- Identification and mitigation of job-site hazards;
- Mandatory use of personal protective equipment (PPE);
- Emergency response procedures, including on-site first aid and evacuation protocols;
- Worker training in safety procedures and environmental awareness;
- Specific provisions for managing community safety risks, such as securing open pits, posting warning signage, and restricting unauthorized access.

Particular attention must be paid to preventing communicable disease transmission and ensuring hygienic conditions at worker camps or staging areas.

Labor and Employment Standards

All labor practices must conform to the project's Labor Management Procedures (LMP). The contractor must provide workers with formal contracts, maintain accurate employment records, and ensure equal opportunity in recruitment and pay.

A Workers' Code of Conduct must be developed, covering core principles such as:

- Prohibition of child labor and forced labor;
- Prevention of sexual exploitation, abuse, and harassment (SEA/SH);
- Respect for community customs and norms;
- Prohibition of discrimination and promotion of respectful workplace behavior.

Workers must be informed of and have access to a grievance redress mechanism (GRM) that allows confidential reporting and timely resolution of employment-related concerns.

Training and Capacity Building

The contractor is responsible for training all workers and subcontractors on environmental and social safeguards, occupational health and safety, and the community interaction protocols established for the project. This includes:

- Pre-employment induction sessions;
- Toolbox talks and periodic refresher trainings;
- Specialized training for high-risk tasks (e.g., handling drilling chemicals or operating generators).

Contractors are expected to cooperate with the PIU's monitoring and safeguards teams to verify training quality and participation.

Monitoring, Reporting, and Accountability

Each contractor must assign a qualified ESHS Officer to oversee compliance at the site level. Monthly progress reports are to be submitted to the PIU and should include:

- Waste handling records and disposal logs;
- Health and safety statistics (e.g., incidents, near misses, injuries);
- Labor force composition and grievances filed;
- Summary of community interactions and stakeholder engagement activities.

Contractors must allow the PIU, the Ministry of Environment and Climate Change (MoECC), and World Bank representatives full access to project sites for the purposes of inspections, audits, and spot-checks. Any non-compliance will result in the issuance of corrective action requests and, if necessary, enforcement actions such as payment withholding, penalties, or contract suspension.

RFP and Contractual Clauses

The RFP and the subsequent works contract shall contain legally binding provisions requiring full adherence to ESHS performance standards. These include:

- Submission and implementation of a compliant C-ESMP and Occupational Health and Safety Plan;
- Inclusion of ESHS conditions in all subcontracts;
- Measurable performance indicators for environmental and social compliance;
- Clear enforcement provisions for breaches of ESHS obligations, including potential contract termination.

Capacity Building Program

The capacity-building program for the project is designed to enhance the skills, knowledge, and institutional capacity of key stakeholders to ensure sustainable water management, environmental compliance, and social safeguards. The program targets a wide range of participants, including the Water User Committee, local government authorities, borehole operators, contractors, and community members, ensuring that all relevant groups are equipped to effectively manage the borehole and associated infrastructure. Training will focus on technical skills for borehole operation and maintenance, environmental and social safeguard implementation, and governance structures to promote equitable water distribution.

A major component of the capacity-building initiative is technical training for borehole operators and local technicians, provided by the MoWRD and private sector experts. This training covers pump operation, routine maintenance, water quality testing, and emergency repair protocols, ensuring that the borehole remains functional and efficiently managed in the long term. Additionally, water quality monitoring training should be provided to the Water User Committee, enabling them to conduct regular water sampling, detect contamination early, and implement corrective actions to maintain safe drinking water standards.

Beyond technical skills, the program also includes social and governance training to build local leadership in water resource management. The Water User Committee and community elders should receive training on conflict resolution, transparent financial management of user fees, and inclusive decision-making to ensure equitable water access for women, pastoralists, and vulnerable groups. To address gender-based violence (GBV) and sexual exploitation and abuse (SEA/SH) risks, all construction workers, contractors, and community leaders must undergo training on gender-sensitive approaches, grievance redress mechanisms, and the enforcement of a strict Code of Conduct. These capacity-building efforts will empower the community to take ownership of the borehole, improve resilience against water scarcity, and ensure the long-term success of the project.

Table 29 Capacity Building Program

Training Topic	Participants	Trainer	Schedule
Water Quality Monitoring and Management	Water User Committee, MoWRD staff	MoECC, PIU	Before operation
Borehole Maintenance and Pump Management	Borehole Operators, Local Technicians	MoWRD, Private Contractors	Post-construction
Health and Safety for Workers	Contractors, PIU staff	Labor Department, NGOs	Pre-construction
Conflict Resolution and Water Governance	Water User Committee, Community Elders	Local Authorities, NGOs	Post-construction
SEA/SH and GBV Prevention	Construction Workers, Community Leaders	Gender Specialists, NGOs	Pre-construction

9. GRIEVANCE REDRESS MECHANISM

9.1. Objectives

A Grievance Redress Mechanism (GRM) is a vital tool for ensuring accountability, transparency, and conflict resolution in the project. It provides an accessible and structured process for community members, workers, and other stakeholders to raise concerns, seek redress, and resolve disputes related to environmental, social, or labor issues. A well-functioning grievance mechanism enhances community trust, project sustainability, and compliance with World Bank ESS10 on stakeholder engagement. For more information on the project's GM, please see the Project Operational Manual (POM) and Environmental and Social Management Framework (ESMF).

The primary objectives of the grievance mechanism are:

Ensure Transparent and Fair Conflict Resolution: The GM provides a formal, unbiased process for addressing community concerns, ensuring that complaints are handled promptly, fairly, and equitably.

Promote Community Participation and Trust: By providing a safe and open channel for feedback, the GM helps strengthen relationships between the project team and the local population, reducing potential tensions.

Mitigate Project-Related Social and Environmental Risks: The mechanism allows for early identification of disputes or grievances, enabling the project team to resolve issues before they escalate into conflicts.

Protect Vulnerable Groups and Prevent Retaliation: The GM ensures that all community members, including women, youth, and marginalized groups, can voice concerns without fear of intimidation or retaliation.

Support Compliance with International and National Standards: The grievance mechanism aligns with Somaliland's legal framework and World Bank safeguards, ensuring that complaints related to land acquisition, labor rights, gender-based violence (GBV), or environmental damage are addressed in line with global best practices.

Improve Project Accountability and Learning: By documenting and analyzing grievance trends, the GM provides valuable insights into recurring issues, allowing for continuous improvement in project implementation and governance.

A well-structured grievance mechanism contributes to greater project acceptance, social stability, and long-term success, ensuring that local communities remain engaged and benefit equitably from the borehole project.

9.2. Alignment with GW4R GRM

The Grievance Redress Mechanism (GRM) developed for the GW4R Project provides a structured, transparent, and accessible process through which project stakeholders can raise concerns, complaints, or feedback related to the project's activities. It is aligned with World Bank Environmental and Social Framework (ESF) standards—particularly ESS10 on stakeholder engagement—and supports responsive, equitable project implementation.

The GRM is designed to address a wide range of issues, including:

- Environmental and social impacts,
- Disruption of access to water or land,
- Misconduct by contractors or project staff,
- Gender-based violence (GBV) and Sexual Exploitation, Abuse, and Harassment (SEAH),
- Labor and working conditions.

The GRM operates at three levels: community (village), state (FMS), and federal (FGS). Complaints may be submitted through multiple channels, including:

- **A 24-hour toll-free number (9992)**,
- **Designated email addresses** for general and GBV-specific grievances,
- **In-person reporting** via village focal points, Village Development Committees (VDCs), or contractor representatives,
- **Suggestion boxes** and verbal reporting during community meetings.

Confidentiality is prioritized—especially in GBV cases—and grievances are logged, investigated, and resolved within clear timeframes: acknowledgment within 7 days, and resolution where feasible within 21 days. Unresolved or serious complaints are escalated to higher levels and, if necessary, shared with the World Bank for further action.

Extension of the GRM to the Borehole Project

For the borehole sub-project, the existing GRM structure will be fully applied and reinforced at the local level. The borehole project may trigger concerns related to land access, water sharing, labor practices, or the influx of people—thus necessitating a localized yet connected grievance system.

Key adaptation measures include:

- **Appointing a dedicated GRM focal point at the borehole site**, either through the Village Development Committee or project staff. This individual will receive and document complaints using the national Kobo-based digital platform or paper forms.
- **Training contractor personnel and site supervisors** on how to recognize, document, and refer grievances, especially those related to health and safety, construction impacts, or labor issues.
- **Disseminating GRM information at the site** through posters, oral announcements, and community meetings to ensure accessibility by illiterate or nomadic populations.

- **Ensuring survivors of GBV or SEAH have safe, confidential referral pathways**, with links to trained GBV focal points at state and federal levels.
- **Tracking all grievances from the borehole site through the national GRM database**, ensuring follow-up, resolution, and reporting are consistent with the broader project requirements.

By embedding the GRM into the operational framework of the borehole project, stakeholders will have a reliable avenue to raise concerns, enabling the Project Implementation Unit (PIU) to manage risks proactively, resolve tensions early, and reinforce community trust and accountability.

9.3. Structure and Process

The grievance mechanism provides a structured, accessible, and transparent process for community members, workers, and stakeholders to raise concerns and seek redress. The system will ensure confidentiality, fairness, and timely resolution while aligning with the project's standards.

Grievance Submission Process

Multiple Channels for Submitting Complaints:

- In-person submissions to the Village Water Committee (VWC), grievance focal points, or local authorities.
- Anonymous complaints via suggestion boxes placed at community gathering points, including the mosque, school, and health center.
- Phone or SMS submissions through a dedicated grievance hotline.
- Meetings or outreach sessions where grievances can be raised verbally and recorded by grievance officers.

Types of Grievances Handled:

- Water access disputes (e.g., complaints about unfair water distribution or overuse by certain groups).
- Environmental concerns (e.g., pollution, over-extraction, improper drilling waste disposal).
- Health and safety issues (e.g., workplace hazards, sanitation concerns).
- Labor and working conditions (e.g., unfair wages, child labor risks, lack of protective equipment).
- Gender-based violence (GBV), SEA/SH complaints, or discrimination issues, handled with survivor-centered protocols.

Steps from Complaint Submission to Resolution

Table 30 Steps in Grievance Mechanism

Step	Action	Responsible Party	Timeframe
Step 1: Complaint Submission	The grievance is received through one of the available channels. The complainant receives an	Village Water Committee (VWC), Project Grievance Officer	Within 3 days of receipt

Step	Action	Responsible Party	Timeframe
	acknowledgment receipt (unless the complaint is anonymous).		
Step 2: Initial Review and Categorization	The grievance is reviewed and categorized as either low, moderate, or high risk. Urgent cases (e.g., GBV, SEA/SH) are immediately escalated.	Project Grievance Officer, PIU Social Specialist	Within 5 days of submission
Step 3: Investigation and Resolution Proposal	The case is investigated, and resolution options are developed in consultation with the relevant parties.	VWC for local disputes, District Committee for escalations, PIU for high-level issues	Within 10–14 days
Step 4: Decision and Resolution	The complainant is informed of the resolution and given the opportunity to appeal if dissatisfied.	VWC (for local cases), PIU (for appeals)	Within 20 days
Step 5: Appeal Mechanism	If the complainant is not satisfied, they can escalate the case to the District Water Committee or PIU for further review.	District Water Committee, PIU, MoWRD	Within 30 days
Step 6: Closure and Documentation	The grievance is closed, and all actions taken are recorded in a grievance log/database.	Grievance Officer, PIU Social Specialist	Ongoing

Confidentiality and Survivor-Centered Protocols for GBV, SEA/SH Cases

- GBV, SEA/SH, and child exploitation cases will be handled separately from other grievances to ensure survivor safety and confidentiality.
- Dedicated female grievance focal points will be assigned to handle SEA/SH-related complaints sensitively and privately.
- Survivors will have access to legal, medical, and psychosocial support services, as per established referral pathways.
- Complaints can be submitted anonymously, with no requirement for survivors to face perpetrators or provide excessive personal details.
- Strict non-retaliation policies will be enforced to protect complainants from intimidation or harm.

Grievance Tracking, Logging, and Reporting

All grievances will be recorded in a centralized grievance log or database to ensure proper documentation, tracking, and resolution of complaints. Each grievance entry will include details such as the complaint description, date of submission, acknowledgment receipt, assigned resolution level, actions taken, and final resolution status. Sensitive cases, particularly those related to gender-based violence (GBV), sexual exploitation and abuse (SEA/SH), and child protection, will be anonymized to maintain confidentiality and safeguard the identity of the complainant. Regular grievance reviews will be conducted to identify trends, assess the effectiveness of the resolution process, and address any systemic issues within the project.

Monthly reports summarizing grievance activity, including the number of complaints received, types of grievances, resolution rates, and pending cases, will be submitted to the PIU, MoECC, and MoWRD. To maintain transparency and accountability, a summary of grievance trends and resolution progress should be shared with community stakeholders during quarterly engagement meetings. Additionally, ongoing monitoring and evaluation of the grievance mechanism will ensure that it remains efficient, accessible, and responsive to community needs.

9.4. Awareness and Disclosure of the Grievance Mechanism

Ensuring that the community is fully aware of the grievance mechanism (GM) is essential for its effectiveness. Awareness and disclosure efforts will focus on making the GM accessible, culturally appropriate, and widely understood by all stakeholders, including women, youth, and marginalized groups. Outreach will be conducted using multiple communication channels to ensure that all community members, regardless of literacy level or access to technology, can understand how to submit complaints and seek resolution.

Community Awareness Strategies

Posters and Notices at Public Locations: Informational posters should be displayed at water kiosks, livestock watering troughs, village meeting areas, health centers, schools, and mosques. These posters should provide simple, clear instructions on how to submit grievances, the contact details of grievance focal points, and the process for resolving complaints. Posters will be designed with visual symbols and illustrations to ensure accessibility for those with low literacy levels.

Radio Announcements and Loudspeaker Broadcasts: Regular radio announcements should be made on local stations in Somali and other relevant languages to explain the purpose, process, and accessibility of the GM. Announcements should be scheduled during high-listenership hours, particularly before or after community prayers. Additionally, loudspeaker broadcasts should be conducted in weekly village markets or during community meetings to reach mobile pastoralists and other hard-to-reach populations.

Village Meetings and Sensitization Sessions: The Village Water Committee (VWC) and community elders should host public meetings to explain how the GM works, ensuring that residents understand their rights and the process for submitting complaints. These meetings must be conducted in a culturally appropriate manner, allowing for questions, discussion, and clarification.

Engagement with Women and Vulnerable Groups: Specific focus group discussions (FGDs) with women’s groups, youth, and displaced persons should be conducted to ensure that marginalized groups understand their rights to report grievances, including sensitive cases related to gender-based violence (GBV) or discrimination. Special emphasis will be placed on confidentiality protections for survivors of GBV and SEA/SH complaints.

Training of Local Focal Points: Grievance focal points, including members of the Village Water Committee, local leaders, and women's representatives, should be trained in recording, handling, and referring grievances in a professional and confidential manner. These individuals will serve as community liaisons, ensuring that grievances are collected and forwarded properly.

Printed Materials in Local Languages: Flyers and leaflets explaining the grievance process, contact details, and confidentiality protections should be distributed at key community locations. These materials will be translated into Somali and any other locally spoken languages, ensuring wider comprehension.

Ensuring Accessibility and Cultural Sensitivity

- Anonymous reporting options should be made available through suggestion boxes at water points and village centers to protect individuals who fear retaliation.
- Multiple reporting channels (verbal, written, phone-based) should be provided to accommodate different literacy levels and communication preferences.
- Gender-sensitive communication will be prioritized by ensuring that grievance information is shared through trusted female representatives and that survivors of GBV and SEA/SH have access to confidential and safe reporting mechanisms.

Ongoing Engagement and Feedback

Community engagement on the GM will be an ongoing process, not just a one-time activity. Quarterly review meetings will be held with village elders, the Water User Committee, and local government authorities to assess whether the community is aware of the GM and if any modifications are needed. Periodic surveys and feedback sessions will also be conducted to evaluate whether stakeholders feel comfortable using the mechanism and whether it is effectively addressing grievances.

Through effective communication, accessible reporting options, and culturally appropriate outreach, the grievance mechanism will be fully integrated into the community's water governance structure, ensuring fair, transparent, and timely resolution of complaints.

10. CONCLUSION AND RECOMMENDATIONS

The deep borehole project in Cali Ciise is environmentally and socially feasible, provided that the proposed mitigation measures and Environmental and Social Management Plan (ESMP) are fully implemented. The project will significantly improve water availability for households, livestock, and small-scale irrigation, enhancing public health, economic stability, and resilience to climate variability. However, it also presents risks related to groundwater sustainability, rangeland degradation, land and water access conflicts, and social impacts, which must be effectively managed through strict environmental safeguards, community engagement, and robust governance mechanisms.

With proper well integrity measures, sustainable pumping limits, erosion control, and wastewater management, the physical environmental risks can be minimized. Social risks, such as land acquisition disputes, gender-based violence concerns, and water-sharing conflicts, can be mitigated through transparent resource governance, grievance mechanisms, and inclusive decision-making processes. The establishment of a Water User Committee, equitable stakeholder participation, and ongoing monitoring will ensure that the borehole remains a sustainable and conflict-free water source for the community.

10.1. Recommendations

To ensure the long-term success of the borehole project, the following key recommendations must be implemented:

Ongoing Stakeholder Engagement and Governance Strengthening:

- Regular engagement with community members, pastoralists, local government, and traditional leaders will be essential for maintaining transparency and fair water distribution.
- The Water User Committee must be fully trained and operational before the borehole becomes active, ensuring equitable management and conflict resolution.

Capacity Building and Training Programs:

- Local borehole operators and technicians should be trained in pump maintenance, water quality monitoring, and sustainable water extraction practices.
- Community members should receive awareness training on sanitation, responsible water use, and grievance redress procedures.
- Contractors and workers must undergo mandatory training on environmental safeguards, occupational health and safety (OHS), and GBV prevention.

Compliance Monitoring and Adaptive Management:

- Groundwater levels should be monitored biannually to prevent over-extraction and aquifer depletion.
- Water quality should be tested quarterly to detect and address any contamination risks.

- The grievance mechanism should be continuously reviewed and improved, ensuring efficient conflict resolution and accessibility for all stakeholders.

By implementing these critical steps before and during project execution, the deep borehole will serve as a long-term, sustainable water resource for the Cali Ciise community, improving livelihoods, reducing vulnerability to drought, and fostering social stability.

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Annex

Annex 1: Summary of BoQ

Below is a summary of the Bill of Quantities (BoQ) for the planned deep borehole at Cali Ciise, based on the Construction Investment Report (CIR) and supplementary project documents. It includes key material quantities, itemized costs (where available), annual operation/maintenance estimates, and the contractor's environmental and social obligations.

Borehole Drilling (US$180,020)

These costs cover all activities needed to drill and case the well to a depth of approximately 450 meters. The table below highlights the main line items. All amounts are in USD.

Table 31 Borehole costs

Item	Unit	Quantity	Rate (USD)	Subtotal (USD)
Mobilization & demobilization of drilling equipment	L.S.	1.0	4,000.00	4,000.00
Drilling by 14" diameter (0–500 m), including service casing	m	450.0	260.00	117,000.00
Sampling (2 m intervals)	No.	225.0	5.00	1,125.00
203 mm blind casing (wall thickness 13.4 mm)	m	270.0	50.00	13,500.00
203 mm screened pipe (slotted 1.0–1.5 mm)	m	180.0	60.00	10,800.00
Centralizers (installed at ±20 m spacing)	unit	22.0	45.00	990.00
1" U-PVC piezometric pipe	m	430.0	1.50	645.00
Gravel pack (3–5 mm)	m^3	65.0	180.00	11,700.00
Inert backfill (above gravel/bentonite seal)	L.S.	1.0	2,000.00	2,000.00
Bentonite/cement sanitary seal	L.S.	1.0	500.00	500.00
Cement grout, protective slab	unit	1.0	560.00	560.00
Steel well cap (8" casing)	unit	1.0	500.00	500.00

Item	Unit	Quantity	Rate (USD)	Subtotal (USD)
Site clearing after drilling, backfilling mud pits, etc.	L.S.	1.0	500.00	500.00
Borehole development (jetting/air lifting)	hr	12.0	450.00	5,400.00
Test pumping (setup, step tests, 48 hr constant discharge)	L.S.	1.0	—	(see below)
– Supply & install equipment		1.0	4,000.00	4,000.00
– Step drawdown test (4 steps)	steps	4.0	500.00	2,000.00
– Constant discharge (48 hr) + recovery	hr	48.0	100.00	4,800.00
Total Drilling Cost				180,020.00

Appurtenant Structures (US$225,803.27)

In addition to drilling, the project includes installing a submersible pump, building water kiosks, troughs, a watchman's house, and a power system (generator and/or solar):

Pumping System: One submersible pump sized for ~5 L/s (including riser pipes, electrical cables, control panel).

Elevated Water Tank: 30 m³ capacity, typically on a steel or concrete tower, to stabilize water flow.

Water Kiosk: Fitted with taps for domestic users. Also includes fittings for a potential RO/UV system if brackish water demands treatment for human consumption.

Livestock Troughs: Constructed roughly 50–80 m from the kiosk to reduce crowding, with a second trough if large herds are expected.

Photovoltaic Array and Diesel Generator: A solar field (costing a substantial portion of the appurtenant structures) plus a backup diesel generator with associated fuel storage. This dual-power approach reduces diesel consumption and ensures steady pump operation.

Additional Items: Watchman/Operator's shelter, perimeter fencing, and minor site works.

Total Capital Expenditure: US$405,823.27

Drilling + Structures = US$ 180,020 + US$ 225,803.27 = **US$ 405,823.27**

Operation and Maintenance (US$41,743/year)

Fuel and Lubricants: Diesel is still used—especially for nighttime pumping or when solar output is insufficient—to run the generator.

Pump Replacements and Repairs: Routine checks on submersible motors, seals, and cables.

Minor Civil Works: Occasional re-plastering of troughs or kiosk, fence repairs, and replacement of worn piping or valves.

Solar Panel Cleaning & Inspection: Panels must be cleaned and monitored at least yearly to maintain efficiency.

Water Quality Testing: Conducted periodically to detect any salinity or contamination issues.

Contractor Environmental, Labor, and Social Requirements

As spelled out in the BoQ for the project, the following are the environmental, labor and social requirements of the contractor.

Environmental Safeguards

Waste Management: Contractors must securely dispose of drilling fluids, cuttings, and packaging. They should also avoid leaks from fuel storage.

Dust and Noise Control: Required during drilling and construction. Water spraying or mufflers may be employed to minimize community disturbances.

Habitat Protection: Minimal vegetation clearing near the well site, especially around acacia stands that provide shade and reduce erosion.

Labor Conditions

Occupational Health and Safety (OHS): Supplying personal protective equipment (PPE), ensuring first-aid kits, hazard signage, and safe working platforms at drilling rigs.

Fair Wages & Working Hours: Aligned with local labor laws and World Bank standards (ESS2).

Onsite Facilities: Basic latrines and rest areas for crew during the drilling phase, plus safe worker accommodations if needed.

Social and Community Engagement

Consultations & Public Disclosure: The contractor must coordinate closely with the Village Development Council regarding drilling schedules, potential disruptions, and site security.

Grievance Mechanism (GM): Ensures that residents can report complaints on dust, noise, or other impacts—requiring timely follow-up by the contractor or the project’s PIU.

Female Participation: Encouraged in water-user committees or maintenance teams to ensure inclusive decision-making.

Other Notable Areas

Quantities of Core Materials

- ~450 m of borehole drilling and casing
- Up to 65 m^3 of gravel pack
- 1–2 tons of cement for sanitary sealing and potential wellhead construction

Testing and Commissioning

- A 48-hour constant-discharge test plus recovery analysis to confirm yield and drawdown.
- Bacteriological and chemical water tests to finalize potability for domestic use.

Capacity-Building Line Items

- Funds for training local operators or committees in routine maintenance, record-keeping, and simple mechanical repairs.

Conclusion

The BoQ for Cali Ciise's borehole project outlines roughly US$ 405,823.27 in capital costs, primarily split between drilling (~US$ 180k) and appurtenant infrastructure (~US$ 226k). Once operational, the system is expected to require US$ 41,743 annually for fuel, repairs, and periodic checks. These figures cover not only tangible items (drilling equipment, pipelines, pumps) but also the contractor's environmental safeguards, labor protections, and social engagement duties.

Annex 2: Borehole Maintenance Plan

The following table provides a structured maintenance schedule for the borehole in Cali Ciise, categorizing regular (preventive) and irregular (corrective) maintenance tasks, along with responsible parties and key actions.

Preventative Maintenance Schedule

Table 32 Regular Maintenance Tasks

Frequency	Maintenance Task	Key Actions	Responsible Party
Daily	General site inspection	Check for leaks, water clarity, and unusual odors. Ensure site cleanliness.	Borehole operator, Water User Committee (WUC)
Weekly	Pump and power source check	Inspect pump operation for unusual noise, vibrations, or reduced output. Clean solar panels and check generator fuel levels.	Borehole operator, WUC
Monthly	Pipe and fitting inspection	Examine pipes, valves, and seals for leaks or wear. Lubricate moving parts in mechanical pumps.	Borehole operator, WUC
Quarterly (Every 3 Months)	Water quality testing	Test for bacteria, pH, nitrates, and turbidity to ensure safe drinking water. Flush and disinfect the distribution system.	Ministry of Water Resources Development (MoWRD), Health Ministry
Biannual (Every 6 Months)	Pump efficiency assessment	Test pump power consumption and motor efficiency. Inspect and clean pump filters and screens.	MoWRD, Borehole Technician
Annual (Once a Year)	Full borehole inspection	Use a downhole camera to check casing integrity. Measure depth and static water level. Service pump motor and replace worn-out components.	MoWRD, External Borehole Specialist

Corrective Maintenance Tasks

Table 33 Irregular Maintenance Tasks

Issue	Corrective Action	Responsible Party
Pump Breakdown	Replace damaged pump impellers, motors, or electrical components. Remove debris clogging pump inlets.	Borehole Technician, WUC
Water Contamination	Shock chlorinate borehole, repair damaged casing, flush and disinfect system.	Health Ministry, MoWRD
Pipe or Valve Failure	Replace leaking or corroded pipes, clear blockages, repair or replace gate valves and check valves.	Borehole Operator, WUC
Structural Damage (Erosion, Land Subsidence)	Stabilize borehole platform, reinforce casing, repair collapsed screens.	MoWRD, Local Authorities
Groundwater Depletion	Monitor and adjust pumping rates, install recharge tracking measures, consider borehole deepening.	MoWRD, WUC

Annex 3: Chance Find Procedure

1. Introduction

This *Chance Find Procedure* was developed Federal Government of Somalia for the proposed Horn of Africa Ground Water for Resilience Project (GW4R) in accordance with the World Bank's ESS8-cultural heritage. A *chance find* is any unanticipated discovery or recognition of cultural heritage. Chance finds occur during the construction phase of a project. Such finds include the discovery of a single artifact, an artifact indicating the presence of a buried archaeological site, human remains, fossilized plant or animal remains or animal tracks, or a natural object or soil feature that appears to indicate the presence of archaeological material. A chance find procedure is included in relevant procurement documents and instructions to contractors. The procedure covers discovery of artifacts in the soil or underwater. A chance find procedure is not a substitute for pre-construction surveys and analyses.

2. Purpose of the chance find procedure

The *Chance Find Procedure* is a project-specific procedure that outlines actions required to prevents chance finds from being disturbed until an assessment by a competent specialist is made and actions consistent with the requirements are implemented.

3. Scope of the chance find procedure

This *chance find procedure* covers the identification, notification, documentation, and management of *chance find* in accordance with national laws and, where applicable, internationally accepted practice. This procedure is applicable to all activities conducted by the personnel, including contractors, that have the potential to uncover a heritage item/site. The procedure details the actions to be taken when a previously unidentified and potential heritage item/site is found during construction activities. Procedure outlines the roles and responsibilities and the response times required from both project staff, and any relevant heritage authority.

4. Induction/Training

All personnel, especially those working on earth movements and excavations, are to be inducted on the identification of potential heritage items/sites and the relevant actions for them with regards to this procedure during the Project induction and regular toolbox talks.

5. Chance find procedure

If any person discovers a physical cultural resource, such as (but not limited to) archaeological sites, historical sites, remains and objects, or a cemetery and/or individual graves during excavation or construction, the following steps shall be taken:

i. Stop construction activities;
ii. Delineate the discovered site area;
iii. Secure the site to prevent any damage or loss of removable objects. In case of removable antiquities or sensitive

remains, a full-time guard should be present until the responsible authority takes over;

iv. Notify the responsible foreman, who in turn should notify the GW4R project SPIU and NPCU, who will then notify World Bank and local authorities responsible for cultural heritage (within less than 24 hours);

v. The significance and importance of the findings will be assessed according to various criteria relevant to cultural heritage including aesthetic, historic, scientific or research, social and economic values;

vi. Decision on how to handle the finding will be reached based on the above assessment and could include changes in the project layout (in case of finding an irrevocable remain of cultural or archaeological importance), conservation, preservation, restoration or salvage;

vii. Implementation of the decision concerning the management of the finding;

viii. Construction work can resume only when permission is given from the respective authorities, NPCU and World Bank after the decision concerning the safeguard of the heritage is fully executed;

ix. In case of delay incurred in direct relation to archaeological findings not stipulated in the contract (and affecting the overall schedule of works), the contractor may apply for an extension of time. However, the contractor will not be entitled for any kind of compensation or claim other than what is directly related to the execution of the archaeological findings works and protections.

Annex 4: Community Engagement Report

Ministry of Water Resources Development
Republic of Somaliland

Horn of Africa Groundwater for Resilience

Groundwater for Resilience Project

Cali ciise

Community Engagement Report

Environmental and Social Impact Assessment (ESIA) Mission

Prepared by: Abdirashid Ahmed
SL-GW4R Environment Specialist

1. Introduction

On February 13 - 14, 2025, a team from the Groundwater for Resilience (GW4R) Project Implementation Unit (PIU) and Hydronova Consultants visited Cali Ciise village to conduct an initial community engagement session. The session aimed to introduce the project's objectives, discuss the role of the community, and gather baseline environmental and social information through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). A total of 130 villagers participated, including 30 women. The session was attended by all segments of the community, though no minority groups or Internally Displaced Persons (IDPs) were identified. Additionally, pastoralists from other areas who had come for pasture also took part in the discussion.

2. Objectives of the Community Engagement Session

The engagement session aimed to:

3. Summary of the Discussion

- The GW4R PIU and Hydronova consultant team provided a comprehensive briefing on the project's mission and objectives.
- The importance of community engagement was emphasized, highlighting its role in ensuring the long-term sustainability of the water supply infrastructure.
- The team raised awareness about upcoming activities and detailed the responsibilities of the community in supporting project implementation.
- The Environmental and Social (E&S) team encouraged community members to actively participate in KIIs and FGDs to facilitate the team collect the baseline information for the ESIA.
- A special emphasis was placed on the role of women in managing the water point, ensuring equitable access and efficient usage.
- Discussions on water point management and sustainability explored strategies to maintain the infrastructure effectively.
- The issue of land donation was discussed in detail. The community expressed readiness to allocate sufficient land for all necessary water infrastructure. Some elders stated that even if the designated area encroached on their homes, they would voluntarily relocate. According to the elders, the land belongs to the Cali Ciise community, who share the same tribe and sub-clan. The elders and the Village Development Committee (VDC) affirmed their willingness to voluntarily donate the required land for this investment.
- VDC establishment: The village has a functioning VDC, but it lacks representation from the women's group. The team discussed this matter with the community to ensure inclusivity while avoiding any conflicts. The VDC decided to establish a new committee responsible for managing the water source after the borehole is drilled. Post-drilling activities will focus on forming and training a water management committee, and discussions were held on how to ensure sustainable water source management.

4. Community Feedback and Concerns

The community expressed strong concerns regarding delays in borehole drilling. They noted that since 2016, when the first borehole in Cali Ciise failed, the government promised multiple times to drill a new borehole but had yet to drill. The community urged the government to accelerate the process, emphasizing their urgent need for water. Some community members stated that the companies who came previously brought very weak drilling rigs, which led to the failure of the water point. They requested the government to be cautious in selecting the contractor this time. They emphasized that this area requires an expert team and a strong, capable drilling rig to complete the job efficiently.

The community expressed strong concerns regarding delays in borehole drilling. They noted that since 2016, when the first borehole in Cali Ciise failed, the government had conducted multiple hydrogeological and geophysical surveys but had yet to drill a new borehole. The community urged the government to accelerate the process, emphasizing their urgent need for water.

5. Key Outcomes

- The community reaffirmed its commitment to supporting the project and participating in necessary assessments.
- The team successfully conducted KIIs and FGDs to collect baseline data.
- The community emphasized the need for expedited action in borehole drilling.
- The community showed readiness to allocate land for the water infrastructure development.
- The community agreed to establish a VDC with better representation, particularly including women, and form a water management committee for sustainability.

Figure 32: Community members in the engagement session

6. Minutes of the Meeting

Date: February 13 -14, 2025

Location: Cali Ciise Village

Agenda Items:

1. Opening remarks and introduction of the GW4R project.
2. Discussion on community engagement and responsibilities.
3. Awareness on upcoming project activities.
4. Importance of community participation in the ESIA process.
5. Role of women in water management.
6. Water point management and sustainability.
7. Community concerns and feedback.
8. Land allocation for water infrastructure.
9. Establishment of an inclusive VDC and water management committee.
10. Closing remarks and next steps.

Key Discussions and Agreements:

- The GW4R team explained the project scope and objectives.
- Community members were encouraged to take an active role in monitoring and managing the future water infrastructure.
- The need for urgent action to drill a new borehole was reiterated by the community.
- The GW4R E&S team completed KIIs and FGDs for the ESIA process.
- The community expressed readiness to donate land for the project, with elders confirming their willingness to relocate if necessary.
- The village agreed to establish a more inclusive VDC and form a water management committee after the borehole is drilled to ensure long-term sustainability.

7. Conclusion and Next Steps

- The engagement session was successful in gathering community perspectives and reinforcing the importance of collaboration. Moving forward, the GW4R team will:

- Analyze data collected from KIIs and FGDs.
- Provide updates on the borehole drilling timeline.
- Ensure continuous communication with the community to address their concerns and keep them informed on project progress.
- Support the formation and training of a water management committee post-drilling.

Horn of Africa Groundwater for Resilience

Community/Stakeholder Engagement Meetings

Attendance Sheet

Investment Type: ESIA

Village: Cali Ciise

District: Durugsi

Region: Togdheer

Meeting Dates:

From: 13/2/2025 To: 14/2/2025

Meeting 1: .... Date: ....

Meeting 2: .... Date: ....

Meeting 3: .... Date: ....

Meeting 4: .... Date: ....

Meeting 5: .... Date: ....

Meeting 6: .... Date: ....

