ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT SUMMARY PROJECT REPORT

FOR

THE PROPOSED DRILLING OF FOUR EXPLORATORY BOREHOLES FOR STUDYING AND MONITORING OF THE PROPOSED WELL FIELDS CUM COMMUNITY WATER SUPPLY PROJECTS, AT ADEMASAJIDA AND ARBAJAHAN IN WAJIR COUNTY.

COORDINATES FOR THE BOREHOLE AT:

Livestock Market: Latitude 1.0239317N; Longitude 39.494205 E;

Waso Girls Primary School: Latitude 1.0163888 N; Longitude 39.4825 E;

Arbajahan Primary School: Latitude: 2.062859 Longitude: 39.009005

Bula Madina: Latitude: 1.987012 Longitude: 39.050097

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CERTIFICATION

This Environmental and Social Impact Assessment Summary Project Report has been prepared by a team of EIA experts lead by Mr. Godfrey Wabomba; NEMA registered EIA/EA Lead Expert No. 6127. The Summary project report was prepared in accordance with the requirements of the Environmental (Impact Assessment and Audit) (amendment) Regulations, 2019, pursuant to *The Environmental Management and Coordination Act, (CAP 387).*

DISCLAIMER

This Environmental and Social Impact Assessment Summary Project Report is strictly confidential to the proponent and any use of the materials thereof should strictly be in accordance with the agreement between the client/proponent and Mr. Godfrey Wabomba (the lead EIA Expert). It is, however, subject to conditions in the Environmental (Impact Assessment and Audit) (amendment) Regulations, 2019.

We, the undersigned, certify that the particulars given in this report are correct to the best of our knowledge.

Signature: …….. Date: ……..

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Proponent
On behalf of
Northern Water Works Development Agency (NWWDA)

Name……

Chief executive officer (CEO)

Signature_____
Date

Stamp

EXECUTIVE SUMMARY

Wajir town remains plagued with challenges of sustainable water sources for social and economic development of the rapidly expanding town. There is a concerted effort by the Government to alleviate the situation and in light of this, the Government of Kenya received a credit from the World Bank through the M0WSI under Water and Sanitation Development Project (WSDP) to among other Counties, improve water supply in Wajir town. Merti aquifer is one of the key long-term sources that were identified through a series of studies that were conducted by Earth Water Limited and Zamconsult Consulting Engineers Ltd. The findings of the studies indicated that the potential well-field supplying water to Wajir town from Merti aquifer would either be located at Ademasajida or Arbajahan, which were found to have fresh water. In this regard, Northern Water Works Development Agency (NWWDA) being an implementing agency under WSDP is proposing to drill 4 No. exploratory boreholes, 2 No. at Ademasajida and 2 No. at Arbajahan for the purposes of providing critical data for studying and monitoring the proposed well fields as well as the Merti aquifer recharge, abstraction and quality. In addition, it is proposed that the water from the exploratory boreholes shall partly be supplied to the community. The 4 No. exploratory boreholes at Ademasajida and Arbajahan are proposed to be drilled to a depth of 350m.; The 2 No. boreholes at Ademasajida shall be drilled at existing Ademasajida Habaswein Livestock market and Waso Girls primary school respectively as was indicated by the Hydro-geological survey conducted, while those at Arbajahan shall be drilled at Bula Madina and Arbajahan primary School respectively.

The scope of this report covers the drilling of 4 No. exploratory boreholes with 2 No. each at Ademasajida, and Arbajahan for studying and monitoring of the proposed well fields and the Merti aquifer hydraulics as well as for domestic water supply to the local communities of Ademasajida and Arbajahan. For the supply of water to the local community, the proposed project shall in addition equip 2 No. boreholes, construct 2 No. elevated steel tanks, construct 6.5km of transmission pipeline, 5 No. water kiosks, 2 No. Cattle troughs at Bula Madina and fencing around the boreholes at each of the proposed project location. The boreholes are expected to produce fresh water with an approximate yield of 20 to 25m^3 per hour. The designs of the facilities are as indicated in Annex IC. The proposed sub-project falls under the World Bank's support to the Kenyan government through investment lending towards improving water supply and sanitation services focusing on coastal and northern Kenya regions and priority areas, along with strengthening sector institutional capacity to deliver improved services. The proposed drilling of exploratory boreholes and construction of community water supply activities will thus trigger the Bank's Safeguard Policy (OP 4.01 Environment Assessment) which is the subject of this report.

ESIA regulation

In light of this and according to section 58 of the Environmental Management and Coordination Act CAP 387, it is a requirement under the national legal framework that a proponent carries out an ESIA study before being issued with an EIA license to undertake any project activities that may be considered harmful to the environment. This includes application of the “Environment Impact Assessment and Audit

Regulations of 2003" and consideration of other national legislations as captured in Chapter 3 of this ESIA. In this regard separate project summary project reports/ESMPs shall be submitted to NEMA for ESIA licensing.

Project Location

The proposed drilling of 2 exploratory boreholes at Ademasajida shall be located at the new Habaswein Ademasajida Livestock Market while the second borehole shall be located at Waso Girl's primary school. On the other hand, the proposed boreholes in Arbajahan shall be located at Arbajahan primary School and Bula Madina centre located 9.5km South of Arbajahan. The coordinates of the proposed boreholes are as indicated in Table 0-1.

Table 0-1: Coordinates for the Proposed Boreholes

No.	Borehole Location	Latitude	Longitude	Location
1.	Habaswein Ademasajida Livestock Market	1.0239317N	39.494205 E	Ademasajida
2.	Waso Girl's primary school	1.0163888 N	39.4825 E	Ademasajida
3.	Arbajahan Primary School	2.062859 N	39.009005 E	Arbajahan
4.	Bula Madina	1.987012 N	39.050097 E	Arbajahan

The proposed sub-project is generally located in Wajir County, Wajir West Sub-county and in Ademasajida and Arbajahan wards, locations and sub-locations. The land for the development of the facilities is a community land within Ademasajida and Arbajahan sub- location. The community through elected representatives signed land resolution and consent forms permitting the construction of the proposed project components at Arbajahan and at Ademasajida livestock market as per the attached signed land resolution and consent permit attached in annex IIA &C. Arbajahan and Waso Girls primary schools have land allotment letters and the school management allowed the drilling of the boreholes in the schools as per the Annex IIB&D.

Estimated Project Cost

The estimated cost of the proposed development is about KShs. 61.5 Million[1] inclusive of taxes. This cost includes construction materials, labour and professional support services. The main works considered include: drilling and construction of the boreholes, preliminary and general items, solar systems, submersible pumps and other electrical mechanical works for the boreholes, distribution pipelines, elevated steel tanks, plastic water tanks, water kiosks, fencing and cattle troughs.

[1] *The estimate cost is according to the figures provided in the bill of quantities in the project proposal document.*

Approach and Methodology

The main approach and methods employed during the ESIA study were desktop literature review and field survey, as noted in Section 1.6. The desktop study involved; reviewing available published and unpublished reports, development plans, and maps to compile relevant baseline biophysical and socio-economic information about the study area. Field surveys involved environmental and socio-economic data collection. Environmental profiling of the proposed project areas was done through assessment of various environmental parameters, including; climatic factors, hydro-geological surveys, solid and liquid waste management, drainage, noise and vibrations, air quality, landscape, and aesthetic value of the proposed project area as indicated in sections 4.3 of this report. On the other hand, the socio-economic survey approach consisted of quantitative and qualitative data collection. It involved public participation through use of community Baraza's discussions guide, administering household questionnaires and key informant interviews. Data needs were based on predetermined socio-economic parameters, as highlighted in section 4.5 and chapter 5. The units of data collection were public meetings, household heads and key informants. The tools used to collect data were questionnaires administered to households in the area, community baraza meeting discussions guides and from key informant interview guide was used.

Key Study Findings

The proposed exploratory boreholes are to be drilled to a depth of 350m deep with an objective of understanding the localized area aquifer hydraulics and hence aiding in the design of the well field(s) for Wajir water supply project in addition to supplying water to the host communities of Arbajahan and Admesajida. The proposed project area is a modified environment with settlement and commercial being the main land uses. The community in Ademasajida area reported to draw its water from 4 sources, 3 of which are boreholes drilled by NWWDA, and handed over to WAJWASCO while the fourth source was reported to be a private borehole. The WAJWASCO boreholes are the community's primary source of water and they include one in Habaswien at the sub-county HQ, the second in Bula Qasad or the old Hadado Borehole and the other is the Qulqul (plenty water) Borehole. The community in Arbajahan reported to draw its water from 2 community boreholes which were also drilled by NWWDA, and handed over to WAJWASCO for management.

The water sources were reported to be insufficient and thus unreliable. Due to inadequate water supply in Ademasajida, the local people reported incurring high costs of accessing water resources which was reported to be around Kshs 200 for every 200L tank. Some of the participants reported spending up to 25,000 Kshs per month depending on water use. The existing boreholes at Arbajahan were reported to serve the community within a radius of about 10KM, mainly for livestock watering and for domestic use. The water was reported to be safe for consumption and the local community members rarely treat before use. Inadequate water supply in the 2 areas was attributed to; relying on solar and with low solar energy at the time of the study, there wasn't enough solar energy to pump the water. Occasional pump failures which take long to be repaired, in Admesajida one of the boreholes was reported not fitted with a pump and thus does not supply water to the community; private boreholes' owners in Ademasajida were also

reported to sometimes being unwilling to share or even sell their water. The challenges of inadequate water supply have led to rationing in which the community members receiving water after every 3 days which is not sufficient. It was indicated that those with young children bear the brunt the most, inadequate water for washing hands during this COVID-19. Pandemic, slow development of the town and though locals want to do development (construction), it's limited by availability of water. The slow development of Arbajahan market was also attributed to low water supply and though locals want to do development (construction), it's limited by availability of water for construction.