Attendance Sheet

SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
1	Cali Axmed Faarax	m	Elder								
2	Cirisaaq Yaxye Daahir	m	Elder								
3	Maxamed Cabdi Cigaal	m	Elder								
4	Xasan Maxamed Cismaan	m	Elder								
5	Caydiid Kaariye Ibraahim	m	Elder								
6	Saleebaan Cabdi yusuf	m	Youth ~~Elder~~								
7	Xuseen Jaamac Maxamed	m	Youth ~~Elder~~								
8	Suhayb Cabdi Xuseen	m	Youth								
9	Siciid Yusuf Siciid	m	Youth								
10	Maxamed Siciid Ismaciil	m	Youth								
11	Kayse Xasan Siciid	m	Youth								

1

SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
12	Cabdi Faarax Maxamed	m	Youth								
13	Xuseen Caalin Cumar	m	Youth								
14	Maxamed Yoonis Ibrahim	m	Youth								
15	Axmed Cali Nuur	m	Youth								
16	Axmed Cabdi Cali	m	Youth								
17	Cllaahi Ibrahim Hanuun	m	Youth								
18	Maxamed Xaaji Xasan	m	Youth								
19	Sacad Saleeban Cabdilahi	m	Youth								
20	Yaxye Ibrahin Faarax	m	Youth								
21	Cabdala Maxamed Ibrahim	m	Youth								
22	Abokor Aadan Cali	m	Youth								
23	Cabdi Yusuf Kahin	m	Youth								

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SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
24	Jaamax Cabdi Yusuf	m	Youth								
25	Guuleed Ibraahin	m	Youth								
26	Cabdale Cali	m	Youth								
27	Saadaam Saleebaan	m	Youth								
28	Deeq Naasir	m	Youth								
29	Bashiir Cabdi	m	Youth								
30	Sharmaarke Cabdinaasir	m	Youth								
31	Cabdisalaan Axmed	m	Youth								
32	Cali Cilmi Mataan	m	Youth								
33	Cabdirisaaq Saleeban	m	Youth								
34	Cismaan Maxamed	m	Youth								
35	Cabdiraxman Cali	m	Youth								

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SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
36	Sayid Khadar	m	Youth								
37	Yuusuf Ibraahin	m	Youth								
38	Khadar Deeq	m	Youth								
39	Maxamed Saalax	m	Youth								
40	Axmed Ducaale	m	Elder								
41	Maxamed Cabdi	m	Elder								
42	Mustafe Maxamed	m	Youth								
43	Cabdifani Sugule	m	Youth								
44	Maxamed Ahmed	m	~~Youth~~ Elder								
45	Yuusuf Maxamed Nuur	m	Elder								
46	Cabdala Axmed Yaasin	m	Youth								
47	Cabdiraxman Maxamed Warsame	m	Youth								

4

SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
48	Sakariye Adan Cabdi	m	Youth								
49	Yousuf Jaamac	m	Youth								
50	Cali Maxamed Yousuf	m	Youth								
51	Deeq Diiriye Jaamac	m	Youth								
52	Khadar Cumar Xasan	m	Youth								
53	Cabdikarin Cali Jaamac	m	Youth								
44 54	Xasan Sheekh Maxamud	m	Youth								
55	Cumar Maxamed Cumar	m	Elder ~~Youth~~								
56	Axmed Cige Cilmi	m	Elder								
57	Dubad Xaashi Ibraahim	m	Elder								
58	Siciid Warsame Dullale	m	Elder								
59	Khayre Ibraahim Cige	m	Elder								

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SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
60	Faadumo Cisman Bixi	F	Woman								
61	Sahra Xariir Maxamed	F	Women								
62	Suleekha Cabdi Ciise	F	Women								
63	Nuura Cabdi Ibraahim	F	Woman								
64	Khadra Aadan Cabdi	F	Woman								
65	Xasan Ibraahim Nuur	M	Elder								
66	Cabdiraxman Maxamed Cali	M	Elder								
67	Aadan Cali Ciise	M	Elder								
68	Cawil Maxamed Haruun	M	Elder								
69	Cabdilahi Cali Cigaal	M	Elder								
70	Suhayb Cumar Ibraahim	M	Elder								
71	Ibraahim Faarax Cafaas	M	Elder								

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SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
72	Maxamed Caydiid Jamac	M	Youth								
73	Sakariye Cabdi Maxamed	M	Youth								
74	Maxamed Cabdi Yousuf	M	Youth								
75	Axmed Deeq Ibraahim	m	Youth								
76	Maxamed Cabdilahi Ibrahim	m	Youth								
77	Cabdiraxman Yuusuf Maxed	m	Youth								
78	Cabdinaasir Yusuf Ibrahim	M	Youth								
79	Gorane Xasan Sh. Maxamud	M	Youth								
80	Cabdikadir Cumar Cabdi	M	Youth								
81	Shucayb Maxamed Cabdi	M	Youth								
82	Cabdinasir Addan Cali	m	Youth								
83	Marwo Naasir Ducale	F	Woman ~~Youth~~								

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SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
84	Saado Yuusuf Xasan	F	Women								
85	Indhodeeq Farax Maxamed	F	Women								
86	Xasan Axmed Xaaji Ibrahim	M	Elder								
87	Maxamed Ibraahim	M	Elder								
88	Xuseen Maxamed Ismaacil	M	Elder								
89	Maxamed Axmed Xasan	M	Elder								
90	Ismaaiil Maxamed Aadan	M	Elder								
91	Mawliid Axmed Caynaashe	M	Elder								
92	Maxamed Mustafe	M	Youth								
93	Cali Cabdi Jibriil	M	Youth								
94	Naasir Maxamed Cabdi	M	Youth								
95	Maxamed Naasir Cali	M	Youth								

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SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
96	Muur Mustafe Muuse	M	Youth								
97	Jibriil Jaamac Cumar	M	Youth								
98	Axmed Caliil Xasan	M	Youth								
99	Cabdicasiis Mustafe	M	Youth								
100	Cabdifataax Xasan Cismaan	M	Youth								
101	Muniir Axmed Yousuf	M	Youth								
102	Caasha Jaamac Maxamed	F	Women								
103	Khadija Faarax Oday	F	Women								
104	Canab Cumar Cali	F	Women								
105	Luul Obsiiye Khayar	F	Women								
106	Asma Xasan Ismaaciil	F	Women								
107	Miciima Maxamed ~~[illegible]~~ Ibraahim	F	Women								

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SN	Name	Sex	Group/ Org.	Role	Tel	Meetings					
						General	Women	VDC			
108	Fardus Maxamud Barud	F	Women								
109	Cali Maxamed Cartan	M	Elder								
110	Xasan Cabdi Sicid	M	Youth								
111	Ibraahim Maxamed Ibrahim	M	Youth								
112	Salmaan Maxamed Ismaciil	M	Youth								
113	Maxamed Yusuf Caydiid	M	Youth								
114	Yaxye Maxamuud Ibraahim	M	Youth								
115	Asma Mubaarik Cismaan	F	Youth								
116	Saynab Yuusuf Xasan	F	Youth								
117	Farxiya Nuur Maxamed	F	Youth								
118	Hinda Muxumed Maxamed	F	Women								
119	Caasha Nuur Abokor	F	Women								
120	Istaahil Maxamud Cismaan	F	Women								

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Annex 5: Drilling and Pump System Technical Specifications

The Contractor must assume full responsibility, for all purposes of civil or criminal law, for the execution of the service and will be solely responsible for the interventions entrusted to it, the materials used and the means and tools provided for this purpose, both directly and indirectly.

The Client reserves the right to control all interventions in the various phases of execution. However, it is understood and agreed that all control interventions, without distinction, may never and in any way lead to liability for the Client, that is, the presence on site of the Client's coordination and surveillance personnel, the sharing of the type of intervention and the acceptance of the materials do not limit or reduce the full and unconditional liability of the Contractor.

All equipment, fixtures, installations and tools supplied by the Contractor must meet high technological characteristics, be of the best brands and comply with the national or international standards, or in their absence, with the rules of good execution, both for the quality of the raw materials, and for the manufacturing methods, dimensions, tolerances, acceptance tests and for anything else provided for by the current technical; they must, in any case, be suitable to replace the existing ones.

Therefore, the Contractor must provide the Client in advance with the technical specifications of the equipment and materials that are the object of each individual supply, the name of the suppliers and the location of their production plants, submitting the technical specifications and any certifications of tests and inspections for approval.

Each equipment must have, at the time of delivery, the following technical documentation:

1) n.1 copy of the maintenance manual;

2) n.1 copy of the corresponding catalogue sheet indicating the technical assembly characteristics;

The Company must, at any time, guarantee to the Client the execution of all tests and inspections on the supplies, deemed necessary and appropriate, both in the factory and on site.

The Client has the discretionary right to reject supplies deemed unsuitable, globally or for individual batches and also to order the replacement of the supplier, without the Contractor being able to claim any right to compensation or reimbursement for this.

All charges and expenses for the tests and inspections requested by the Client, without exception, and the charges related to the supplies (transport and packaging), are included and fully borne by the Contractor.

All supplies are guaranteed for two years from the date of installation.

Mobilization

Mobilization shall consist of the transport of all, necessary manpower, drilling rig, tools, casing pipes and construction materials to the drilling site. Demobilization shall consist of clean-up work and operations including, but not limited to those necessary to the removal of personnel, equipment, and incidentals from the project site.

The Contractor shall also mobilize all the necessary materials such as water for drilling, drilling chemicals fuels etc, which are required during the progress of the works.

Drilling

The drilling is carried out up to a depth in the interval 400-450 m. However, the borehole can be stopped by the contracting authority and finalized also at a depth lower than 400 m with no claim of any compensation. The contracting authority will appoint a supervisor for the drilling operations, who will be responsible, on behalf of MoWRD, for all activities related to drilling, completion of works and subsequent pumping tests. At the end of the drilling operations the supervisor will decide on the basis of the drilling logs, water quality etc. if to finalize the borehole or to abandon it, thus cancelling all the remaining operations with no claim of any compensation by the contractor.

The contracting Authority supervisor should possibly be a geologist or a person with wide experience of boreholes drilling supervision.

<u>The drilling site is near Cali Ciise village, Togdher region, the coordinates are: 8.542460° N and 45.519554° E. It is suggested to drill in a radius of 200 m from this location.</u>

Expected Lithology and Water Levels

The material expected during the drilling is constituted by sand, silt, shales and possible limestones or marly levels. More in detail, it is expected a shallow cover (10-15 m) of alluvial sand or limestone, then shales/marls up to 150-170 m, and below sandy deposits with mudstones intercalations. It is not expected crystalline basement up to 600 m, but in case the basement is found the drilling shall stop after penetrating 10 m in it.

Groundwater is not expected up to 250-350 m of depth.

Drilling Methodology and Use of Additives

The drilling shall be executed with the only methodology of rotary with mud circulation, to face hole wall collapses, frequently occurring in the area. The use of bentonite may be used on the base of specific conditions. The diameter of the drilling tools shall be suitable for the installation of 8” casing plus an annular space of 3” around the casing for the gravel pack installation, therefore no less than 14”.

Centralizer

Borehole casings and screens shall be fitted into the open hole with centralizers placed at intervals of 20 m. Centralizers shall be made by plastic material or iron and of an approved design which does not hinder the installation of either gravel, backfill or cement seal.

Sampling

Samples from the cutting are taken each 2 meters, put in small transparent plastic bag and the depth interval to which the sample refers is written with black indelible ink marker. The samples are stored in a wooden or plastic box with small wooden dividing panels on which the depth is written with the same indelible markers. The wooden boxes are stored in a shadowy location and always available to the drilling supervisor.

Activity Recording

On a field book are registered all the operations done while drilling, including the drilling time per pipe length interval, the lithology, including grain size for sand, the drilling diameter, the use of temporary casing (and its diameter), each start and interruption of the operations, any machinery breakdown or hole collapse, possible losses of circulation. It is requested to compile daily forms with all the data above described. In the notes shall be reported also the supposed or verified presence of water with the depth at which the water income occurred.

Gravel Pack and Piezometric Pipe

The gravel pack is made by quartz/feldspar type, selected rounded grains of diameter 3 - 5 mm maximum. The size is mandatory given the expected presence of fine deposits (fine sand and silt). Coarser gravel grains allow the passage into the hole of such deposits.

Before pouring the gravel pack, a piezometric pipe of 1" in U-PVC is installed in the annular space up to the half of the last (deepest) screened casing section. The pipe shall reach the depth of 20 m above the lower edge of the screened section, the expected maximum length is 430 m.

The gravel pack is washed to remove small particles then gradually inserted into the annular space around the casing. Its volume is measured before pouring. Verify the consistency between the theorical volume and the measured volume. Record the volume poured for the drilling report.

During the borehole development by air and pumping gravel pack will be added as per need.

Casing

The casing shall be in PVC 8" to allow the installation of a pump with 6"diameter. The expected length is 300 m for the blind casing and 200 m for the screened sections. The screens are slotted 1-1.5 mm to allow a yield of 99-109 liters/minute per meter, open, with minimum thickness wall of 13,4 mm.

Borehole Development

Borehole development shall be limited to jetting, air lifting and over-pumping methods only. Any damage caused by development procedures shall be rectified by the Contractor to the supervisor's satisfaction. Not less than 12 hours of development pumping will be carried out.

Pumping Test

The pumping test is performed with a pump suitable for yields up to 5 l/s with a head of 400 m and 6" of diameter. The contractor shall provide, beyond the pump and the generator, a gate valve, a flowmeter, a piezometric probe or dipmeter (up to 500 m of length) and a calibrated EC-meter for the measurement of electrical conductivity. The EC-meter is calibrated on a standard solution of known conductivity, before the start of drilling operations. Field forms are supplied for each type of test. The test is followed by the drilling supervisor or by a person appointed by him/her.

The activity consists of 3 different tests, preceded by a test of one hour to verify the reasonable yield range of the borehole.

- Step Test: it is performed by 4 steps at growing yields, at ¼, ½, ¾ of the maximum expected yield. The last step is done at the maximum yield. The time of pumping for each step is 1 hour. The passage to each next step is done without intermediate recovery. After the last step is concluded, a recovery phase of 2 hours measurements is done. During the test, readings of the water level are taken in the time intervals indicated on the step test form. Flowmeter readings, EC and temperature are measured at the start of each step and in the last minute of the last step.
- Constant rate test: once the recovery from step test is completed at 100%, a constant rate test of 72 hours is performed. The yield is selected by the drilling supervisor, on the base of the results of the step test and specifically at a yield of ¾ of the critical yield. During the test, readings of the water level, of the flowmeter, of EC and temperature are taken in the time intervals indicated on the step test form. It is recommended to verify the pump yield each 12 hours calculating the time necessary to fill a 200 litres drum by stopwatch. No generators stops are admitted, in case a stop occurs to the generator, the test shall restart from time 0, after a full recovery of the water level. Before the end of the test a sample of 5 litres of water is taken for chemical analyses.
- Recovery: as soon as the pump is shut the recovery measurements start following the timing of the recovery form. The recovery is followed for a maximum of 10 hours or up to 95% of the whole draw-down is recovered by the water level.

Hole Protection

The annular space between the open hole and the PVC lining shall be filled to a depth of at least 2,0 m with a cement concrete to form the support base.

Report

The drilling report is written by the contractor and contains:

- Contractor data, driller name, start and end of the drilling operations, equipment brand and type.
- Site name, village name and coordinates, taken by GPS
- All data regarding methodology, additives use, drilling diameters and intervals of utilization, casing and screen diameters and intervals.
- Short history of the operations, including breakdowns, collapses, change of drilling diameters, dates, etc.
- Log of the drilling time per pipe length interval.
- Stratigraphic log approved/written by the drilling supervisor, with pictures of significant samples for each lithological unit (no more than 5-7 pictures). In the log are indicated the verified/supposed main water incomes.
- Drawing of the casing/screen column of the annular space refilling, and of the diameters used during the drilling.
- Gravel pack description and pictures.
- Description of the development activity, with significant water levels variations.
- Complete description of the pumping test equipment, dates, times and full tables and graphs with data measured during each test.

Submersible Centrifugal Pump and Riser Pipe General Standards

- Pumps should be multistage, centrifugal type, Vertical directly coupled to wet type submersible motor for Pumping ground water from deep wells.
- Pump Sets must comply with the latest E.U and I.S.O. standards.
- Manufacturer authorization letter, Certificates of compliance, and ISO or other certificate should be submitted along with bid offer.
- Suitable diameter of each pump/motor over the cable for use in 8 inch diameter Well Casing.

Pump Performance

- Pump performance curves should be indicated and clearly seen.
- Duty point flow rate and head for each pump must be within application range recommended by manufacturer.
- Guaranteed Pump efficiency at design flow should be equal or greater than 65%.
- Actual pump operational point should be between 110-80% of BEP (Best Efficiency Point).
- NPSH required should be less than 4m.

Pump Construction Material

- Impellers should be made of abrasion resistant bronze or stainless steel; statically and dynamically balanced.
- Main pump body should be made of corrosion resistant, Zinc free, closely grained cast iron or casted stainless steel.
- Pump shaft, coupling, suction grid & retaining valves should be made of stainless steel(SS310 /SS316 or higher class SS).
- Non-returning valve with Strainer incorporated with the pump.
- Pump tightening bolts and lock nuts should be made of stainless steel.

Submersible Electronic Motors

All motors shall be of a make approved by the Engineer and shall be suitable for operating from the specified power supply. Motors shall comply in all respects with the relevant parts of BS 4999 and BS 5000, and shall be designed to run at high power factor and efficiency at the prescribed plant duty.

Motors shall be three phase, squirrel cage, induction type, continuously rated for the heaviest specified duty, totally enclosed and suitable for operation on the electricity supply and determined by the Contractor in relation to the power requirements, ambient temperature, altitude and normal working conditions of the mechanical plant offered.

The starting (locked rotor) current of any motor shall not exceed 6 times the full load operating current; Motor starting torque shall be at least 120% of the pump torque requirements throughout the starting sequence. Motors shall be capable of running backwards at rated speeds under backflow conditions without damage to the motor.

In addition to the requirements of BS 5000, the motors shall be capable of satisfactory operation with a frequency variation of = 5% above or below the normal frequency of 50 Hz.

The design of the motor shall be adequate in all respects for the number of starts per hour required when the pumping plant is in normal operation. Where an insulation Class is specified the requirements of BS 4999 shall be met. The limit of temperature rise shall be for the appropriate Class of insulation quoted. Class F insulation shall be provided, but with Class B temperature rise limitations.

Motors shall be fitted with locating type bearings and/or heavy type thrust bearings at the non-drive end and roller type bearings at the drive and according to the type of motor offered, but all bearings shall be of adequate proportions and design suitable for the particular application, and shall have ample capacity all allow the pump to operate for short periods with the discharge valve closed.

Details of the bearing types being proposed, grease, oil, shall be submitted for all vertical motors together with details of the grease lubricated bearings for horizontal split case motors.

The motors shall be built of high-grade components and materials in accordance with the best practice for the type of plant offered.

Motors 5 kW and above shall be fitted with temperature sensitive thermistors embedded in the motor to control a winding over-temperature relay mounted in the control cubicle. Each motor shall have at least 3 thermistors. The thermistors shall be suitable for connection to a monitoring unit in the motor control circuit to provided protection against winding failing due to overheating. The motor starters shall trip in the event of high winding temperature being experienced.

The motors shall be capable of delivering 10% in excess of the maximum power absorbed by the equipment being driven. The motors, where practicable, are to be selected to provide an element of commonality, thus flexibility in use at each site, particularly dosing pump motors.

Only ISO standard roller and/or ball grease lubricated bearings shall be fitted.

The grease lubrication shall be applied using hydraulic type nipples, which are freely accessible, without, and dismantling, or otherwise piped out to a readily accessible location.

"Sealed for life" bearings shall not be used.

Continuously rated anti-condensation heaters shall be installed in all motors above 5 kW that are to be installed or in damp or cold environments. They shall be sized by the supplier to suit the motor frame size.

Heaters shall be located within the motor so that the heat dissipated does not damage the insulation of any of the windings or associated cables.

Terminals boxes shall be separated from the frame and shall be reversible to allow cable entry at the top, bottom or either side, suitable for cable glands required. Terminal mountings shall be arranged such that the motor supply wiring can be disconnected without disturbing its internal connections.

The end of each winding shall be brought out to a separate terminal, connecting links being provided to facilitate interconnection of individual terminals.

A diagram of connections shall be fixed inside the terminal box cover, which shall be provided with watertight, oil resisting gaskets.

Where motor anti-condensation heaters are fitted additional terminals and a separate cable gland entry shall be provided. A warning label on the terminal box cover shall be provided stating" WARNING, LIVE HEATER TERMINALS, ISOLATE BEFORE REMOVING COVER".

Plates shall be fixed on each motor, giving the following information:

BS No_____________________ Manufacturer_____________________

Serial No_____________________ Insulation Class_____________________

Frequency_____________________ No. of Phases_____________________

Motor kW_____________________ Voltage_____________________

Current at FL_____________________ Speed_____________________

Vertical spindle motor units rated in excess of 5 kW shall be fitted with a at the upper thrust bearing to shut down the motor in the event of the thermocouple bearing temperature exceeding a recommended value. Details shall be provided for approval.

Motor that are water-cooled shall include suitable protection to safeguards against lack of water flow.

Where required by the specified operation system, motor circuits shall include the suitable rated rotary off, manual or automatic switches.

Control Panel and Starter

Pump functioning must be under inverter connection to guarantee soft start and stop

- Control panel with TPN (Triple pole and neutral) switch with selector from Main On/Off, the power from Generator and A.C., replaceable fuses, phase indicator, voltmeter, ammeter and starter.
- Manufacturer's standard automatic type starter of suitable amperage with provision for lay ampere setting and automatic restarting when the water level goes up to a safe level.
- Automatic protection for over loading.
- Water level monitoring Relay for dry run protection.
- All incorporated and assembled in lockable painted steel box.

Additional Equipment

- Water level monitoring system to prevent pump from running dry, suitable for lowering on the specified bore-hole diameter vulcanized 2 electrodes with single insulated and flexible wire length equal to pump head.
- PVC cable clamp kit.
- One pairs of pump clamp with bolts and nuts for 4 inch pipe diameter, unless specified
- Pressure gauge.
- Submersible cables of proper length for each pump
- One cable jointing kit with quick drying epoxy resin compound
- Control panel.
- Strainer
- Non-Return Valve (Check Valve) incorporated with pump.

Technical Information Required

- Copies of Installation and Operation Manuals in English, for each pump.
- Pump discharge and total head.
- Complete pump performance curves at duty point and at different heads and discharge

- Pump HP
- Pump efficiency at 0.8 power factor
- Number of stages, total length of pump, and motor
- Pump diameter, motor diameter Over submersible cable
- Outlet connection diameter.
- Type of impeller
- Impeller, pump shaft motor and pump casing material
- Size of submersible cable
- Make and type of starter.
- Control panel box full details
- Impeller vane thickness, number of vane, vane angle at inlet and outlet diameter of a typical stage
- Other relevant information

Riser Pipes

Riser pipe should be in galvanized steel, minimum inside diameter 4'' with minimum thickness 5mm and minimum yield stress 235 N/mm2.

The installation of non-return valve located at 10m from the delivery mouth of pump and a further non-return valve every 50 m of pipeline.

The Contractor, under his own responsibility, may propose riser pipes with different technical characteristic with greater performance in terms of structural and hydraulic functioning.

In any case the contractor is always obliged to issue a structural technical report about the fitness of the riser pipes installed, in accordance with the final installation diagram and the technical characteristics of the submersible pump installed.

Annex 6: Construction Investment Report

PREPARED FOR:

Republic of Somaliland, Ministry of Water Resources Development
Groundwater for Resilience Project (GW4R)

'Abaar-Tir'

Provision of Continuous Backstopping Engineering Services

Task 5 - Deliverable D7

Construction Investment Report

Caali Ciise Site, Togdheer Region, Somaliland

Submission Date: November 2024

PREPARED BY:

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Summary of Intervention

Objective

This Construction Investment Report (CIR) seeks to assist the Somaliland State in determining whether a borehole near the village of Cali Ciise, located in Togdheer, is feasible. The report is based on project site selection criteria and a joint feasibility evaluation of the proposed site by PIU staff and backstopping engineers. Detail geophysical work, community discussions, and an assessment of alternative enhanced supply options are all part of the project. The report serves as the foundation for deciding where to invest.

Intended Result

The site for the new borehole was selected due to its proximity to the communities and the fact that the nearest borehole is approximately 50 kilometers away, as the area urgently needs a reliable water source to support residents during the dry season when traditional water storage structures run dry. The investment proposal includes the construction of a new borehole capable of pumping enough water to meet up to 97% of the community's water needs for both humans and livestock during the 150-day dry period without rain, when the community cannot rely on surface water storage.

Proposed Activities

The proposed investment is subdivided into three components:

1. **Construction of the borehole.** The proposed structure will be 450 meters deep and will be able to pump about 54,000m^3 of water during the dry season. The drilling of the borehole will cost an estimated US$ 180,020.00.
2. **Construction of the ancillary structures.** The borehole will be supplemented by a pumping system, an elevated water tank, a kiosk, and animal troughs. Finally, the proposed water system is completed by a watchman house (with RO and UV system) and a power generation system (PV system). These additional infrastructures will cost an estimated US$ 225,803.27 bringing the total initial investment to **US$ 405,823.27**. The photovoltaic system required to operate the pumping system represents a significant investment. Although it has been fully designed and it is considered in the cost-benefit analysis, it may be implemented at a later stage, depending on the final budget allocation. The borehole can operate using the diesel generator included in the pumping system design.
3. **Operation and Maintenance Costs.** Once constructed, the water project will regularly incur in several normal and extraordinary costs estimated in the range of **US$ 41,743 / year**. This value is primarily determined by the diesel supply needed for the generator's operation during the hours when sunlight is insufficient to power the photovoltaic panels.

Location

Name and Coordinates

Cali Ciise site (Latitude: 8.5425° - Longitude: 45.5196°), located about 100 kilometers south of the capital city of Burco, is one of the sites the government of Somaliland has considered to be developed under the GW4R Project.

Village / City

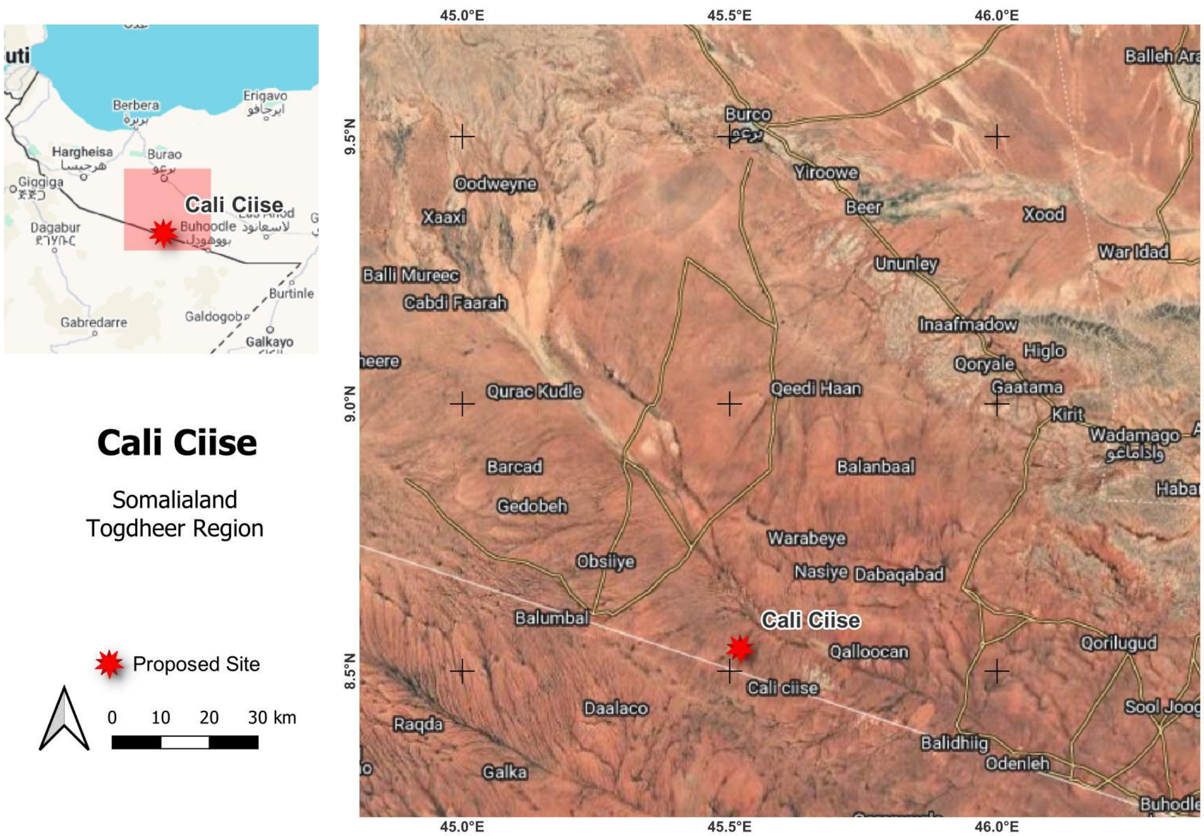


Figure 33: Cali Ciise Site - Location map

The communities within the project area, located along the border between Somaliland and Ethiopia, face an acute water shortage due to limited groundwater resources. This strategic location will attract a substantial number of beneficiaries, including not only nearby Somali communities but also populations from neighboring Ethiopia. While the borehole's water quality is expected to be relatively low, it will serve as an essential resource during the dry season, when traditional surface water sources (such as berkads, balleys, and haffir dams) become depleted, leaving communities dependent on groundwater for critical needs like livestock watering and washing. Therefore, the cost-benefit analysis presented in this report is conservative, considering that the borehole's value extends beyond the immediate locality, supporting numerous communities during the dry season.

Additionally, with the closest borehole situated 50 km away, the new water point will significantly contribute to the hydrogeological knowledge of the region, offering critical data that will aid future drilling projects and improve resource management in this currently understudied area.

Map

The new borehole will bring relief to all nearby communities, addressing the widespread need for reliable water access in the region. By providing a steady water supply, it is expected to benefit not only the primary community but also surrounding areas that face similar water shortages. Therefore, the needs of these neighboring communities have been included in the analysis of beneficiaries, ensuring that the project effectively supports all who will rely on this essential resource.

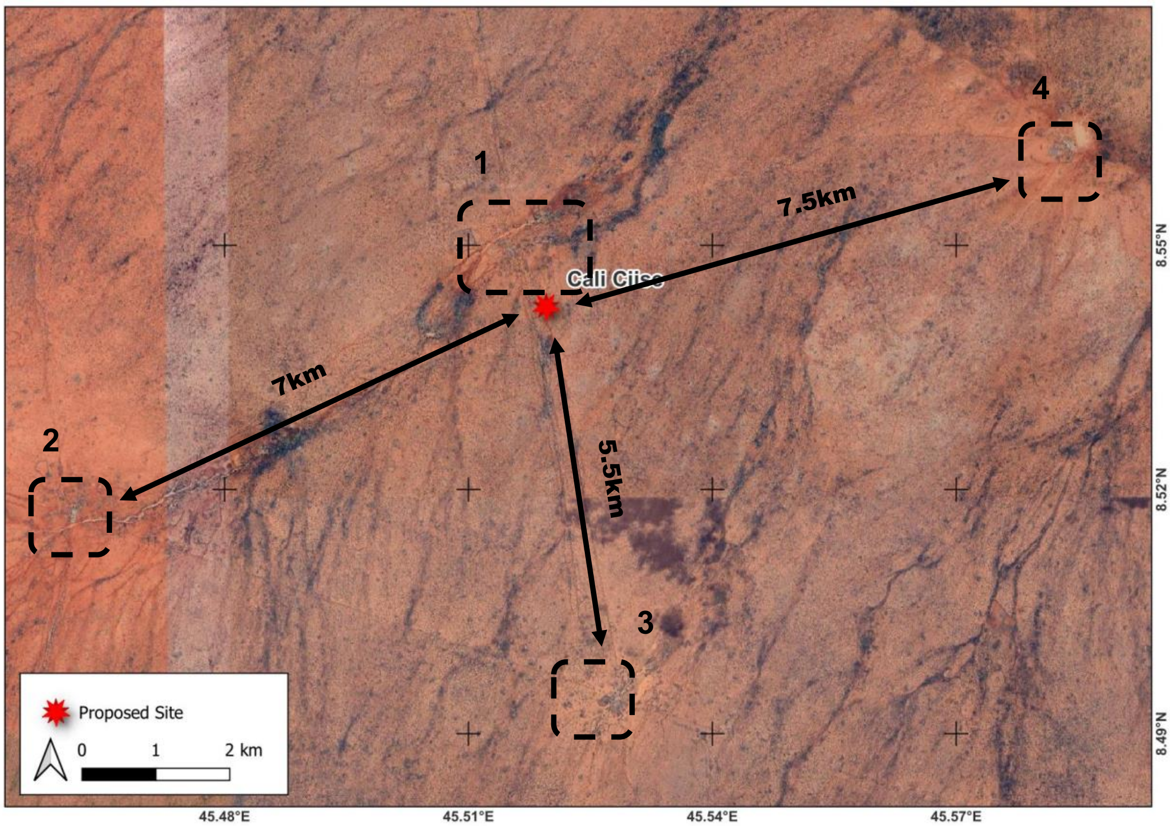


Figure 34: Aerial View of the proposed location for the water structure and the distance with the closest communities

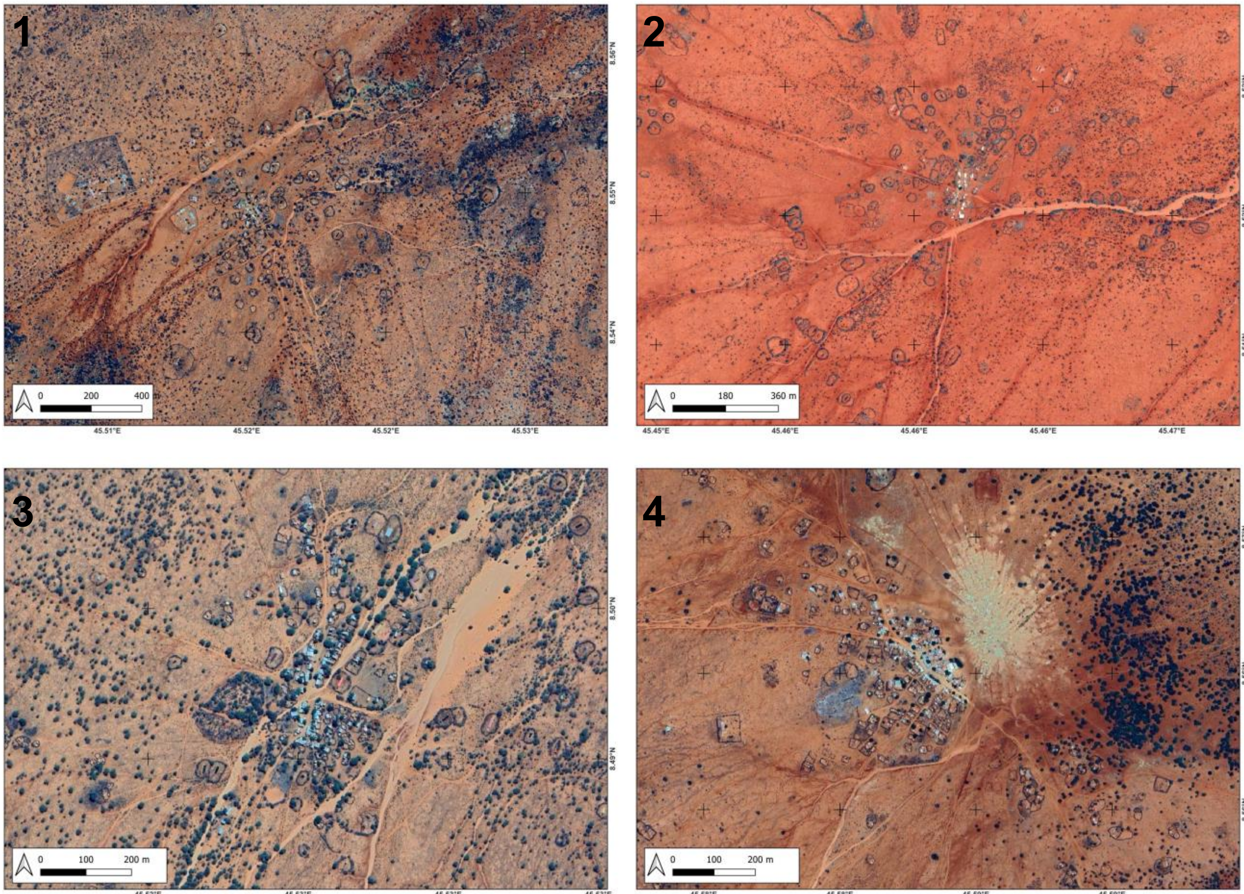


Figure 35: Satellite images of the closest communities to the new water point location

Delivery Targets

Volume

Number of Beneficiaries

The estimation of beneficiaries for the newly constructed water infrastructure was derived by the socio-economic survey done by the PIU and the satellite imagery, allowing for a detailed assessment of surrounding population densities. It was also possible to identify the predominant economic activities in the area, distinguishing between farming and nomadic practices based on visible land use patterns. An average number of livestock per household was considered to characterize the community water needs.[4]

The analysis considered the villages that would benefit from the new water point, that have been previously presented in this report, home to approximately 800 households that rely mainly on pastoralism and approximately 250 nomadic families that rely on water availability at the site during the dry season. Livestock, including camels, goats, cattle and donkeys play a significant role in the local economy, with varying numbers in each category.

Table 34: Number of beneficiaries estimation

	Community households	Nomadic families	Camels	Sheep	Goats	Cattles	Donkeys
Beneficiaries	800	250	1,396	10,470	11,168	2,094	698

Water Availability

The community’s main water sources are berkads, balleys, and haffir dams, located near the villages. These sources rely on surface runoff during the rainy season to store water for use in the dry season. Although surface water generally has low electrical conductivity, it carries high contamination risks. The reliability of these sources depends on both rainfall and the amount of water stored.

When these sources are insufficient, communities rely on water trucking from distant boreholes, which often provides lower-quality water with high salinity.

[4] The estimates of average livestock numbers per household were derived from the study "Impact of Climate Change on Agricultural Production in Marodijeh and Gabiley Regions (Somaliland)." The analysis synthesizes data from various local agricultural surveys and expert consultations to ensure accuracy in the context of regional livestock management practices.

Figure 36: Water structures in the area of interest: on the left, an existing haffir dam; on the right, several berkads

Water Demand

The analysis revealed that pastoralism is integral to the community's livelihoods. Agriculture is not practiced.

Daily consumption quantities are calculated based on the estimated number of liters for each consumer type[5] and are presented in the following three tables.

Table 35: Estimation of the water demands by villagers and nomadic pastoralists.

		Number of HH				
Type of Villager	HH Size	Share	Number	Total Number of People (H)	Unitary Water Consumption [L/D/H]	Total Water Consmption [MC/D]
Agro-Pastoralists (i.e. livestock and crop land)	12.0	5%	40	480	25	12.0
Farmers (i.e. crop land only)	8.8	5%	40	350	25	8.8
Nomadic Pastoralists	6.5	24%	250	1,625	25	40.6
Pastoralists (i.e. livestock only)	8.7	51%	408	3,563	25	89.1
Village Household	9.0	15%	120	1,081	25	27.0
					Total Water Need for Villagers	177.5

Table 36: Estimation of the water demand for livestock

[5] These figures are estimated based on two main sources of literature: Coppock et al. 1988 and Erik Nissen-Petersen (2006): Water for Arid Land (Danida). Hofkes (1983) emphasized that livestock in semi-arid areas require approximately 20-30 liters per Tropical Livestock Unit (TLU), with each TLU having a live weight of 250 kg. Thus, camels have a TLU of 1.6, beef cattle (as opposed to dairy cattle) have a TLU of 0.8, and sheep and goats have a TLU of 0.1. The water demand figures have been rounded to the nearest multiple of 10 for ease of reference.

Type of Livestock	Average Number of Livestock per HH	Total Current Number of Livestock	Total Additional Livestock that the Project can Support	Unitary Water Consumption [L/D/H]	Total Water Consmption [MC/D]
Camels	2.0	1,396	0	30	41.9
Sheep	15.0	10,470	0	5	52.4
Goats	16.0	11,168	0	3	33.5
Cows	3.0	2,094	0	24	50.3
Other	1.0	698	0	25	17.5
				Total Water Need for Livestock	**195.4**

Finally, if the proposed water structure had to -alone- satisfy the demand for the entire drought season (150 days) for all water users, the water requirement would be approximately **55,941m^3** or **373m^3/day**.

Water Balance

Based on the hydrogeological analysis conducted for the new borehole study and considering the presence of a deep, permanent aquifer, the new water point will conservatively pump approximately 5l/s. This equates to about 54,000m^{3}of water over a 150-day dry season, assuming 20 hours of pumping each day. It means that the proposed structure will provide water to the 97% of the community's needs for people and livestock throughout the dry season.

Capacity and Quality

The new borehole is expected to tap into the Yesomma Sandstones aquifer, with water likely available at a depth between 350 and 450 meters. The expected water yield ranges from 12-18 m^3 per hour, though the quality may vary from slightly brackish to strongly brackish (electrical conductivity from 2,500 to over 4,000 µS/cm. While this may limit its use for drinking, the borehole remains valuable for livestock and other essential activities, especially during the dry season when surface water sources are unavailable.

However, precise values for both water quality and yield can only be confirmed after drilling.

Service and Access

Currently, the community relies on water trucking during the dry season when traditional storage sources, such as berkads, balleys and haffir dams, dry up. During these periods, the cost of water[6] can reach up to $17 per cubic meter, creating a significant financial burden on households. This high cost reflects the scarcity of accessible water in the area and underscores the necessity of establishing a borehole to provide a more consistent and affordable water source, especially for essential needs during dry months.

6 Somalia WASH Cluster, Somalia: Monthly Water Price Updates (as of 14th April 2021). The study analyzes water costs during the dry season in various areas of Somalia.

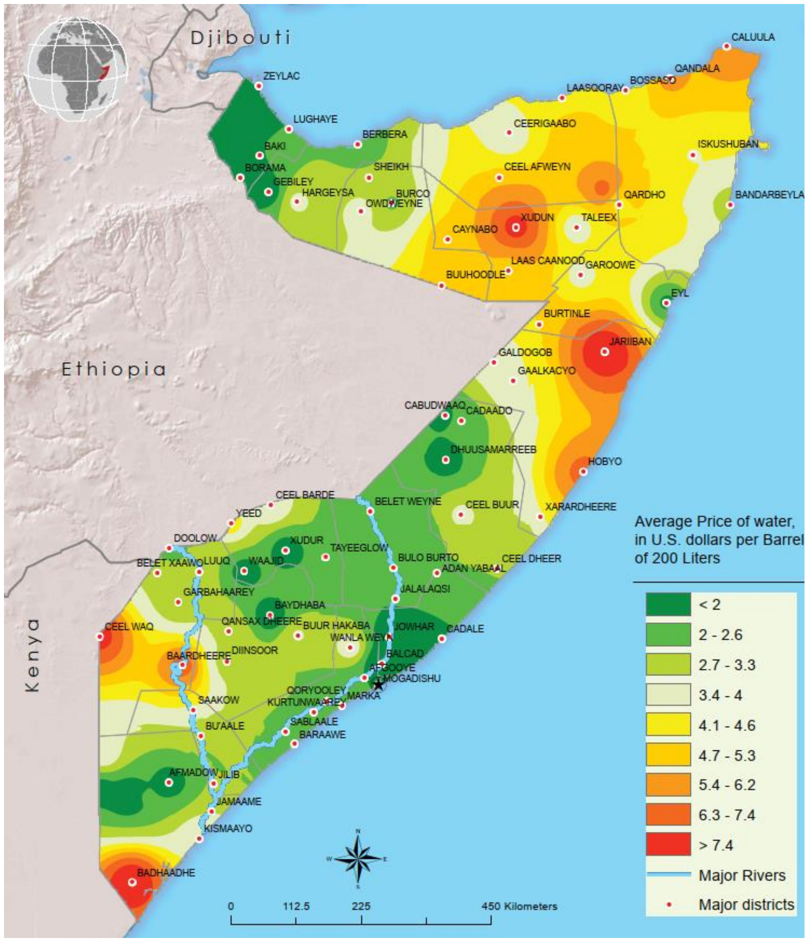


Figure 37: Average price of water reported by WASH Cluster Somalia in April 2021

Cost

The cost of the proposed structure is summarized as follows:

Cost of the borehole drilling	US$ 180,020.00
Cost of the appurtenant structures	US$ 225,803.27
Total Cost	**US$ 405,823.27**

In addition to these initial investments, it will be necessary to allocate an estimated US$ 41,743 / year to operate and maintain the structure.

Data and Information

This construction investment report provides extensive analyses on hydrology, geology and the natural environment surrounding the proposed project site. The main report provides a high-level summary of the details included in four separate annexes. Specifically:

- Annex 1 provides the details of the hydrogeological characterization.
- Annex 2 provides the details of the hydrological analyses including climate change.
- Annex 3 provide the details of the proposed community engagement plan.

A summary of these sections is provided below.

Hydrology and Climate

The precipitation patterns in the area of interest were analyzed using satellite data from the Tropical Rainfall Measurement Mission (TRMM), which was compared and validated against data from ground weather stations provided by SWALIM.

The local precipitation estimates were derived from the nearest TRMM data to the site, revealing an average of 266 mm per year over 22 years. Rainfall peaks typically occur in April/May and September/October, with a dry period lasting from November to March.

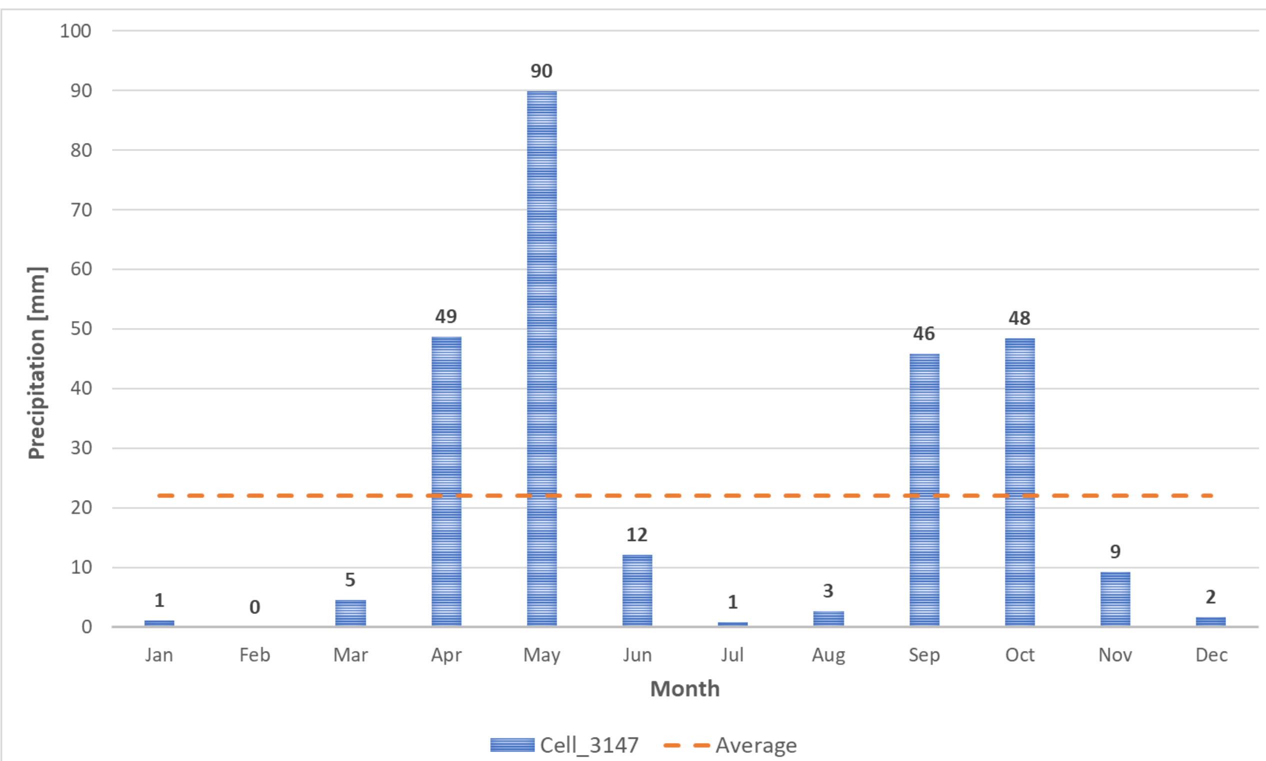


Figure 38: Average cumulative monthly rainfall data of the cell 3147 of the TRMM database (1998-2019)

Projections from the Climate Change Knowledge Portal indicate a slight increase in precipitation in the region, particularly under the conservative SSP5-8.5 scenario. These changes are not expected to significantly worsen local water issues. Additionally, the maximum number of consecutive dry days is projected to slightly decrease, suggesting that the new water point will adequately meet the community's needs in the future.

Hydrogeology and geophysical Characterization

The region is characterized by three main geological units, predominantly covered by a thin layer of Quaternary alluvial-aeolian deposits. The Auradu Limestone Formation is notable for its nodular limestones and sandy components, exhibiting a variable thickness from a few dozen meters in the southern hills to over 400–500 meters along the northern escarpment near Laas Canood. In contrast, the Yesomma Sandstone Formation, a continental unit composed mainly of quartzose sandstones and siltstones, typically exceeds 400 meters in thickness. Below these formations lies the Precambrian Undifferentiated Basement (PCB), comprising crystalline rocks of intrusive and metamorphic origin, expected to be found at depths greater than 500 meters.

The hydrogeological assessment reveals that the aquifer, particularly from Tog Wajale to Balidhiig, is predominantly located within the sandy deposits of the Yesomma Formation. The static water level (SWL) is usually close to the top of the basement, and the saturated section of the Yesomma rarely exceeds 50 meters. Consequently, yields from drilled boreholes are generally low, often not surpassing 10 m^3/hour. In Togdheer, however, the saturated section is anticipated to be much thicker, with yields reported between 10 and 20 m^3/hour, even when the SWL is deeper than 300 meters. Water quality assessments indicate moderate salinity in some areas, while others exhibit poorer quality.

The survey involved 15 Vertical Electrical Soundings (VES) conducted in two phases, which revealed significant insights into the subsurface geology. The VES data identified several resistivity units. The Top Unit consists of a thin layer of loose alluvial and aeolian deposits, with variable resistivity. Beneath this, the Conductive Unit primarily comprises marly deposits from the Auradu Formation, indicating unsuitability for groundwater. The Deep Semi-Resistive Unit, likely part of the Yesomma Formation, displays resistivity values suggesting it could host an aquifer, though its boundaries can be difficult to define. The Bottom Resistive Unit, found at depths beyond 500 meters, is thought to represent the Precambrian Basement.

The findings suggest several favorable locations for groundwater exploration, where high resistivity values indicate the potential for sandy layers conducive to aquifer development. The recommended drilling site has a suggested depths ranging from 400 to 500 meters. The study emphasizes the possibility of the Yesomma Formation providing a viable aquifer, with expected water quality varying from slightly brackish to strongly brackish.

Proposed Intervention

The proposed water project includes the drilling of a new borehole, with a pumping system, an elevated water tank, a kiosk, and animal troughs. Finally, the proposed water system is completed by a watchman house (with RO and UV system) and a power generation system (PV system).

Both the RO and UV systems are designed exclusively for human consumption and, for this reason, are connected only to the kiosk.

The photovoltaic system required to operate the pumping system represents a significant investment. Although it has been fully designed and it is considered in the cost-benefit analysis, it may be implemented at a later stage, depending on the final budget allocation. The borehole can operate using the diesel generator included in the pumping system design.

Considering the large number of livestock that will arrive at the site in search of water, the animal troughs must be constructed at more than 80 meters apart from each other and at an adequate distance from other nearby structures to guarantee their integrity.

The following images depict the layout of the proposed alternative. The following sections go into greater detail about the components.

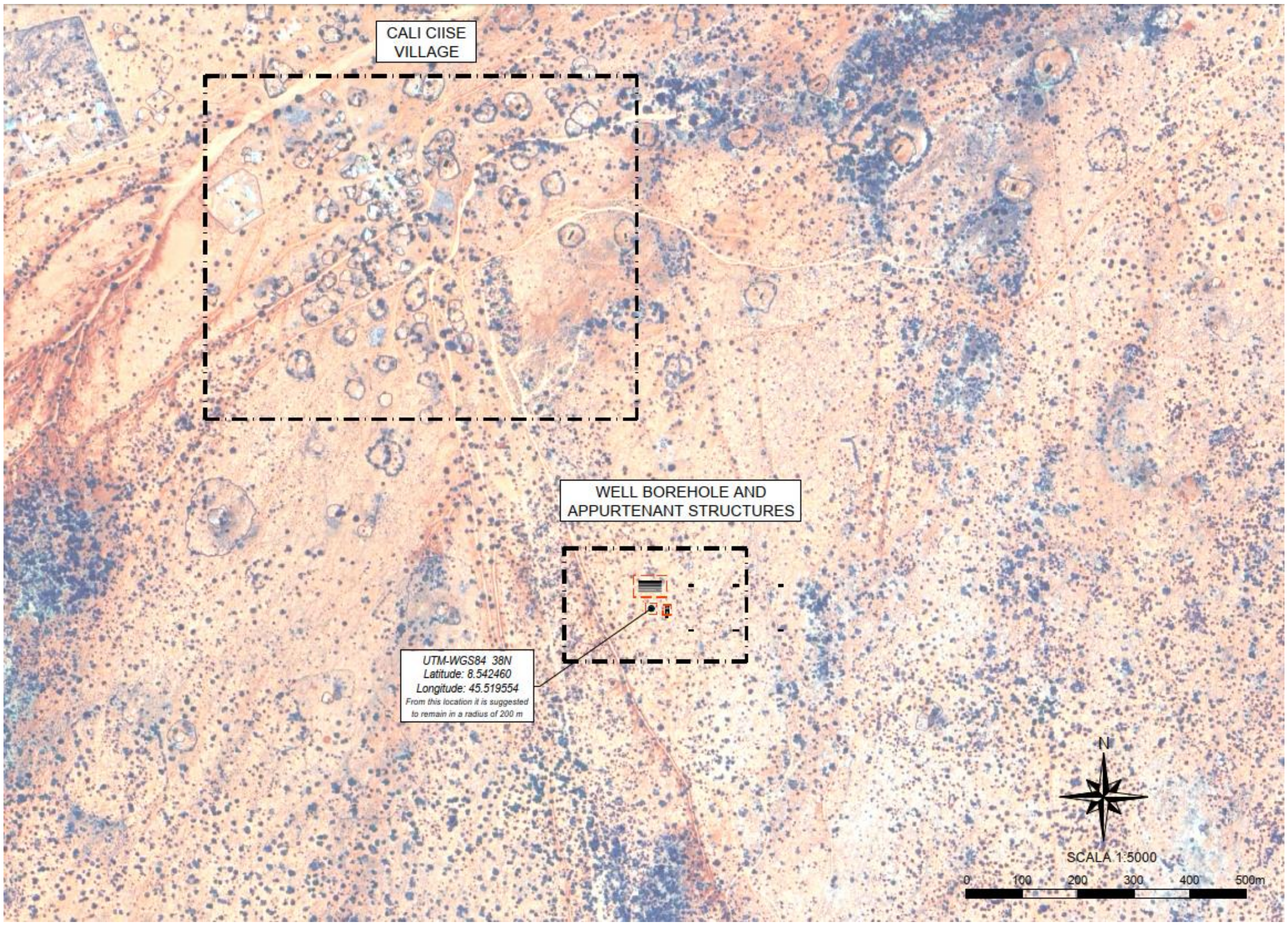


Figure 39: General planimetry view of the proposed water structure

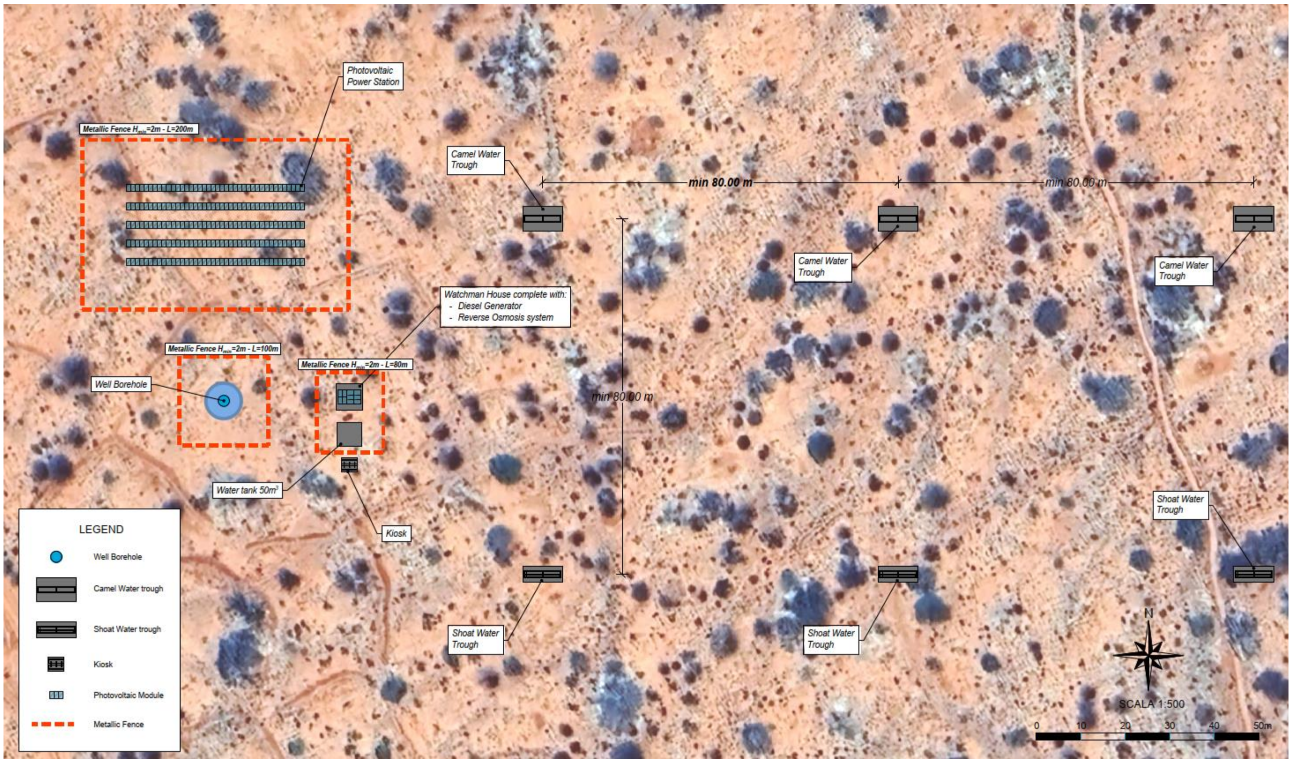


Figure 40: Layout view of the proposed water structure

Capital Expenditures

A preliminary estimate of the costs involved for the drilling (including overhead and labor costs) of the proposed borehole are provided in the table below.

Table 37: Preliminary estimate of the total capital investments required for the drilling of the borehole

ITEM	DESCRIPTION	UNIT	QUANTITY	RATE (USD)	AMOUNT (USD)
Drilling, Casing and construction work of a borehole <u>up to 450m</u> of depth					
2.1	Mobilization and demobilization of all drilling equipment (incl. transportation of rig, compressors, materials and crew/personnel to and from site and setting up and dismantling of equipment).	Ls	1.00	$4,000.00	$4,000.00
Complete Drilling work up to 500m depth of 14" diameter borehole well and installation of 8" (ø 203 mm) casings blind and screens. Include the unit rate for all necessary works, installation of service casing, materials and equipment such as disposal of excavated materials; supply water for drilling; taking any remedial					

measures to overcome caving in, or over drilling to accommodate sloughed material, drilling fluid, bentonite for sealing/grounding, fuel and water.					
2.2	Drilling by 14" diameter: 0-500 m. Using Rotary with mud drilling method	m	450.00	$260.00	$117,000.00
2.3	Sampling (at 2m interval) and storage of representative drill samples (incl. driller's log)	No.	225.00	$5.00	$1,125.00
Well construction and Casing					
2.4	Supply and installation of 203 mm (8"), minimum wall thickness 13.4 mm (R12.5) blind casing, selected and approved by the supervisor *(provisional)*. This will be a remeasurable cost.	m	270.00	$50.00	$13,500.00
2.5	Supply and installation of 203 mm (8"), wall thickness 13.4 mm (R12.5) screened pipe, 1,0-1.5 mm slotted and give a minimum open area of 10% selected and approved by the supervisor *(provisional)*. This will be a remeasurable cost.	m	180.00	$60.00	$10,800.00
2.6	Supply and install centraliser approved by the supervisor.	unit	22.00	$45.00	$990.00
2.7	Supply and install 1" U-PVC pipes for piezometric measurement in the annular space	m	430.00	$1.50	$645.00
2.8	Supply and installation of well-graded gravel pack filter material (of siliceous rock resistant to weathering and rounded) 3-5 mm	Cum	65.00	$180.00	$11,700.00
2.9	Installation of inert backfill material above the gravel packing / bentonite seal to 10 m bgl.	Ls	1.00	$2,000.00	$2,000.00
2.10	Supply and installation of Bentonite / cement seal at approved depth above the gravel pack (sanitary sealing), for 10 meters	Ls	1.00	$500.00	$500.00
2.11	Cement grout between the inner casing and the outer surface casing (including 1.00mX1.00mX0.60m well neck protective concrete slab casting in place).	unit	1.00	$560.00	$560.00
2.12	Install a standard well cap made of steel, as per Engineer's approval	No	1.00	$500.00	$500.00
2.13	Clear site of all drilling remains and debris including backfilling and leveling of mud pits, drains, temporary structures, etc.	Items	1.00	$500.00	$500.00

Borehole Development					
2.14	Borehole development through jetting, air lifting or over-pumping until clear sediment-free water is attained	hr	12.00	$450.00	$5,400.00
Test Pumping . Test pumping will include 4 step draw down and constant discharge test for 48 hrs and recovery test. This will include installation, removal of test pumping equipment, water level observations and draw down measurements and water analysis. NB: the pump is suitable for yields up to 5 l/s with a head of 400 m					
2.15	Supply, mobilize, set-up and install test pumping equipment as necessary and dismantle when completed.	Unit	1.00	$4,000.00	$4,000.00
2.16	Perform step draw-down/ recovery testing under the supervisor's instruction as necessary	steps	4.00	$500.00	$2,000.00
2.17	Perform perform constant-discharge test and full recovery test under the supervisor's instruction as necessary.	hr	48.00	$100.00	$4,800.00
TOTAL COST OF BOREHOLE DRILLING					$180,020.00
	supply and install 13" temporary surface casing steel welded	m	1.00		
	Note: the quantities mentioned in the BoQ, above, are to be understood as indicative and may be modified during the execution of the works as instructed by Supervisor's Representative				

Cost of the Appurtenant Structures

In addition to the construction of the borehole, we suggest adding several appurtenant structures which includes pumping system (powered by a photovoltaic field) connected to a new water tank located in the proximity of the watchman house. One kiosk and animals throughs will also be added to the intervention.

The costs required for the implementation of the appurtenant structures are summarized in the following table:

Table 38: Preliminary estimate of the total capital investments required for the construction of the appurtenant structures.

No	Item	Number	Unit Cost [US$]	Total Cost [US$]
1	General Items	1.00	$ 7,970.00	$ 7,970.00
2	Borehole drilling	1.00	$ -	$ -
3	Water pumping, RO & UV treatment	1.00	$ 46,200.00	$ 46,200.00
4	Water Tank	1.00	$ 21,756.83	$ 21,756.83
5	Construction of one Kiosk with 6 tabs	1.00	$ 503.87	$ 503.87
6	Construction animal water troughs for Camels/Catles	3.00	$ 5,829.70	$ 17,489.10
7	Construction animal water troughs for Goats and Sheep	3.00	$ 3,788.50	$ 11,365.50
8	WatchMan House	1.00	$ 11,017.96	$ 11,017.96
9	Diesel & Domestic PV Generators	1.00	$ 19,500.00	$ 19,500.00
10	Photovoltaic Field	1.00	$ 90,000.00	$ 90,000.00
			TOTAL COST OF PROJECT	**$ 225,803.27**

Operation and Maintenance

The chapter provides guidelines for the operation and maintenance of the borehole and its essential components. Boreholes require consistent monitoring of mechanical parts such as the pump, casing, and piping, as well as routine water quality testing. Although daily maintenance is minimal, quarterly checks on pump efficiency and seasonal inspections on the casing and connections are recommended to ensure optimal functionality. Each inspection should document the status of equipment, note any wear, and include photos to identify material changes or performance concerns.

Water quality testing should also be conducted periodically, as borehole water quality can vary due to environmental changes or usage patterns. Maintenance logs should detail the condition of components, along with any repairs made, including before-and-after photos. Keeping thorough inspection and repair records will support effective long-term maintenance, as it enables the tracking of part performance over time and helps forecast future maintenance needs. This proactive maintenance approach will sustain borehole operation, ensuring reliable water access for the community.

Specific Recommendations

Operation and Maintenance (O&M) of a groundwater source or wellfield includes all the tasks needed to keep the system functional. O&M includes regular tasks such as replacement of worn parts, refuelling, servicing, cleaning and monitoring, as well as dealing with irregular breakages, outages and malfunctions. Long-term, successful O&M needs suitably skilled and motivated personnel and depends in turn on a set of institutional and organizational systems.

This O&M manual is a guide to assist water supply managers, technical staff, plant operators, water practitioners and others to manage groundwater infrastructure. O&M activities ensure that the infrastructure delivering potable water to consumers is always operational. The information in this manual is derived from International Standards and best practices

The following is the operation and maintenance procedures that the community should regularly employ at the proposed borehole and its appurtenant structures.

Community Involvement: Skilled personnel and joint community management are recommended for effective monitoring and maintenance of the dam. Strengthen community capacity for management.

Management Committee: Form a management committee based on location and revenue capacity, with a minimum size of five members and gender balance.

Water Treatment: Ensure water is properly treated before human use. Extensive community training and awareness campaigns are required.

Borehole Operation and Maintenance

O&M tasks for boreholes include, monthly:

- Routine Inspection: Regularly inspect the borehole casing for signs of corrosion or damage, and address any issues promptly.
- Water Quality Testing: Conduct periodic water quality tests to ensure the water meets health standards, focusing on contaminants that may affect the aquifer.
- Preventive Sealing: Ensure proper sealing at the surface to prevent surface water infiltration and contamination.
- Water level measurements to establish if there is a decline
- Abstraction volumes to establish if there is a decline
- Keep away livestock from the well by fencing it off and ensuring the fence is always intact
- Repair any holes developing around the well
- Ensure that there is no stagnant water near the well by filling the depressions/holes
- Always keep the surroundings tidy

Pumps Operation and Maintenance

The submersible borehole pump is made up of several centrifugal pump chambers, each with its own impeller, stacked on top of each other. These are called stages and the more stages a pump has, the greater the height it can pump to. The size of the stages and the impellers governs the volume of water that can be pumped.

With an automatic electrical submersible pump, the operator must check the settings and correct operation of the pump control and pump protection systems.

This would typically include the operation timer, no-flow switch, and pressure cut off switch, and can include electrical components like variable speed drives, soft starters, phase failure protection relays, overload and underload protection relays.

On each visit:

- Check condition all electrical connections and wires
- Check that all three phases of power supply have power
- Visual check for dangerous electrical connections or wires
- Check nuts, bolts and screws (tighten if necessary)
- Check water level in borehole
- Record in logbook (hours run, flow meter, water pressure, water level)
- Start pump
- Check pipework for leaks
- Check that the water meter is turning, if not stop pump, investigate and repair the problem.
- Measure and record flow rate

Weekly

- Clean inside and outside of pump station

Every 4 months (or every 1000 hours of service)

- Check that the pressure cut out is operating
- Check that the no flow switch is working
- Inspect electrical connections, instrumentation, and pump protection relays and wiring
- Check the pump by measuring pressure, groundwater level and flow, and compare with the pump curve

Regular recording of the following parameters allows the operator to identify when the pump performance is deteriorating and is an early warning of potential pump problems.

- Motor hour meter
- Power drawn for an electric motor
- Flow meter – volume of water pumped
- Flow rate measurement
- Water pressure
- Groundwater levels

If the pump stops working the records of these parameters are especially useful for identifying the trends and specifying the problem with the pump. The following procedure can be followed for site investigation of a non-functioning

Water Tank Operation and Maintenance

Cracks of any size in masonry mortar must be carefully investigated by an engineer. Structural cracks often require professional investigations to determine the cause and appropriate method of repair. For that, it is not allowed to make changes or in any case compromise the integrity of the structures for any reason. It is necessary to periodically check any anomalies, such as the presence of lesions, swelling, hollows, cracks, disintegration, In case of ascertained anomaly, a qualified technician must be consulted as soon as possible for extraordinary maintenance.

Conditions that may necessitate ordinary maintenance tasks or repair actions include efflorescence and other stains, spalling, deteriorating mortar joints, interior moisture damage and mold growth. Once one or more of these conditions becomes evident, the origin of the problem should be determined and action taken to correct both the cause and the visible effect of the condition.

After investigating all possible contributors, the actual cause(s) of distress conditions may be determined through the process of elimination. Often the source will be self-evident, as with deteriorated and missing materials; however, in instances such as improper flashing or differential movement, the source may be hidden and determined only through building diagnostics. In any case, it is suggested to first visually inspect for a self-evident source before performing a more extensive investigation.

Table 39: Possible causes of masonry destress

Possible Causes of Masonry Distress

Observed Condition	Potential Cause of Condition								
	Incompletely filled mortar joints	Missing or clogged weeps	Plant growth	Deteriorated or torn sealant	Capillary rise	Missing or damaged flashing	Differential movement	Previous acid cleaning	Previous sandblasting
Cracked units	✓		✓				✓		
Spalled units	✓	✓		✓	✓	✓	✓		
Deteriorated mortar	✓	✓	✓		✓	✓	✓	✓	✓
Biological growth	✓	✓	✓	✓	✓	✓			
Efflorescence	✓	✓		✓	✓	✓		✓	
Moisture-related stains	✓	✓		✓	✓	✓			
Corrosion of concealed materials	✓	✓		✓	✓	✓		✓	
Damaged interior finishes	✓	✓		✓	✓	✓	✓		

The engineer, after inspection, can evaluate if the following ordinary specific maintenance can be performed:

- Removing Efflorescence (white deposits on the brick surface left when moisture carrying dissolved salts evaporates). Use solutions specifically manufactured to remove efflorescence from brickwork. Improper cleaning procedures such as insufficient prewetting, insufficient rinsing and strong chemical concentrations may cause additional staining, etched mortar joints and increase moisture penetration in brickwork. Stains caused by improper cleaning are not water soluble but can be removed by proprietary cleaners. To avoid improper applications of proprietary cleaners, it is imperative that the manufacturer's instructions be carefully followed.
- Sealant Replacement: Missing or deteriorated sealants in and between brickwork and other materials such as windows, doorframes and expansion joints may be a source of moisture penetration. The sealant joints in these areas should be closely observed to identify areas where the sealant is missing or was installed but has deteriorated, torn or lost elasticity. Deteriorated sealants should be carefully removed and the opening cleaned of all existing sealant material. The clean joint should then be properly primed and filled with an appropriately sized backer rod (bond breaker tape if the joint is too small to accommodate a backer rod) and a full bead of high-quality, elastomeric sealant compatible with adjacent materials. Sealant manufacturers should be consulted for the applicability and suitability of their sealants for expansion joint applications.
- Plant Removal Certain types of plant growth may contribute to moisture penetration. To effectively remove ivy and similar plants, the vines should be carefully cut away from the wall. Avoid pulling the vines away from the wall, as this could damage the brickwork. After cutting the ivy, the shoots will remain. These shoots are embedded in the wall and should be left undisturbed until they dry, shrivel and turn dark. This usually takes two to three weeks. Care should be taken not to allow the suckers to rot and oxidize, as doing so can make them difficult to remove without damaging the wall surface. Once these shoots become dry, they can be removed with a stiff fiber brush and laundry detergent. Chemicals or acids should not be used to remove them, as this increases the risk of damaging or staining the wall.

Where the masonry blocks are loose, they should be carefully removed from the surface of the masonry, set to one side and the condition of the exposed material should be assessed. Where a number of blocks in one area are loose, it is possible that their condition reflects a problem in the area behind them and the condition of this whole area should be assessed before the surface masonry is put back in place. Where it is found that the material behind the masonry is in good condition, the masonry blocks should be stitched back into place. The blocks should be set flush with the surrounding blocks, not proud or inset in order to reduce the pressures acting on them.

Watchman House Operation & Maintenance:

Masonry walls and structures

Generally cracks in masonry walls get localized at weak sections such as door and window openings, stair case wall etc. In external walls of a building generally shrinkage cracks run down wards from window sill to plinth level. On the upper story they run from window sill to the lintel level of a lower story.

Shrinkage cracks in masonry could be minimized by adopting following measures:

a) Avoiding the use of rich cement mortar of 1:3 in the masonry. Preferably weak mix of 1:6 should be used,

b) Plaster work should not be carried out till masonry has properly dried out after curing and has under gone most of its initial shrinkage.

Masonry work should be done with weak composite cement lime and sand mortars of 1:1:6, 1:2:9 or 1:3:12 proportion. These mixes being weak will have lesser tendency to crack due to shrinkage in individual masonry unit. The shrinkage to a great extent will get accommodated in the mortar itself.

Where the masonry blocks are loose, they should be carefully removed from the surface of the masonry, set to one side and the condition of the exposed material should be assessed. Where a number of blocks in one area are loose, it is possible that their condition reflects a problem in the area behind them and the condition of this whole area should be assessed before the surface masonry is put back in place. Where it is found that the material behind the masonry is in good condition, the masonry blocks should be stitched back into place. The blocks should be set flush with the surrounding blocks, not proud or inset in order to reduce the pressures acting on them.

Although this is not an entirely sympathetic option as far as appearance is concerned, it has the advantage of being relatively quick and inexpensive whilst at the same time achieving a good and thorough infill and bond within the gap. Coloured cements can be used for colour matching to the adjacent masonry, if desired.

Electric system (Photovoltaic modules) Operation & Maintenance

One of the most valuable techniques for identifying existing problems and preventing future problems is to walk the site and conduct a thorough visual and hands-on inspection of the PV system components. These inspections should be conducted at regular intervals, and personnel should use checklists developed for these periodic maintenance activities to ensure that the inspections are thorough and complete.

At least once a year, O&M personnel should conduct a general and detailed inspection and a of the PV installation site.

<u>PV system General site annual inspection:</u>

During this inspection, technicians should:

- ensure roof penetrations are watertight, if applicable;
- ensure roof drainage is adequate, roof drains are not clogged, and confirm that there are no signs of water pooling in the vicinity of the array;
- check for vegetation growth or other new shade items such as a satellite dish;
- check for ground erosion near the footings of a ground mount system;
- confirm proper system signage is in place;
- confirm appropriate expansion joints are used where needed in long conduit runs;
- confirm electrical enclosures are only accessible to authorized personnel, are secured with padlocks or combination locks, and have restricted access signage;

- check for corrosion on the outside of enclosures and the racking system;
- check for cleanliness throughout the site—there should be no debris in the inverter pad area or elsewhere;
- check for loose hanging wires in the array;
- check for signs of animal infestation under the array.

PV system Detailed Visual Inspection

The installation should be inspected regularly for issues that impact the physical integrity or performance of the PV system. A visual inspection should include the following actions:

- Inspect the inverter/electrical pad to make sure it does not show excessive cracking or signs of wear. The inverter should be bolted to the pad at all mounting points per the manufacturer installation requirements. Depending on the size, location, and accessibility of the system to unqualified personnel, the inverters, combiner boxes, and disconnect switches should require tools or have locks to prevent unauthorized access to the equipment.
- Look for warning placards including arc flash or PPE requirements for accessing equipment. Be sure to comply with all warning placards. If no placards are present, or if some placards are missing, make a note of it and install the missing placards during the maintenance visit.
- Inspect PV modules for defects that can appear in the form of burn marks, discoloration, delamination, or broken glass.
- Check modules for excessive soiling from dirt buildup or animal droppings.
- Ensure that the module wiring is secure and not resting on the roof, hanging loose and exposed to potential damage, bent to an unapproved radius, or stretched across sharp or abrasive surfaces.
- Inspect racking system for defects including rust, corrosion, sagging, and missing or broken clips or bolts.
- If sprinklers are used to spray the array, check that the water is free of minerals (demineralized) as these minerals can cause gradual performance degradation.
- Inspect conduits for proper support, bushings, and expansion joints, where needed.
- In roof-mounted systems, check the integrity of the penetrations.
- In ground-mounted systems, look for signs of corrosion near the supports.
- Open combiner boxes and check for torque marks on the connections. Torque marks are made when lugs have been tightened to the proper torque value. Ideally they are applied during initial installation, but if not, the technician can mark the lug after torquing during a maintenance visit. A proper torque mark is made with a specialized torque marking pen. The mark is a straight line through the lug and the housing. Over time, if the line separates between the lug and the housing, it shows that the lug has moved and needs to be re-torqued. Look for debris inside the boxes and any evidence of damaging water intrusion. Look for discoloration on the terminals, boards, and fuse holders.
- Open the door to the disconnect(s) and look for signs of corrosion or damage. Check to make sure the cabinet penetrations are properly sealed and there is no evidence of water ingress. Check for torque marks on the terminals.
- Perform a visual inspection of the interior and exterior of the inverter. Look for signs of water, rodent, or dust intrusion into the inverter. Check for torque marks on the field terminations.
- If a weather station is present, ensure that the sensors are in the correct location and at the correct tilt and azimuth. A global horizontal irradiance sensor should be flat, and a plane of array irradiance sensor should be installed to the same pitch and orientation as the array. Irradiance sensors should be cleaned to remove dirt and bird droppings.

Only qualified personnel must work on PV installations. Safety is a serious concern when servicing PV installations. Safety considerations require that qualified personnel use properly rated equipment and be trained for servicing the higher voltage systems. Qualified personnel should always work in teams of two people when working on live equipment. In addition, on a given jobsite, there should always be at least two qualified persons trained.

Not all installations have appropriate signage, and qualified persons must be trained to recognize potential hazards with or without signage present.