Public Consultation and Stakeholder Engagement

Public consultations and stakeholders' engagement was undertaken through conducting community meeting (baraza) in an open space in view of the existing Government Covid-19 protocol and limitation in the number of attendees' in public meetings by Governments. Due to limitation in the numbers of stakeholders and conditions by the Ministry of Health on COVID-19, the first consultation meeting at Ademasajida was held in 2 parts with men having one meeting and women and girls having a separate one. The second meeting was held at Ademasajida livestock market and the minutes of the discussion and attendance list are as indicated in annexes IIIA & IVA. Similar discussions were held at Arbajahan and the attendance list and minutes were as shown in annexes IIIB & IVB. In the table below is a summary of the discussion as captured in Chapter 5.

Summary of Public Consultation Issues

KEY ISSUES RAISED	RESPONSES
Clarity on whether there was a connection between the proposed community project and the long-term water solution for Wajir town project.	It was clarified that though it is within the same package, they are separate and if the consultant who was to be on board establishes the need to drill the boreholes in Ademasajida or Arbajahan, then the community will be consulted to give their opinion or if the water shall be from Tana River then similar consultations shall be conducted. It was also noted that it is not necessarily that the boreholes shall be drilled in the area, it could be anywhere including Arbajahan along the Merti aquifer but the exact point shall be guided by the outcome of the Wajir long term water supply study.
The concern that existing water supply is not enough for the community at Arbajahan and how come it will be supplied to Wajir town?	The proposals to supply water to the community from the proposed exploratory boreholes are part of the measures to improve water supply to the community. The community was also advised to make their request known during consultative process by the Wajir long term water supply study consultant assessing the possibility of bulk water supply to Wajir.
Why the drilling up to 350m yet community get water at a depth of 100 to 200m	The project coordinator clarified that the 2 boreholes shall assist in collection of data on the condition of the general aquifer health (recharge and abstraction levels). And that was the reason it was designed to be deeper for better study and understanding of the

	aquifer
Question on whether the community welcome the project or not.	The exploratory boreholes to be drilled for the community at Admesajida and Arbajahan without any conditions attached. That the community was willing to have a discussion with the consultant who will be studying the options to supply water to Wajir from Ademasajida.
Transparency in allocation of job opportunities/outsider's infiltration for labour/ employment	A local committee will be formed and a transparent recruitment process initiated. Local Community members will be prioritized for jobs.
Noise pollution during construction work	The contractor will abide by EMCA– Noise and excessive vibration pollution control generation 2009, legal notice No. 61. Where possible drilling around school areas to be done during the holiday
Excitement among women about provision of water	This will save time spend on searching for water on other income generating activities and the focus on studies by the girl child.

Impacts of the Project

The proposed drilling of the exploratory boreholes and construction of community water supply associated facilities is anticipated to have both negative and positive impacts on the residents, users, the environment and the project area in general, as indicated in chapter 6 of this report. The mitigation measures have been put in place to mitigate for the negative impacts at both construction and operation phases of the project.

Positive Impacts

The proposed drilling and construction of associated community water supply facilities is anticipated to have overall positive impacts including but not limited to; creation of temporary employment opportunities, tree planting within homesteads, creation of markets for project construction materials, faster growth of the local urban centers, reliable, easy and faster access to clean water, improved Livestock production, stabilized household incomes from livestock and improved sanitation, increased revenue to WAJWASCO, development of Kitchen gardening, reduced cost of water, improved water reliability, improved living conditions through elimination of water fetching chores for women and children who can then focus on income-generating activities and education respectively, in view of the time saved as a result of the water supply sources being closer and more reliable and reduce child mortality.

Negative Impacts

The proposed project activities during construction, operation, and decommissioning phases are anticipated to lead to negative impacts and risks including but not limited to: Public safety hazards including school pupils, Air quality degradation from exhaust fumes and dust emission, noise impacts from the rig and construction vehicles, accidents and injuries to workers, increased solid waste generation, spread of invasive species like *Prosopis julisflora (Mathenge)* which was noted within the

project area, spread of livestock pest and diseases at watering point, conflicts among water users especially during droughts at watering points, water lose from bursting of the distribution pipelines, leakage and spillage of oil, grease or fuel from drilling rig or construction vehicles, increase in waste water, wind erosion and impact to aesthetic value from the construction of the elevated steel water tanks, Occupational Health and Safety (OHS) issues on site, increase in grievances among water resource users, child labour, gender based violence, spread of covid-19 among community members and workers, HIV/AIDS spread, sexual harassment and abuse at community and work sites.

Mitigation Measures for Negative impacts during Construction Phase

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
1.	**Occupational Health and Safety (OHS).** Accidents may occur on site causing injuries during implementation of the project works affecting the workers.	**<u>Impact is low</u>** The impact is temporal and will be of local scale given the volume of works, anticipated volume of contractor machines and vehicles on site	▪ Contractor to develop a site safety action plan detailing safety risks, safety equipment to be used, emergency procedures, restriction on site, frequency, and personnel responsible for safety inspections and controls. This should be ready and approved by the supervising engineer before commencing works ▪ Train workers on safety before commencing works ▪ Ensure safety of the construction workers by putting first aid area and injury reporting mechanism ▪ Ensure compliance to Occupational Safety and Health Act Cap. 514 and its Subsidiary Legislations. ▪ Provide appropriate personal protective equipment (PPE) to workers and training on appropriate use. *(Reflective jackets, helmets, face masks, ear plugs gloves, safety boots, etc.)* ▪ There should be adequate provision of the requisite sanitation facilities for human waste disposal ▪ Recording of all injuries that occur on site in the incident register, corrective actions for their prevention are instigated as appropriate. ▪ The contractor should consider having WIBA insurance policy to cushion self and workers against loss of income in an accident on site. ▪ Provide adequate clean drinking water for the workers to mitigate against dehydration ▪ As applicable, only qualified personnel shall be allowed to operate construction/drilling equipment

2.	**Public Safety** Public safety issue are anticipated to arise during borehole drilling, at construction site, movement of machines and equipment to and from site, movement of construction vehicles and possibility of the elevated steel tank falling/collapsing during operation due to high wind force in the area or for some other reasons.	**Impact is minor** The impact is temporal and will be of local scale given the volume of works, anticipated contractor machines and vehicles on site. And with quality workmanship and use of recommended material, there will be no reason for collapsing of the elevated steel tank.	• Ensure the safety of residents by providing safety signs at strategic places around the access roads. • Hording off working sites to protect the public or unauthorized persons. • Use of signs and warnings on sites with high risks especially at the elevated tank and drilling rig sites. • Reduce unnecessary speeding to control for accidents from the movement of pedestrians or livestock in the area. • Barricading the site to limit access; • Using dedicated site access separate from that used by the school children • Planning noisy drilling activities to occur outside learning hours etc, • The design and construction of the elevated steel tank to consider the changes in wind force in the area and works shall be quality assured. • Limit the extent of open trenches to what can be readily backfilled within a working day
3.	**Air quality** It is anticipated that exhaust fumes and dust emission will be generated during drilling and construction works of the proposed borehole facilities.	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated contractor machines and vehicles on site	• Workers to use masks when working in dusty conditions. • The community members to be discouraged from going to site to watch construction activities particularly the drilling rig • Consider shielding wind impacts during drilling to reduce mud particulate matter being blow away if it's in the direction of settlement. • Reduced speeding on the dusty roads • Construction vehicles to have catalytic devices to ensure complete burning of waste gases, • use of clean petroleum that is low in sulphur, lead or other pollutants, • proper servicing of vehicles and Construction machines • Use all means possible to suppress dust if considered to be a menace during excavations
4.	**Excessive Noise and Vibrations.** Drilling rig is anticipated to generate high level of noise impacting mainly workers working on	**Impact is Moderate** The impact is temporal and will be of local scale given the volume of works, anticipated number of contractor machines and vehicles on site. However, water drilling rig	• The community members to be discouraged from going to site to watch drilling/construction activities • Machines and equipment to be fitted with silencer/muffler devices where possible, • Using equipment and machines with low noise emission. • Switching off vehicles and machines when not

	rig. Noise shall also be from movement of construction vehicles on site.	generates high amount of noise and given the amount of hours the workers spent on site could have substantial impacts.	in use, • Avoiding unnecessary hooting, • Workers to be provided with personal protection equipment earplugs. • Reduce working hours for the workers on site during drilling by having working shifts • Machines to be serviced to reduce generation of noise and vibrations, • the noisy activities should be restricted during daytime • Ensure that NEMA noise and Vibration standards are observed in all project activities. • Training/sensitization/awareness on use of PPEs and personal safety measures. • Liaising with the school management on scheduling of drilling activities, especially noisy operations, to ensure least disturbance to school activities
5.	**Solid waste generation** The main source of waste shall be the contractors camp, construction waste, drilling mud and soil cuttings	**Impact is low** The volume of works are low and the team onsite is also anticipated to be small	• Reuse of all soil cuttings from the excavation works • Proper disposal of waste from the contractor's camp • Disposing off contaminated soils in cutting pit if volumes are low. • The contractor to develop site specific incident management or response plan in the evident of hazardous waste contamination *(used tyres, Oil and Fuel filters*). • Preparation of waste management plan to guide waste management and disposal activities, ensuring segregation of the wastes generated
6.	**Spread of invasive species.** Spread of invasive species due to use of infected materials or equipment, leading to loss of indigenous species, injury to animal and local people	**Impact is Moderate** *Prosopis juliflora* was noted in the project area and can easily be spread due to project related activities.	• Raw materials used for construction such as sand and rocks should be sourced in areas where there are no invasive species. • Equipment required for the construction works should be clean and free from any alien plants and mud which may contain seeds or tuber of alien species. • Care should be taken while working along areas with invasive species to reduce spread. • Sensitizing workers on invasive species and handling requirements • Regular monitoring of the project site for the spread of alien plant growth and in the event of such observation, to take remedial action. •
7.	**Leakage and spillage** Leakage and spillage of grease, fuel or oil	**Impact is low** The low volume of works anticipated to attract a low	• In the event of hazardous waste leakage or spills, engage authorized waste handlers to dispose contaminated soils. • Disposing off contaminated soils in cutting pit if