Kiosk and Shoats/Camel Water Trough Operation & Maintenance

Due to the large number of cracks or damages observed in these components of the structure, the repair and rehabilitation of such members assumes greater importance.

The exposed surface of concrete and reinforcement are coated with a primer compatible with the repair system. The primer can be applied by rolling it on the surface with a paint roller and allowed to harden. The primer coat on the reinforcement provides it an additional protection against corrosion. After the primed surface has hardened adequately, it becomes impervious to moisture and could remain protected from environmental effects.

Costs of Operating and Maintaining the Water Project

The cost for operating and maintaining the proposed borehole and the appurtenant structures, sums up to an estimated US$ 41,743 / year. This value is primarily determined by the diesel supply needed for the generator's operation during the hours when sunlight is insufficient to power the photovoltaic panels. The details of the activities and cost included in the regular and extraordinary maintenance are presented below.

Table 40: Investments required for Operating and Maintaining the water project

Element Type	Ordinary/extraordinary Operation&Maintenance	Description	Frequency (n°/year)	U.M.	Unit cost (US $)	QTY (U.M.)	Yearly Single Items Cost (US$)	Yearly Cost Per Group (US$)	Yearly Total Cost (US$)
Well & Pump	*Ordinary O&M*	Diesel supply for the operation of the generator, for 12 out of the 20-hour daily operation during the dry season (150 days)	1	L.S.	30000		$30,000		

		Conduct periodic water quality tests to ensure the water meets health standards, focusing on contaminants that may affect the aquifer	4	L.S.	250		$1,000		
		Ensure proper sealing at the surface to prevent surface water infiltration and contamination	2	L.S.	250		$500		
		Water level measurements to establish if there is a decline and Abstraction volumes to establish if there is a decline	2	L.S.	500		$1,000		
		Ensuring the fence is always intact, Repair any holes developing around the well	4	L.S.	100		$400		
		Ensure that there is no stagnant water near the well by filling the depressions/holes	4	L.S.	100		$400		
		Always keep the surroundings tidy	4	L.S.	50		$200		
		Remove the unsound concrete into protective concrete slab, apply a protective coating to the reinforcement steel, cleaning and applying repair mortar	0.2	L.S.	350	-	$70		

	Extraordinary O&M	Overhaul pump, valves and other electromechanically components, if any	0.5	L.S.	1000	-	$500	**$34,070.00**	**$35,184.00**
Water Tank	*Ordinary O&M*	If there's water in the aquifer but nothing inside the well, excavation and repair of filter drain	0.2	L.S.	3500	-	$700		
		Control settlements, cracks, exposure of reinforcement steel bars and any other alteration visible in the structure	1	L.S.	100	-	$100		
	Extraordinary O&M	Cleaning and removal of trees, bushes and grasses from nearest area to the structure	1	L.S.	250	-	$250		
		Removed loosen masonry blocks and replace them with a new ones.	0.2	m^3	70	1	$14		
		Replace any deteriorated sealants	0.2	L.S.	250	-	$50	**$1,114.00**	**$1,114.00**
WatchMan House	*Ordinary O&M*	If there's water in sand dam but nothing inside the well, excavation and repair of filter drain	0.2	L.S.	3500	-	$700		
		Control settlements, cracks, exposure of reinforcement steel bars and any other alteration visible in the structure	1	L.S.	100	-	$100		
		Visual inspection of PV system discovering issues that impact the	1	L.S.	100	-	$100		

		physical integrity or performance							
		Clean PV panels according with manufactures' indications and washing products	1	L.S.	250	-	$250		
	Extraordinary O&M	PV system inspection and check by qualified personnel	0.5	L.S.	400	-	$200		
		Removed loosen masonry blocks and replace them with a new ones.	0.2	m^3	70	1	$14		
		Replace any deteriorated sealants	0.2	L.S.	250	-	$50	**$1,414.00**	**$36,598.00**
Kiosk and Shoats/Camel Water Trough	*Ordinary O&M*	Remove the unsound concrete, apply a protective coating to the reinforcement steel, cleaning and applying repair mortar	0.2	L.S.	350	-	$70		
		Control settlements, cracks, exposure of reinforcement steel bars and any other alteration visible in the structure	1	L.S.	100	-	$100		
	Extraordinary O&M	Check and repair taps or other minor hydraulic device that can be damaged by users	1	n°	25	6	$150		
		Appling to the exposed surface of concrete and reinforcement steel	0.5	L.S.	250	-	$125	**$445.00**	**$37,043.00**

		bar a compatible primer							
Photovoltaic System	*Ordinary O&M*	Control settlements, cracks, exposure of reinforcement steel bars and any other alteration visible in the concrete foundation. Control integrity of aluminum support of each panel.	1	L.S.	1000	-	$1,000		
		Visual inspection of PV system discovering issues that impact the physical integrity or performance	1	L.S.	200	-	$200		
		Clean PV panels according with manufactures' indications and washing products	1	L.S.	2500	-	$2,500		
	Extraordinary O&M	PV system inspection and check by qualified personnel and substitute one or more panels if necessary or other electric component of the system	1	L.S.	1000	-	$1,000	**$4,700.00**	**$41,743.00**
								Total	**$41,743.00**

Cost-Benefit Analysis

The total investment required for the implementation of the proposed project is summarized in the following table:

Table 41: Summary of capital expenditures required for the entire project.

No	Item	Number	Unit Cost [US$]	Total Cost [US$]
1	General Items	1.00	$ 7,970.00	$ 7,970.00
2	Borehole drilling	1.00	$ 180,020.00	$ 180,020.00
3	Water pumping, RO & UV treatment	1.00	$ 46,200.00	$ 46,200.00
4	Water Tank	1.00	$ 21,756.83	$ 21,756.83
5	Construction of one Kiosk with 6 tabs	1.00	$ 503.87	$ 503.87
6	Construction animal water troughs for Camels/Catles	3.00	$ 5,829.70	$ 17,489.10
7	Construction animal water troughs for Goats and Sheep	3.00	$ 3,788.50	$ 11,365.50
8	WatchMan House	1.00	$ 11,017.96	$ 11,017.96
9	Diesel & Domestic PV Generators	1.00	$ 19,500.00	$ 19,500.00
10	Photovoltaic Field	1.00	$ 90,000.00	$ 90,000.00
			TOTAL COST OF PROJECT	**$ 405,823.27**

Based on the capital costs required for building the proposed water project and the comparison between water demand and water availability, a cost-benefit analysis for the proposed solution is summarized in the following table.

Table 42: Summary of the key numbers of the Cost/Benefit analysis

C/B ANALYSIS				
N	**Name of Site**	Cali Ciise		
1	Type of Intervention	Borehole		
2	Total Extractable Amount of Water over the dry season	m^3		54,000
3	Total Water Needs during the dry season	m^3		55,941
4	**Capital Investments**	**US$**	**$**	**405,823.27**
5	*Rehabilitation of the Well*	*US$*	*$*	*180,020.00*
6	*Construction of Appurtenant Structures*	*US$*	*$*	*225,803.27*
7	Capital Cost per m^3 of water Produced	US$	$	7.52
8	Percentage of water needs covered	%		97%
9	Number of people the dam can serve annually	n		6,853
10	Capital cost per person	US$	$	59.22
11	Fixed Annual Cost (CAPEX)	*US$*	*$*	*7.40*
12	Variable Annual Cost (OPEX)	*US$*	*$*	*6.09*
13	**Total annual costs**	**US$**	**$**	**13.49**
14	**Unit Cost per m3 of water**	**US$/m3**	**$**	**1.20**
15	Average Cost per m3 of water sold by water trucks	US$/m3	$	17.00

Based on the above, the proposed borehole, with an extractable volume of 54,000m^3 and a capital cost of US$405,823.27, will provide support to 97% of the total local needs (human + livestock) for a period of up to 150 days of dry season (when the storage water structures dry up). The raw water cost for this borehole is therefore estimated to be (US$405,823.27/ 54,000) = US$7.52 per cubic meter. The capital cost of the borehole and appurtenant structures is estimated at (US$405,823.27/ 6,853) = US$59.22 per person. The proposed water project is assumed to have a lifespan of 20 years with fixed annual costs of US$7.40 per person per year, and a recurrent cost of US$6.09 per person per year. The total recurrent and fixed annual costs of the earth dam are therefore estimated to be US$13.49 per person[7].

If people reduce their water usage in the dry season to 25 litres per day and increase that amount to 35 litres in the rainy season, we can estimate the annual water demand of one person to be 11,275 litres/year or 11.3 m^3/year[8].

The unit cost for the proposed water project would therefore be **US$1.20 per cubic meter of water**[9]. According to the Somalia WASH Cluster, in the area, communities pay up to $17 per cubic meter for water used for washing, cooking, and livestock during the dry season. Based on this information, the construction of the proposed project would bring significant benefit to the village.

[7] Annual depreciation rate of the infrastructure is linear at (((US$405,823.27/ 20 years)/ 405,823.27) *100) = 5.0% per year. The interest rate is assumed to be fixed at 7.5% per year. Hence the fixed costs for the water project will be (7.5% + 5.0%) = 12.5% of $59.22, which is $7.40 per person per year. The recurrent annual cost for operating and maintaining the borehole and appurtenant structures are approximately US$ 41,743 per year. The annual cost, divided by the number of people served by the proposed structure, gives a recurring cost of $6.09 per person per year. Hence a total annual cost of (US$7.40 + $6.09) is US$13.49 per person.

[8] ((25 litres*150 dry season days) + (35 litres*215 days)) = 11,275 litres per person per year.

[9] The unit cost of water is estimated by dividing the annual capital costs by the annual water demand ($13.49 / 11.3$m^3$) = US$ 1.20 per cubic meter.

Conclusions and Recommendations

Cali Ciise site (Latitude: 8.5425° - Longitude: 45.5196°), located about 100 kilometers south of the capital city of Burco, is one of the sites the government of Somaliland has considered to be developed under the GW4R Project.

The surrounding communities are home to approximately 800 households that rely primarily on livestock and approximately 250 nomadic families that rely on water availability at the site during the dry season. Livestock, including camels, goats, cattle and donkeys play a significant role in the local economy, with varying numbers in each category.

The site for the new borehole was selected due to its proximity to the communities and the fact that the nearest borehole is approximately 50 kilometers away, as the area urgently needs a reliable water source to support residents during the dry season when traditional water storage structures run dry.

In addition to the construction of the borehole, we suggest adding several appurtenant structures which includes pumping system (powered by a photovoltaic field) connected to a new water tank located in the proximity of the watchman house. One kiosk and animals throughs will also be added to the intervention.

The implementation of the borehole and all the appurtenant structures is estimated to be US$405,823.27 to which an additional US$ 41,743 should be added in support of operation and maintenance activities.

The cost-benefit analysis presented in this report has shown that the village and the nearby communities of nomadic pastoralists would benefit for the construction of the water structure and all the appurtenant structures. In such scenario the unitary cost per cubic meter of water will be US$1.20 which is lower than the average price villagers pay during drought years (when the cost of one cubic meter of water used for the animals can be as high as US$17/$m^3$).

Annex 1 – Hydrogeological Investigations

Geological Frame

A geophysical survey was conducted in an area near the border where the Auradu Limestone Formation outcrops. The regional geology is characterized by three main geological units, which are mostly covered by a thin layer of Quaternary alluvial-aeolian deposits:

- Auradu Limestone Formation (Ea, Middle-Early Eocene): This unit consists of nodular limestones, abundant marls, and sandy limestones. Its composition and thickness vary by location, ranging from a few dozen meters in the hills south of Hargeisa to over 400–500 meters along the northern escarpment of the plateau near Laas Canood. The closest data to the study site come from Balidhiig, about 50 km ESE, where the Auradu Formation was found at depths of up to 300 meters, and from the Shanshacade borehole (50 km ENE), where the unit was present up to the bottom of the drilling at 400 meters. The Auradu is the first post-Cretaceous marine unit and lies unconformably on the Yesomma Formation.
- Yesomma Sandstone Formation (Cretaceous): The Yesomma Formation (Ky) is a continental unit composed of variegated quartzose sandstones and siltstones, primarily of fluvial and/or lacustrine origin. It extends across much of the Haud Plateau, with thicknesses typically exceeding 400 meters. In some tectonic trenches, such as the Nugal Valley and Xood Trench, this formation unconformably overlies Jurassic limestones. However, no data from the nearby border area confirm the presence of Jurassic limestones, so it is assumed that in the study area, the Yesomma Formation lies directly and unconformably on the basement.
- PCB (Precambrian Undifferentiated Basement): This is a complex of crystalline rocks of intrusive and metamorphic origin, forming part of the ancient African Shield. It outcrops at the border between the Awdal and Marodijeex regions and along the northern edge of the Haud Plateau. It has likely been encountered in most drillings in the Marodijeex region, with depths ranging from less than 100 meters at Tog Wajale to over 350 meters in the Salaxley-Balli Gubadle area. In the study area, it is expected to be at depths of no less than 500 meters. However, drilling logs are completely absent in the area from Balli Gubadle toward the southeast. At Balidhiig, the PCB was not encountered, indicating a depth of more than 460 meters.

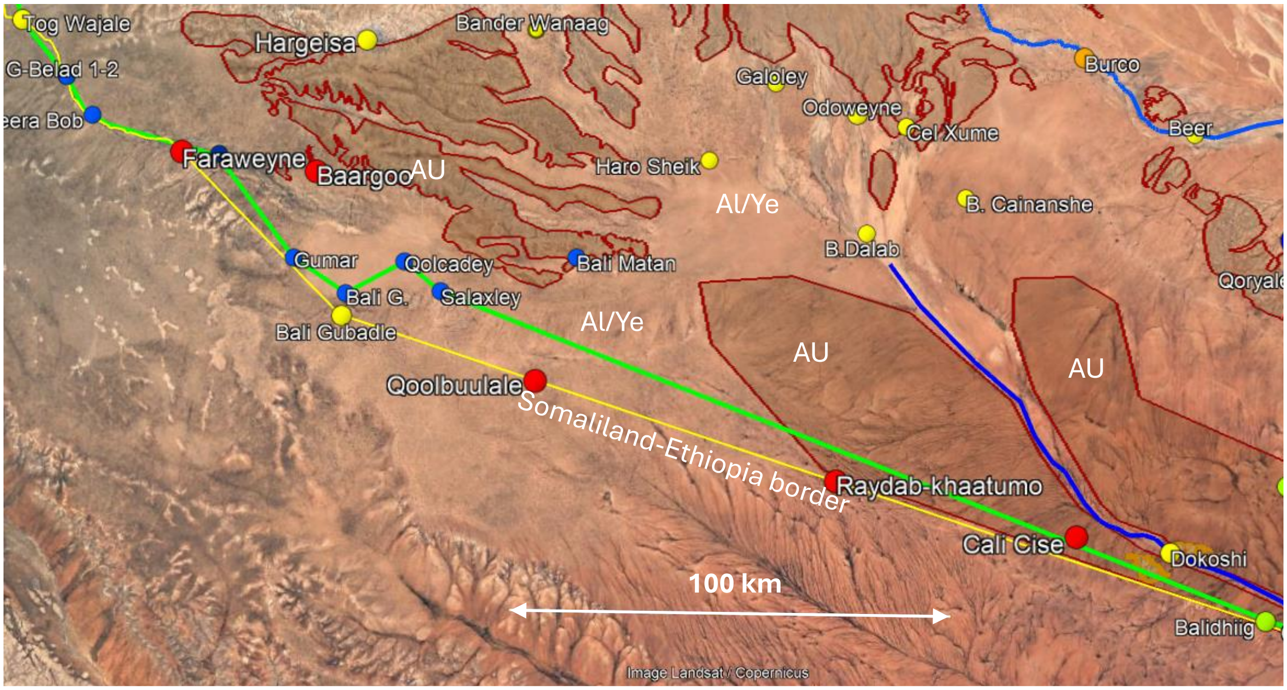


Figure 41: Geological map of South Somaliland with borehole location – Al/Ye: Yesomma Sandstone, with alluvial cover – AU: Auradu Limestones – yellow line: international border – green line: cross-section shown in more detail below– blue/green points: boreholes – red points: sub project proposed sites – map modified by Abate et Al (1994)

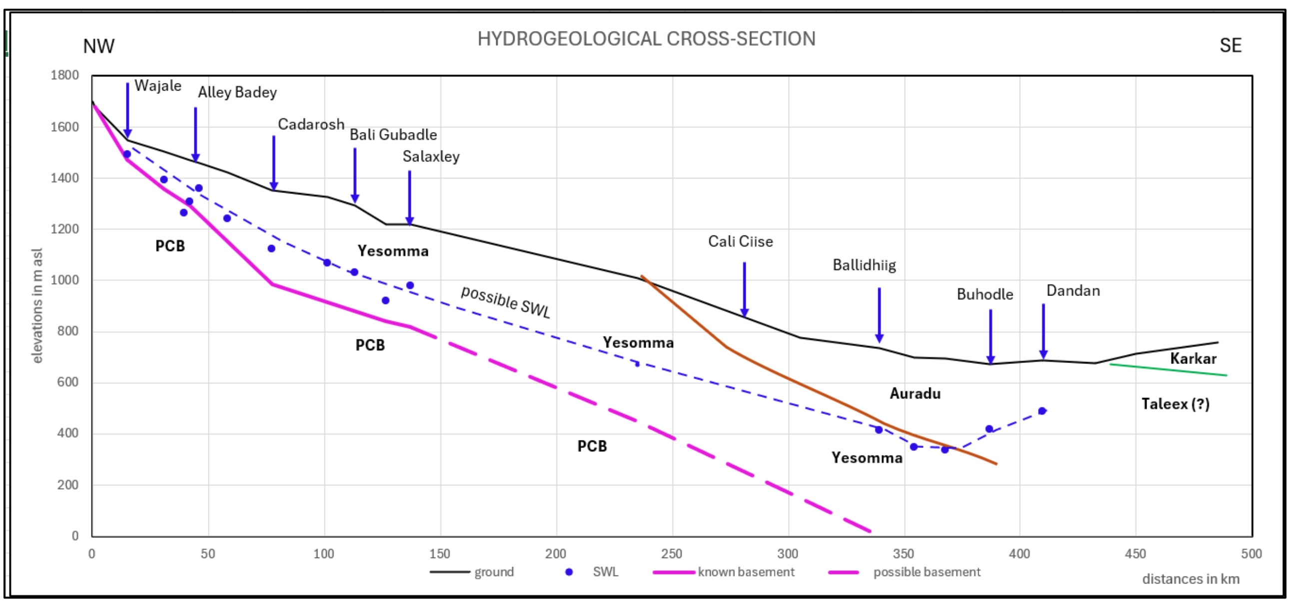


Figure 42: Hydrogeological cross-section along the Somaliland Ethiopia border

Hydrogeology

Along the border, from Tog Wajale to Balidhiig, the aquifer is located in the sandy deposits of the Yesomma Formation. In the Marodijeex region, up to Salaxley, the static water level (SWL) is typically close to the top of the basement, and in most cases, the saturated section of the Yesomma rarely exceeds 50 meters. As a result, the yields of drilled boreholes are generally low, rarely exceeding 10 m^3/hour. This scarcity of yield can be attributed to several factors, including the abundance of fine deposits in the Yesomma Formation, the challenges of drilling, poorly completed boreholes, and the limited capacity of submersible pumps, which require significant power to raise water from depths of 200–300 meters.

In Togdheer, the saturated section of the Yesomma Formation is expected to be much thicker. Data reported by SWALIM and measured during pumping tests show yields of nearly 10 to 20 m^3/hour, even at SWL depths greater than 300 meters, as seen in Balidhiig.

At Buhodle, the aquifer appears to be partly located in the Auradu Formation, likely due to the presence of thicker limestone intervals and a lesser amount of marly-shale components. Eastward from Buhodle, the water table begins to rise, likely due to the presence of the Taleex evaporites, which host aquifers at shallow depths in the Laas Canood area (Nugal Valley).

Water quality, measured using an EC meter in July, was found to be moderate in the area between Geed Belad and Wadabarish and in the Bali Gubadle borehole (2,300–3,000 µS/cm). However, water quality was poor in Gumar, Salaxley, and Shanshacade (3,600–5,000 µS/cm). At Balidhiig, the borehole was non-functional, so no measurements were taken, although testing during pumping indicated poor quality at the end of drilling.

Based on this information, in the study area, the aquifer is likely to be found in the Yesomma Formation, where sandy deposits dominate. The SWL is expected to be between 250 and 350 meters, with potential yields of 12–18 m^3/hour. The water quality, however, remains unknown.

The following table presents a summary of borehole data provided by the Ministry of Water Resources Development (MoWRD), extracted from the SWALIM database, and gathered during a field mission in July 2024. The mission visited boreholes near the border from Tog Wajale, where three new boreholes have been drilled, up to Shanshacade and Balidhiig in Togdheer. Unfortunately, many boreholes were temporarily closed due to heavy rains that filled the valleys, providing the population with fresh and affordable water. In some cases, there was no personnel available to provide information on yield, daily pumping times, or other data, and it was not possible to obtain water samples for EC measurement. However, during the field mission, the geologist confirmed the presence of Precambrian basement (PCB) fragments near the boreholes, indicating that the basement had been reached during drilling.

Table 43: Boreholes location and hydraulic parameters – PVB: Precambrian Basement

name	Latitude	Longitude	Depth	SWL	DWL	pump depth	Yield	pump time	Yield	EC	Status	Lithology
	decimal degree		m	m bgl	m bgl	m	m3/hr	hours	m3/day	µS/cm		
Tog-wajale 1	9.63330	43.36373	180	68.7		abandoned					not working	
Tog-wajale 2	9.63736	43.35383	180	67		155	12	3	36	3700	Active	
Tog-wajale 3	9.64334	43.40393	180	66.5		138	14	new		4650	new	PCB frag.
Tog-wajale 4	9.63769	43.38407	218	65	72	145	27	new		4500	new	PCB frag.
Tog-wajale 5	9.63481	43.37925	210	65	70	148	26	new		5457	new	PCB frag.
Geed Belad 1	9.48774	43.42720	144	sealed		232	3.5	0-23		2550	Active	
Geed Belad 2	9.48531	43.42803	160	sealed		146	2.5	0-23	10	2620	Active	
Walixdoor	9.42022	43.46156	216	174		210	10	0-18		2370	Active	PCB frag.
Dameera Bob	9.40679	43.48204	250	sealed		180	15	0-23			Active	PCB frag.
Cadaroosh	9.32703	43.74477	377	sealed		310	13.5	18		2800	Active	PCB frag.
Wadabarish	9.20625	43.79685	326	sealed		305	4			3020	not working	PCB frag.
Gumar	9.11774	43.90090	340	sealed	260	280	3	3	10	3600	Active	PCB frag.
Baligubadle	9.04583	44.00847	360	sealed		300	13	3	50	2790	Active	
Qolcadey	9.11047	44.12960	360	sealed		damage					not working	
Salaxley	9.05532	44.20271	400	300		362	11	5	55	4080	Active	
Salaxley new	9.06256	44.19918	400	borehole under completion. Drilling samples label (depth) not readable								
Balidhiig	8.37452	45.90854	462	320	No	370	11				not working	PCB frag.
Shanshacade	8.64969	45.95254	360	182		315	15	3	45	5010	Active	

Table 44: Location and hydraulic parameters of the boreholes along Somalia-Ethiopia border

name	Latitude	Longitude	Elevation	Depth (m)	SWL	Pump depth	Yield	pump time	Draw-Down	DWL	AqH//SCL	T	K	EC	Recovery 90%	Ye/PCB depth		Main Aquifer	Year	Agency	Region
	decimal degree		m asl	m	m bgl	m	m^3/hr	hours	m	m bgl	m	m^2/day	m/day	µS/cm	min	m					
Tog Wajale	9.60065	43.33477	1555	84	57		2.5		dried up							77	PCB	YE	2003	Africa 70	Marodijeex
Wado Godka	9.54815	43.42520	1530					abandoned for water salinity										YE	2005	Africa 70	
Geed Belad 1	9.48531	43.42803	1508	160	130		8.7	23						2450				YE	2005	Africa 70	
Geed Belad 2	9.48774	43.42720	1505	162	112		12.9	12	13.35	129	33	1.2E+02	3.6E+00		50	148	PCB	YE	2006	COSOB Co.	
Walixdoor	9.42010	43.46150	1480	216	150													YE	2019	SWALIM	
Dameera Bob 1	9.40679	43.48204	1471	200/212	>150/80	188	12/7							2870				YE	2005/14	A70/SWALIM	
Dameera Bob 2	9.40650	43.48180	1467	230	200				22									YE	2019	SWALIM	
Alley Badey	9.38700	43.51370	1459	180	100		7											YE	2014	SWALIM	
Wado Makail	9.35944	43.61015	1422	265	180		4											YE	2019	SWALIM	
Fararweyne	9.33240	43.66869	1401	270	245		4		12					2570	3			YE	2019	SWALIM	
Cadaroosh	9.32800	43.74579	1374	377	232.5	300	16	24	23	46.65	242	1.4E+02	2.4E+01		10	368	PCB	YE	2021	MoWRD	
Wadabarish	9.20602	43.79650	1384	300	225		16							3020				YE	2019	SWALIM	
Gumar	9.11774	43.90090	1327	340	257	300	9	72	3.45	260.5	41			1730	40			YE	2018	MoWRD	
Qolcadey 2	9.11047	44.12960	1223	376	300-330		4	7	2					3170	4			YE	2017	TS/SWALIM	
Qolcadey 1	9.08800	44.19152	1198	340	300			abandoned for low yield										YE	2019	TS/SWALIM	
Salaxley	9.05014	44.20447	1200	390	240		12	8						3300				YE	2022	SWALIM	
Bali Matan	9.11882	44.48454	1426	460	430		5	20						3160				YE	2022	SWALIM	
Balidhiig	8.37452	45.90854	736	462	320	370	18	24	3	323	80	4.2E+02	2.9E+00		10	306	YE	YE	2022	MoWRD	Togdheer
Shanshacade	8.64969	45.95254	784	395	183	370	12	24	122	305	146	3.1E+00	1.5E-02		70			AU	2022	MoWRD	
Coodanle	8.33506	46.04233	700	350	320		8	5						1670					2022	SWALIM	
Xadhadhanka	8.29970	46.15640	696	360	333		16	24	not working in 2019 for problem to pump										2019	SWALIM	
Qori Lugud	8.56011	46.23796	741	354	176		16	12						1360					2022	SWALIM	
Shangalli	8.28255	46.31196	656	398	239		18	12						3830					2022	SWALIM	
Buhodle 3	8.25550	46.31960	672	350	270	12	16	24											2022	SWALIM	
Buhodle 2	8.24664	46.32216	672	400	252	380	14.4	24	47	298.55	75.4	1.6E+01	1.04E-01	n.a.	240	397	YE	AU +YE	2021	MoWRD	
Qararrooyin	8.22000	46.35600	660	360	270																
Dandan	8.25140	46.52950	683	370	200	200	16	12						4280					2019	SWALIM	

data source	MoWRD	SWALIM	COSOB Co.	Africa 70	TS
red color	dried or abandoned or temporarily not working				

AqH//SCL	aquifer thickness/filters lenght
Ye/PCB	Yesomma/Precambrian basement

VES Survey

The survey was conducted using 15 Vertical Electrical Soundings (VES) with a maximum AB/2 spacing of 1,000 meters during the first phase, which took place from August 24th to 28th, 2024. An additional five VES were completed in the second phase, from September 18th to 21st. The VES layout was generally oriented at 280–300° E, with a few exceptions due to accessibility constraints.

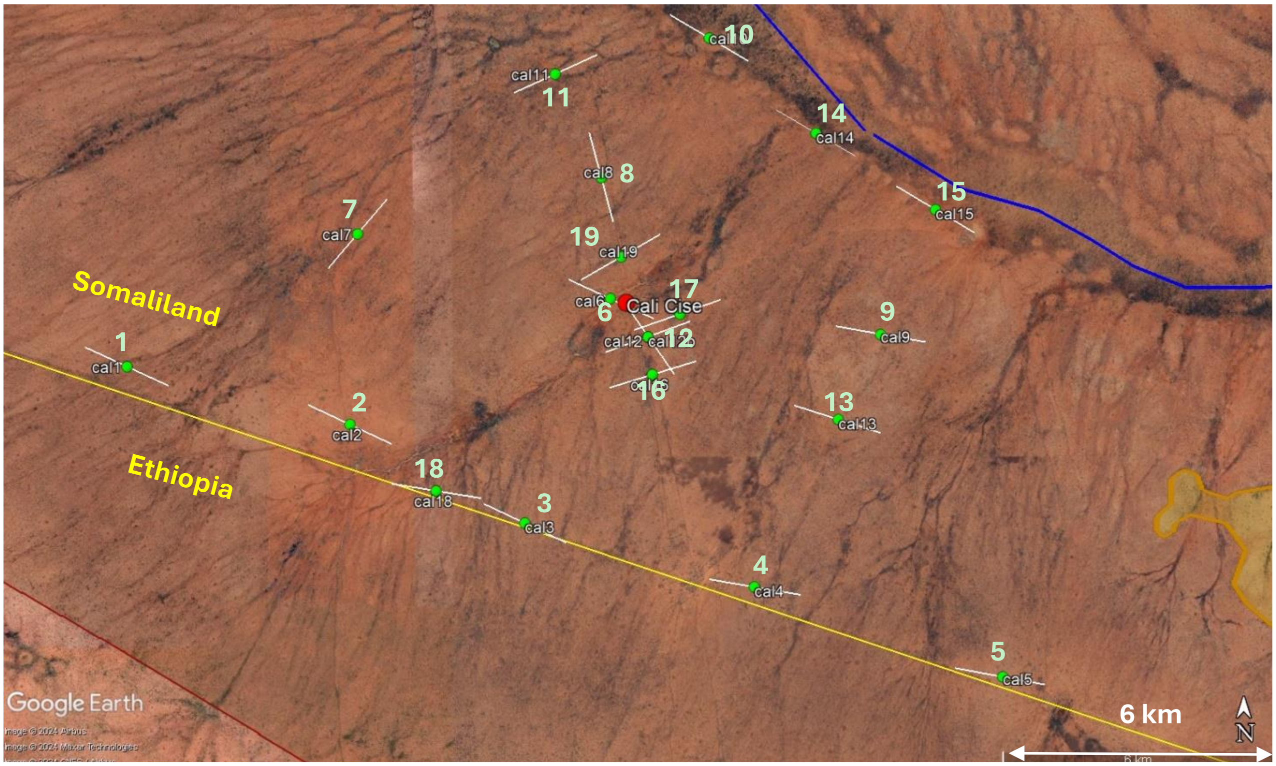


Figure 43: VES locations (green points), denomination and azimuth (white lines) – green numbers: VES denomination – red point: village – yellow line: border – blue line: main area drainage

The VES data were interpreted using the NEW-VES program, which also generated cross-sections. After the initial interpretation, the resistivity models were subjected to mathematical control to verify their compatibility with field data. For nearly all VES, a second (or more) model was built and validated, as it is common in this type of subsoil for multiple numerical (and thus geological) interpretations to be consistent with the field resistivity data.

The ground's response in terms of resistivity (Rho) to different geological configurations is not unique, as it depends on the ratios between resistivity and thickness of the layers. The main challenge in the study area is the presence of predominantly fine deposits (such as marls, shale, and silt) from the Auradu Formation, underlain by sandy-silty deposits of the Yesomma Formation, and at greater depths by the Precambrian Undifferentiated Crystalline Basement (PCB). The resistivity ratios between these three units increase with depth, and the VES curves show a gradual rise.

When the thickness of the Yesomma sands exceeds 300 meters, the boundary between this formation and the PCB is well detectable. However, when the thickness is less, the boundary can be harder to define due to the depth range, and multiple resistivity models can be consistent with the field data.

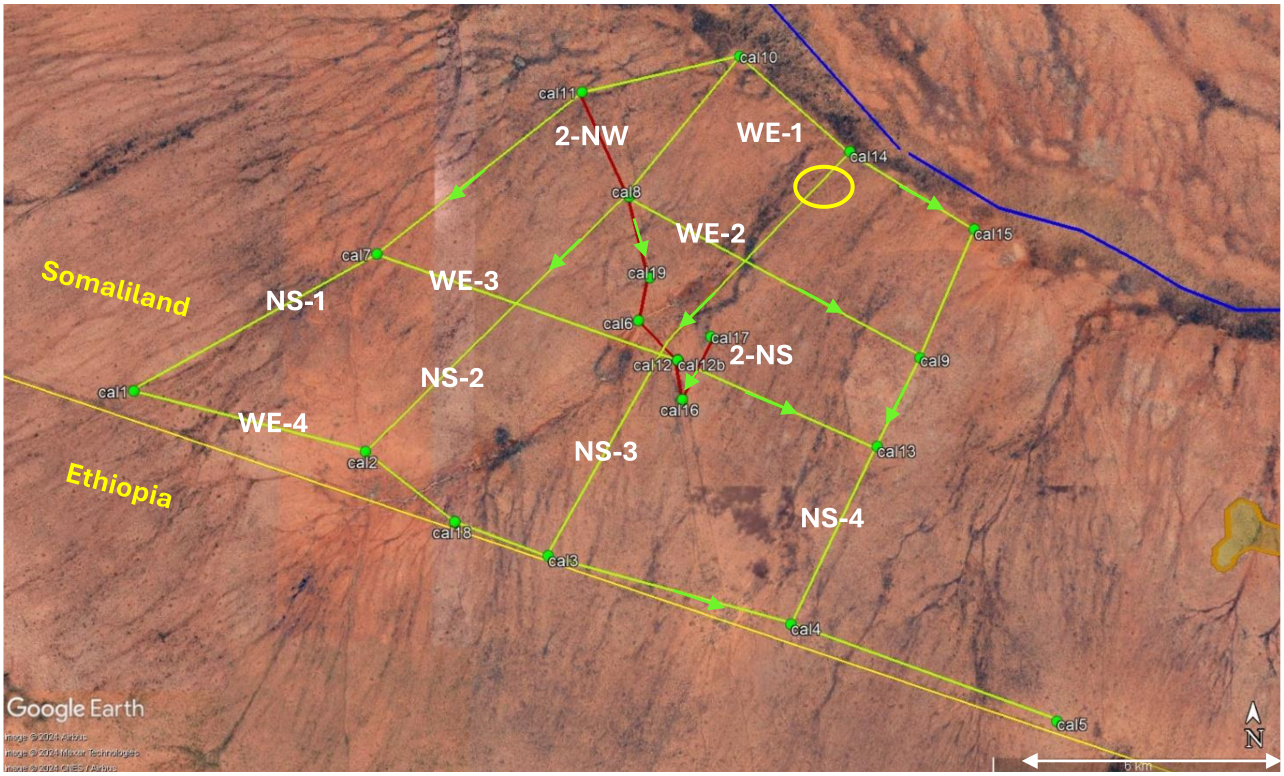


Figure 44: VES and cross-sections positions (green points and lines) – green arrows: cross-section direction – white letters: cross-section name – yellow ellipse: previously failed borehole (probable collapse) – yellow line: Ethiopia – Somaliland border

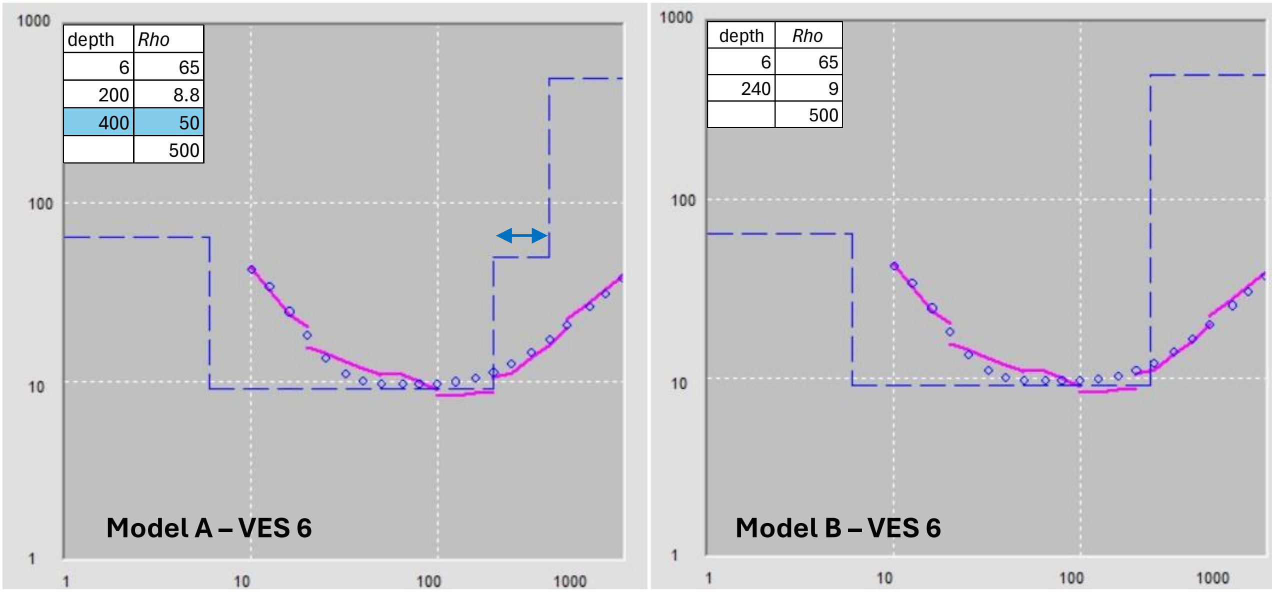


Figure 45: *Comparison between different resistivity models (dashed blue lines and blue circles) and field resistivity data (violet lines). The blue double arrow shows the layer missing in the model B.*

In the previous figure, two different resistivity models (represented by blue dashed lines) that were subjected to mathematical control produced nearly identical results (small blue circles), with a difference of only 0–0.2% from the field data (violet lines). Although the mathematical difference between the two models is negligible, the hydrogeological implications are significant: in Model B, the deep sandy fraction of the Yesomma Formation, which could potentially host the aquifer, is absent. In contrast, Model A shows a possible sandy layer extending from 200 to 400 meters deep, providing a higher likelihood of aquifer presence.

Performing multiple interpretations of the VES curves helps to identify locations where the margin for multiple interpretations is very narrow, indicating areas where favorable groundwater conditions are more likely. For example, the figure illustrates (with the red dashed line) how the VES curve would differ if the potential aquifer layer were reduced from 600 meters to 350 meters deep. In this case, we can be reasonably confident that the aquifer likely extends to a depth of no less than 400–500 meters. This particular VES location is one of the sites considered suitable for groundwater exploration, and, along with a few others, it became the focus of further surveys conducted during the second phase.

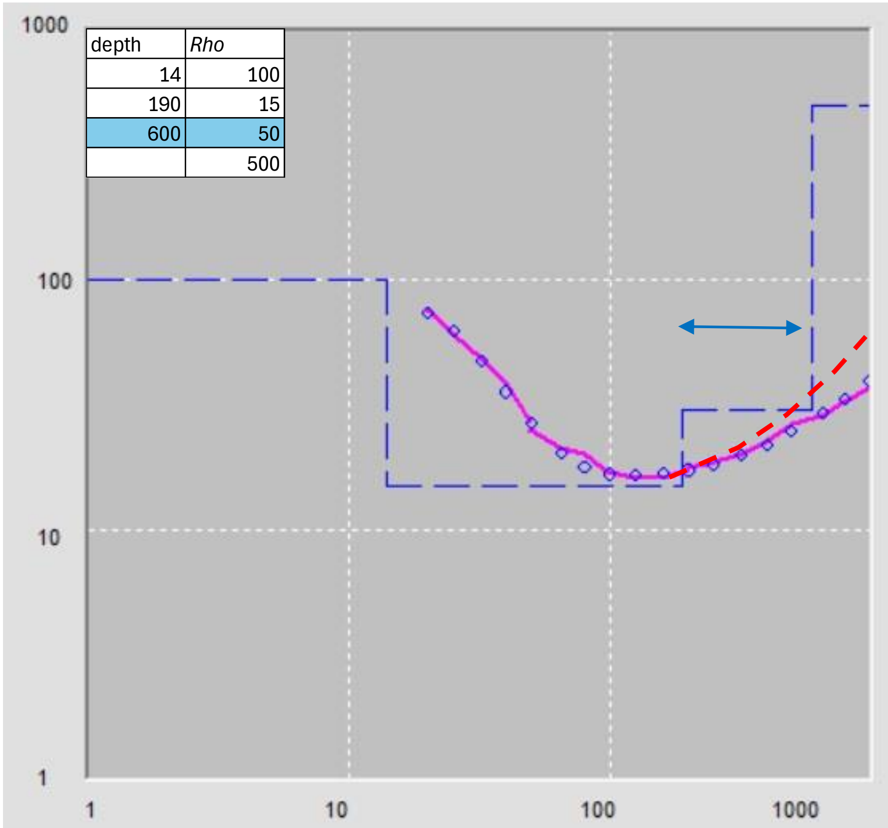


Figure 46: Impact of a reduction of depth/thickness of the possible aquifer (double blue arrow) on the field resistivity data in the curve of VES 12. The red dashed line shows the deep impact on the VES curve of a minor depth (350 against 600 m) of the bottom of the possible

Different VES shapes and interpretations may result from lateral variations in resistivity along the VES layout. This effect can be more pronounced with longer layouts, such as the present survey, which used an AB spacing of 2,000 meters. For this reason, one of the promising areas, around VES 12, was further investigated during the second phase with additional VES (12b, 16, and 17) aligned along a different azimuth. This was done to verify that the interpretative model did not change with the direction and to confirm the area's suitability. These three VES confirmed that the selected area is favorable for the deep extension of a possible aquifer. Additionally, VES 18 confirmed the potential of the area between VES 2 and 3, while VES 19 indicated a probable reduction in aquifer depth near the previously conducted VES 6, located northwest of the village.

Based on the field data interpretation, four main resistivity units were identified:

- *Top Unit*: This is a thin unit, typically less than 15 meters thick, with highly variable resistivity values, indicating the presence of loose alluvial and aeolian deposits, ranging from sands to clayey materials. In some cases, where the resistivity exceeds 100 Ωm, it may include limited layers of Auradu limestones. The resistivity (Rho) values range between 5 and 500 Ωm.
- *Conductive Unit*: The second unit is a conductive layer with Rho values between 10 and 20 Ωm. It can extend, overlain by the Top Unit, to depths of 150–300 meters, and in some areas, mostly in the northern

part of the study area, it reaches beyond 500 meters. This unit consists mainly of marly deposits from the Auradu Formation and is considered unsuitable for groundwater, especially where Rho values are ≤10 Ωm, even when found deeper than 350 meters, the potential maximum depth of the regional water table. Where this unit extends deeper, it may transition into the Yesomma Formation, dominated by finer sediments.

- ***Deep Semi-Resistive***: This third formation has Rho values between 30 and 50 Ωm, though in some cases, the values are lower (below 20 Ωm), making it difficult to distinguish from the Conductive Unit. As explained earlier, this unit is not always clearly detectable because it may be obscured by the deeper layers. It likely occurs throughout the study area, though its thickness may vary. VES with Rho values around 50 Ωm exhibit this uncertainty. This unit is attributed to the Yesomma Formation, which has a wide range of resistivity due to its composition of sandstones and mudstones, and it may extend to depths ranging from 300 to 800 meters.
- ***Bottom Resistive***: This is the deepest unit detected, but when its top lies beyond 500 meters, it becomes difficult to define. Its resistivity is approximated at 500 Ωm, though the high depth makes precise calculation challenging from the VES curves. The nature of this unit remains unclear: it could represent the Yesomma Formation or the Precambrian Basement (PCB). However, the PCB is unlikely to be found at depths shallower than 500 meters, as the combined thickness of the Auradu and Yesomma Formations should be at least 500–600 meters. Furthermore, since the aquifer is expected at depths of 350–400 meters, the sandy deposits of the Yesomma Formation at these depths should not exhibit Rho values above 50 Ωm. It is also uncertain whether Jurassic limestones might exist between the Yesomma sandstones and the basement in this area. However, even if present, Rho values should remain below 50 Ωm in an aquifer environment. The most plausible explanation is that this Bottom Resistive Unit represents the Precambrian Basement, potentially displaced by tectonic thrusts.

In conclusion, the first phase of the survey identified several locations (VES 2, 3, 8, 11, and 12) where the Yesomma Formation exhibits high resistivity values (Rho > 20–35 Ωm), consistent with the presence of sandy layers extending to depths greater than 350–400 meters, which is considered the possible depth of the regional water table. In these VES, the margin of error for defining the aquifer depth interval is minimal. However, where Rho values approach 50 Ωm, there is greater uncertainty regarding the extent of the Yesomma Formation. The second phase confirmed the existence of three positive areas, with suitable Rho values and depths exceeding 500 meters.

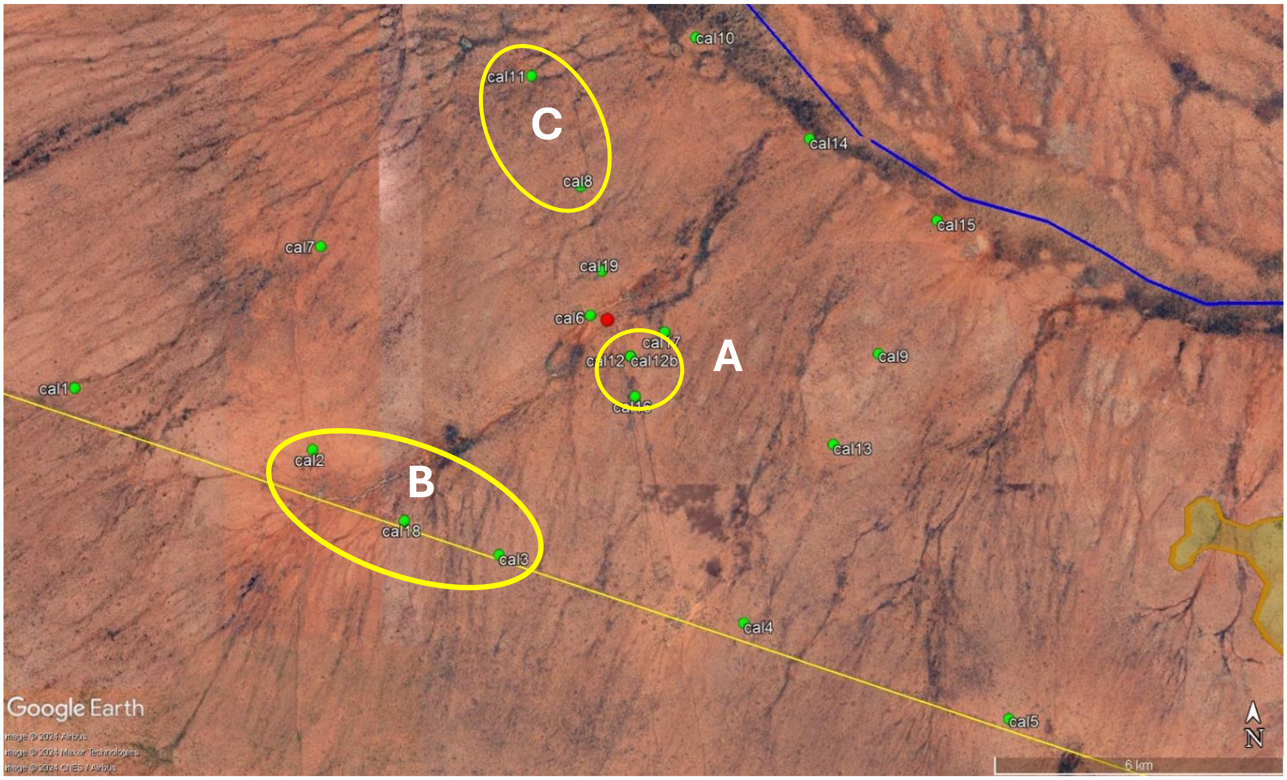


Figure 47: VES locations (green points) - red point: village – yellow line: border – yellow ellipses: areas suitable for groundwater research - blue line: main area drainage

From the interpretation of the survey it is possible to conclude that:

- In the study area around the Cali Ciise village, the probable subsoil configuration is made by 3 geological units:
  - Auradu limestones, present at shallow depth and locally outcropping, mostly made by marly clayey deposits.
  - Yesomma sandstones, made by alternances of sandstones and mudstones. This unit can reach up to 600-700 m of depth and is the only possible aquifer.
  - PCB (Precambrian Undifferentiated Basement), made by crystalline rocks, overlain by the Yesomma Fm.
- These units are roughly represented by three resistivity units, identified by the geophysical survey and described in the chapter 3 as ***Conductive Unit***, ***Deep Semi-Resistive***, ***Bottom Resistive***.
- The possible aquifer is expected in the formation of the Yesomma Sandstones, at depth starting from 350-400 m and extending up to the PCB (***Bottom Resistive***), at depth of 300-700 m. The SWL is expected between 250 and 350 m, the water quality can range from slightly brackish (2,500 µS/cm) up to strongly brackish (>4,000 µS/cm).
- All the deposits above the regional water level are dry. For this reason, the suitable locations for groundwater research are those where the depth of the Yesomma Fm is beyond 450 m. Given the normal uncertainty of the VES interpretation, suitable locations are considered those where the depth of Yesomma is expected beyond 500 m.

- The locations where the sandy component is abundant are the more suitable, once the condition of the depth is respected. The higher percentage of sand (or higher ratio of coarse/fine deposits) are indicated by the resistivity interval 20-35 Ωm.
- The VES survey detected 3 suitable areas, where the last 2 conditions (PCB depth > 500 m and resistivity of 20-30 Ωm) are respected. These areas are indicated by the yellow ellipses, named A, B and C. The areas A and B are considered the more suitable, and the final suggestion is the area A for the nearness to the village. We indicate specifically the location of the VES 12 as the site to make a drilling. The coordinates are: 8.542460° N and 45.519554° E. From this location it is suggested to remain in a radius of 200 m. The suggested minimum depth is 400 m and maximum is 500 m. The drilling director is in charge to decide at which depth to stop drilling operations.

VES Data and Graphs

Table 45: VES coordinates

VES	Latitude	Longitude	elevation
Cali 1	943645	545760	863
Cali 2	942395	550645	845
Cali 3	940260	554482	839
Cali 4	938878	559517	831
Cali 5	936929	564976	829
Cali 6	945139	556352	808
Cali 7	946535	550802	827
Cali 8	947771	556147	800
Cali 9	944366	562289	794
Cali 10	950817	558517	785
Cali 11	950024	555131	797
Cali 12	944307	557177	811
Cali 13	942516	561358	811
Cali 14	948750	560866	781
Cali 15	947090	563496	775
Cali12b	944307	557177	811
Cali16	943488	557275	814
Cali17	944803	557881	804
Cali18	940953	552533	839
Cali19	946046	556588	805

Table 46: VES field data

VES n.	1	
Site:	Durukhsi	
Date:	26-Aug-24	
Azimuth	294	
Elevation:	863	
Latitude	545760	
Longitude	943645	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
20	5	53.60
25	5	48.37
32	5	42.81
40	5	31.42
50	5	31.65
50	10	31.40
65	10	23.13
80	10	19.30
100	10	14.15
100	25	14.8
125	25	15.1
160	25	16.8
200	25	17.3
200	50	16.5
250	50	17.0
320	50	19.1
400	50	22.3
500	50	24.1
500	100	38.8
660	100	37.4
800	100	49.5
1000	100	54

VES n.	2	
Site:	Duruqsi	
Date:	27-Aug-24	
Azimuth	295	
Elevation:	845	
Latitude	550645	
Longitude	942395	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	34.79
12.5	1	40.70
16	1	39.09
20	1	37.60
20	5	36.31
25	5	27.80
32	5	25.80
40	5	21.67
50	5	18.51
50	10	19.08
65	10	15.87
80	10	14.25
100	10	11.82
100	25	12.4
125	25	13.9
160	25	14.3
200	25	15.1
200	50	14.3
250	50	17.2
320	50	19.8
400	50	21.8
500	50	24.1
500	100	18.8
660	100	28.7
800	100	32.7
1000	100	36

VES n.	3	
Site:	Durukhsi	
Date:	26-Aug-24	
Azimuth	295	
Elevation:	839	
Latitude	554482	
Longitude	940260	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
20	5	113.18
25	5	77.77
32	5	41.15
40	5	29.59
50	5	24.96
50	10	26.28
65	10	21.58
80	10	20.58
100	10	21.30
100	25	18.3
125	25	20.5
160	25	20.2
200	25	19.3
200	50	17.7
250	50	18.5
320	50	20.4
400	50	21.8
500	50	24.1
500	100	26.0
660	100	27.4
800	100	30.7
1000	100	36

VES n.	4	
Site:	Yucub-yabooh	
Date:	28-Aug-24	
Azimuth	280	
Elevation:	831	
Latitude	559517	
Longitude	938878	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	186.61
12.5	1	169.83
16	1	145.60
20	1	119.83
20	5	117.81
25	5	96.43
32	5	52.79
40	5	32.66
50	5	19.91
50	10	31.82
65	10	20.02
80	10	16.72
100	10	14.00
100	25	15.7
125	25	14.4
160	25	14.4
200	25	14.3
200	50	14.8
250	50	15.5
320	50	17.3
400	50	19.8
500	50	24.9
500	100	24.1
660	100	28.7
800	100	34.6
1000	100	42

VES n.	5	
Site:	Candho-dhexe	
Date:	28-Aug-24	
Azimuth	280	
Elevation:	829	
Latitude	564976	
Longitude	936929	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	74.58
12.5	1	72.28
16	1	64.77
20	1	56.53
20	5	50.67
25	5	29.59
32	5	25.42
40	5	24.44
50	5	24.18
50	10	24.50
65	10	23.52
80	10	20.29
100	10	17.42
100	25	16.4
125	25	15.1
160	25	14.3
200	25	13.6
200	50	13.8
250	50	15.1
320	50	16.3
400	50	20.3
500	50	25.7
500	100	23.8
660	100	33.4
800	100	38.6
1000	100	45

VES n.	6	
Site:	Cali cise	
Date:	26-Aug-24	
Azimuth	295	
Elevation:	808	
Latitude	556352	
Longitude	945139	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	43.45
12.5	1	32.31
16	1	23.63
20	1	19.99
20	5	15.63
25	5	14.42
32	5	12.80
40	5	11.78
50	5	10.81
50	10	10.93
65	10	10.82
80	10	9.99
100	10	8.86
100	25	8.5
125	25	8.3
160	25	8.6
200	25	8.7
200	50	10.5
250	50	11.1
320	50	13.5
400	50	15.8
500	50	20.2
500	100	22.6
660	100	27.4
800	100	32.7
1000	100	39

VES n.	7	
Site:	Cali cise	
Date:	27-Aug-24	
Azimuth	40	
Elevation:	827	
Latitude	550802	
Longitude	946535	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	27.65
12.5	1	30.17
16	1	30.88
20	1	30.65
20	5	26.22
25	5	27.71
32	5	32.67
40	5	32.76
50	5	31.18
50	10	26.39
65	10	27.99
80	10	26.72
100	10	24.88
100	25	20.6
125	25	18.8
160	25	21.2
200	25	18.6
200	50	17.3
250	50	17.5
320	50	18.5
400	50	18.8
500	50	20.2
500	100	17.0
660	100	23.4
800	100	26.7
1000	100	30

VES n.	8	
Site:	Cali cise	
Date:	24-Aug-24	
Azimuth	165	
Elevation:	800	
Latitude	556147	
Longitude	947771	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
20	5	34.05
25	5	26.75
32	5	22.28
40	5	20.29
50	5	19.28
50	10	19.60
65	10	23.46
80	10	24.54
100	10	26.28
100	25	26.9
125	25	31.6
160	25	34.5
200	25	34.6
200	50	35.3
250	50	33.2
320	50	33.3
400	50	32.2
500	50	30.3
500	100	31.7
660	100	30.8
800	100	31.7
1000	100	33

VES n.	9	
Site:	Cali cise	
Date:	25-Aug-24	
Azimuth	280	
Elevation:	794	
Latitude	562289	
Longitude	944366	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
20	5	306.31
25	5	263.89
32	5	226.72
40	5	174.66
50	5	141.82
50	10	168.02
65	10	108.27
80	10	75.70
100	10	62.20
100	25	64.2
125	25	41.7
160	25	22.8
200	25	17.8
200	50	18.7
250	50	17.2
320	50	19.5
400	50	23.8
500	50	26.4
500	100	33.2
660	100	34.8
800	100	39.6
1000	100	45

VES n.	11	
Site:	Cali cise	
Date:	27-Aug-24	
Azimuth	300	
Elevation:	785	
Latitude	558517	
Longitude	950817	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	14.29
12.5	1	13.53
16	1	13.34
20	1	11.28
20	5	10.26
25	5	10.07
32	5	10.17
40	5	9.60
50	5	11.04
50	10	11.65
65	10	13.02
80	10	13.26
100	10	14.15
100	25	13.7
125	25	14.4
160	25	15.5
200	25	15.6
200	50	15.2
250	50	15.6
320	50	17.6
400	50	20.3
500	50	24.1
500	100	31.3
660	100	28.7
800	100	33.6
1000	100	39

VES n.	11	
Site:	Cali cise	
Date:	27-Aug-24	
Azimuth	244	
Elevation:	797	
Latitude	555131	
Longitude	950024	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	36.36
12.5	1	34.56
16	1	34.93
20	1	31.59
20	5	25.78
25	5	22.62
32	5	19.46
40	5	15.49
50	5	13.76
50	10	15.57
65	10	14.45
80	10	13.66
100	10	14.00
100	25	14.4
125	25	14.6
160	25	16.0
200	25	17.6
200	50	17.0
250	50	18.1
320	50	22.3
400	50	25.2
500	50	25.7
500	100	25.6
660	100	27.4
800	100	29.7
1000	100	36

VES n.	12	
Site:	Cali cise	
Date:	24-Aug-24	
Azimuth	145	
Elevation:	811	
Latitude	557177	
Longitude	944307	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
20	5	76.58
25	5	61.07
32	5	48.65
40	5	38.10
50	5	27.21
50	10	25.15
65	10	21.38
80	10	19.99
100	10	16.64
100	25	17.1
125	25	16.0
160	25	16.0
200	25	17.3
200	50	17.7
250	50	18.7
320	50	20.1
400	50	22.3
500	50	26.4
500	100	23.0
660	100	28.7
800	100	32.7
1000	100	37

VES n.	13	
Site:	Yucub-yabooh	
Date:	28-Aug-24	
Azimuth	287	
Elevation:	811	
Latitude	561358	
Longitude	942516	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	146.02
12.5	1	141.08
16	1	122.49
20	1	111.50
20	5	112.48
25	5	90.01
32	5	85.52
40	5	74.71
50	5	65.78
50	10	65.56
65	10	52.03
80	10	48.19
100	10	44.32
100	25	45.1
125	25	42.4
160	25	43.9
200	25	35.4
200	50	39.5
250	50	33.9
320	50	26.7
400	50	25.7
500	50	29.5
500	100	29.8
660	100	34.8
800	100	41.6
1000	100	50

VES n.	14	
Site:	Cali cise	
Date:	25-Aug-24	
Azimuth	300	
Elevation:	781	
Latitude	560866	
Longitude	948750	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
20	5	7.14
25	5	6.03
32	5	4.93
40	5	5.44
50	5	6.22
50	10	6.79
65	10	6.48
80	10	6.93
100	10	8.40
100	25	8.7
125	25	9.1
160	25	11.6
200	25	12.4
200	50	11.7
250	50	12.6
320	50	13.8
400	50	16.3
500	50	18.7
500	100	23.4
660	100	24.7
800	100	27.7
1000	100	34

VES n.	15	
Site:	Cali cise	
Date:	25-Aug-24	
Azimuth	300	
Elevation:	775	
Latitude	563496	
Longitude	947090	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
20	5	9.53
25	5	9.97
32	5	10.76
40	5	11.83
50	5	13.92
50	10	13.76
65	10	14.84
80	10	14.94
100	10	15.71
100	25	15.3
125	25	16.8
160	25	17.3
200	25	18.3
200	50	16.7
250	50	19.0
320	50	21.3
400	50	21.8
500	50	28.8
500	100	35.8
660	100	36.1
800	100	40.6
1000	100	47

VES n.	12b	
Site:	Cali cise	
Date:	19-Sep-24	
Azimuth	70	
Elevation:	811	
Latitude	944307	
Longitude	557177	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	81.00
12.5	1	82.01
16	1	78.71
20	1	72.83
20	5	70.64
25	5	55.23
32	5	43.44
40	5	36.57
50	5	30.25
50	10	30.57
65	10	19.83
80	10	18.11
100	10	17.57
100	25	17.7
125	25	15.6
160	25	15.7
200	25	16.1
200	50	15.7
250	50	17.7
320	50	20.4
400	50	24.2
500	50	27.2
500	100	31.3
660	100	28.1
800	100	31.7
1000	100	36

VES n.	16	
Site:	Cali cise	
Date:	19-Sep-24	
Azimuth	73	
Elevation:	814	
Latitude	943488	
Longitude	557275	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	63.46
12.5	1	56.09
16	1	51.43
20	1	48.26
20	5	48.16
25	5	45.24
32	5	37.82
40	5	31.62
50	5	25.11
50	10	26.50
65	10	19.50
80	10	16.72
100	10	14.31
100	25	15.3
125	25	13.2
160	25	12.6
200	25	13.1
200	50	12.8
250	50	13.4
320	50	15.4
400	50	18.8
500	50	22.5
500	100	24.5
660	100	27.4
800	100	30.7
1000	100	36

VES n.	17	
Site:	Cali cise	
Date:	19-Sep-24	
Azimuth	70	
Elevation:	804	
Latitude	944803	
Longitude	557881	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	29.48
12.5	1	30.82
16	1	30.16
20	1	29.33
20	5	28.59
25	5	28.63
32	5	28.12
40	5	22.66
50	5	19.05
50	10	19.04
65	10	15.10
80	10	14.15
100	10	13.22
100	25	13.1
125	25	10.9
160	25	10.7
200	25	11.4
200	50	11.5
250	50	14.3
320	50	16.6
400	50	20.8
500	50	25.7
500	100	26.4
660	100	31.4
800	100	33.6
1000	100	37

VES n.	18	
Site:	Cali cise	
Date:	20-Sep-24	
Azimuth	100	
Elevation:	839	
Latitude	940953	
Longitude	552533	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	155.51
12.5	1	142.69
16	1	99.14
20	1	66.87
20	5	65.74
25	5	37.00
32	5	22.75
40	5	18.60
50	5	15.55
50	10	15.83
65	10	14.51
80	10	14.65
100	10	14.77
100	25	14.4
125	25	15.6
160	25	17.1
200	25	18.6
200	50	19.4
250	50	18.7
320	50	18.8
400	50	20.3
500	50	22.5
500	100	22.6
660	100	27.4
800	100	30.7
1000	100	37

VES n.	19	
Site:	Cali cise	
Date:	20-Sep-24	
Azimuth	60	
Elevation:	805	
Latitude	946046	
Longitude	556588	
AB/2	**MN/2**	**Resistivity**
m	m	ohm x m
10	1	137.92
12.5	1	124.64
16	1	119.77
20	1	100.59
20	5	105.68
25	5	96.85
32	5	63.49
40	5	40.72
50	5	29.78
50	10	33.02
65	10	24.17
80	10	19.59
100	10	16.48
100	25	17.9
125	25	15.1
160	25	13.7
200	25	13.4
200	50	12.7
250	50	13.4
320	50	16.6
400	50	19.8
500	50	23.3
500	100	22.6
660	100	26.7
800	100	30.7
1000	100	36

Table 47: VES interpretation

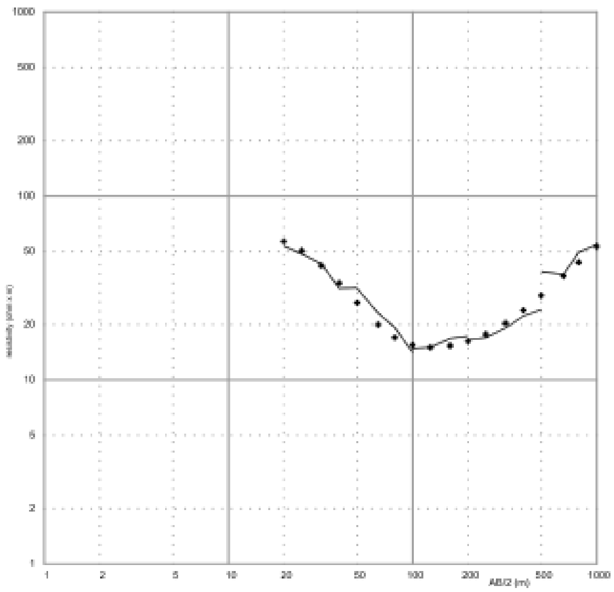
VES	num of	layer 1		layer 2		layer 3		layer 4			layer 5
	layers	depth 1	rho 1	depth 2	rho 2	depth 3	rho 3	depth 4	rho 4	depth 5	rho 5
Cali01	4	17	67			200	13	300	30		500
Cali02	4	12	50			150	12	650	30		500
Cali03	4	10	240			250	17	750	36		500
Cali04	4	11	210			280	14	500	50		500
Cali05	5	7	90	28	40	230	12	400	50		500
Cali06	4	6	65			220	9	400	40		500
Cali07	4	8	26			30	40	550	16		500
Cali08	5	9	60	40	15	150	57	600	17		500
Cali09	5	10	500	50	140	190	10	500	50		500

Cali10	4	8	15			40	9	400	19	∞	500
Cali11	4	9	40			100	13	600	25		500
Cali12	4	14	100			170	15	600	29		500
Cali12b	5	10	90	24	45	140	12	600	29		500
Cali13	5	8	180	100	54	290	16	600	50		500
Cali14	5	7	15	36	4	280	15	500	50		500
Cali15	3	10	7					300	16		500
Cali16	4	17	63			180	11	600	30		500
Cali17	5	2	22	25	32	120	8	600	30		500
Cali18	4	8	200			100	13	700	26		500
Cali19	5	5	180	21	100	240	12	500	30		500

layer 1 - 2	Auradu	dry sand or limestones p ≥ 90 Ωm
		very dry sand 40 < p < 70 Ωm
		clayey top deposits 3 < p <30 Ωm
layer 3 - 4	Au-Ye	clayey-sandy deposits p < 20 Ωm
	Yesomma	sandy deposits 25 ≤ p ≤ 40 Ωm
		sandy deposits p = 50 Ωm (uncertain lithology)
layer 5	PCB	Precambrian crystalline basement p =500 Ωm
notes	the depth of the layer 5 is considered infinite	
	possible aquifer expected below 300 m	

project GW4R VES Cali01

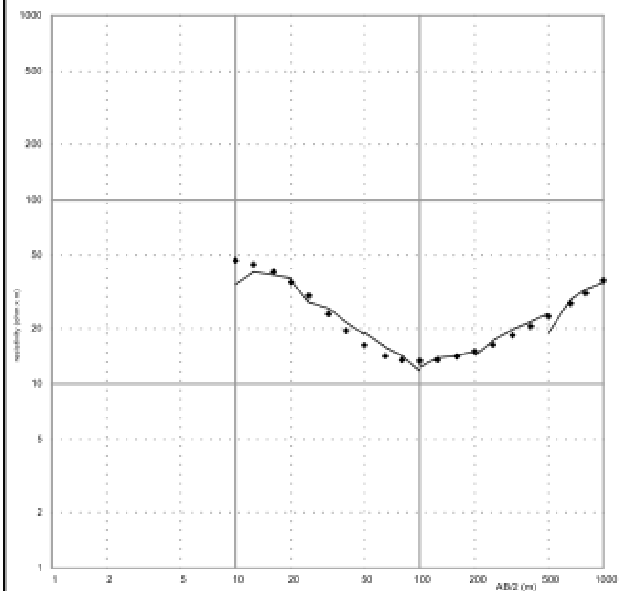
site Cali Ciise elevation 863 m



layer	1	2	3	4	5	
resistivity	67	13	30	500		ohm x m
thickness	17	183	100			m

project GW4R VES Cali02

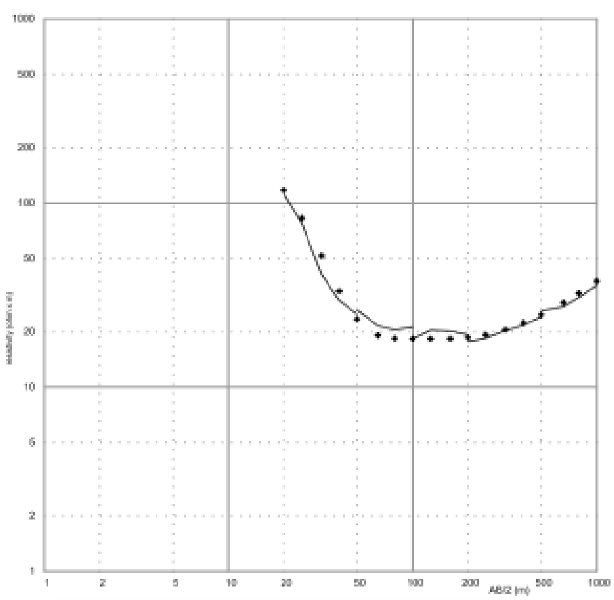
site Cali Ciise elevation 845 m



layer	1	2	3	4	5	
resistivity	50	12	30	500		ohm x m
thickness	12	138	500			m

project GW4R VES Cali03

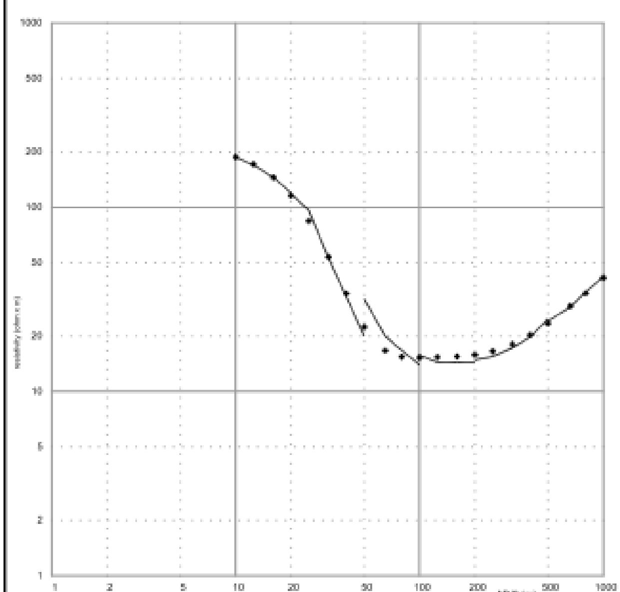
site Cali Ciise elevation 839 m



layer	1	2	3	4	5	
resistivity	240	17	36	500		ohm x m
thickness	10	240	500			m

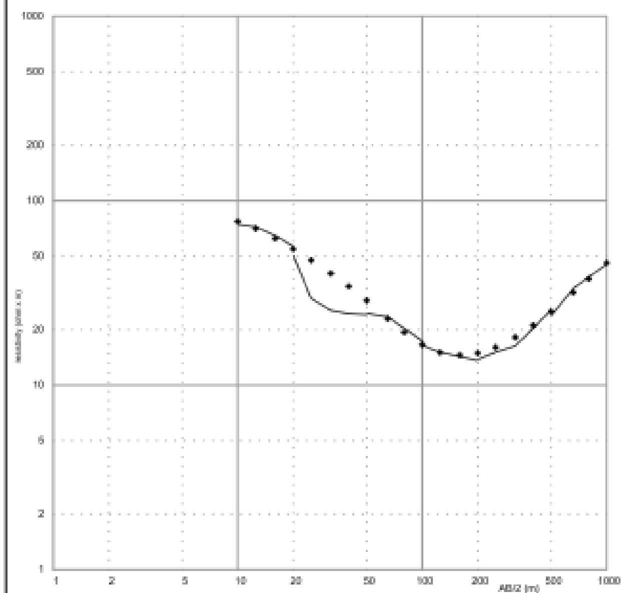
project GW4R VES Cali04

site Cali Ciise elevation 831 m



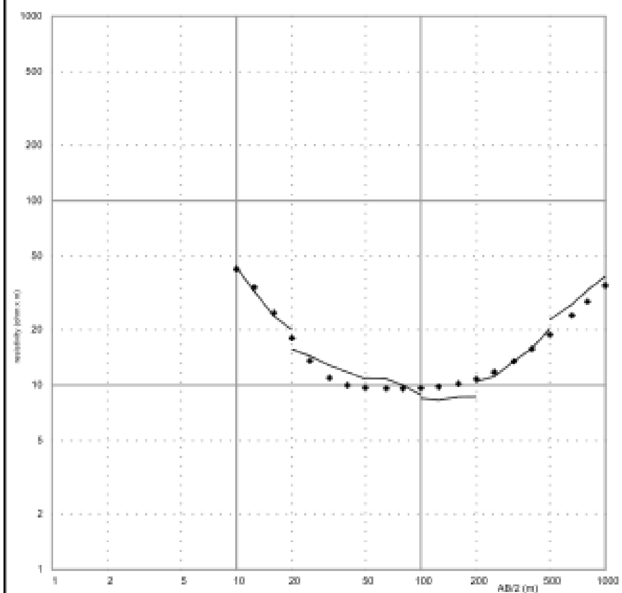
layer	1	2	3	4	5	
resistivity	210	14	50	500		ohm x m
thickness	11	269	220			m

project GW4R VES Cali05
site Cali Ciise elevation 829 m



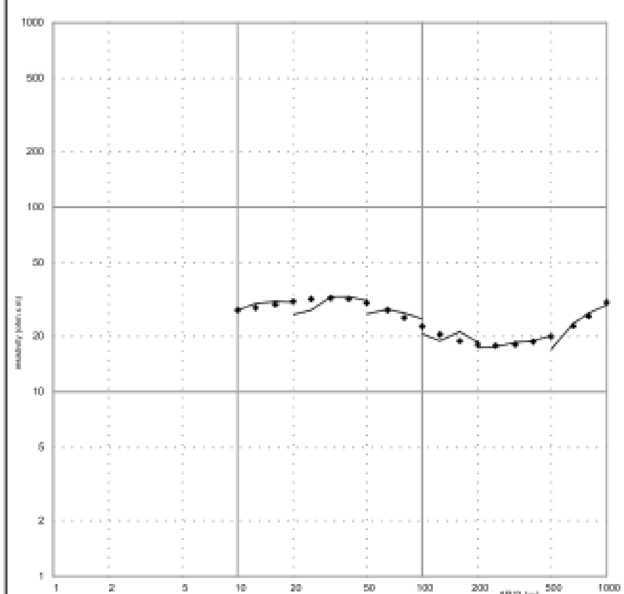
layer	1	2	3	4	5	
resistivity	90	40	12	50	500	ohm x m
thickness	7.0	21	202	170		m

project GW4R VES Cali06
site Cali Ciise elevation 808 m



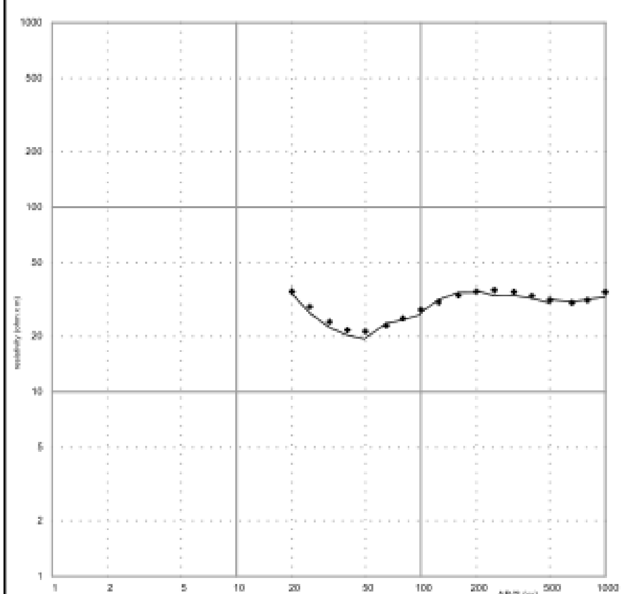
layer	1	2	3	4	5	
resistivity	65	9.0	40	500		ohm x m
thickness	6.0	214	180			m