	from the contractor's machines and equipment is anticipated at the site during boreholes drilling and construction of the associated community water supply facilities	number of machines	volumes are low. • Use of NEMA licensed waste handlers to dispose in licensed disposal areas. • Development of site-specific incident management or response plan, and maintaining all requisite emergency response kits on site. • Taking all measures possible to reduce any spillage
8.	**Soil erosion**	**<u>Impact is minor</u>** Although the land topography within the project site is more flat with sandy soils as well as the area experiencing low rains, the number of livestock especially goats is high. The wind action in the area is substantial and the soil is bare without vegetation cover. It is therefore anticipated that more loosening of soil particles by livestock movement at the water points shall be substantial.	• Consider using human labour to excavate pipe laying trenches • Back filling and compacting the soils • provision of alternative livestock watering points • Planting vegetation to reduce wind erosion. • Timing the implementation to avoid wet seasons. • Discouraging communities from grazing around the project area and livestock watering point.
9.	**Covid-19** *Spread of COVID-19. During construction at work sites*	**<u>Impact is minor</u>** The spread of the virus is more likely but with proper management and adherence to guidelines from the ministry, World Bank and WHO shall reduce the impact of the covid-19.	• The Contractors will develop standard operating procedures (SOPs) for managing the spread of Covid-19 during project execution and submit them for the approval of the Supervision Engineer and the Client, before mobilizing to site. The SOPs shall be in line with the World Bank guidance on COVID-19, Ministry of Health Directives and site-specific project conditions; • Mandatory provision and use of appropriate Personal Protective Equipment (PPE) shall be required for all project personnel including workers and visitors; • Avoid concentrating more than 15 workers at one location. Where two or more persons are gathered, maintain social distancing of at least 2 meters; • Install hand washing facilities with adequate running water and soap, or sanitizing facilities at entrance to work sites including consultation venues and meetings and ensure they are used; • Ensure routine sanitization of shared social facilities and other communal places routinely

			including wiping of workstations, door knobs, hand rails etc.;
10.	**Spread of COVID-19** amongst community members during consultation processes	**<u>Impact is minor</u>** The spread of the virus is more likely but with proper management and adherence to guidelines from the ministry, World Bank and WHO shall reduce the impact of covid-19.	• Electronic means of consulting stakeholders and holding meetings shall be encouraged, whenever feasible. One-on-one engagements with stakeholders while observing social distance and adhering to PPE wearing shall be enforced; • Avoid concentrating more than 15 community members at a venue. Where two or more participants are gathered, maintain social distancing of at least 1.5 meters (5 feet); • The team carrying out engagements within the communities on one-on-one basis will be provided with appropriate PPE for the number of people and stakeholders they intend to meet. • Use traditional channels of communications (TV, newspaper, radio, dedicated phone-lines, public announcements and mail) when stakeholders do not have access to online channels or do not use them frequently. Ensure to allow participants to provide feedback and suggestions. • Hold meetings in small groups, mainly in form of FGDs if permitted depending on restrictions in place and subject to strict observance of physical distancing and limited duration. • In situations where online interaction is challenging, disseminate information through digital platform (where available) like Facebook and WhatsApp & Chat groups. • Ensure online registration of participants, distribution of consultation materials and share feedback electronically with participants.
11.	**HIV/AIDS**	**Low** Drilling and construction works are anticipated to take a short duration due to low volumes of work. Therefore the impacts are anticipated to be low	• Promote HIV/AIDS prevention messaging • Install HIV testing services at the construction site • Support infected workers with ARVs • Peer counseling services at the site
12.	**GBV: Sexual exploitation and abuse (SEA)**	**Low** Drilling and construction are anticipated to take short period due to the low volumes of work. Therefore, the impact is anticipated to be low	• Develop and implement a SEA management action plan with an Accountability and Response Framework as part of the ESMP. The SEA action plan will follow guidance on the World Bank's Good Practice Note for Addressing Gender-based Violence in Investment Project Financing. • The SEA action plan will include how the

			project will ensure necessary steps are in place for: • Prevention of SEA: including CoCs and ongoing sensitization of staff on responsibilities related to the CoC and consequences of non-compliance; project-level IEC materials; • Response to SEA: including survivor-centred coordinated multi-sectoral referral and assistance to complainants according to standard operating procedures; staff reporting mechanisms; written procedures related to case oversight, investigation and disciplinary procedures at the project level, including confidential data management; • Engagement with the community: including development of confidential community-based complaints mechanisms discrete from the standard GRM; mainstreaming of PSEA awareness-raising in all community engagement activities; community-level IEC materials; regular community outreach to women and girls about social risks and their PSEA-related rights; • Management and Coordination: including integration of SEA in job descriptions, employments contracts, performance appraisal systems, etc.; development of contract policies related to SEA, including whistle-blower protection and investigation and disciplinary procedures; training for all project management; management of coordination mechanism for case oversight, investigations and disciplinary procedures; supervision of dedicated PSEA focal points in the project and trained community liaison officers.
13.	**Gender Equity, Sexual Harassment and abuse** amongst workers in the workplace	**Low** Construction is anticipated to take short period due to the low volume of work. Therefore the impact is anticipated to be low	• The contractor should prepare and enforce a No Sexual Harassment and Non-Discrimination Policy • The contractor should strive for an equitable distribution of employment opportunities between men and women. • Provision of gender disaggregated

			bathing, changing, sanitation facilities • Whenever harassments are recorded on site, the contractor should ensure prompt and effective remedial action • The employees should be trained and sensitized on appropriate behaviour
14.	**Gender-based violence at** community level	**Low** Construction is anticipated to take short period due to the low volumes of work. Therefore the impact is anticipated to be low	• The contractor will implement provisions that ensure that gender-based violence at the community level is not triggered by the Project, including: • Effective and on-going community engagement and consultation, particularly with women and girls; • Review of specific project components that are known to heighten GBV risk at the community level, e.g.; community level water management, representation or related economic activities etc. • Specific plan for mitigating these known risks, e.g. sensitization around gender-equitable approaches to employment, representation, management etc • The contractor will ensure adequate referral mechanisms are in place if a case of GBV at the community level is reported related to project implementation.
15.	**Child Labour and Protection**	**Low** Construction is anticipated to take short period due to the low volumes of work. Therefore, the impact is anticipated to be low	• Ensure no children are employed on site in accordance with national labour laws. This can be done through incorporating prohibitive provisions in the code of conduct and also having the recruitment policies that prohibits child labour. • Ensure that any child sexual relations offenses among contractors' workers are promptly reported to the police.
16.	**Grievance Redress**	**Low** Drilling and construction are anticipated to take short period due to the low	• Establish community grievance committees at the sub - project site • Ensure a separate contractor staff grievance handling mechanism exist.

	volumes of work. Therefore, the impact is anticipated to be low	

Mitigation Measures for Negative impacts during Operation Phase

NO	ASPECT	IMPACT RATING	MITIGATION MEASURES
1.	**Occupation health hazards**	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated volume of contractor machines and vehicles on site	• Ensure compliance to Occupational Safety and Health Act Cap. 514 and its Subsidiary Legislations standards. • Provide personal protective equipment to operation and maintenance workers. • Recording all injuries that occur on-site to workers while doing their daily duties in the incident register, corrective actions for their prevention should be initiated as appropriate. • Cordoning off working sites to protect the public or unauthorized persons during repair and maintenance of the different project utility systems on site • Creation of awareness and training of workers on site safety and first aid skills. • Hiring employees with proper qualifications for specialized and risky tasks during operation and maintenance of the various utility systems. • Adherence to Covid-19 rules as provided by the ministry of health and the WHO while conducting daily duties. • Training of workers on covid-19 rules and requirements.
2.	**Spread of invasive species.** The spread of invasive species is anticipated during operation and maintenance of the transmission pipeline. The spread could be due to dispersal by livestock particularly goats which feed on pods. This shall lead	**Impact is Moderate** *Prosopis Juliflora* was noted in the project area and can easily be spread due to project related activities.	• Regular monitoring of the project site for the spread of alien plant growth and in the event of such observation. • Care should be taken while working along areas with invasive species to reduce spread. • Control of livestock movement into the project area from infested areas • Create awareness among the local community on management of the spread of the invasive species. • Employing relevant management practices e.g uprooting young plants or burning to control the spread of the plant.

	to loss of indigenous species, injury to animal and local people		
3.	**Water Loss** There shall be water losses occasioned by leakage in the water transmission pipeline this will lead to increased abstraction, reduced supply and increase in cost of operation and maintenance. Water loss is mainly anticipated from burst of water transmission pipelines, vandalism and damages from movement of livestock in the area	**Impact is Minor** Leakages in the system and deliberate vandalism of the pipeline for livestock watering.	• Use of water meters in strategic sections of the system network to audit loses in the system to reduce NRW. • Proper coordination and provision of pipe burst reporting mechanism among the local community. • Adequate maintenance and prompt response to reported bursts or leakages. • Use of quality piping materials and control of pressure in the network. • Creation of awareness on water conservation among employees of water service provider and the local people. • Provision of valves at strategic points to reduce waste after bursts on sections of the line and reduce pressure in the system • Installation of automated leak detection by monitoring deviation in water pressures from the norm if possible. • Sensitization and awareness creation among the community against vandalizing the pipeline for livestock watering • Deep trenching of the transmission pipes to avoid damages by moving livestock.
4.	**Spread of livestock pest and diseases** Spread of livestock pest and diseases. Due to convergence of several livestock at the same watering point, especially visiting livestock may lead to infections	**Impact is minor** The impact is considered to be minor	• Frequently monitoring livestock pest and diseases particularly during droughts • vaccination of livestock during drought periods • To quarantine livestock from infected areas from watering or moving to project area • Frequent spraying or treating of livestock by the local community members
5.	**Conflict among water resource users** Strife among community members and outsiders from neighbouring villages during droughts. Particularly while watering animals	**Impact is minor** The Local community has a well-organized conflict resolution mechanism through community elders. The impacts are considered to be minor since local people respect elders and are bound by decision made by the	• Consider agreeing on guidelines regulating the access to water resources by the various interest groups. • The elders to work with the office of County Commission to resolve any perceived conflicts from other pastoralists accessing water resources in the project area particularly livestock watering points.

		elders.	
6.	**Increase in waste water** Test pumping of the borehole shall lead to high waste water depending on the quality of water struck. Anticipated also at operation for the waste water to be generated since 75% 0f water supplied is discharged in the environment as waste water.	**Impact is low** The impact is anticipated low given the population of the area, the water evaporation rate and the type of soils with high infiltrations which may reduce the flow or stagnation of such waste water.	• Create awareness on reusing waste water for kitchen gardening or tree planting • Do not allow any livestock to drink water during test pumping before the quality is ascertained. • Create awareness and sensitization among the locals on the possibility of risks posed by test pumping water to livestock. • WAJWASCO to consider construction of waste management and treatment system in the long-term.
7.	**Soil erosion** Movement of livestock at watering points during operation of the boreholes shall lead to loosening of soil particles exposing soil to wind erosion. Excavations of 6,500 m for the main transmission is also anticipated to loosen the soils	**Impact is minor** Although the land topography within the project site is more flat with sandy soils as well as the area experiencing low rains, the number of livestock especially goats is high. The wind action in the area is substantial and the soil is bare without vegetation cover. It is therefore anticipated that more loosening of soil particles by livestock movement at the water points shall be substantial.	• Back filling and compacting the soils • Ensure distribution of alternative livestock watering points such as the water pans existing within the project area. • Planting vegetation to reduce wind erosion. • Sensitization and awareness creation among the community members. • Discouraging communities from grazing around the project area and livestock watering point.

ESMP Implementation and Institutional Management

The implementation of the proposed measures shall be by several actors including the client (NWWDA), NWWDA safeguards specialist, the supervision engineer and the contractor who is expected to have environment, health and safety officer to implement and report on safeguard requirements.

The estimated cost for the implementation of the ESMP and ESMoP is 2.2 Million. However, the actual costs covering the construction phase shall be prepared by the contractor and captured in the C-ESMP.

The project's Bid Documents will incorporate the Environment, Social Health and Safety Provisions discussed under this ESMP. The Project Contract Document shall include provisions for the contractor preparing and implementing site specific Construction Environment and Social Management Plan (C-EMSP). The C-ESMP shall provide for incident classification criteria and an incident escalation hierarchy. The C-ESMP shall guide the implementation of safeguards requirements. The supervising engineer shall on a daily basis supervise the implementation of the C-ESMP, ESMP and ESMoP. The client's Environmental safeguards consultant shall conduct regular and impromptu monitoring to ensure that all the requirements of the World Bank and National laws are adhered to as captured in the ESMP and ESMoP.

Reporting on implementation activities of the exploratory boreholes shall be done at several levels. The supervising engineer shall be in charge of the daily reporting on site on behalf of the client (NWWDA). The engineer shall in consultation with the contractor team prepare all the required reports including site meeting minutes and submit to the client. The progress reports prepared shall be on monthly and quarterly basis. The client (NWWDA) including the project engineer and social safeguards consultant shall review the reports and submit to the World Bank. Further to regular reporting, all ESHS incidents, accidents, dangerous occurrences including occupational diseases shall be promptly reported to the respective regulatory institution in the prescribed manner and template outlined in DOSH ML/DOSH/FORM 1 and further to the World Bank in line with the requirement of the Occupational Health and Safety Act (OSHA) 2007, EMCA CAP 387, and World Bank EHS guidelines. Investigation shall be conducted, and a corrective action plan developed for every reportable incident to prevent recurrence

Health Impacts due to covid-19

The review of this ESIA is undertaken during the era of the Coronavirus disease (COVID-19) pandemic outbreak. As such, specific mitigation measures have been introduced to prevent the spread of the virus during the construction period. Moreover, consultations required as part of the mitigation measures, during training on E&S issues, also pose a risk of infection to communities. For this reason, the risk of contracting the virus during consultations will be avoided, minimized and mitigated with specific measures to ensure national requirements on social distancing and recommendations on how to minimize contact are adhered to.

Conclusion

Merti aquifer is one of the key long-term water sources that were identified through a series of studies that shall supply fresh water to Wajir town. The findings of the studies indicated that the potential well field supplying water to Wajir town from Merti aquifer could either be at Ademasajida or Arbajahan. The aquifer is of trans-boundary significance and therefore, there was a need to collect data on the impacts of water extraction for supply to the town. In this regard, it has been proposed to drill 4 No. exploratory boreholes, 2 No. at Ademasajida and 2 No. at Arbajahan for the purposes of studying and monitoring the aquifer water quality and quantity for sustainable extraction. The implementation of the proposed project is therefore anticipated to address these challenges by increasing water supply to the local people but of significance to collect data that shall be used to study and monitor the Merti aquifer for sustainable

utilization of the resource. Such monitoring system does not exist anywhere along the aquifer, at least in Kenya and this shall provide an opportunity for trans-boundary data sharing in additional to national data. The proposed project shall therefore provide water to the local community from two of the proposed 4No. Exploratory boreholes in the proposed areas. The project shall consist of drilling of 4boreholes, laying of 6.5km of pipeline transmission mains, 5 No. water kiosks, fencing of the borehole, 2 No. livestock watering troughs at Bula Madina and 2 No. elevated steel tanks. The proposed project area showed characteristics of modified habitat mainly due to anthropogenic activities related but not limited to commercial activities and settlement. The environmental and social assessment findings indicated that the project impacts are of low impacts. The implementation of the project therefore is not anticipated to significantly influence the physical and social environment. It was further noted that the anticipated impacts shall be of low magnitude due to the size of the project and with mitigation measures having been proposed in this report.

Recommendations

Drilling and development of the proposed exploratory boreholes together with the water supply facilities is anticipated to have some negative impacts socially and to the physical environment. In spite of the anticipated environmental and social impacts, with proper mitigation measures, the project is environmentally viable. The environmental assessment team therefore proposes the implementation of the project with the following recommendations which need to be considered;

- The project proponent NWWDA to ensure full implementation of ESMP and ESMoP proposals during implementation stage while Wajir County Government through WAJWASCO to do so during operation and decommissioning stages of the project as will be required.
- The contractor will not allow any use of the water particularly test pumping water before conducting water quality tests and found fit for consumption, which could not be curtained at the time of this study.
- NWWDA and the supervising engineer are responsible of ensuring the costing of the ESMP measures as described in this ESIA report, or any additional safeguards management instructions for the project are included in the Bill of Quantities, and that the contractor include in its offer of the project implementation budget to implement these measures.
- The project implementing agency (NWWDA), the contractor and the supervising engineer will ensures that the Ministry of Health and World Bank covid-19 guidelines are implemented to the latter at the project site during construction period and that all the workers commit to observing the rules.
- Deliberate (affirmative action) measures will be taken by the proposed project to consider connecting vulnerable and marginalized individual to water within the project area or ensuring provision of water kiosks is near dwelling of such groups and making the commodity affordable.
- The project in addition to consider supplying water to social amenities such as schools and dispensaries observed within the project area.

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LIST OF ACRONYMS AND ABBREVIATIONS

AOI	Area of Interest
CIDP	County Integrated Development Plan
CIGs	Community Interest Groups
EIA	Environmental Impact Assessment
EMCA	Environmental Management and Coordination Act
ESIA	Environmental and Social Impact Assessment
ESMoP	Environmental and Social Monitoring Plan
ESMP	Environmental and Social Management Plan
FGDG	Focus group discussion guide
FGDs	Focus Group Discussions
GDP	Gross Domestic Products
HHQ	Household Questionnaires
KIID	Key informant Interview Guide
KIIs	Key Informant Interviews
MJ	megajoules
NEMA	National Environment Management Authority
NWWDA	Northern Water Works Development Agency
PPE	Personal Protective Equipment
WAJWASCO	Wajir Water and Sanitation Company
WRA	Water Resources Authority
WSDP	Water and Sanitation Development Project

1 INTRODUCTION

1.1 Project Background

Wajir town remains plagued with challenges of sustainable water sources for social and economic development of the rapidly expanding town. The Government of Kenya through a World Bank financed credit under Water and Sanitation Development Project (WSDP) is making concerted efforts to ensure that sustainable water sources to Wajir town are identified and developed. The interventions to Wajir water supply are categorized into immediate, intermediate and long-term. Merti aquifer is one of the key long-term sources that were identified through a series of studies that were conducted by Earth Water Limited and Zamconsult Consulting Engineers Ltd. The findings of the studies indicated that the potential well-field supplying water to Wajir town from Merti aquifer could either be located at Ademasajida or Arbajahan, which were found to have fresh water. In this regard, Northern Water Works Development Agency (NWWDA) being an implementing agency under WSDP is proposing to drill 4 No. exploratory boreholes, 2 No. at Ademasajida and 2 No. at Arbajahan for the purposes of providing critical data for studying and monitoring the Merti aquifer recharge, abstraction and quality. However, it is proposed that the water from the exploratory boreholes shall partly be supplied to the community. The scope of the report therefore covers the drilling of 4 No. exploratory boreholes with 2 No. each at Ademasajida and Arbajahan. The 2 No. boreholes at Ademasajida shall be drilled one at existing Ademasajida Habaswein Livestock market and at Waso Girls primary school as was indicated by the Hydro-geological survey conducted, while those at Arbajahan shall be drilled at Bula Madina and the second at Arbajahan primary School. The land for the development of the facilities is a community land within Ademasajida and Arbajahan sub- locations. The community through elected representatives signed land resolution and consent forms permitting the construction of the proposed project components as per the forms attached in Annex II. However, the boreholes in the 2 schools Arbajahan and Waso primary schools have allotment letters indicating the parcels of land belong to the schools. The school management through the Board of management gave consent for the drilling of the boreholes in the schools as also indicated in Annex II.