project GW4R VES Cali07
site Cali Ciise elevation 827 m



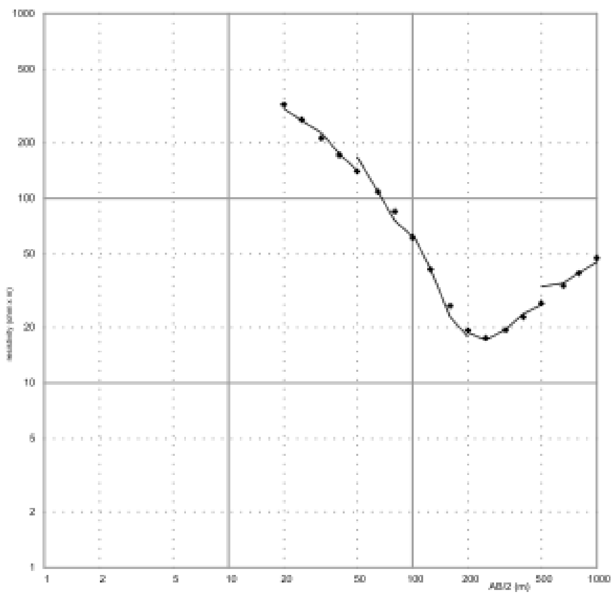
layer	1	2	3	4	5	
resistivity	26	40	16	500		ohm x m
thickness	8.0	22	520			m

project GW4R VES Cali08
site Cali Ciise elevation 800 m



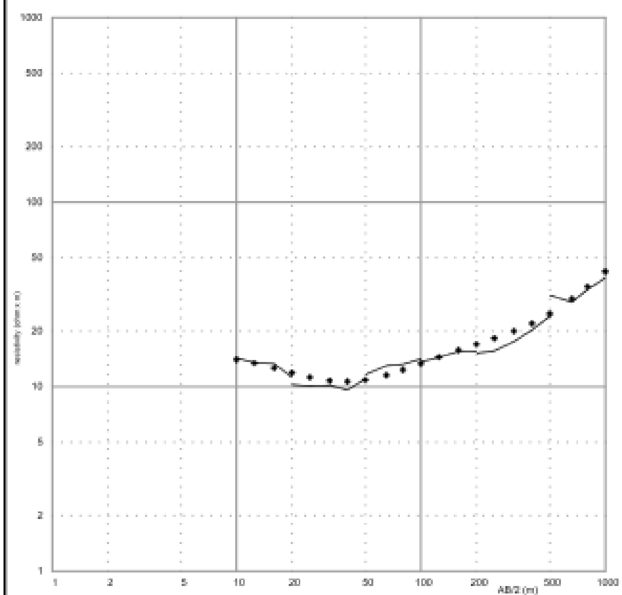
layer	1	2	3	4	5	
resistivity	60	15	57	17	500	ohm x m
thickness	9.0	31	110	450		m

project GW4R VES Cali09
site Cali Ciise elevation 794 m



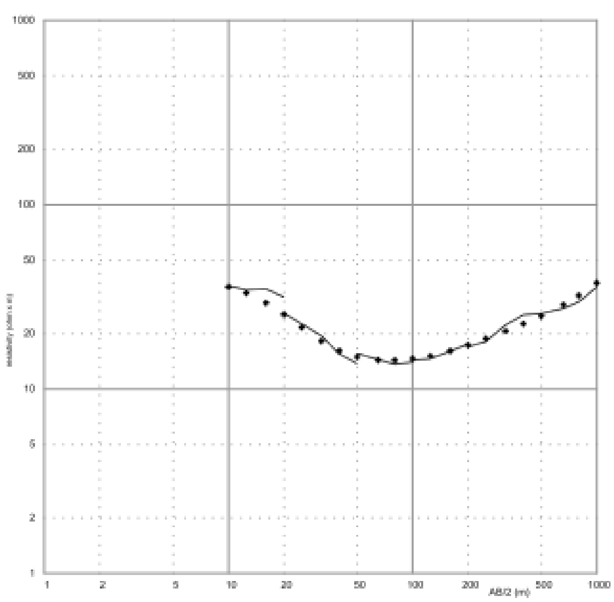
layer	1	2	3	4	5	
resistivity	500	140	10	50	500	ohm x m
thickness	10	40	140	310		m

project GW4R VES Cali10
site Cali Ciise elevation 785 m



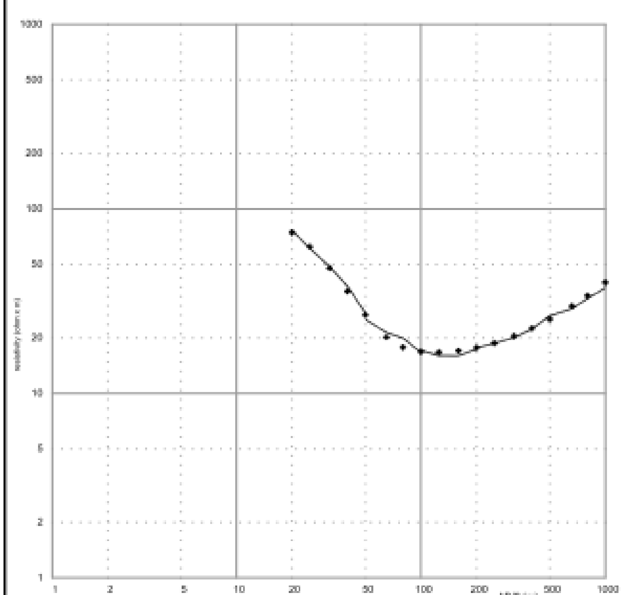
layer	1	2	3	4	5	
resistivity	15	9.0	19	500		ohm x m
thickness	8.0	32	360			m

project GW4R VES Cali11
site Cali Ciise elevation 797 m



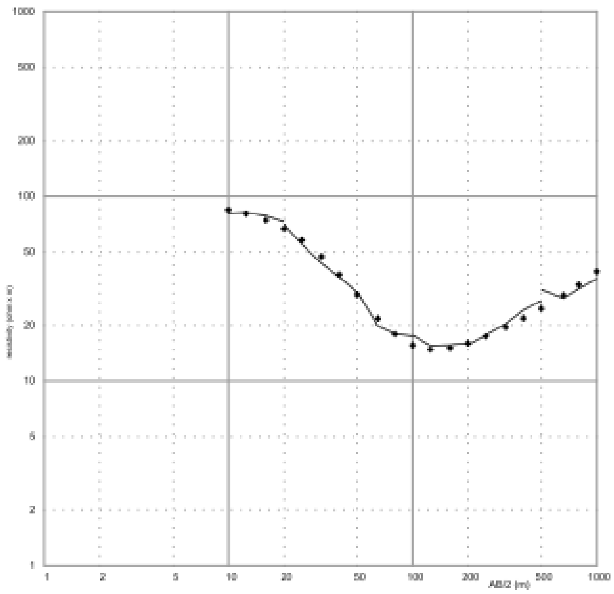
layer	1	2	3	4	5	
resistivity	40	13	25	500		ohm x m
thickness	9.0	91	500			m

project GW4R VES Cali12
site Cali Ciise elevation 811 m



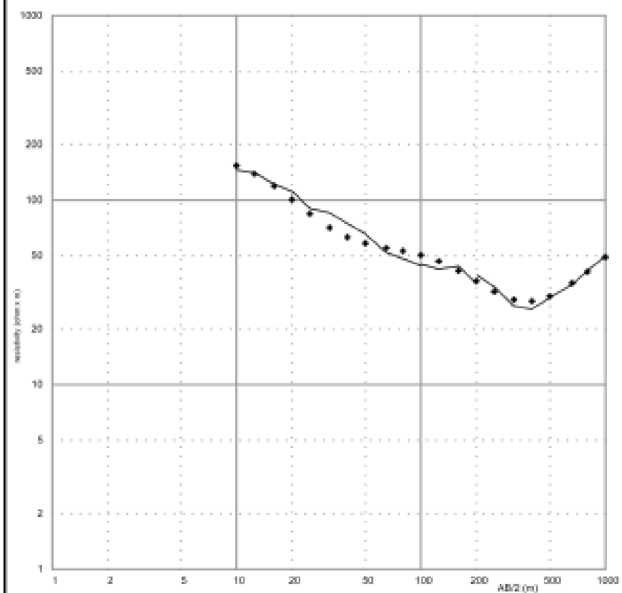
layer	1	2	3	4	5	
resistivity	100	15	29	500		ohm x m
thickness	14	156	430			m

project GW4R VES Cali12b
site Cali Ciise elevation 811 m



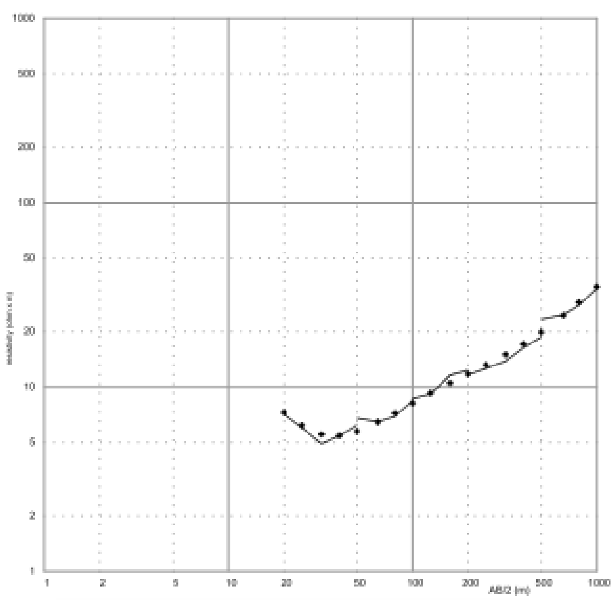
layer	1	2	3	4	5	
resistivity	90	45	12	29	500	ohm x m
thickness	10	14	116	460		m

project GW4R VES Cali13
site Cali Ciise elevation 811 m



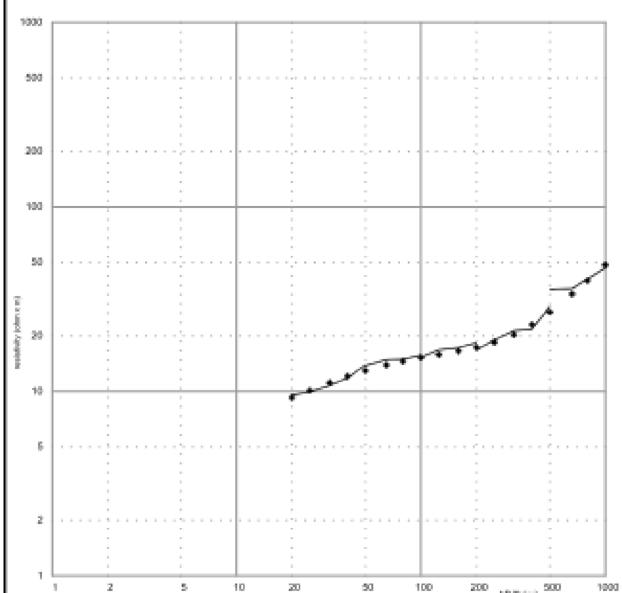
layer	1	2	3	4	5	
resistivity	180	54	16	50	500	ohm x m
thickness	8.0	92	190	310		m

project GW4R VES Cali14
site Cali Ciise elevation 781 m



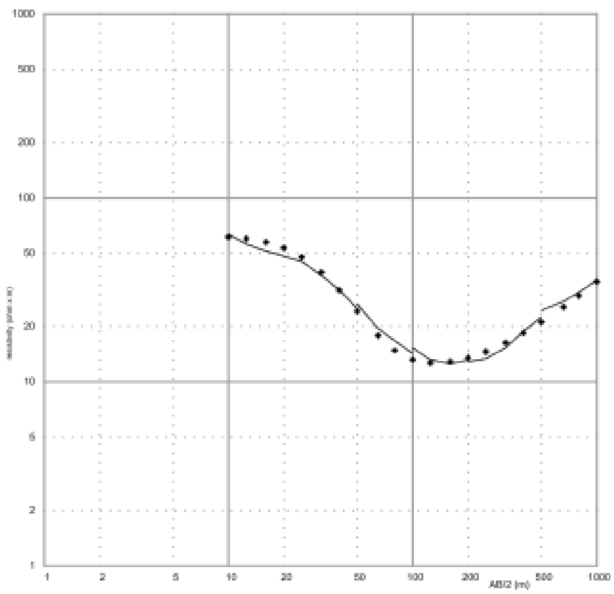
layer	1	2	3	4	5	
resistivity	15	4.0	15	50	500	ohm x m
thickness	7.0	29	244	220		m

project GW4R VES Cali15
site Cali Ciise elevation 775 m



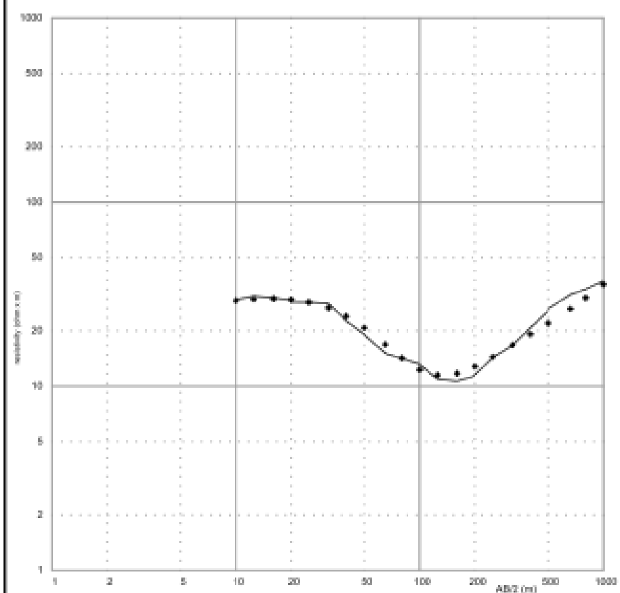
layer	1	2	3	4	5	
resistivity	7.0	16	500			ohm x m
thickness	10	290				m

project GW4R VES Cali16
site Cali Ciise elevation 814 m



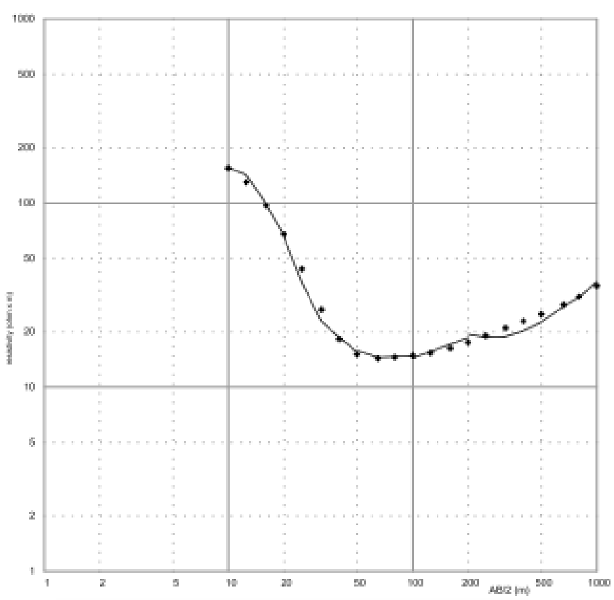
layer	1	2	3	4	5	
resistivity	63	11	30	500		ohm x m
thickness	17.5	162.5	420			m

project GW4R VES Cali17
site Cali Ciise elevation 804 m



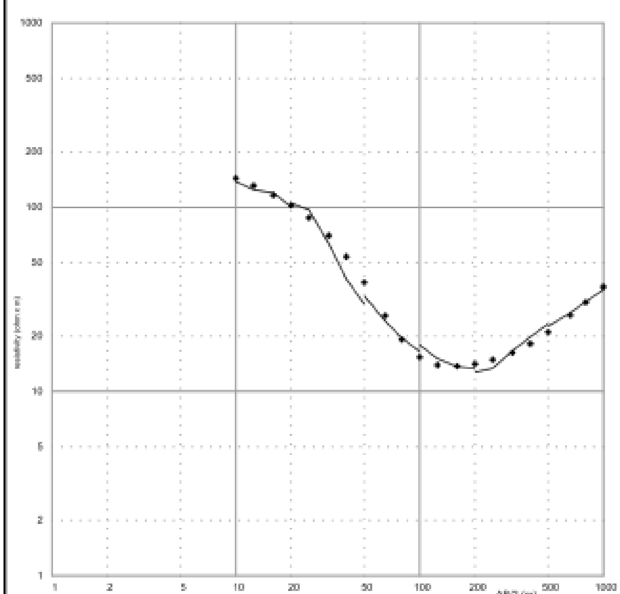
layer	1	2	3	4	5	
resistivity	22	32	8.0	30	500	ohm x m
thickness	2.0	23	95	480		m

project GW4R VES Cali18
site Cali Ciise elevation 839 m



layer	1	2	3	4	5	
resistivity	200	13	26	500		ohm x m
thickness	8.0	92	600			m

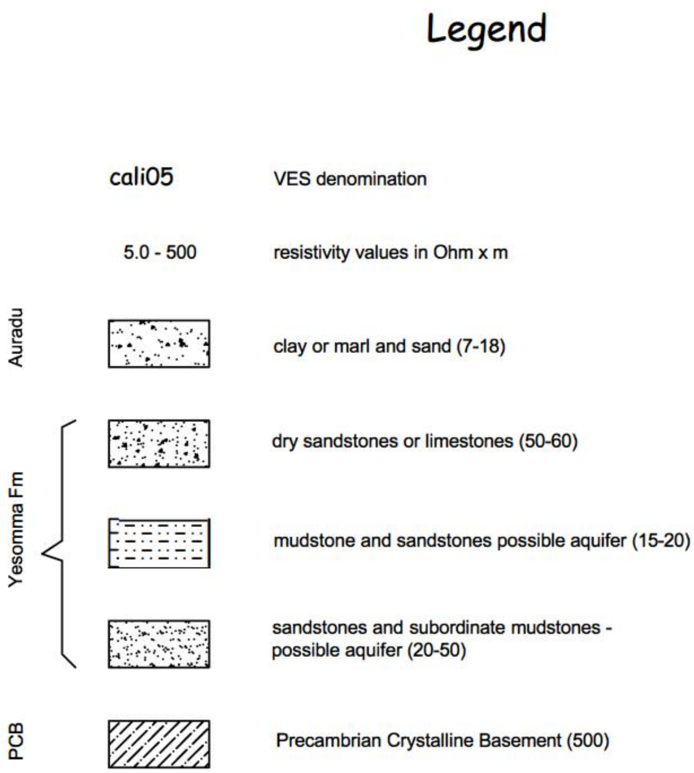
project GW4R VES Cali19
site Cali Ciise elevation 805 m

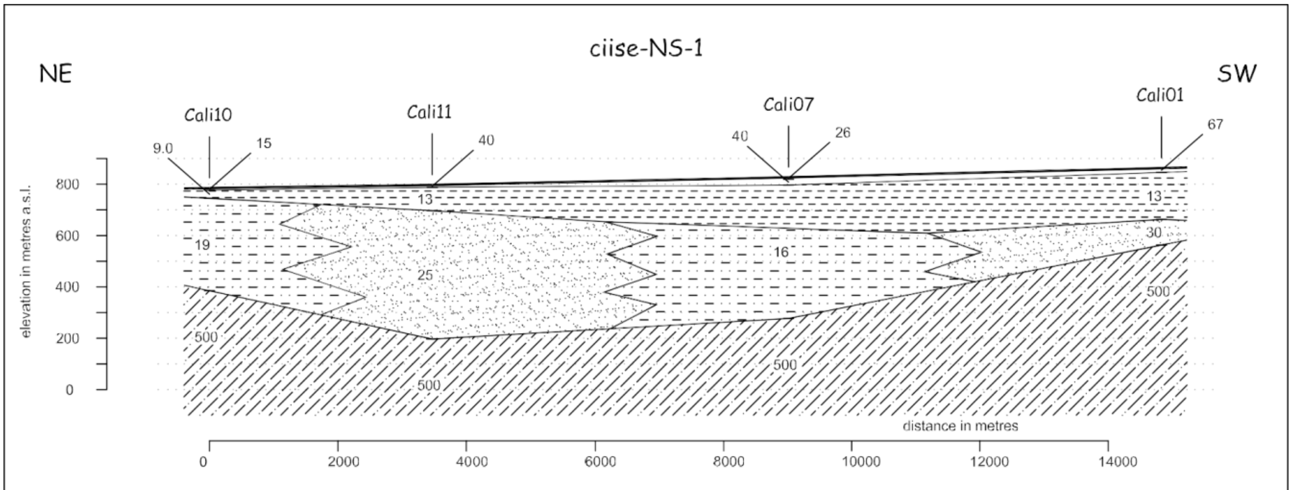


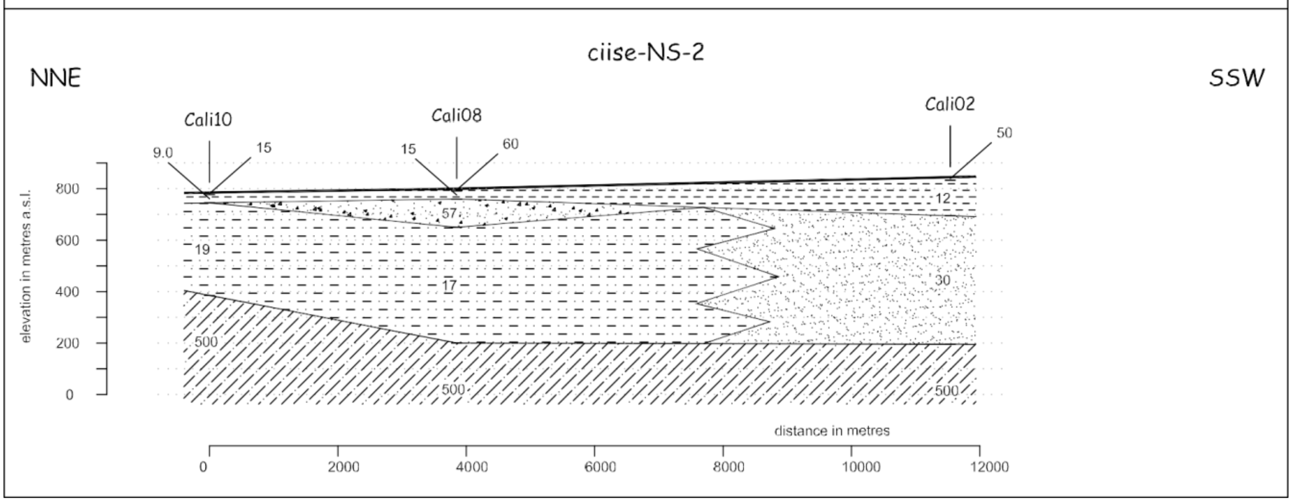
layer	1	2	3	4	5	
resistivity	180	100	12	30	500	ohm x m
thickness	5.0	16	219	250		m

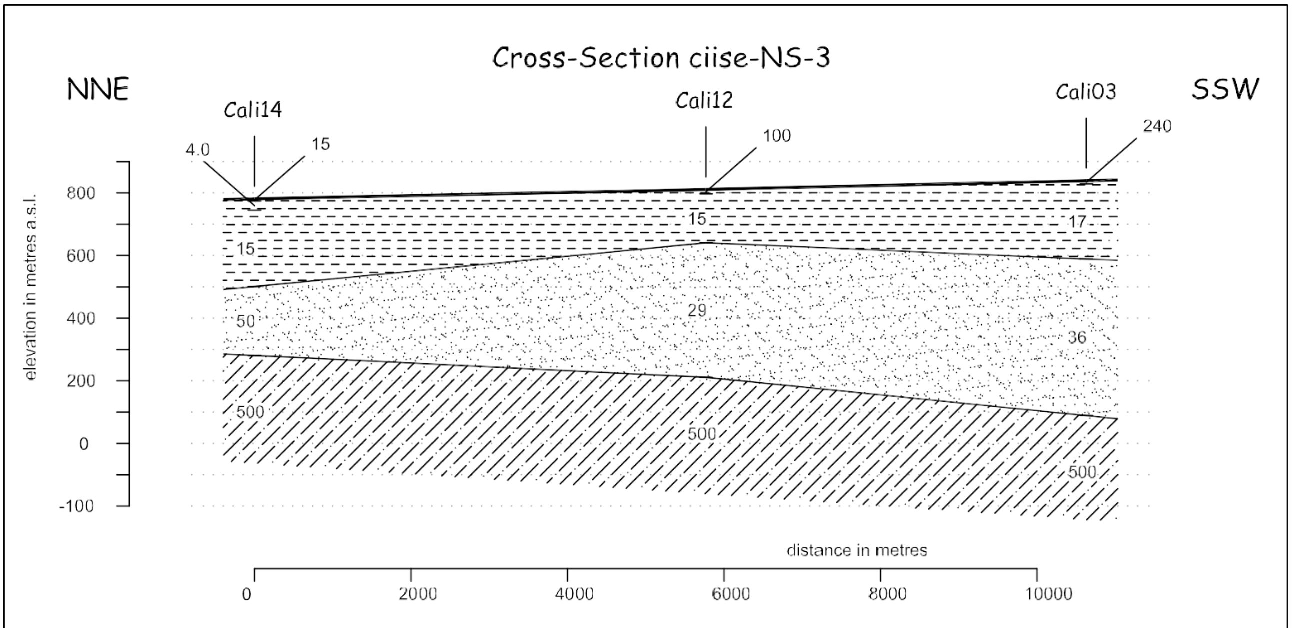
Figure 48: VES graphs

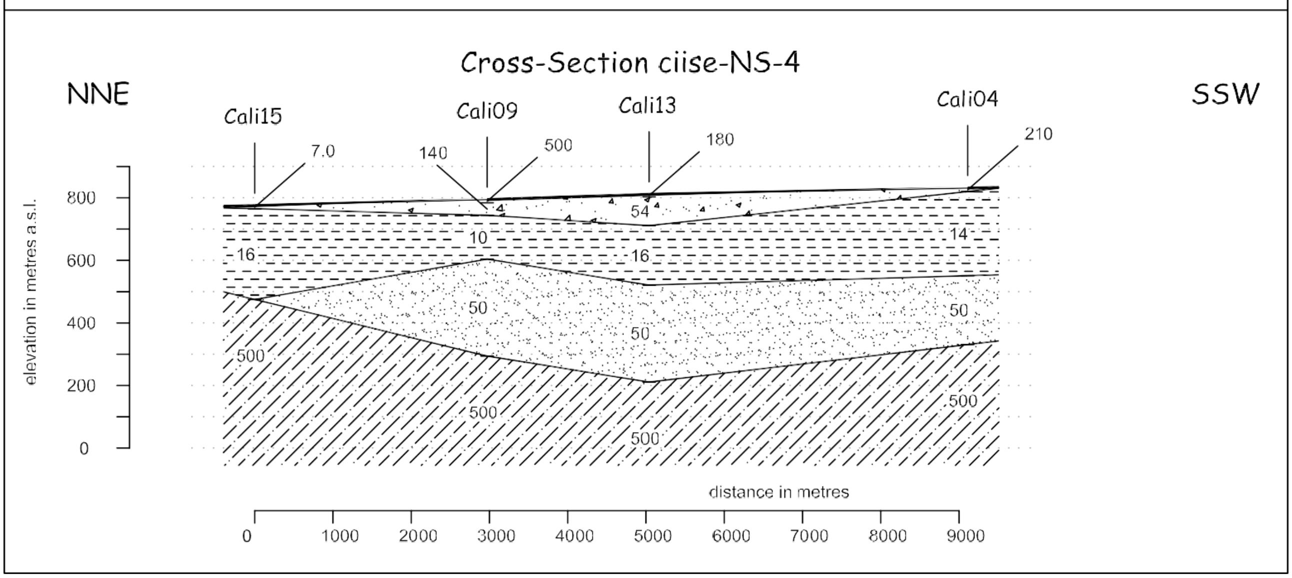
Resistivity Cross-Sections

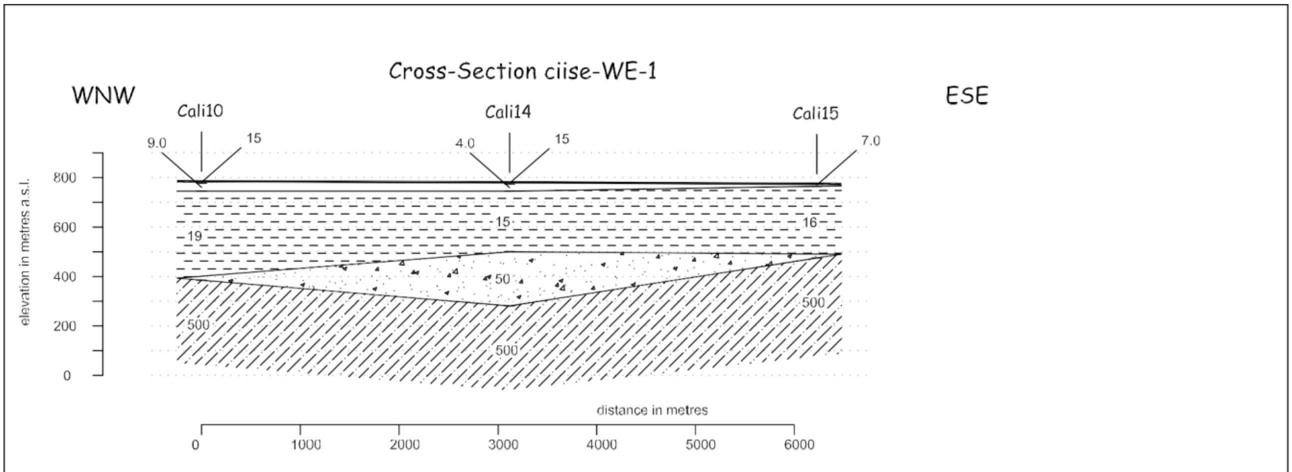


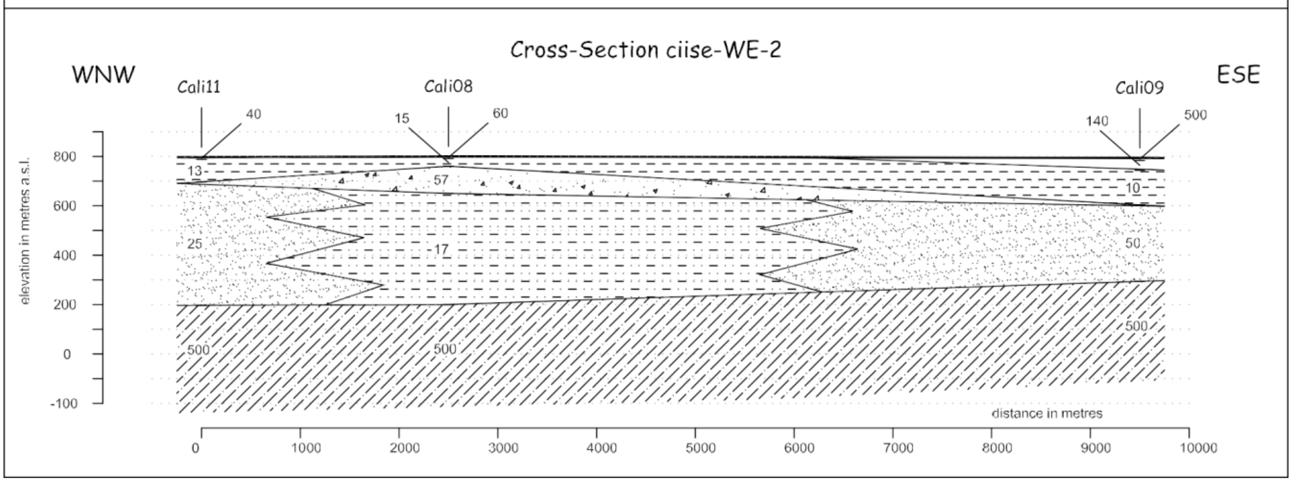

ciise-NS-1
NE
SW
Cali10
Cali11
Cali07
Cali01
elevation in metres a.s.l.
distance in metres

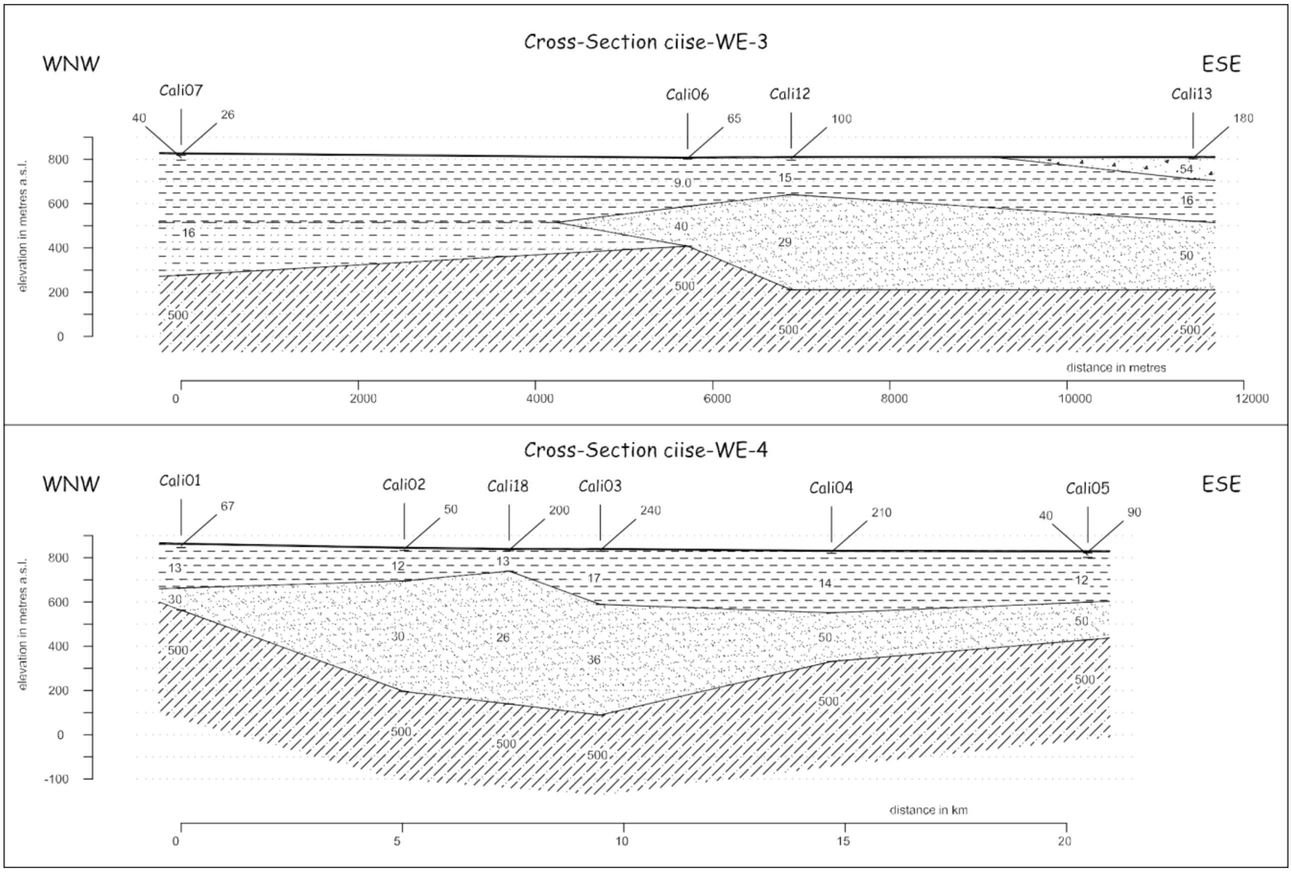

ciise-NS-2
NNE
SSW
Cali10
Cali08
Cali02
elevation in metres a.s.l.
distance in metres


Cross-Section ciise-NS-3
NNE
SSW
Cali14
Cali12
Cali03
4.0
15
100
240
15
17
15
29
50
36
500
500
500
elevation in metres a.s.l.
800
600
400
200
0
-100
distance in metres
0
2000
4000
6000
8000
10000


Cross-Section ciise-NS-4
NNE
SSW
Cali15
Cali09
Cali13
Cali04
7.0
140
500
180
210
54
10
14
16
16
50
50
50
500
500
500
500
elevation in metres a.s.l.
800
600
400
200
0
distance in metres
0
1000
2000
3000
4000
5000
6000
7000
8000
9000


Cross-Section ciise-WE-1
WNW
ESE
Cali10
Cali14
Cali15
9.0
15
4.0
15
7.0
800
600
400
200
0
elevation in metres a.s.l.
19
15
16
50
500
500
500
distance in metres
0
1000
2000
3000
4000
5000
6000


Cross-Section ciise-WE-2
WNW
ESE
Cali11
Cali08
Cali09
40
15
60
140
500
800
600
400
200
0
-100
elevation in metres a.s.l.
13
57
10
25
17
50
500
500
500
distance in metres
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000


Cross-Section ciise-WE-3
WNW
ESE
Cali07
Cali06
Cali12
Cali13
elevation in metres a.s.l.
distance in metres
Cross-Section ciise-WE-4
WNW
ESE
Cali01
Cali02
Cali18
Cali03
Cali04
Cali05
elevation in metres a.s.l.
distance in km

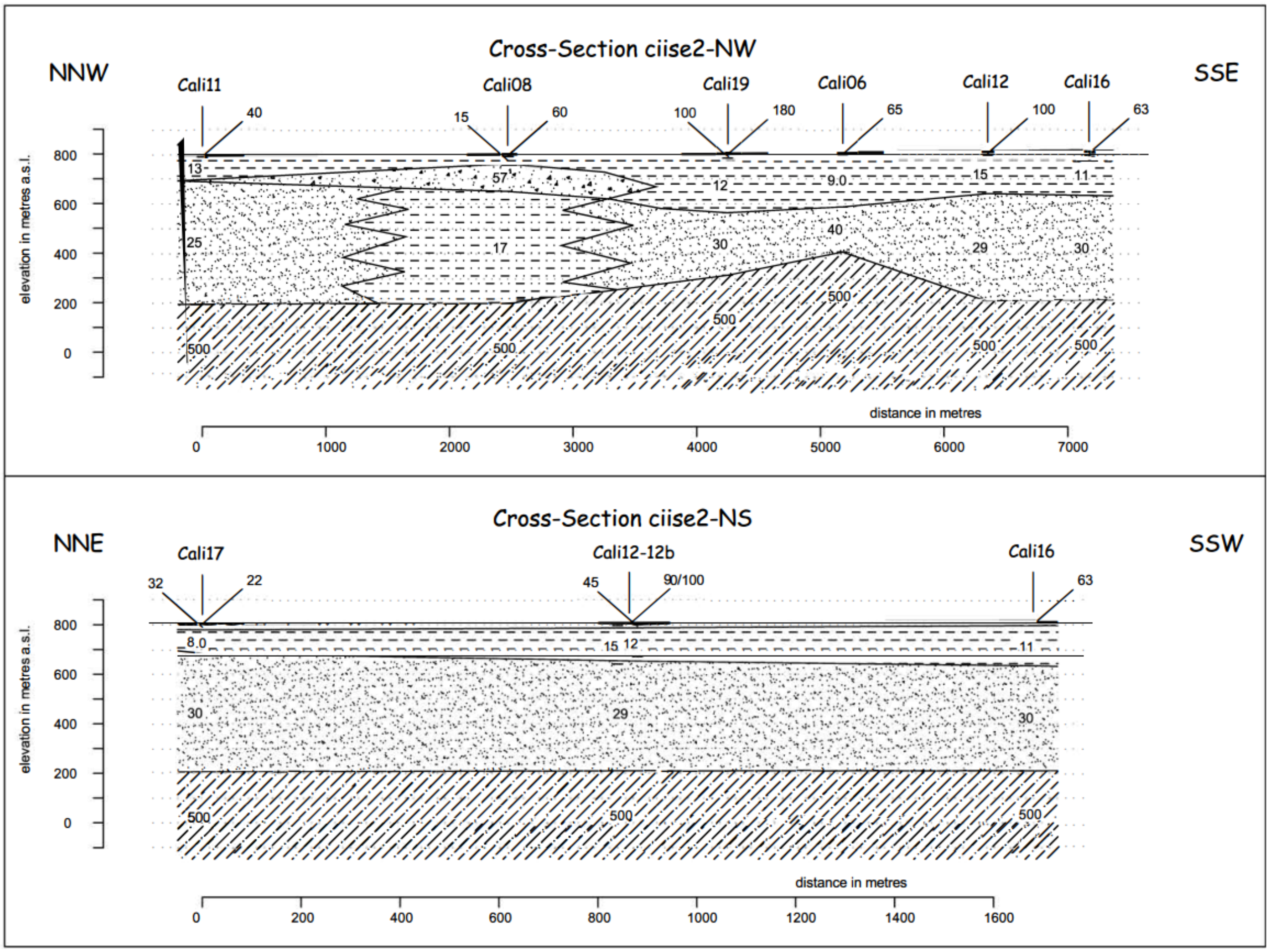


Figure 49: Resistivity cross-sections

Drilling and Pump System Technical Specifications

The Contractor must assume full responsibility, for all purposes of civil or criminal law, for the execution of the service and will be solely responsible for the interventions entrusted to it, the materials used and the means and tools provided for this purpose, both directly and indirectly.