The implementation of the project is expected to have environmental and social impacts that need to be anticipated and mitigated or enhanced. This shall be in line with the World Bank OP 4.01 and section 58 of the Environmental Management and coordination Act CAP 387, which requires a project proponent to carry out an ESIA study before being permitted to undertake activities considered to have potential adverse impacts on the environment. This includes observance of other national legislations guiding public participation and consultation, conservation, management and utilization of natural resources. In light of this and in response to the requirements of the law, there was need to conduct an environmental impact assessment which is the subject of this report. The ESIA summary project report was undertaken in consultation with the community with an aim of allowing for early identification of key environmental and social issues for input into the implementation and operation of the proposed development facilities. This will improve the overall community understanding of possible positive and negative impacts of the proposed sub-project under WSDP, hence increasing its social and environmental sustainability.

1.2 Proposed Project Objective

The project objective is to drill 4 No. exploratory boreholes 2 No. each at Ademasajida and Arbajahan for studying and monitoring of Merti aquifer hydraulics in addition to domestic water supply to the local community. The boreholes for water supply shall be 2 No. one at Admesajida and Arbajahan. The supply of water to the local community, in addition will include construction of 2 No. elevated steel tanks, construction of 6.5km pipeline transmission mains, constructing 5 No. water kiosks, construction of 2 No. livestock water troughs at Bula Madina and fencing around all the drilled boreholes. The boreholes at Arbajahan primary and at Ademasajida have been proposed to supply water to the respective communities.

1.3 Rationale of the ESIA study

The proposed sub-project falls under the World Bank's support to the government through investment lending towards improving water supply and sanitation services focusing on coastal, Northern Kenya regions and priority areas, along with strengthening sector institutional capacity to deliver improved services. The proposed drilling of exploratory boreholes and construction activities of community water supply facilities, operation and decommissioning will thus trigger the Bank's Safeguard Policies *(OP 4.01 Environment Assessment)*.

Also, as required by Kenya's EIA regulations under section 58 of the Environmental Management and Coordination Act CAP 387, it is mandatory that a proponent carry out an ESIA Study before being issued with an EIA license to undertake any project activities that may be considered deleterious to the environment. This includes compliance with the Environment Impact Assessment and Audit Regulations of 2003 and consideration of other national legislations guiding conservation, management, and utilization of natural resources. Therefore, the assessment under this study was to identify significant potential impacts of the project to the project site's physical, biological, social, and economic aspects. The proposed sub-project falls under low risk project according to NEMA categorization and therefore this Summary project Report is prepared in response to requirement.

1.4 Objectives and Scope of the ESIA Study

1.4.1 General Objective of the ESIA Study

The objective of the study was to identify positive impacts of the sub-project and associated enhancement measures, negative impacts and the mitigation measures as well as to comply with section 58 of the Environmental Management Act (EMCA) CAP 387 which requires that a project proponent carries out an EIA study before being issued with a license to undertake a project that is found in Schedule II of the Act. This will include observance to the components described below:

- Identification of significant potential impacts of the proposed project to physical, biological, social, Cultural and economic environment.
- Formulate mitigation measures to any adverse impacts on the environment and people's health throughout all phases of the project while enhancing the positive impacts.

This will ensure the proposed project is environmentally friendly, socially acceptable and sustainable.

1.4.2 Scope of the ESIA study

The scope of the ESIA study is confined to the sites where the proposed works shall be implemented and the assessment assignment therefore included:

- Concise description of the national environmental legislative and regulatory framework for implementation and management of the proposed drilling of the 4 boreholes at Ademasajida and Arbajahan.
- Concise description of the project design including technology, procedures and processes to be used during project implementation and operation.
- Conduct a baseline assessment and description of the physical, biological, social, cultural and economic environment of the project area.
- Conduct an assessment of environmental and social impacts due to the proposed development.
- Conduct public consultations and participation
- Identify mitigation measures for negative impacts as well as enhancing measures for the positive impacts of the project.
- Develop an environmental and social management plan (ESMP).
- Develop an environmental and Social monitoring plan (ESMoP).
- Submit to NEMA for approval and licensing.

1.5 Justification of the Project

Wajir town is among the fast growing towns within the north-eastern region. However, the rapid growth of the town is faced with a challenge of sustainable water supply, a key enabler for socio-economic development for the residents. There is a concerted effort by the government to alleviate the situation and in light of this, the government of Kenya received a credit from the World Bank through the M0WSI under WSDP as an intervention to improve water supply for Wajir town. The town residents rely on a shallow water aquifer which is contaminated with faecal coliforms, saline and brackish. Yet there is currently no sustainable water sources whether ground or surface near the town. It is in this regard that the government through World Bank financing is pursuing immediate, intermediate and long-term interventions under WSDP. Among the long-term interventions of water supply to Wajir town was to source ground water from Merti Aquifer either at Ademasajida or Arbajahan being areas known to have fresh water.

To ensure the sustainability of the proposed water source, there was a need to have comprehensive analysis of the characteristics of the proposed well fields in the Merti aquifer before the project is implemented on a large scale. Therefore, drilling of exploratory boreholes at both Ademasajida and Arbajahan was necessary to provide data to be in put into the Wajir long term water supply design study. The data being sought includes but not limited to lithology, Turbidity, TDS, Salinity, driller logs and pump test information, all which is critical. In addition to providing scientific knowledge on the recharge, abstraction and quality of the aquifer, 2 of the 4 boreholes shall be used to supply water to the local community who just as Wajir Town residents are faced with inadequate water supply.

1.6 The Study Approach and Methodology

1.6.1 Desktop Review

A desktop study was conducted to review available published and unpublished reports, development plans and maps in order to compile relevant baseline biophysical and socio-economic information about the study area. The biophysical information was compiled on environmental aspect such as flora, fauna, topography, drainage, soils, geology, hydrogeology, climate and vegetation. On the socio-economic aspects, the study compiled information on aspects such as population, Social amenities and physical infrastructure, land use and ownership, water and sanitation coverage, livelihood systems income and wellbeing, vulnerable and marginalized groups

1.6.2 Field Survey

The study team conducted field work within the project area on 28-29th of July 2021, 22-25November 2021 and again from the 3rd -10th of March 2022. The field work exercise involved visiting and paying courtesy calls to key stakeholders including the ward administrators, community members, the area chiefs, Waso and Arbajahan primary school management. The survey team further conducted a site visit to familiarize and appreciate the general setting in respect to the proposed project sites accessibility, social amenities, environmental setting and physical features among others. The team took the opportunity to conduct community consultations and social economic baseline survey.

1.6.2.1 Environmental Data Collection

The environmental study team carried out environmental profiling of the proposed project area, by conducting a transect walk through the proposed project sites as indicated in Plate 1-1 The objectives of the transect walk were to conduct environmental profiling, identification of the rising main and distribution pipelines way leave and location of water kiosks, livestock watering troughs and elevated steel tank location. The team also visited Bula and Waso girls' primary school where 2 of the boreholes were proposed to be drilled. The transect walk was conducted by a team of representative from the implementing partner (NWWDA), the selected community representatives, the surveyor, community leaders and the consultant team as shown in Plate 1-2. The activities conducted were to identify areas for location of the water supply facilities, determine the social impacts of the distribution pipeline, to assess waste generation and management within the area of interest, drainage and existing impacts to water resources, identifying potential sources of noise and vibrations as well as likely receptors, potential sources of air quality issues, vegetation type and cover, invasive species management, habitats, landscape and aesthetic value of the proposed project area. The main data collection methods were through observations, photo taking, expert judgment and consultations with community representatives and leaders. The data collected was triangulated with secondary data.

Plate 1-1: Transect Walk Along Pipeline Route in Ademasajida together with the survey team

Plate 1-2: NWWDA, Survey and some of elected Community Representatives during a transect walk at Arbajahan

1.6.2.2 Socio-Economic Data Collection

The socio-economic survey data was collected using both quantitative and qualitative techniques depending on the target respondents. For collection of quantitative data, a semi-structured household questionnaire was used to target household heads for information. Observations/judgment and limited Key Informant Interviews (KII) were used for collecting of qualitative data from selected community members, community representatives and key informants particular the local leaders. The household data collection tool was developed and discussed within the survey team for consensus, before training of enumerators, pre-testing and data collection conducted.

1.6.2.3 Data collection Procedure

Part of the community engagement process was to conduct a household survey from the proposed project area of interest. The household baseline survey involved use of structured questionnaires on a digital platform used to collect data from individual households (HH). The household data collection tool was pre-tested on the 28th and 29th of July 2021 at Ademasajida and Arbajahan respectively. The data collectors randomly choose households within Ademasajida market centres for pre-testing and the necessary adjustments made on the data collection tool. The data collection commenced immediately thereafter with the same tool pre-tested at Admesajida. The enumerators were from NWWDA, and were familiar with the use of the digital data collection platform having been trained from previous similar studies using the software. The process however began with going through the hardcopy of the questionnaire for the data collectors to familiarize with questions as well as the art of engaging the respondents. The process was followed with installing the data collection software "Kobo collect" and taking the survey team through the application process. The software was adopted as part of the measures

to reduce exposure to covid-19 of the survey team and enhancing efficiency in the household data collection process. The data collectors used own smart phones.

1.7 ESIA Project Study Team

Northern Water Works Development Agency contracted an individual safeguards consultant to assist in preparing the Environmental and Social Impact Assessment (ESIA) summary project report for the proposed drilling of the 4 exploratory boreholes. Environmental scoping and subsequent preparation of the ESIA summary project report was accomplished through involvement of several experts from NWWDA and consultant with varied inputs. The assignment team composition was as indicated in Table 1-1.

Table 1-1: The ESIA Project Study Team

NO	NAME OF EXPERT	PROPOSED POSITION	SIGNATURE
	Geoffrey Nyasagare	Project coordinator/Design Engineer	
	Godfrey Wabomba	Environmentalist	
	Meshack Amimo	Hydro-geologist	
	Emmanuel Mukhwana	Assistant Environmentalist	
	Mohamed Musa	Sociologist	
	Jibril Ahmed Shune	Assistant Hydrologist	

1.8 Content and Structure of the Report

1.8.1 Purpose of the Report

This report is intended to meet the overall assignment objectives of carrying out an ESIA ESMP report for the proposed drilling of the exploratory boreholes and construction of a community water supply system, in accordance with requirement by the Bank's safeguards policies OP 4.01 and project ESMF. This was also done in line with statutory requirements by NEMA on projects under EMCA CAP 387 schedule II for preparing of Summary project Report (SPR). The report will assist NEMA and Lead Agencies in decision making process as well as ensuring that the project activities complies with sound environmental management practices. The report is also intended to assist the project proponent (NWWDA and other implementing partners (Bank)) and the contractor in their obligation of maintaining environmental integrity during the overall management of the project activities.

1.8.2 Structure of the Report

To clearly highlight and determine environmental and social impacts that will occur due to project implementation and operation phases, the ESIA summary project report has been structured to cover areas required under EMCA, CAP 387 and Environmental Impact Assessment and Audit regulations 2003. The

report is also consistent with the international best practices. The ESIA project report contains 9 chapters as outlined below;

- Chapter 1 introduces the project in general giving the background, project justification, study methodology and rational used to achieve the objectives of the project study.
- Chapter 2 describes the project components and the various alternatives considered for implementation.
- Chapter 3 highlights the environmental policy, legal and institutional framework that will inform the overall management of the project and its components at various stages of the project cycle. Local, national and international legal instruments and best practices have been considered.
- Chapter4 outlines existing environmental baseline information including physical, biological and socio-economic conditions of the project area. The chapter also highlights how the project will influence or be influenced by the baseline conditions.
- Chapter 5 summarizes the public consultative process and the outcomes
- Chapter 6 present the project impacts both positive and negative that are anticipated due to implementation and operation phases of the proposed development project
- Chapter 7 presents the project Environmental and Social Management Plan (ESMP)
- Chapter 8 presents Environmental and Social Monitoring Plan (ESMoP) outlining impacts that require supervision and monitoring during project implementation and operation stages
- Chapter 9 presents the EIA project study team's conclusions and recommendations.

2 PROJECT DESIGN AND DESCRIPTION

2.1 Overview

The chapter describes the proposed project components, project location, proposed project design, project alternatives and the estimated financial cost of implementing the proposed works.

2.2 Proposed Project

2.2.1 Proposed Scope of the Exploratory Boreholes Project

The scope of the proposed project will consist of 4 exploratory boreholes in Ademasajida and Arbajahan some with the following facility/Infrastructure. The drawings and designs of the facilities are as highlighted in annex IC.

- Borehole drilling (250mm bore, 350m deep)-4No;
- Construction of the above 4No. Boreholes with -200mm diameter plain casings;
- Borehole construction-200mm diameter slotted screen casing with Gravel pack;
- Equipping two (2) of the four (4) Boreholes above with approximately 17Kw submersible pump each or other rating specified once Test pumping is confirmed;
- Powering two (2) of the above boreholes with approximately 34KW of Panels on a solar support platform one at Arbajahan primary school and a similar one other at the Livestock market in Admesajida;
- Construction of 2 No. 100m^3 15m high Elevated steel Tank one at Arbajahan and the other at livestock market;
- A combined water transmission Mains (HDPE 90mm PN 10) aggregating to 6,500m long for the entire project;
- 5 No. Communal water point/Water Kiosks. 2 No. at Arbajahan and 3 No. at Ademasajida for livestock market borehole that shall supply water to the respective communities;
- 2 No. cattle troughs at Bula Madina
- Fencing all the 4 No boreholes and any water infrastructure therein;

The details of the above scope are as elaborated as follows below.

2.2.1.1 Borehole drilling

According to the Merti aquifer study reports, the exploratory boreholes are supposed to be drilled up to a depth of 350m deep. On the other hand, according to the specifications developed with the assistance of

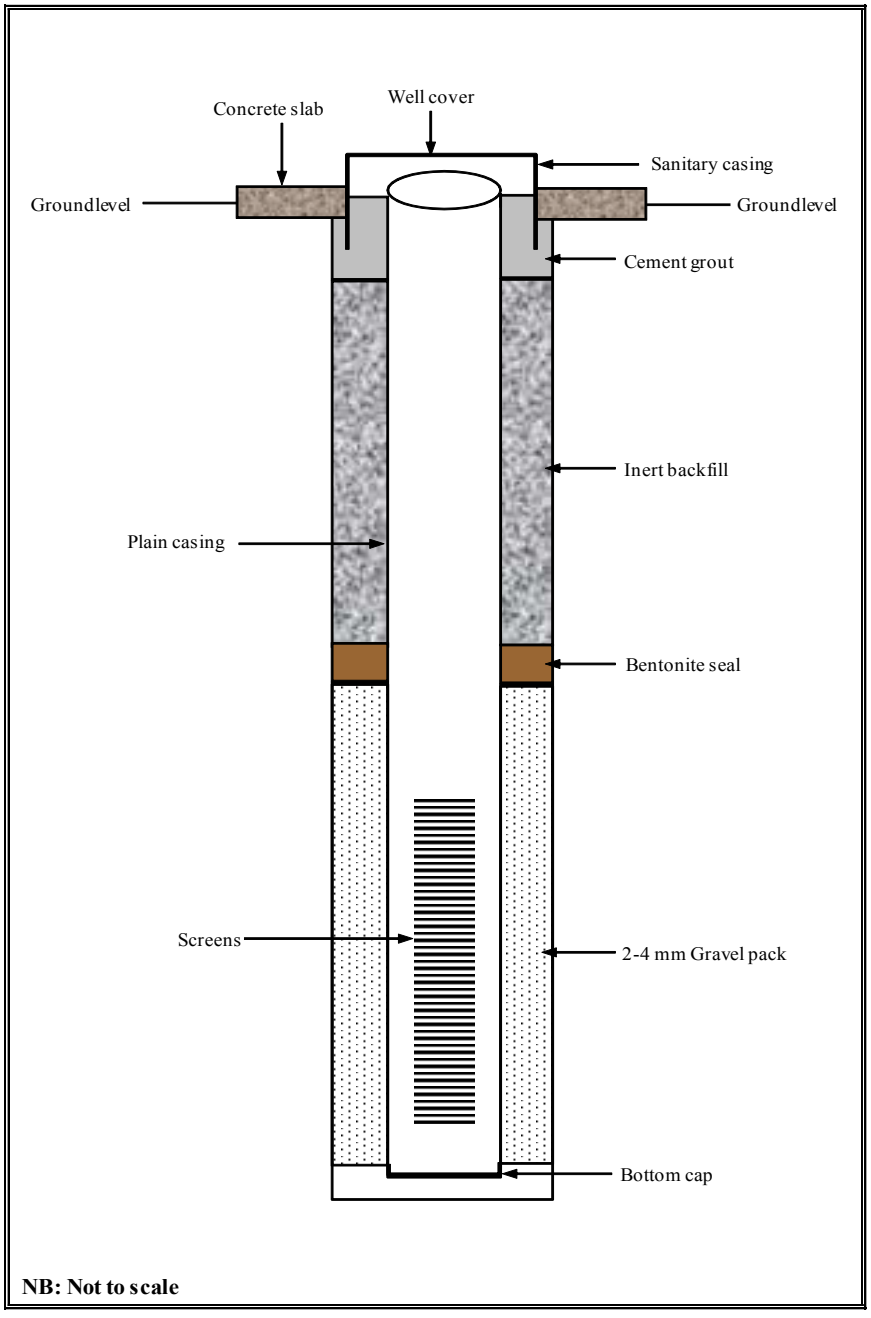
Earth Water Limited consultant, indicate that the boreholes should be of 250mm diameter. The drilling is proposed to be carried out at a diameter of not less than 10", using a rotary type machine. The drilling rig shall be able to drill a recommended depth of 350m, at the specified diameter. The rig and the drilling method adopted must be suitable for drilling through both unconsolidated material, and hard, compact volcanic rocks. The boreholes are expected to produce fresh water with an approximate yield of 20 to 25 m^3 per hour.

2.2.1.2 Gravel Pack

The use of a gravel pack was recommended within the aquifer zone, because the aquifer was suspected to contain sands or silts, which are finer than the screen slot size. A 10" diameter borehole screened at 8" will leave an annular space of approximately 1", which is sufficient to allow the insertion of fine, quartzitic gravel. The grain size of the gravel pack shall be within the range of 2 to 5 mm, and granules should be rounded to well-rounded. Over 95% should be siliceous. The gravel pack shall be washed down with copious volumes of water to avoid bridging. The best method, which is unfortunately rarely used, involves the insertion with a tremie pipe.

2.2.1.3 Borehole construction

The boreholes will be installed with 200mm diameter plain casing and similar diameter screens at all aquifer occurring formations of the well. The screen casing is supposed to be surrounded with well graded gravel pack to specifications. In installing screen and casing, centralizers at 6 metre intervals shall be used to ensure centrality within the borehole. This is particularly important to insert the artificial gravel pack all around the screen. The gravel packed sections shall be sealed off at the top and bottom with clay or bentonite seals (2 m). In this case, it is also recommended to install a 3 m long, cement grout plug at the surface, to prevent contaminants from entering the borehole. The remaining annular space shall be backfilled with inert material (drill cuttings may be used), and the top five metres grouted with cement to ensure that no surface water at the well head can enter the well bore and thus prevent contamination.



NB: Not to scale

2.2.1.4 Borehole equipping

An appropriate submersible pump will be installed based on the test pumping results of the respective boreholes once drilling is completed. In this regard, the submersible pump item has been provided as a **provisional sum** for each of the boreholes in the Bills of quantities**.**

2.2.1.5 Solar Power

The size of solar shall be the function of the submersible pump size which in turn is a function of borehole yield and dynamic water level as determined during the test pumping exercise. However, for purposes of estimation the projected pump size and projected yield are as illustrated in 2.2.2.3 below.