The Client reserves the right to control all interventions in the various phases of execution. However, it is understood and agreed that all control interventions, without distinction, may never and in any way lead to liability for the Client, that is, the presence on site of the Client's coordination and surveillance personnel, the sharing of the type of intervention and the acceptance of the materials do not limit or reduce the full and unconditional liability of the Contractor.

All equipment, fixtures, installations and tools supplied by the Contractor must meet high technological characteristics, be of the best brands and comply with the national or international standards, or in their absence, with the rules of good execution, both for the quality of the raw materials, and for the manufacturing methods, dimensions, tolerances, acceptance tests and for anything else provided for by the current technical; they must, in any case, be suitable to replace the existing ones.

Therefore, the Contractor must provide the Client in advance with the technical specifications of the equipment and materials that are the object of each individual supply, the name of the suppliers and the location of their production plants, submitting the technical specifications and any certifications of tests and inspections for approval.

Each equipment must have, at the time of delivery, the following technical documentation:

1) n.1 copy of the maintenance manual;

2) n.1 copy of the corresponding catalogue sheet indicating the technical assembly characteristics;

The Company must, at any time, guarantee to the Client the execution of all tests and inspections on the supplies, deemed necessary and appropriate, both in the factory and on site.

The Client has the discretionary right to reject supplies deemed unsuitable, globally or for individual batches and also to order the replacement of the supplier, without the Contractor being able to claim any right to compensation or reimbursement for this.

All charges and expenses for the tests and inspections requested by the Client, without exception, and the charges related to the supplies (transport and packaging), are included and fully borne by the Contractor.

All supplies are guaranteed for two years from the date of installation.

Mobilization

Mobilization shall consist of the transport of all, necessary manpower, drilling rig, tools, casing pipes and construction materials to the drilling site. Demobilization shall consist of clean-up work and operations including, but not limited to those necessary to the removal of personnel, equipment, and incidentals from the project site.

The Contractor shall also mobilize all the necessary materials such as water for drilling, drilling chemicals fuels etc, which are required during the progress of the works.

Drilling

The drilling is carried out up to a depth in the interval 400-450 m. However, the borehole can be stopped by the contracting authority and finalized also at a depth lower than 400 m with no claim of any compensation. The contracting authority will appoint a supervisor for the drilling operations, who will be responsible, on behalf of MoWRD, for all activities related to drilling, completion of works and subsequent pumping tests. At the end of the drilling operations the supervisor will decide on the basis of the drilling logs, water quality etc. if to finalize the borehole or to abandon it, thus cancelling all the remaining operations with no claim of any compensation by the contractor.

The contracting Authority supervisor should possibly be a geologist or a person with wide experience of boreholes drilling supervision.

The drilling site is near Cali Ciise village, Togdher region, the coordinates are: 8.542460° N and 45.519554° E. It is suggested to drill in a radius of 200 m from this location.

Expected Lithology and Water Levels

The material expected during the drilling is constituted by sand, silt, shales and possible limestones or marly levels. More in detail, it is expected a shallow cover (10-15 m) of alluvial sand or limestone, then shales/marls up to 150-170 m, and below sandy deposits with mudstones intercalations. It is not expected crystalline basement up to 600 m, but in case the basement is found the drilling shall stop after penetrating 10 m in it.

Groundwater is not expected up to 250-350 m of depth.

Drilling Methodology and Use of Additives

The drilling shall be executed with the only methodology of rotary with mud circulation, to face hole wall collapses, frequently occurring in the area. The use of bentonite may be used on the basis of specific conditions. The diameter of the drilling tools shall be suitable for the installation of 8” casing plus an annular space of 3” around the casing for the gravel pack installation, therefore no less than 14”.

Centralizer

Borehole casings and screens shall be fitted into the open hole with centralizers placed at intervals of 20 m. Centralizers shall be made by plastic material or iron and of an approved design which does not hinder the installation of either gravel, backfill or cement seal.

Sampling

Samples from the cutting are taken each 2 meters, put in small transparent plastic bag and the depth interval to which the sample refers is written with black indelible ink marker. The samples are stored in a wooden or plastic box with small wooden dividing panels on which the depth is written with the same indelible markers. The wooden boxes are stored in a shadowy location and always available to the drilling supervisor.

Activity Recording

On a field book are registered all the operations done while drilling, including the drilling time per pipe length interval, the lithology, including grain size for sand, the drilling diameter, the use of temporary casing (and its diameter), each start and interruption of the operations, any machinery breakdown or hole collapse, possible losses of circulation. It is requested to compile daily forms with all the data above described. In the notes shall be reported also the supposed or verified presence of water with the depth at which the water income occurred.

Gravel Pack and Piezometric Pipe

The gravel pack is made by quartz/feldspar type, selected rounded grains of diameter 3 - 5 mm maximum. The size is mandatory given the expected presence of fine deposits (fine sand and silt). Coarser gravel grains allow the passage into the hole of such deposits.

Before pouring the gravel pack, a piezometric pipe of 1” in U-PVC is installed in the annular space up to the half of the last (deepest) screened casing section. The pipe shall reach the depth of 20 m above the lower edge of the screened section, the expected maximum length is 430 m.

The gravel pack is washed to remove small particles then gradually inserted into the annular space around the casing. Its volume is measured before pouring. Verify the consistency between the theorical volume and the measured volume. Record the volume poured for the drilling report.

During the borehole development by air and pumping gravel pack will be added as per need.

Casing

The casing shall be in PVC 8” to allow the installation of a pump with 6“diameter. The expected length is 300 m for the blind casing and 200 m for the screened sections. The screens are slotted 1-1.5 mm to allow a yield of 99-109 liters/minute per meter, open, with minimum thickness wall of 13,4 mm.

Borehole Development

Borehole development shall be limited to jetting, air lifting and over-pumping methods only. Any damage caused by development procedures shall be rectified by the Contractor to the supervisor's satisfaction. Not less than 12 hours of development pumping will be carried out.

Pumping Test

The pumping test is performed with a pump suitable for yields up to 5 l/s with a head of 400 m and 6” of diameter. The contractor shall provide, beyond the pump and the generator, a gate valve, a flowmeter, a piezometric probe or dipmeter (up to 500 m of length) and a calibrated EC-meter for the measurement of electrical conductivity. The EC-meter is calibrated on a standard solution of known conductivity, before the start of drilling operations. Field forms are supplied for each type of test. The test is followed by the drilling supervisor or by a person appointed by him/her.

The activity consists of 3 different tests, preceded by a test of one hour to verify the reasonable yield range of the borehole.

- Step Test: it is performed by 4 steps at growing yields, at ¼, ½, ¾ of the maximum expected yield. The last step is done at the maximum yield. The time of pumping for each step is 1 hour. The passage to each next step is done without intermediate recovery. After the last step is concluded, a recovery phase of 2 hours measurements is done. During the test, readings of the water level are taken in the time intervals indicated on the step test form. Flowmeter readings, EC and temperature are measured at the start of each step and in the last minute of the last step.
- Constant rate test: once the recovery from step test is completed at 100%, a constant rate test of 72 hours is performed. The yield is selected by the drilling supervisor, on the base of the results of the step test and specifically at a yield of ¾ of the critical yield. During the test, readings of the water level, of the flowmeter, of EC and temperature are taken in the time intervals indicated on the step test form. It is recommended to verify the pump yield each 12 hours calculating the time necessary to fill a 200 litres drum by stopwatch. No generators stops are admitted, in case a stop occurs to the generator, the test shall restart from time 0, after a full recovery of the water level. Before the end of the test a sample of 5 litres of water is taken for chemical analyses.
- Recovery: as soon as the pump is shut the recovery measurements start following the timing of the recovery form. The recovery is followed for a maximum of 10 hours or up to 95% of the whole draw-down is recovered by the water level.

Hole Protection

The annular space between the open hole and the PVC lining shall be filled to a depth of at least 2,0 m with a cement concrete to form the support base.

Report

The drilling report is written by the contractor and contains:

- Contractor data, driller name, start and end of the drilling operations, equipment brand and type.
- Site name, village name and coordinates, taken by GPS
- All data regarding methodology, additives use, drilling diameters and intervals of utilization, casing and screen diameters and intervals.
- Short history of the operations, including breakdowns, collapses, change of drilling diameters, dates, etc.
- Log of the drilling time per pipe length interval.
- Stratigraphic log approved/written by the drilling supervisor, with pictures of significant samples for each lithological unit (no more than 5-7 pictures). In the log are indicated the verified/supposed main water incomes.
- Drawing of the casing/screen column of the annular space refilling, and of the diameters used during the drilling.
- Gravel pack description and pictures.
- Description of the development activity, with significant water levels variations.
- Complete description of the pumping test equipment, dates, times and full tables and graphs with data measured during each test.

Submersible Centrifugal Pump and Riser Pipe General Standards

- Pumps should be multistage, centrifugal type, Vertical directly coupled to wet type submersible motor for Pumping ground water from deep wells.

- Pump Sets must comply with the latest E.U and I.S.O. standards.
- Manufacturer authorization letter, Certificates of compliance, and ISO or other certificate should be submitted along with bid offer.
- Suitable diameter of each pump/motor over the cable for use in 8 inch diameter Well Casing.

Pump Performance

- Pump performance curves should be indicated and clearly seen.
- Duty point flow rate and head for each pump must be within application range recommended by manufacturer.
- Guaranteed Pump efficiency at design flow should be equal or greater than 65%.
- Actual pump operational point should be between 110-80% of BEP (Best Efficiency Point).
- NPSH required should be less than 4m.

Pump Construction Material

- Impellers should be made of abrasion resistant bronze or stainless steel; statically and dynamically balanced.
- Main pump body should be made of corrosion resistant, Zinc free, closely grained cast iron or casted stainless steel.
- Pump shaft, coupling, suction grid & retaining valves should be made of stainless steel(SS310 /SS316 or higher class SS).
- Non-returning valve with Strainer incorporated with the pump.
- Pump tightening bolts and lock nuts should be made of stainless steel.

Submersible Electronic Motors

All motors shall be of a make approved by the Engineer and shall be suitable for operating from the specified power supply. Motors shall comply in all respects with the relevant parts of BS 4999 and BS 5000, and shall be designed to run at high power factor and efficiency at the prescribed plant duty.

Motors shall be three phase, squirrel cage, induction type, continuously rated for the heaviest specified duty, totally enclosed and suitable for operation on the electricity supply and determined by the Contractor in relation to the power requirements, ambient temperature, altitude and normal working conditions of the mechanical plant offered.

The starting (locked rotor) current of any motor shall not exceed 6 times the full load operating current; Motor starting torque shall be at least 120% of the pump torque requirements throughout the starting sequence. Motors shall be capable of running backwards at rated speeds under backflow conditions without damage to the motor.

In addition to the requirements of BS 5000, the motors shall be capable of satisfactory operation with a frequency variation of = 5% above or below the normal frequency of 50 Hz.

The design of the motor shall be adequate in all respects for the number of starts per hour required when the pumping plant is in normal operation. Where an insulation Class is specified the requirements of BS 4999 shall be met. The limit of temperature rise shall be for the appropriate Class of insulation quoted. Class F insulation shall be provided, but with Class B temperature rise limitations.

Motors shall be fitted with locating type bearings and/or heavy type thrust bearings at the non-drive end and roller type bearings at the drive and according to the type of motor offered, but all bearings shall be of adequate proportions and design suitable for the particular application, and shall have ample capacity all allow the pump to operate for short periods with the discharge valve closed.

Details of the bearing types being proposed, grease, oil, shall be submitted for all vertical motors together with details of the grease lubricated bearings for horizontal split case motors.

The motors shall be built of high-grade components and materials in accordance with the best practice for the type of plant offered.

Motors 5 kW and above shall be fitted with temperature sensitive thermistors embedded in the motor to control a winding over-temperature relay mounted in the control cubicle. Each motor shall have at least 3 thermistors. The thermistors shall be suitable for connection to a monitoring unit in the motor control circuit to provided protection against winding failing due to overheating. The motor starters shall trip in the event of high winding temperature being experienced.

The motors shall be capable of delivering 10% in excess of the maximum power absorbed by the equipment being driven. The motors, where practicable, are to be selected to provide an element of commonality, thus flexibility in use at each site, particularly dosing pump motors.

Only ISO standard roller and/or ball grease lubricated bearings shall be fitted.

The grease lubrication shall be applied using hydraulic type nipples, which are freely accessible, without, and dismantling, or otherwise piped out to a readily accessible location.

"Sealed for life" bearings shall not be used.

Continuously rated anti-condensation heaters shall be installed in all motors above 5 kW that are to be installed or in damp or cold environments. They shall be sized by the supplier to suit the motor frame size.

Heaters shall be located within the motor so that the heat dissipated does not damage the insulation of any of the windings or associated cables.

Terminals boxes shall be separated from the frame and shall be reversible to allow cable entry at the top, bottom or either side, suitable for cable glands required. Terminal mountings shall be arranged such that the motor supply wiring can be disconnected without disturbing its internal connections.

The end of each winding shall be brought out to a separate terminal, connecting links being provided to facilitate interconnection of individual terminals.

A diagram of connections shall be fixed inside the terminal box cover, which shall be provided with watertight, oil resisting gaskets.

Where motor anti-condensation heaters are fitted additional terminals and a separate cable gland entry shall be provided. A warning label on the terminal box cover shall be provided stating" WARNING, LIVE HEATER TERMINALS, ISOLATE BEFORE REMOVING COVER".

Plates shall be fixed on each motor, giving the following information:

BS No______________________ Manufacturer______________________

Serial No______________________ Insulation Class______________________

Frequency______________________ No. of Phases______________________

Motor kW______________________ Voltage______________________

Current at FL______________________ Speed______________________

Vertical spindle motor units rated in excess of 5 kW shall be fitted with a at the upper thrust bearing to shut down the motor in the event of the thermocouple bearing temperature exceeding a recommended value. Details shall be provided for approval.

Motor that are water-cooled shall include suitable protection to safeguards against lack of water flow.

Where required by the specified operation system, motor circuits shall include the suitable rated rotary off, manual or automatic switches.

Control Panel and Starter

Pump functioning must be under inverter connection to guarantee soft start and stop

- Control panel with TPN (Triple pole and neutral) switch with selector from Main On/Off, the power from Generator and A.C., replaceable fuses, phase indicator, voltmeter, ammeter and starter.

- Manufacturer's standard automatic type starter of suitable amperage with provision for lay ampere setting and automatic restarting when the water level goes up to a safe level.
- Automatic protection for over loading.
- Water level monitoring Relay for dry run protection.
- All incorporated and assembled in lockable painted steel box.

Additional Equipment

- Water level monitoring system to prevent pump from running dry, suitable for lowering on the specified bore-hole diameter vulcanized 2 electrodes with single insulated and flexible wire length equal to pump head.
- PVC cable clamp kit.
- One pairs of pump clamp with bolts and nuts for 4 inch pipe diameter, unless specified
- Pressure gauge.
- Submersible cables of proper length for each pump
- One cable jointing kit with quick drying epoxy resin compound
- Control panel.
- Strainer
- Non-Return Valve (Check Valve) incorporated with pump.

Technical Information Required

- Copies of Installation and Operation Manuals in English, for each pump.
- Pump discharge and total head.
- Complete pump performance curves at duty point and at different heads and discharge
- Pump HP
- Pump efficiency at 0.8 power factor
- Number of stages, total length of pump, and motor
- Pump diameter, motor diameter Over submersible cable
- Outlet connection diameter.
- Type of impeller
- Impeller, pump shaft motor and pump casing material
- Size of submersible cable
- Make and type of starter.
- Control panel box full details
- Impeller vane thickness, number of vane, vane angle at inlet and outlet diameter of a typical stage
- Other relevant information

Riser Pipes

Riser pipe should be in galvanized steel, minimum inside diameter 4'' with minimum thickness 5mm and minimum yield stress 235 N/mm2.

The installation of non-return valve located at 10m from the delivery mouth of pump and a further non-return valve every 50 m of pipeline.

The Contractor, under his own responsibility, may propose riser pipes with different technical characteristic with greater performance in terms of structural and hydraulic functioning.

In any case the contractor is always obliged to issue a structural technical report about the fitness of the riser pipes installed, in accordance with the final installation diagram and the technical characteristics of the submersible pump installed.

Annex 2 – Hydrology and Climate

Rainfall Analysis

The assessment of precipitation in the area of interest is essential for identifying local rainfall patterns that may indicate the water availability and water needs of the population. For this analysis, data from ground weather stations provided by SWALIM and remotely sensed data from GPM (Global Precipitation Measurement) and TMPA (TRMM Multisatellite Precipitation Analysis) using TRMM (Tropical Rainfall Measurement Mission) data will be utilized. The available ground monitoring network alone cannot be expected to fully represent the area's diverse precipitation patterns, so remotely sensed data will complement these observations. GPM and TRMM, a joint mission of NASA and the Japan Aerospace Exploration Agency launched in 1997 to monitor rainfall for weather and climate studies, offer precipitation data at a 3-hour interval with a 0.25° x 0.25° spatial resolution. This dataset will be analyzed to assess its capability to accurately represent local precipitation compared to data from weather stations.

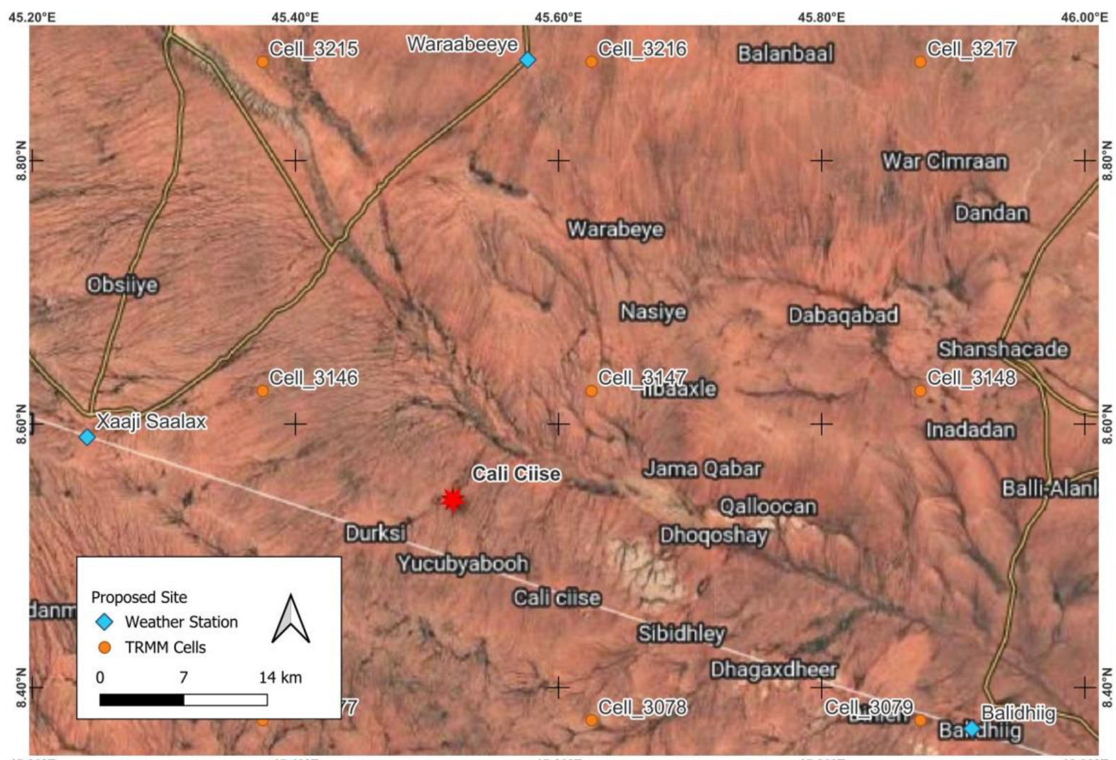


Figure 50: Location of the closest weather station and TRMM cell compared to the location of the site

An analysis was performed on the TRMM dataset, comparing the Waraabeeye station (the closest with the longest series of data) with the closest TRMM cell available (3216 in the map above). The comparison of the two datasets considered both the monthly pattern and the average yearly values. As shown below, the analysis demonstrates a quite good correlation between the two records, with similar monthly patterns and a ratio between the average annual rainfall of the two-time series of 1.4 (this means that, on average, there is less than 40% difference between the recorded data and those provided by TRMM).

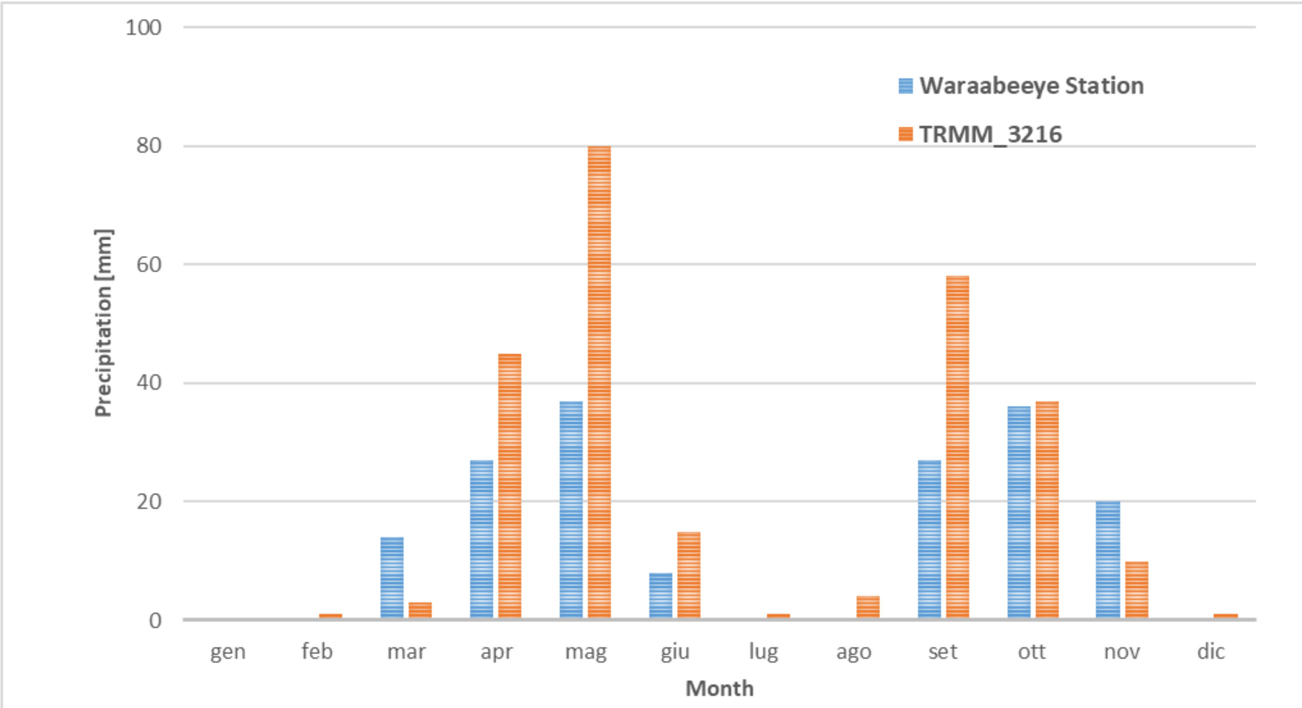


Figure 51: Average cumulative monthly rainfall data comparison between the Waraabeeye weather station and the closest TRMM cell

Table 48: Comparison between the average cumulative annual rainfall between the Waraabeeye weather station and the closest TRMM cell in mm

Weather Station	TRMM	Ratio
169	245	1.4

Given the distance between Waraabeeye weather station and the location of the proposed site (about 37 km) and the satisfactory match between TRMM data and ground observed data, the TRMM dataset can be employed since it is assumed to be more representative of the rainfall in the area of interest, it provides data every 3 hours and has a longer series of data.

TRMM dataset is available for a total of 22 years. According to such records, average rainfall precipitation is 266 mm/year.

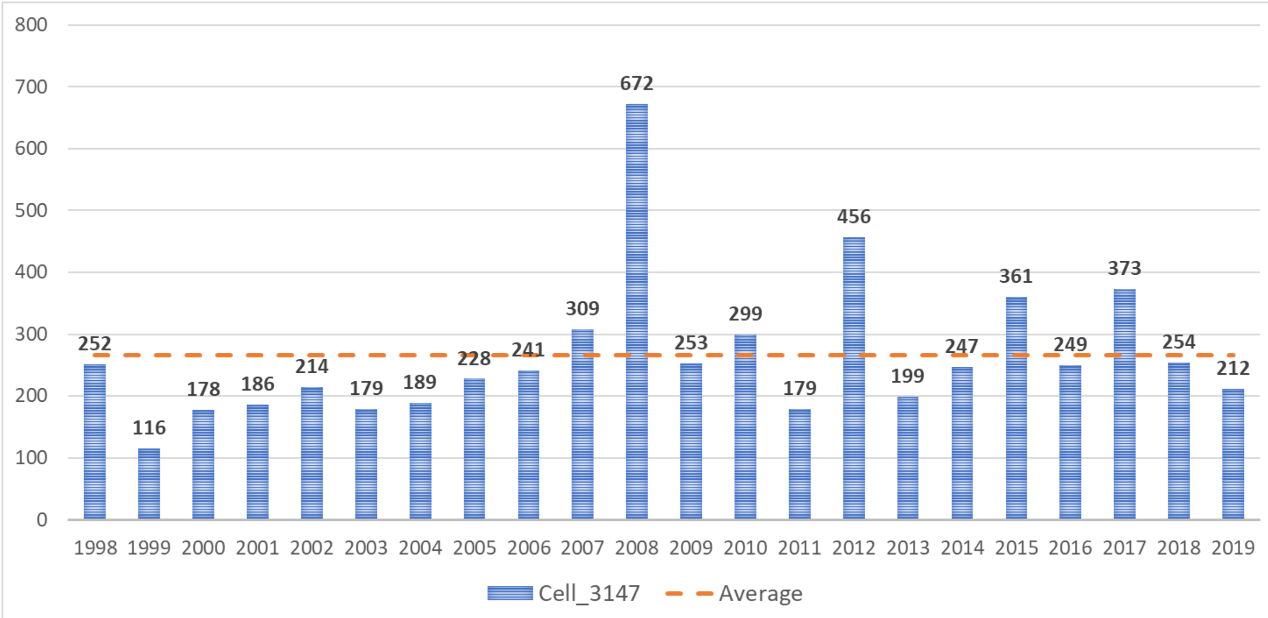


Figure 52: Cumulative yearly rainfall data of the cell 3147 of TRMM database

From the data available the average cumulative monthly was calculated and the average trend is presented below.

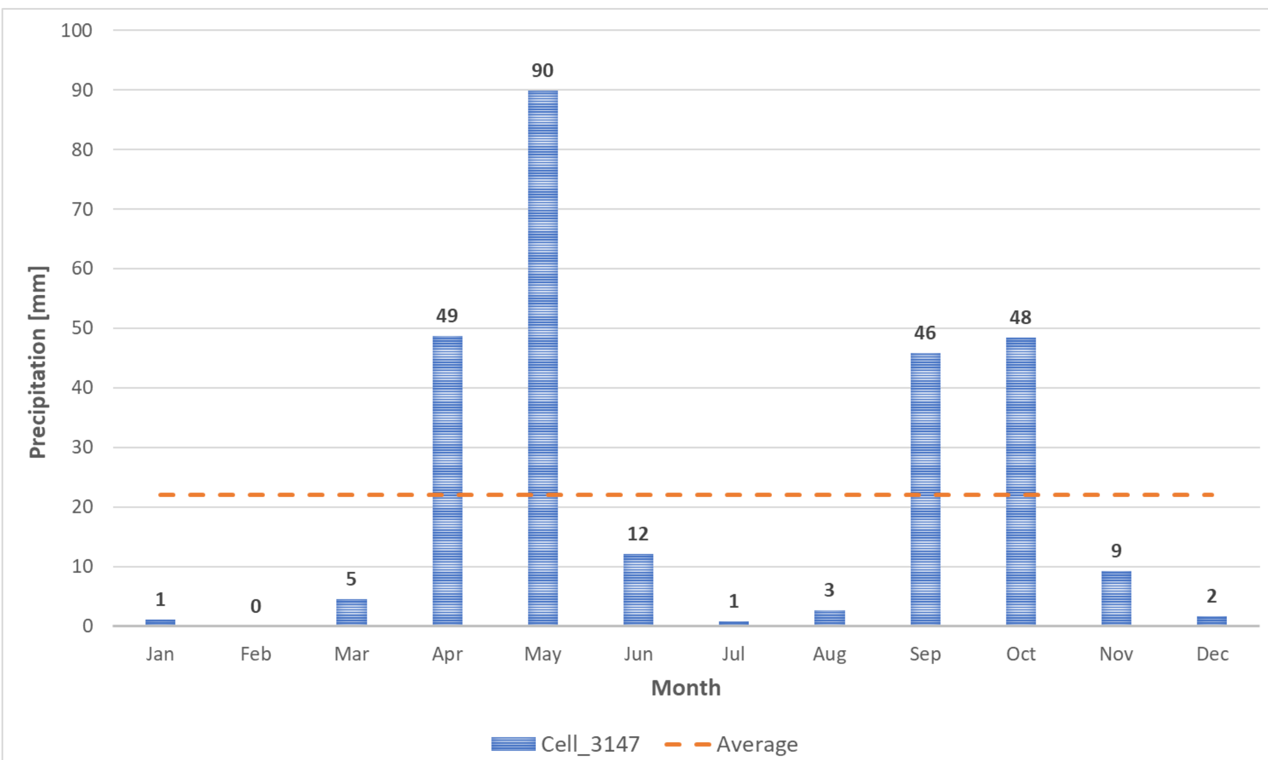


Figure 53: Average cumulative monthly rainfall data of the cell 3147 of the TRMM database (1998-2019)

According to the data, the rainfall peaks usually occur during the months of April/May and during September/October. The very dry period extends from November to March.

Climate Change

The evaluation of climate change impacts on the project site is crucial for accurately estimating changes in water demand and needs during the dry season over the long term, ensuring the project's future viability.

The analysis of the climate change presented follows the data of the Climate Change Knowledge Portal[10]. The site presents Somalia's projected climate and offers CCKP's complete suite of indicators for in-depth analysis into future climate scenarios and potential risks due to changing climates. Data can be investigated as either the projected mean or anomaly (change) and is presented spatially, as a seasonal cycle, time series, or heat plot, which shows seasonal change over long-term time horizons. Data can be analyzed as annual or seasonal and it is possible to select different projected climatology and emission scenarios, or Shared Socioeconomic Pathways (SSPs). SSPs are meant to provide insight into future climates based on defined emissions, mitigation efforts, and development paths.

Indicators can be investigated either as a multi-model ensemble or by individual model. Multi-model ensembles represent the range and distribution of the most plausible projected outcomes of change in the climate system for a selected SSP, while individual models can help to better understand variability across projected climates.

Climate projection data is modeled data from the global climate model compilations of the Coupled Model Inter-comparison Projects (CMIPs), overseen by the World Climate Research Program. Data presented is CMIP6, derived from the Sixth phase of the CMIPs. The CMIPs form the data foundation of the IPCC Assessment Reports. CMIP6 supports the IPCC's Sixth Assessment Report. Projection data is presented at a 1.0º x 1.0º (100km x 100km) resolution.

Climate Change Impacts on Average Precipitation Pattern

According to the Climate Change Knowledge Portal, the projection of precipitation changes in Somaliland appears to highlight a small increase in precipitation throughout the year, most likely due to a slight increase in the intensity of the extreme event.

The precipitation percent change anomaly in the Togdheer region is shown below for the most conservative SSP5-8.5 scenario.