2.2.1.6 Elevated steel Tank 100m^3

Tank sizes of 100m^3 has been assumed while the height has been taken as 15m for both Tanks. With the area being generally flat, a height of 15m is to allow water to move for a distance of up to about 1000m with some residue head to spare in line with the Ministry standards. On the other hand, the capacity of 100m^3 is in accordance with the water design manual which states that the appropriate tank size is approximately half the daily water demand. The design of the tank is as captured in Annex IC.

2.2.1.7 Transmission Mains/Distribution Mains

In Ademasajida, water will be pumped from the borehole in the market, via a 90mm diameter PN 10 HDPE pipe into the plastic Tanks placed on top of Kiosks 1 and 2 with a bypass to the Elevated steel Tank at Bagdad upon which water will gravitate to Water Kiosk 3 and the Mosque around the area. It is expected that the surrounding settlements shall be connected from there as well. The total length of the pipeline for the livestock borehole distribution system is approximately 2,300m long aggregated from sections of approximately; 1,650m, 400m and 250m lengths of HDPE pipeline.

In Arbajahan, water will be pumped from the school borehole via a 90mm dia PN10 HDPE pipe to Barraza Park's proposed 100m^3 Elevated Steel Tank upon which it will gravitate into the two proposed water kiosks as well as the Police and ward administrator's offices among others. Later on as captured in the NWWDA MOU with the school, to provide water to Arbajahan primary school, a bypass is to be provided as well as a 10m^3 plastic Tank on an elevated platform. The Rising main to the Baraza Park is approximately 800m while the Distribution mains from the Elevated steel Tank to the Hospital as well as to the police, ward administration office as well as the D.O is approximately 1,400m (200+1,200). This translates to a total of 2,200m long of pipeline for Arbajahan centre. On the other hand, to connect the schools a pipeline of approximately 2,00m shall be required as shown in annex IB-Layout for Arbajahan proposed water distribution system. This therefore implies that the entire Arbajahan (School + community) shall require a combined pipeline length of approximately 4,200m long.

It is imperative to note that for Ademasajida boreholes, the Waso Girls borehole distribution system is not included in this assessment scope but shall be handled and implemented separately in line with the MOU signed with the school. Similarly, the Bula Madina borehole water supply system is not covered bit shall be handled just like the Waso Girls school case as mentioned.

The entire pipeline length for the entire project is therefore approximately 6,500m long. The layout of the pipeline is as depicted in Annex IA for Ademasajida and IB for Arbajahan.

2.2.1.8 Communal water point/Water Kiosk

As illustrated above, the respective communities in Arbajahan and Ademasajida shall be allowed to access water through the proposed three (3) water Kiosks in Admesajida and two (2) in Arbajahan making a total of five (5). These communal water points otherwise commonly known as water Kiosks are to be situated in designated points that were agreed with the respective communities and are as captured in the project layouts provided in Annexes IA and IB. The design of the kiosks is as captured in annex IC.

2.2.1.9 Fencing off the facilities

It is proposed that each borehole site and the associated solar and electoral mechanical works and where possible the Elevated steel Tank/plastic storage tank as proposed above be fenced with chain-link on concrete post for a perimeter of 200m long enclosing an area of approximately 50m by 50m.

2.2.2 Power Requirements

2.2.2.1 Pump and its sizing

It is proposed that a submersible pump capable of discharging the safe yield (70% of $30m^3/hr=21m^3/hr$) against the head (Dynamic water level below the ground plus Tank Height Plus head losses) be installed.

2.2.2.2 Flow rate (Q) and static head

It is assumed that the expected safe yield of approximately $21m^3/hr$. (**0.005833m/s)** shall be delivered through a tank 15m above ground level through a HDPE pipeline measuring 90mm in diameter and 1000m long. Precise specifications are however to be determined after drilling and test pumping have been completed.

2.2.2.3 Pump Power

From the Ministry of water, sanitation and irrigation design manual, we have the formula below that is used to determine the power rating of pumps. The, safe power required = 1.5*21.25KVA = 31.87 say **30**KVA

Assuming 30KVA Genset

2.2.2.4 Solar Power Requirements

The submersible pump proposed has **17KW** Motor

Assuming a factor of safety of 2 the Solar panels required should = 2*17 = **34Kwatts**

2.3 Project Activities as Source of Impacts

The implementation of the proposed project is anticipated to consist of various activities such as; limited clearance of vegetation during construction works, drilling of 4No. Boreholes one at existing Habaswein Ademasajida Livestock market, Waso Girls primary school, Arbajahan primary school and at Madina. The drilling of 4 No., construction and equipping of 2 No. shall entail digging of mud pits, installation of gravelling, casing of borehole, test pumping, solarization of the boreholes, construction of two (2) elevated steel water tanks, earthworks and excavation of trenches for at least 6,500m of transmission mains, laying and joining of the pipelines in trench, transportation of materials, construction of a chain-link fence for each of the four (4) boreholes, construction of 2No. Cattle troughs and five (5) Water kiosks, operation of the project and decommissioning of the facilities.

In addition to the implementation activities of the project, the operation phase shall consist of activities such as routine operation and maintenance of the facilities (water kiosks, attending to pipeline bursts and leakages, elevated steel tank, watering trough and the solar panels for the 2 No. Boreholes that shall be equipped to supply water to the community. During the operation phase, the other activities associated with the project shall be watering of livestock and ground water extraction.

2.4 Project Materials, Equipment and machinery

2.4.1 Materials for use

The materials to be used shall include but not limited to; solid casing, screen, gravel pack, sanitary seal, water, cement, sand, chlorine, solar panels, building stones, hardcore, fencing post, GI pipes and fittings, wire mesh, submersible pump, concrete fencing posts, chain link, barbed wire, bracing posts, plastic tanks, enamel paint, emulsion paints, red oxides, steel casement door, steel casement windows, reinforcement bars, formworks and damp proof membrane among other materials.

2.4.2 Equipment and Machinery

The anticipated works will require use of the following machineries and equipment on site; drilling rig, backhoe excavator, water bowser, tipper truck, double cab pick-up, poker vibrator, concrete mixer, dewatering pump, pressure testing kit, pedestrian roller and plate compactor among others.

2.4.3 Anticipated Waste material and by-products

The anticipated waste materials shall include drilling mud, waste water from test pumping, demolition debris, wood waste, electrical waste, soil cutting, waste metals, plumbing waste, plastics, organic wastes, waste oil and fuel among others.

2.5 Considerations of Project Alternative

The assessment of project alternatives was limited based on hydro-geological survey as far as the location of the proposed project is concerned. The current engineering designed of the facilities only took into

consideration the best industry practices and appropriate technology for implementation. Therefore, the ESIA study team just compared the option of either maintaining the status quo or choosing to drill the boreholes for exploratory, monitoring and supplying the community with water.

2.5.1 No Project Option

The **"No project"** alternative represents the *status quo* scenario if the proposed project works are not implemented in the project area. Under the alternative, there shall be no works of drilling 4No. boreholes, construction of 2 No elevated steel water tanks, earthworks and excavation of trenches for 6.5km pipeline transmission mains, laying of the main transmission pipeline, construction of fence for each of the 4 No. boreholes, construction of 2No. Cattle troughs at Bula Madina and 5 No. Water kiosks will be done in order to influence local physical environment, biological, socio-economic, land use patterns and no investment in the 4No. Exploratory boreholes. This option is suitable from an environmental and social management perspective with no negative impacts but not good for social economic purpose within the project area. The opportunity cost incurred will imply that there will be no study and monitoring information of the proposed well fields, as well as supply the local community with water. The proposed project is therefore anticipated to address the challenge of lack of monitoring data for the Merti aquifer and the inadequate water supply to the local community in Ademasajida.

2.5.2 Project Development Option

The implementation of the proposed drilling of 4 No. exploratory boreholes and the associated facilities by NWWDA is therefore anticipated to contribute to;

- Improved scientific knowledge about Merti aquifer by Acquisition of data on the profile of the aquifer; abstraction, aquifer recharge and water quality.
- Improved water supply to Ademasajida community
- employment opportunities,
- Improved health and hygiene of the local,
- reduction in diseases related to poor sanitation and
- Provision of piped water to the community members.

Implementation of this option though not the best considering the environmental and social economic costs that shall occur compared to the "No Project Option", mitigation measures have been proposed to ensure that any negative impacts are managed. This alternative would be ideal because of the ability to improve water supply of Wajir town and the project host areas of Arbajahan and Ademasajida and generation of Merti aquifer scientific knowledge.

2.5.3 Alternative Technology Option

The application of best technology is important in reducing the impacts of the project to the environment. The project design team therefore took cognizance of appropriate technology existing on the market in the proposed project facilities and activities.

2.6 Cost of the Project

The estimated cost of the proposed development is about KShs. **61.5 Million** inclusive of taxes. This cost includes construction materials, labour, social costs and professional support services. The main works considered include: drilling and construction of the boreholes, preliminary and general items, solar system, submersible pumps and other electrical mechanical works for the boreholes, water transmission mains, 2no elevated steel tanks, 5No. water kiosk, and fencing of the borehole sites.

3 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

3.1 Overview

The chapter presents the relevant policy, legal and institutional frame work.

3.2 Project Policy Framework

The implementation and operation of the various components of the proposed Exploratory boreholes shall span over several institutions from the National and County government levels as well as the Community. The project activities at different phases will trigger management of various resources including; Borehole monitoring data collection and analysis, environmental management, community land resources management, water resources development and livestock husbandry. For the comprehensive, coordination and continuous planning, development, operation and management (PDOM) of the proposed project components, review of the existing policy, legal and institutional framework requirements was considered critical. The main policies and institutions that will be triggered at different phases of the proposed project are as highlighted in the sub - sections below.

3.2.1 Policy Framework

The following Table 3-1 highlights the policies that shall be triggered during project implementation and operation of the proposed project. There will be need to ensure the proposed project activities are in tandem with the policies' requirements.