[10] https://climateknowledgeportal.worldbank.org/country/somalia/climate-data-projections

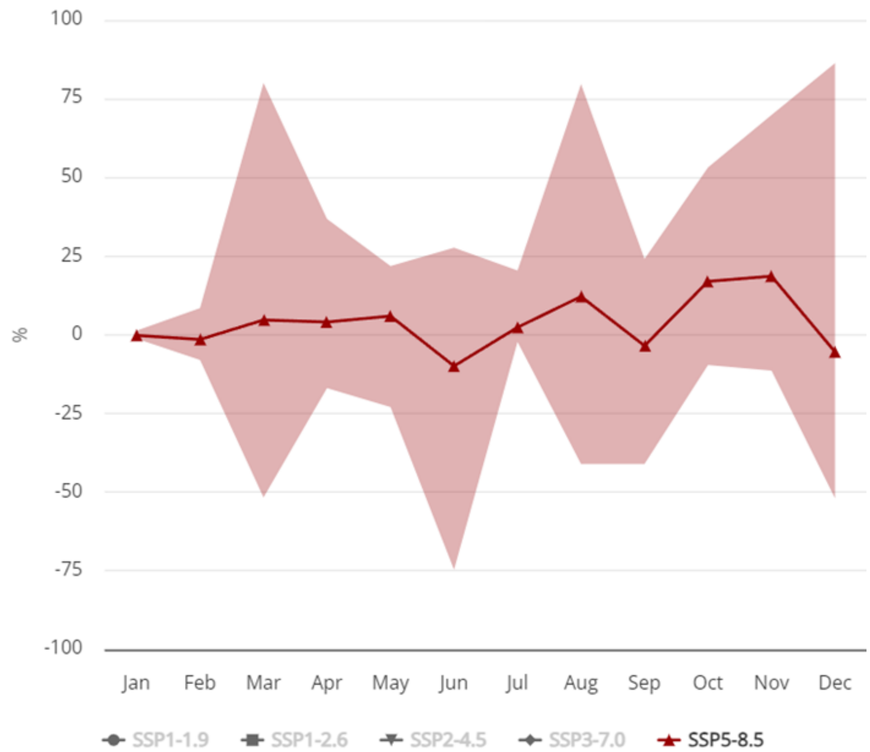


Figure 54: Projected precipitation percent change for 2020-2039 Togdheer region, Somaliland; (reference period: 1995-2014), SSP5-8.5, Multi-Model Ensemble

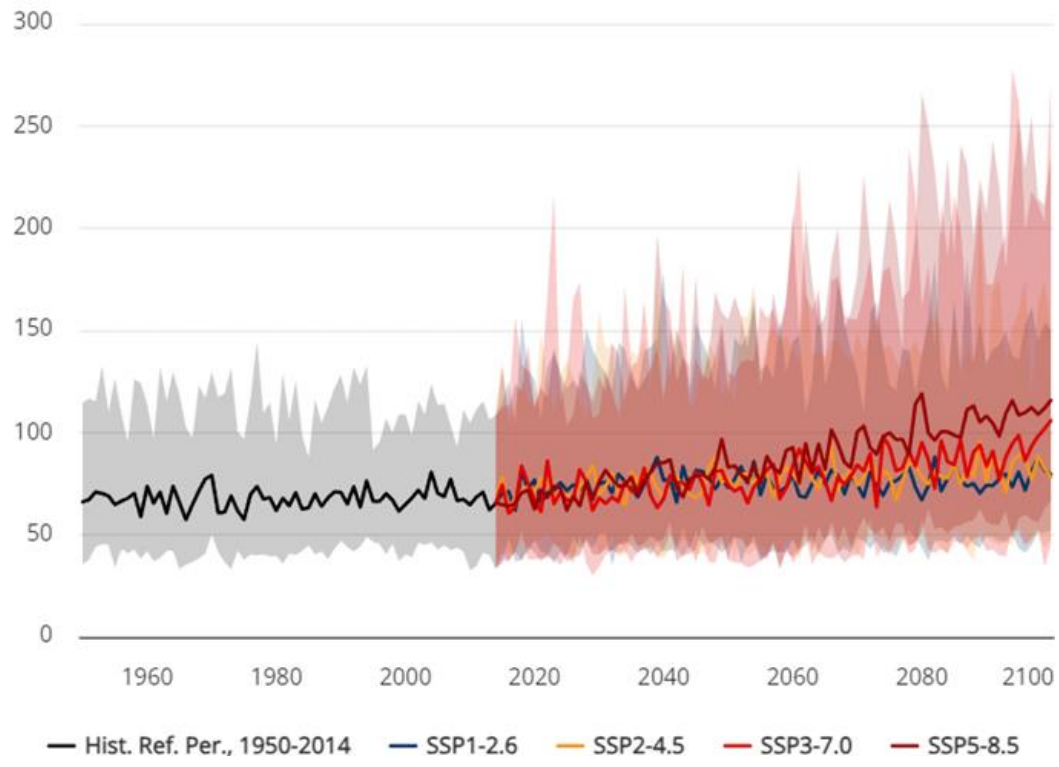


Figure 55: Projected precipitation percent change Togdheer, Somaliland; (ref. period: 1995-2014), Multi-Model Ensemble

From the graphs above it is possible to understand that in the long term a little increase in the precipitation, mainly in the August-November period, is expected. As a result, the water issues faced by the community are unlikely to intensify significantly due to climate-related shifts in precipitation. This stability in rainfall patterns suggests that the new water point will continue to meet community needs.

Climate Change Impacts on Dry Periods

This analysis focuses on the impacts of climate change on water availability for the community, particularly by examining the projected maximum number of consecutive dry days. As dry periods extend due to shifts in climate patterns, consecutive days without rainfall can place substantial pressure on local water resources. By evaluating this critical metric, we aim to understand how prolonged dry spells may affect water availability and the resilience of water supply systems in the community. This approach enables the development of proactive strategies for water management that address potential risks associated with extended dry periods in a changing climate.

Below is presented the projected maximum number of consecutive dry days for the worst-case scenario of SSP5-8.5.

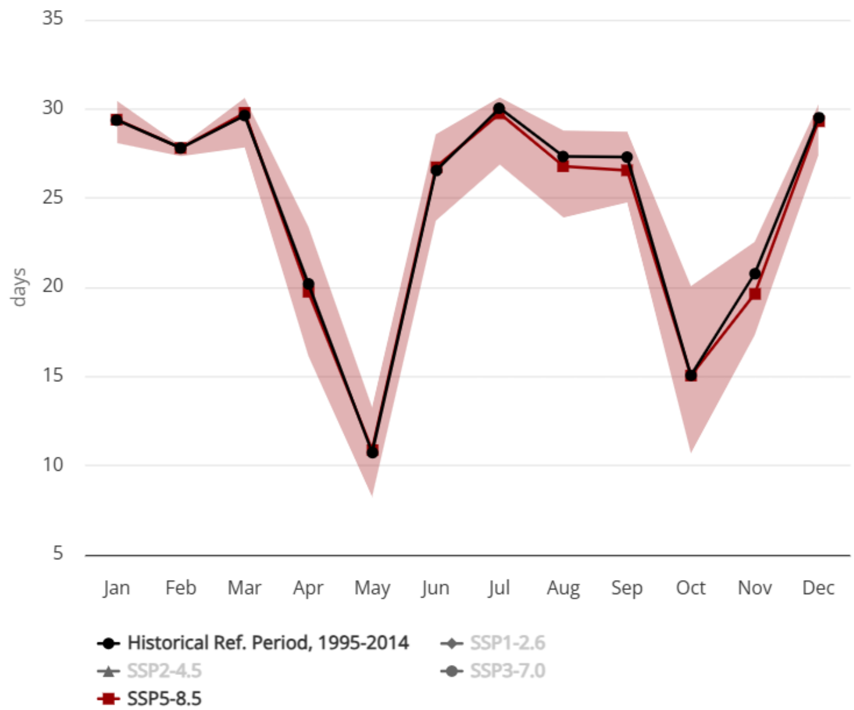


Figure 56: Projected max number of consecutive dry days for 2020-2039 Togdheer region, Somaliland; (reference period: 1995-2014), SSP5-8.5, Multi-Model Ensemble

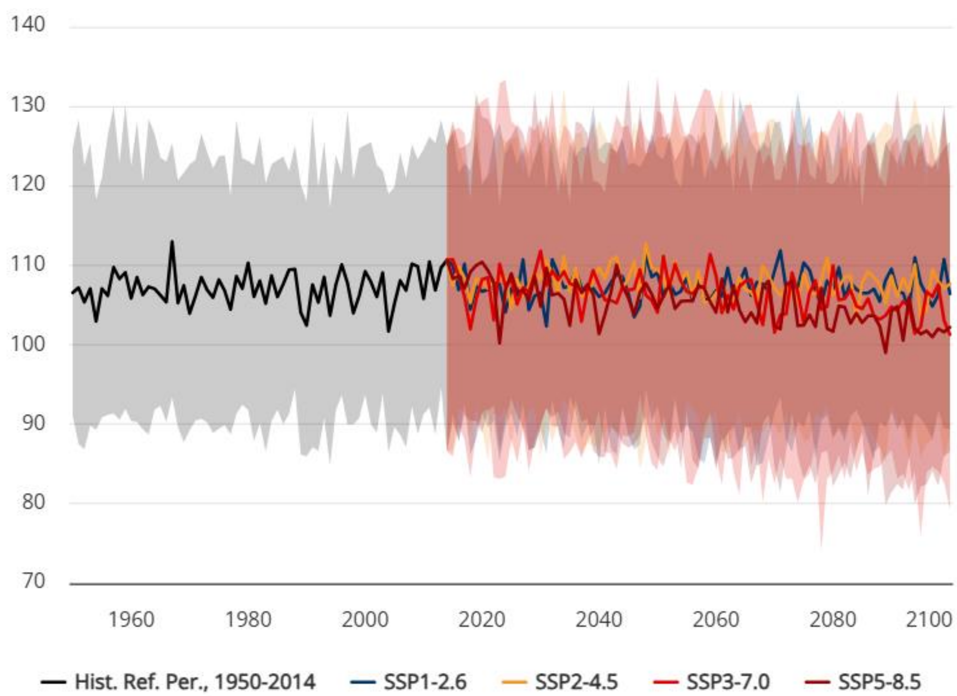


Figure 57: Projected max number of consecutive dry days Togdheer region, Somaliland; (ref. period: 1995-2014), Multi-Model Ensemble

The analysis for the maximum number of consecutive dry days is roughly zero in the projection for the next 20 years, with a trend that highlights a shortening of the dry season, indicating that the new water point will provide sufficient water supply even in the future. This stability in dry periods suggests that the community will have reliable access to water resources, ensuring that the water point will effectively meet both current and anticipated future needs without significant strain.

Annex 7: Gender-Based Violence (GBV) and Sexual Exploitation, Abuse, and Harassment (SEA/SH) Policy

The Sexual Exploitation and Abuse/Sexual Harassment (SEA/SH) Prevention and Response Action Plan for the Horn of Africa Groundwater for Resilience Project in Somaliland outlines the risks, mitigation measures, and accountability mechanisms to address SEA/SH within the project. The key elements of the policy are outlined below.

Key Elements of the Policy

Identified SEA/SH Risks in the Project

High Vulnerability of Women and Girls: Existing data shows 96% of women in Somaliland have undergone Female Genital Mutilation (FGM) and over 70% have faced some form of domestic violence.

Risk of SEA/SH within Project Activities: Increased risk for women in labor-intensive roles, community decision-making exclusion, and power asymmetries that could lead to sexual exploitation or abuse in hiring and service access.

Project-Related Conflict: Poorly designed water points or exclusion from resource allocation could increase tensions, particularly among pastoralists, displaced persons (IDPs), and host communities.

Prevention and Mitigation Measures

Code of Conduct (CoC) for Workers and Contractors: All staff, contractors, and workers must sign a Code of Conduct (CoC) prohibiting SEA/SH; CoC must be translated into Somali and explained in training sessions; violations will lead to strict disciplinary actions, including termination.

Establishment of Grievance Mechanisms (GRM) for SEA/SH Cases: A confidential reporting system has been created to protect survivors; GRM operators will receive specialized training on SEA/SH case management; survivors will be referred to medical, psychosocial, and legal services as needed.

Referral Pathways and Survivor Support Services: Mapping of GBV service providers (hospitals, shelters, psychosocial support) will be completed before construction begins; stakeholders will be informed of where to seek help, ensuring safe and confidential referrals.

Community Awareness and Sensitization: Gender-sensitive engagement with women's groups, youth, and marginalized communities to discuss SEA/SH risks and reporting mechanisms; development of Information, Education, and Communication (IEC) materials in local languages to promote a zero-tolerance SEA/SH environment.

Capacity Building for Contractors and Government Officials: Training for PIU, contractors, and labor supervisors on gender-sensitive labor practices; inclusion of SEA/SH risk mitigation in procurement documents and contractor bidding requirements.

Accountability and Monitoring Mechanisms

- SEA/SH Grievance Mechanism (GRM) to be separate from general complaints to allow for survivor-centered handling.
- Contractor Compliance Monitoring: The PIU will review contractors' GBV response frameworks quarterly.
- Regular Stakeholder Consultations to ensure project workers and communities understand their rights and reporting options.
- SEA/SH Incident Reporting to the World Bank within 24 hours of receiving a complaint.

Annex 8: Site Waste Management Plan (SWMP) for Cali Ciise Borehole Project

Purpose and Scope

The Site Waste Management Plan (SWMP) provides a structured approach to the identification, minimization, handling, storage, transport, and disposal of all waste generated at the site during the site preparation, drilling, and construction phases of the project. It applies to both hazardous and non-hazardous waste, in order to:

- Protect soil, water, and air quality;
- Reduce health and safety risks to workers and communities;
- Comply with national environmental regulations and the ESMP;
- Support responsible, traceable waste handling and disposal.

Key Waste Streams

Waste Type	Typical Source	Classification
Drill Cuttings	Rock and soil fragments brought up by the drilling process	Non-hazardous
Spent Drilling Mud	Water-based fluid used during drilling	Non-hazardous (WBM), may contain residual additives
Used Oil / Lubricants	Generator and rig maintenance	Hazardous
Fuel Residues and Spills	Diesel storage and refueling areas	Hazardous
Solid Domestic Waste	Workers' camps, packaging, food waste	Non-hazardous
Plastic and Packaging	Materials for pipes, pumps, equipment	Non-hazardous (recyclable)
Sanitary Waste (if latrines used)	Worker sanitation areas	Potentially hazardous

Roles and Responsibilities

- **Contractor's ESHS Officer**: Develops, updates, and implements the SWMP. Oversees training and daily supervision.
- **All Site Workers**: Comply with waste segregation, disposal protocols, and reporting of spills.
- **PIU Safeguards Team**: Reviews the SWMP, conducts inspections, and verifies records.
- **MoECC (Regulator)**: May inspect storage and disposal practices in line with national standards.

Waste Handling and Management Procedures

a. Waste Minimization

- Select low-waste drilling techniques (e.g., efficient mud circulation).
- Order materials in precise quantities to reduce surplus and packaging waste.
- Reuse drilling mud where feasible before disposal.

b. Segregation and Labeling

- Separate waste into hazardous, non-hazardous, and recyclable categories at source.
- Use labeled containers or pits for each waste type.
- Never mix used oil, muds, or sanitary waste with general solid waste.

c. Temporary Storage

- Designate a fenced, lined Waste Storage Area (WSA) away from the borehole and community.
- Store:
    - **Hazardous waste** in sealed drums or secondary-containment trays;
    - **Used oil** in clearly labeled drums on impermeable surfaces;
    - **Cuttings and muds** in lined pits, protected from runoff or overflow.

d. Treatment and Disposal

- **Drill cuttings and muds**: Dry in evaporation pits, then backfill on-site in non-sensitive areas.
- **Used oil and lubricants**: Store for collection by an approved handler; or, safeguard and coordinate disposal with MoECC.
- **Solid domestic waste**: Where no licensed disposal facility is available within a practical radius, the contractor shall implement controlled burial of non-hazardous solid waste, using lined and covered pits, sited and managed according to World Bank EHS Guidelines and approved by the PIU and MoECC. If a licensed landfill or collection system becomes available, waste shall be diverted there.
- **Sanitary waste**: Use sealed pit latrines or septic tanks with proper siting and decommissioning.

Spill Prevention and Response

- Place spill kits (absorbents, gloves, shovels) at fuel storage, refueling, and maintenance areas.
- Conduct weekly inspections for leaks or improper storage.
- Train workers on spill containment and reporting procedures.

Waste Tracking and Documentation

- Maintain a Waste Register with quantities, types, and disposal dates for all waste streams.
- Log any incidents, including spills, improper disposal, or community complaints.
- Submit monthly waste reports to the PIU Safeguards Team.

Monitoring and Improvement

- Include waste handling indicators in contractor performance audits.
- Use inspection checklists during weekly site visits.
- Revise the SWMP as needed in response to:
    - New waste streams,
    - Monitoring results,
    - Incident investigations,
    - Regulatory guidance.

Conclusion

The Site Waste Management Plan is a critical tool for ensuring that the borehole project protects human health and the environment. It must be fully integrated into the Contractor's ESMP (C-ESMP) and reflect both national requirements and the project-specific mitigation measures outlined in the ESIA/ESMP.

Annex 9: Emergency Response Plan (ERP)

Cali Ciise Borehole Project, Togdheer Region, Somaliland

Objective

The purpose of this ERP is to:

- Protect workers, nearby communities, and the environment from serious harm,
- Ensure rapid, coordinated, and effective response to emergency situations,
- Comply with World Bank ESF requirements and national HSE obligations,
- Minimize damage to property and interruption to project activities.

Scope

The ERP applies to all project phases during which site-based activities take place, specifically:

- Site clearance and preparation
- Drilling and well development
- Pump and tank installation
- Early commissioning and handover

It applies to all personnel (contractor, subcontractors, consultants, community workers) and extends to interactions with local stakeholders and environments.

Anticipated Emergency Scenarios

Emergency Type	Description	Severity
Fuel or oil spill	Diesel leak during refueling, storage failure	Moderate
Fire or explosion	Ignition of fuel near generator or storage drum	High
Equipment-related injury	Crush, entanglement, or fall during lifting or rig operation	High

Emergency Type	Description	Severity
Drilling mud overflow	Lined pit breach or improper management during circulation	Low
Medical emergency	Heat stroke, fracture, or acute illness on site	Moderate
Conflict or intrusion	Unauthorized access or community conflict	Moderate
Extreme weather	Flash flood or high winds damaging structures or disrupting access	Moderate
Sanitary hazard	Latrine or greywater system overflow or contamination	Low

Roles and Responsibilities

Role	Responsibility
Site Emergency Coordinator	Lead on-site response, decision-making, communication with external parties (MoWRD, MoECC)
Contractor's ESHS Officer	Maintain readiness, conduct drills, inspect emergency supplies, lead root cause analysis post-event
All Supervisors / Team Leads	Account for workers, activate alarms, secure equipment, ensure evacuation routes are used
First Aid Officer	Administer immediate aid, stabilize injured person, communicate with health facilities
Watchman / Security Guard	Secure perimeter, control site access during and after the emergency

Emergency Preparedness Measures

- **Site layout** must clearly show:
    - Emergency assembly point

- Location of firefighting equipment and spill kits
- Storage areas for fuel, oil, and chemicals

- Minimum supplies per site:
  - 2 fire extinguishers (ABC-rated)
  - 2 spill containment kits (absorbent pads, gloves, plastic sheeting)
  - 1 stocked first-aid kit with wound care and emergency medications
- Communication tools:
  - Radio or mobile phone with airtime backup
  - Emergency contact list posted in Somali and English
- Training:
  - Induction for all workers on emergency procedures
  - Fire response and spill drill every 30 days
  - Toolbox talks every week covering rotating risks (e.g., fuel handling, weather)

Response Procedures

A. Fire or Explosion

- Activate alarm (shout or use whistle)
- Shut off fuel supply and evacuate to assembly point
- Use fire extinguishers if safe to do so
- Contact local authorities and PIU focal point immediately

B. Fuel/Oil Spill

- Stop source of spill
- Use spill kit to contain and absorb

- Remove contaminated soil and store in sealed bags for safe disposal
- Record spill in incident log; notify PIU if >10 liters

C. Medical Emergency

- Remove victim from danger
- Apply first aid
- Transport to nearest health facility (Burco hospital or designated clinic)
- Complete incident report within 24 hours

D. Drilling Mud Overflow

- Isolate area
- Repair pit liner or create temporary berm
- Remove contaminated material if needed
- Report and photograph for records

E. Community Conflict or Access Incident

- Notify Site Emergency Coordinator
- Avoid confrontation
- Engage community liaison or VDC focal point
- Temporarily halt work until resolved

F. Severe Weather

- Cease work during lightning, high wind, or flash floods
- Secure equipment
- Evacuate if necessary; reassess site before resumption

Incident Reporting and Follow-up

- All incidents must be recorded in the Incident Logbook maintained by the ESHS Officer.
- High-severity events (injury, environmental release, fire) must be reported to:
  - MoWRD PIU within 24 hours,
  - MoECC if environmental harm occurred,
  - World Bank task team leader, if applicable.
- A Corrective and Preventive Action Report (CAPA) must be completed for each significant incident.

Community Involvement and Communication

- Emergency contact numbers shared with Village Development Committee (VDC).
- At least one community meeting held during mobilization to explain emergency signals and procedures.
- A community liaison officer designated to relay emergency updates if any off-site impacts occur.

Conclusion

This Emergency Response Plan must be incorporated into the Contractor's Environmental and Social Management Plan (C-ESMP), reviewed by the PIU and supervising engineer, and tested through simulation drills. It is a living document and will be updated based on site conditions, incidents, or regulatory guidance.

Annex 10: Social Summary Report

Social Summary Report for Abaartire Projects (max 5 pages)

For

Cali-Ciise Village New Borehole Burao District, Togdheer Region

February 27st, 2025

Social summary report for Abaar Tire sub-projects (max 5 pages). Please attach community engagement minutes, voluntary land donation/agreement documentation, screening form

Proposed sub-project: Cali-CiiseVillage/district/state: Duruqsi Total no. of households who will use the water point_800HH.

- Other than technical selection, why was this site chosen for new compared to other sites (need/distance/challenge with nearest to water point/inclusion etc)

Cali-Ciise faces severe water scarcity, relying primarily on 45 seasonal Barkeds and one small Baley, many of which are either non-functional or inadequate. The nearest reliable water sources are Burao, over 120 km away, and Balidhiig, more than 50 km away, making water access both costly and challenging. Among the existing Barkeds 17 of them suffer from structural issues such as cracks and the absence of roofing, significantly limiting their water storage capacity. The community consists of approximately 800 settled households and an additional 250 nomadic households, creating a high demand for water, particularly among those without private Barkeds. Water remains critical for sustaining livestock and preventing economic hardship. A historic barked, built in 1951 and still operational without rehabilitation ever, has a capacity of 1,512 m³ but is insufficient to meet the community's current needs. Additionally, Cali-Ciise is home to a secondary boarding school and a primary-intermediate school, accommodating 120 and 230 students, respectively, MCH is also located in Cali-Ciise which is very fruitful for community specially women and children. Therefore, enhancing water infrastructure in Cali-Ciise is essential to supporting the community, reducing migration pressures, and improving overall living conditions.

Overview of the project location and key features within 200m of works (to understand impacts): The designated site for drilling the borehole and constructing associated infrastructure, including animal troughs, a water tank, and a caretaker's room, is located 1 km southeast of the Cali-Ciise. A road is situated 100 meters to the west of the site, while another road runs approximately 2 km to the east. There are no existing structures, reservoirs, or Barkeds with in 200m^2 radius. The area is characterized by natural Trees, Shrubs, which is actively preserved by the local community, as charcoal production is not practiced in this area. Additionally, there are no internally displaced persons (IDPs) or minority groups in the area. However, during the rainy season, some nomadic households may temporarily migrate in search of fodder for their livestock and return once water scarcity comes out during dry season.

Key stakeholders and how they were consulted and engaged for the proposed sub-project activities to ensure broad agreement, ownership and risk identification and mitigation

Stakeholder group	Influence in the sub-project	Interest	How were they consulted? (Separate meetings)	How many consulted from that group?	Were there challenges to their engagement?	Key concerns and how they will be addressed
Women	High influence	They are highly interesting construction of new borehole	Attended general consultation meeting and separate meeting even visited their business places or homes to acquire water related information.	21	No	**They mentioned that:** They were mentioned the Village Development Committee comprises nine male members, with no female representation. On the other hand, the Women's Development Association in Cali-Ciise, known as **Fawfiiq**, consists of 30 members. This association is committed to empowering women through the teaching of writing, record-keeping for their business management, and mutual support via contributions to an **"Ayuto"** Group Savings Fund, aimed at enhancing business prospects. Furthermore, the association collaborates with the Village Development Committee and the local

						diaspora to raise awareness about education, ensuring that students remain in school. They also support the top ten students from Cali-Ciise Boarding Secondary School, to awarded scholarships and attend universities in country. Private water sources, commonly known as 'Barkeds,' are often owned by individuals, and in some cases, the owners may lock them, making it difficult to access water. This can lead to delays as it takes time finding Barked with an available owner. Moreover, many of these sources lack roofs, and has a safety risk to women and children. As a result, businesswomen may need to temporarily lock their shops about 1 to 2 hours while searching for water. Likewise, it is obvious that female students often experience delays in arriving at school due to the time spent fetching water. However, during the dry season, challenges arise due to a decline in milk production and weakened livestock, which were unable to be sold because

						of insufficient water and fodder. This situation affected both the villagers and the rural community, limiting their ability to purchase goods from local shops and businesses. As a result, members of the women's association were unable to collect funds for the Ayuto savings initiative, as their businesses suffered significant losses due to rising credit burden. Other risks E&S team observed, most of the Cali-Ciise Barkeds located downstream which has a health risk. To address the concern: ❖ Encourage the inclusion of female members in the Village Development Committee to promote voice towards water related issues and diversity in decision-making. ❖ Construct new borehole and distribute water to the village to minimize the time spent by women, girls, and young men in collecting water,

						and to reduce the burden on surrounding rural communities due to distance and high-water tariffs during dry season. ❖ Advocate for funding projects to improve safety around existing water sources by building roofs and securing the areas to prevent accidents. ***They added that two of the 19 unprotected Barkeds will soon be covered by an NGO after the community informed Duruqsi district administration***. ❖ Encourage women's associations to diversify into other income-generating activities, such as vegetable farming and poultry, to reduce their dependence on livestock and milk production. ❖ Consider establishing water supply systems (house connection) to ensure students do not

						need to find operating Barket to fetch water for their households.
Youth	Hight Influenced	They were highly interested	Participated general community consultation meeting	51	No	The majority of youth in **Cali-Ciise Village** and the surrounding areas are actively pursuing their education, with many enrolled in secondary boarding schools or primary-intermediate schools. **Notably,** a significant number of these students **ranked among the top ten students in Somaliland for the 2023–2024** academic year, reflecting the community's strong emphasis on academic excellence. However, some of the male youth who did not attend university due to various factors, such as the absence of family support in larger cities or never having attended school, have become involved in the **habitual chewing of khat**. The practice of chewing khat has become a major factor driving charcoal production, as those involved in khat chewing often seek ways to cover their daily costs.

						Addressing these challenges requires community engagement, educational support, and viable alternative economic opportunities to safeguard both the future of the youth and the local environment. Raising awareness about the impacts of charcoal production is crucial, not only for the personal development and well-being of the youth but also for environmental sustainability, and avoiding the deforestation associated with the charcoal practices. **N/B:** The Environmental and Social team from GW4R should integrate the Cali-Ciise community **training with future risk management**, apart from the other E&S trainings, including water management.
Customary institutions	High Influenced	They were highly interested	They support community mobilization and participated general community	18 members	No	Elders serve as enforcers of customary law, playing a vital role in resolving community issues related to resources such as grazing, land and water issues. They occasionally issue directives that the Cali-Ciise community must adhere to. In this regard, the Cali-Ciise elders

			consultation meeting			recently declared a ban on charcoal production in the locality, a decision that was fully respected and implemented by community members. The elders were also briefed on the historical challenges associated with drilling deep wells in the Hawt Plateau, particularly in the Cali-Ciise area (where previous borehole failed). Recognizing these difficulties, they emphasized the need for any assigned drilling rig to have the capacity to reach depths of up to 500 meters. Furthermore, they requested the Ministry to take full responsibility for ensuring the successful completion of this initiative. The elders have clearly stated that the land where the borehole and associated infrastructure will be constructed is community land, and there no existing structures around it. They also emphasized that it is their responsibility to voluntarily

						donate this land to community-owned water project. *This highlights the community's urgent need for water and their strong commitment to the success of the borehole project.*
Pastoralists	High Influenced	They were highly interested	They support community mobilization and participated general community consultation meeting	15 members	No	The pastoralists have indicated that the Cali-Ciise locality is considered communal grazing land, which is owned and utilized collectively by the community. There is no privately owned land, except for areas where individuals have established personal structures. Consequently, any land that is donated by community elders for development projects is intended to benefit the entire community and is supported by the community as a whole.
Nomadic pastoralists	High Influenced	They were highly interested	They support community mobilization and participated general community consultation meeting	5 members	No	Currently, approximately 10 nomadic pastoralists reside in Cali-Ciise. However, the majority of nomadic pastoralists have relocated to other areas where water resources are more accessible. This migration is primarily driven by water scarcity, with many pastoralists, particularly

						those with large herds of camels, seeking regions where water availability can sustain their livelihoods. The initial attraction to Cali-Ciise was the availability of both water and grazing land; however, the decline in grazing resources and the worsening water scarcity have led many to move to more viable locations.
Others?						
Total number of people consulted (*check from the CER*) 110						

Has there been any conflict over this land or water resources in the past? If so please describe, what measures the project will take to ensure that project does not exacerbate conflict: Though, community stated that there was no social conflict within community hence, due to the nature of large population around village new source implementing by WB project is obvious that conflict can arise. Therefore, community Elders with Village committee will need to raise up their understanding towards community gather for utilizing water sources.

1. **Has a safeguards field visit been undertaken to the site?** Yes, **Date of visit:** Yes, **Date of visit:** 15/02/2025, Visited **PIU members:** Abdirashiid Ahmed, Hodan Ahmed, Ramla Ali, Huda Ibrahim **Title of visiting:** S&E Team.

2. **Will the ESMP be incorporated into the contract for the works and is a safeguards compliance report required before payment?** Yes__

Type of land required for sub-investment and documentation:

a. **Government land**	Title deed/confirmation document attached?	N/A
b. **Community land**	Voluntary land donation form and community minutes attached?	It is community land and they announced that this location is for water project and signed voluntary land donation document.
c. **Private land**	Voluntary land donation form and conversion document attached?	N/A

3. Land Agreement:

a) **How many people own, live on or regularly use the land where the project will be implemented (including those who might use it as a drought fall back area)?** None of the community members privately owns, community owns collectively site/Land. **And how many agreed to the use of this land for this public facility?** All community groups representatives were agreed that site is to be used as a public water point, it is a large grassing land which historically being in the community.

b) **Explain how the requirements have been met (and attach minutes, land agreement form and signed participants list):**

Requirements for voluntary land donation	Explanation and evidence
1. The land required to meet technical project criteria must be identified in conjunction with the affected community?	**Yes**, the site was discussed and agreed with the community donating this land and community representatives sign the donation document and Duruqsi district will provide land certification.

2. What are the likely impacts of proposed activities on donated land and how were these explained to the community?	The issue of soil degradation at the site was addressed, and efforts will be made to raise awareness among the contractor and water point users. They will be encouraged to use existing roads which is passing by the project location about 100 matters to east.
3. Area of land compared to area owned (no more than 10 percent of the area of any holding can be donated). %	No, the land is community land
4. How will the users and occupiers of the land benefit from this sub-project?	The borehole is intended to supply water to the residents, and there are no inhabitants on this land.
5. What are the conditions of benefiting from this sub-project – connection fees, service charges etc.	The determination of the service charge will involve cooperation between the community elders/Village Development Committee (VDC), the Ministry of Water, and the district local government. The establishment of tariff will consider the community's willingness to pay and its purchasing power, consequently, once the tariff officially set, every community member is obligated to pay the service charge. If the community desires a connection to their homes, the Village Development Committee (VDC) will set a reasonable and reliable price for connection fees. ***Though water supply to the village is not including the design and community expecting to extend water to the village (about 900m distance from water point) .***

	This approach ensures that the costs associated with connecting to individual households are clearly consider fair and inclusive approach.
6. How was the community made aware that refusal was an option and confirmed in writing that they are willing to proceed with the donation? (e.g. at the consultation and in the voluntary land donation document)	During consultation E&S team explained community can decide whether they have willingness to voluntarily donation the land or not.
7. What evidence is there that the act of donation was undertaken without coercion, manipulation, or any form of pressure on the part of public or traditional authorities (e.g. photos/videos of community consultation etc.)?	Broad community consultations were carried out to ensure agreement on the location of the upcoming water project and to promote inclusive land use by both communities, whether from Somaliland or the Ethiopian side. It was highlighted that both communities, from Ethiopia and Somaliland, have integration mechanisms. At times, the Somaliland community crosses the border, ensuring no exclusion and same as with the Ethiopian side.
8. Do all the users and occupants of this land understand that by donating this land it may be gazetted as public land	N/A
9. How was it explained that they have a right to compensation for land and the available compensation options (in-kind compensation, land for land compensation or cash compensation, and the implications of cash compensation?	N/A
10. Were monetary or non-monetary benefits or incentives requested as a condition for the donation and were these provided?	N/A

11. How do you know that the land being donated will not reduce the remaining land area to a level below that required to maintain the donor's livelihood at current levels and will not require the relocation of any household?	N/A
12. Will any structures be moved or any access to land be limited as a result of the sub-project (describe structures and locations)?	There is no any structure in the assigned project site
13. If so, how will they be compensated/facilitated and/or their livelihoods restored?	N/A
14. How was consent provided by all individuals occupying or regularly using the land?	Consultations on the project site were carried out with all community representatives.
15. Was there anyone who did not give agreement and why?	No
16. How was it established that the land to be donated was free of encumbrances or encroachment and was it registered in an official land registry?	N/A
17. All users and occupants of the land have genuinely understood (in local language with sufficient time) and agreed that all conditions for land agreement have been met (refer to consultations above and attach minutes).	Yes

4. GRM: Has the GRM process and contact information for focal points been disseminated to the community? If so, how and to whom (numbers and groups). If not, when will this be done?

Initial awareness-raising on the Grievance Mechanism (GM) has been conducted with the community. However, once the contract is awarded and the site is handed over to the contractor, it is crucial to initiate a new round of awareness efforts regarding the GM for both community members and the contractor's staff. During this educational and training phase, a female volunteer will be designated as the focal point for Gender-Based Violence (GBV) and the prevention of Sexual Exploitation, Abuse, and Harassment (SEAH). This focal person will receive specialized training on how to use communication channels such as landlines, hotlines, and email to connect with the responsible Project Implementation Unit (PIU) personnel.

5. **GBV/SEAH: Has awareness been carried out on GBV, service providers and confidential survivor centric GBV complaints mechanism? If so, how and to whom (numbers and groups). If not, when will this be done?**

Gender-Based Violence (GBV) and Sexual Exploitation, Abuse, and Harassment (SEAH) awareness and training will be provided to both the contractor's staff and the VDC, including selective community members when the contract is signed. This aims to raise awareness about all GBV/SEAH related issues and emphasize the prohibition and zero tolerance for any violations against women and children.

6. **Sustainable management: Who will manage and maintain the sub-project, and how will repairs be funded?**

7. The Ministry is responsible for organizing training programs for water point operators and conducting significant repairs and replacements of costly equipment. These activities require advanced skills that may not be available within the community but are essential for the efficient functioning of the system and the long-term sustainability of water resources. The Village Development Committees (VDCs) are tasked with managing the water point and collecting water usage fees. They should actively engage in discussions with the Ministry of Water and the district administration to establish appropriate water tariffs. The collected fees are to be used for maintaining cleanliness and performing minor maintenance at the Cali-Ciise water point.

8. **Describe the nearest GBV service providers for health, psycho-social and legal support (to inform the site supervisor and stakeholder in the area):**

The nearest GBV service providers for the Cali-Ciise water point rehabilitation activities are listed institutions who are involved in providing GBV services to any females in the community. Cali-Ciise community will contact the GBV nearest service provider through listed contact.

Region	Districts	Location	Service provider name	Type of Service	Focal Person	Designation	Mobile
All regions	Burao	All Somaliland	All City's Hospitals	Medical diagnostics, related	Nimco	Health worker	063-4440388

		Regions' General Hospitals		medications, social support, and psychological assistance/suppo rt.			
Tog-dheer	Duruqs i	Cali-Ciise MCH	MCH	Maternity nutrition, vaccination, emergency care, and minor health concerns	Hamda Hasan	Health worker	
Togdhee r	Duruqs i	Duruqsi MCH	MCH	Child Protection Desk (children on the move)	Fadumo Ali	Health worker	

Annex 11: Voluntary Land Donation Form

COMMUNITY VOLUNTARY LAND DONATION FORM FOR THE GW4R PROJECT

ITEM	DESCRIPTION
Sub-project name:	Cali Ciise
Sub-project description:	Cali Ciise village, the designation BH area located in 1km South-east of the village
Project Location:	Cali Ciise village, Durugsi district
GPS coordinates of land required:	Latitude: 8.5425° - Longitude: 45.5196°
C[illegible]munity or public land:	Community land.

Please attach the community minutes and summary safeguards report explaining how the requirements for use of land for this sub-project have been met.

TERMS OF THE AGREEMENT

As discussed in our community meeting on ..February 17, 2025...to which all residents and regular users of the project site (specify) ....Cali Ciise Borehole site.......... were invited. We the nominated representatives at that meeting confirm that the following issues were discussed and the residents and regular users of this land are in unanimous agreement.

1. That ......8.5425°, 45.5196°...... [GPS & Land dimensions] shall be site of the proposed ......New Borehole site...... and that:
2. We were consulted and are aware of the design and location of the infrastructure and understand the impacts that this may have on the surrounding area e.g. access paths, gathering of livestock and people, influx of households, grazing patterns,
3. We understand that we can refuse the use of this land for the activity;
4. The amount of land being donated for the borehole is minor and will not reduce the remaining land area below that required to maintain anyone's livelihood at current levels;
5. No household relocation is involved
6. The donors of the land will benefit directly from the project; and
7. The land set aside for the investment may be made public land and no one is claiming individual ownership, and no alternative claims will be made later on the land.
8. We have all agreed unanimously that the project implementation should continue.
9. The land is donated/ identified as a public property in consultation with all residents and users of the land.
10. All owners and regular users of the land agreed to this investment and donation of the land without coercion, manipulation, or any form of pressure on the part of public or traditional authorities.

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11. The land is free from encumbrances or encroachment and is not claimed by any individual and its ownership is not contested.
12. If any structure will be moved or any access to land be limited as a result of the sub-project, support will be provided by the contractor/project/community to the individual so their livelihoods are not adversely affected.

We have been designated by the community of (__ Cali ciise ______,
_____Date 17/02/2025 ______, ______,

Confirm the above information to be true and that we have resolved to abide by ALL terms of this agreement. (Please attach minutes of the community meeting including the signed attendance sheet and photos of the meeting).

No.	Name	ID/No./Phone number	Role	Date	Signature
1.	Ahmed Abdi Ali	063-4535432	Head	17/02/	
2.	Ali Ahmed Hassan	063-4161540	member	17/02	
3.	Abdillahi Abdi Egal	063-4315482	member		
4.	Adan Ali ciise	063-4337945	member	—	
5.	Saleban Abdi Yusuf	063-4354223	member	—	
6.	Mahamoud Ibrahim Harun	063-4134057	member	—	
7.	Abdi-ladin Omer Hassan	4314469	member	—	
8.	Abdillahi Hussein Jama	4572412	member		

Agreed/ **Witnessed on this by:**

1. **District Administrator**

Name	ID/No./cell number	Date	Signature& Stamp

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2. District Administrator

Name	ID/No./cell number	Date	Signature
Mohamoud Abdillahi Deputy district Mayor	063-4074183		

3. Regional/District representative of Ministry of Water Resources Development:

Name	ID/No./cell number	Date	Signature
Mustafe Mohamed Ismail MoWRD regional Coordinator	063-4438486		

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