Table 3-1: Policy Framework

NO.	POLICY INSTRUMENT	OBJECTIVES	APPLICATION TO THE PROJECT
1.	Vision 2030	A policy blue print to guide Kenya's development to a middle-income country by the year 2030. It is based on the 3 pillars of political, social and economic advancement and it aims to transform the economy and achieve sustainable growth. The vision recognizes the significance of water resources in sustaining the proposed economic growth of the Country. Water and sanitation services provision have been identified as significant in sustaining long-term	The proposed project shall enable provision of water for the local communities' in order to contribute towards socio - economic development for human wellbeing within the proposed project area.

		economic growth, poverty reduction, health and security.	
2.	Wajir County Integrated Development Plan 2018-2022	To achieve equitable and sustainable use and management of resources for socio-economic development of the county, the plan acknowledges the key roles played by partners in water resources development such as NWWDA. The plan indicates that the development and provision of water resources shall be done in an environmentally conscious manner by undertaking EIAs.	The CIDP recognizes that most parts of the County are water deficient and acknowledges the significance of improving water accessibility to the residents of the county. The proposed boreholes shall come in hand to contribute towards water provisions in the county for socio-economic development of the local people.
3.	Water policy, Sessional Paper No. 1 of 1999	To preserve, conserve and protect available water resources and allocate it in a sustainable rational and economic way. The policy enhances a systematic development of water facilities in all sectors for promotion of the country's socio-economic progress. *Note; the policy is under review to align to the requirements of the new constitution*	The proposed boreholes under the project in addition to provision of water resources to local communities, shall be used to monitor the utilization of the Merti aquifer which data shall be used for development and management of water resources within the aquifer
4.	Kenya Youth Development Policy 2019; Empowered Youth for Sustainable Development	The policy recognizes the significance of the role of youth in social-economic and political development of the nation and therefore, the policy takes deliberate measures to promote youth empowerment and participation to harness their potential for productive engagement at local, county and national level.	The current development process took into consideration the objective of the policy. The youth so far have been actively involved in the processes of the project design, implementation and shall be further involved in operation phase too. The youth were involved in community consultation process and during the decision making process of the proposed project. It is anticipated that the contractor during project implementation will involve the local youth by providing employment opportunities. WAJWASCO is also anticipated to involve the local youth in operation and maintenance works.
5.	National Gender and Development Policy (2000)	To mainstream the needs and concerns of me, women, boys and girls in all areas of development process in the country.	Women, girls, boys and men will play different roles in utilization and management of the water project within the project area. Therefore, the decision

			making process in regard to the project should continuously be engendered throughout the project life cycle. The project will come in hand to alleviate the role of girls and women in travelling long distances to fetch water as well as livestock watering
6.	National Policy for Prevention and Response to Gender Based Violence 2014.	The main objective of the policy is to accelerate the elimination of all forms of gender-based violence in Kenya.	The proposed project shall comply with the policy through the contractor workers signing a code of conduct committing not to engage in any form of GBV whether at the work place or in the community. The project shall also ensure the workers receive training on sensitization and awareness on GBV and on Sexual exploitations and abuse SEA
7.	The National Environment Policy Sessional Paper No. 10 of 2014	To provide comprehensive strategies for government action regarding the quality of the environment and development.	The policy will guide the project compliance with integrating of environmental sustainability during implementation, operation and decommission stages of the project cycles which is the key subject of this report
8.	National Land Policy, Sessional Paper No. 3 of 2009.	To provide an overall framework required to address the critical issues of land administration, land access, land use planning, restitution of historical injustices, environmental degradation, conflicts, unplanned proliferation of informal urban settlements, outdated legal framework, institutional framework and information management	The project shall ensure sustainable utilization of land, particularly community land within the project area that shall be utilized by the proposed project facilities. The land for the project has been donated by public institutions through agreement between the local leadership and the departments in charge of the institutions.

3.2.2 Legal Framework

Table 3-2 highlights the main legislations that will govern the activities of the proposed project during implementation and operation. The legislations also provides for an institutional framework for the proposed project activities at implementation and operation phase. The legal framework provides general framework for coordination of project activities at all phases of the project.

Table 3-2: Legal Framework

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
1.	Constitution of Kenya, 2010	To outlines principles of access to safe water, access to public land, sustainable environmental and natural resource utilization with clear responsibilities between the National and county governments. The constitution provides clarity between the 2 levels of governance on water and sanitation services which are a function of the County Government, the National Government has a role to play in managing water resources and construction of national water works as stated in the fourth schedule of the constitution.	The proposed project design and implementation has integrated constitutional principles of environmental management, Natural resource utilization and the right to access water by the citizens of the project area. The boreholes in addition to supplying water to the local community shall be used to monitor the utilization Merti aquifer water resources as well as assist in monitoring the water quality.
2.	Water Act, 2016	The Act generally provides for the development and managing of water resources, managing use of water resources, managing of water rights, development of facilities, managing the quality of water service provision, water related dispute resolution and financing of water resources development activities.	The Act is relevant to the proposed project and will provide the institutional management from water resource development to water services provision to the consumer at household level. The service provider (WAJWASCO) for Ademasajida shall be required to work closely with the following institutions as stated in the Act The Water Resources Authority (WRA), the Water Works Development Agencies (WWDA) and the Water Services Regulatory Board (WASREB). Wajir county lies under the jurisdiction of the Northern Water Works Development Agency. WRA will issue permit for drilling and abstraction of water as well as monitor the borehole water quantity and quality.
3.	Public Participation Act 2016	The Act provides a general framework for effective public consultations. It gives effect to the constitutional principles of democracy and the participation	Participation is anticipated to promote transparency and accountability in decision making, promote community ownership of public decisions and promote public participation and

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
		of the people. The Act, therefore, gives effect to the principles of public participation as provided for in the constitution.	collaboration in project governance processes. The engagement of the stakeholders has been conducted under this project to ensure ownership as well as incorporation of their opinion in the decision-making process.
4.	The water (Services Regulatory) Rules, 2012	To govern water services provision by the service provider. The rules highlight the role of the service provider in provision of the water supply and waste water treatment facilities on the project. The Rules on the other hand provides for quality services delivery to the consumers and also ensuring environmental management.	The rule shall ensure structures for water service provision in the area under the proposed project.
5.	Land Act 2012, Land Registration Act 2012 and the National Land Commission Act 2012	To ensure proper management and administration of land in accordance with the principles of land policy as set out in the constitution. By ensuring access to land and land utilization rights.	Land will be a major factor in the implementation of the proposed facilities and resolution of any emerging conflicts will require consultation of these Acts. Land within the project area was noted to be communal. And the local leadership was willing through the county government to ensure necessary measures are taken to allocate land for the implementation of the proposed project facilities.
6.	The Community Land Act 2016	The proposed boreholes shall be drilled on public land parcels but the proposed water transmission facilities may pass through community land, which may trigger the Act. Matters dealing with land at the project site shall be guided by the principles and values set out in this act. The Act in part VIII stipulates the procedure to be adopted in settling disputes and conflicts involving community land in the event of such.	The water transmission facilities shall be located on unregistered community land, which is held in trust by the county government on behalf of the communities. During the ESIA assessment the community elected representative who took the survey team along the pipeline route and the location points of water kiosks, elevation tanks and the livestock watering trough points. The representative signed land resolution and consent permits allowing the construction of community water supply facilities as indicated in Annex II

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
7.	Water rules, 2007	The rules govern the various stakeholders in provision of water related services. The rules prohibit any activities that may influence negatively the quality of water in a water course. The rules will ensure proper development, delivery of services and conservation of water resources.	The proposed project boreholes shall also be critical in provision of monitoring data in keeping track of water quality and quantity within the Merti Aquifer as required by the rules.
8.	County Government, Act 2012	The County Government Act provides local governance principles, guides the planning and development process, and community participation in the development process.	The Act guided the consultation process to reduce conflicts between project implementing agency (NWWDA), WRA which shall be in charge of monitoring data collection and analysis during the operation of the borehole. The Act spells out the functions and roles of involved agencies at deferent level of governance. Through the Act the operation of the borehole shall be under WAJWASCO which is mandated for water service provision on behalf of the county. The act was also complied with by consulting the local people before any development is implemented.
9.	Environmental Management and Coordination Act, CAP 387	It sets the legal and institutional framework for the management of environmental issues in the country.	The project triggers the Act to assist in managing and coordinating potential environmental issues likely to emanate from proposed project activities during implementation, operation, and decommissioning. The Act shall guide the relationship between NWWDA, WAJWASCO, Drilling Contractor and NEMA on matters regarding the environment and public concern. It requires ESIA for projects to be undertaken and licensed by NEMA

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
			prior to implementation of works. As per the Second schedule, works involving drilling for purposes of utilizing groundwater for community water supply are considered low-risk project. This report has been compiled in compliance with the Act.
10.	EMCA Waste Management Regulations 2006	Provide for management of different forms of waste streams in the country, given that the project activities during implementation, operation, and decommissioning will result in waste generation.	An increase in waste generation is anticipated during project implementation, and the regulations will come in hand to guide its proper management and disposal. Some of the regulation requirements have been captured in the ESMP
11.	EMCA Noise and Excessive Vibration Pollution Control Regulations, 2009	The regulations prohibit loud, unreasonable, unnecessary, or unusual noise which annoys, disturbs, injures, or endangers the comfort, repose, health, or safety of others and the environment For residential, health facilities, educational institutions and homes for disabled the noise level limits for construction sites is 60 dB during the day and 35dB during the night. But for other areas, the limit is 75dB during the day and 65dB at night.	The proposed exploratory borehole drilling is anticipated to have an impact on ambient noise levels within the proposed project area during drilling and casing, therefore the regulations shall come in hand to guide noise level management standards. Some of the requirements of the regulations have been incorporated in the project ESMP. Occupational noise and vibration need to be controlled during borehole drilling process. The other sources of noise shall be due to vehicle movement that will be involved in the construction of the distribution pipelines, particularly during the transportation of materials to the site.
12.	EMCA Air quality regulations of 2014	The regulation prohibits emissions of air pollutants exceeding permissible levels	The proposed sub-project is anticipated to compromise air quality impacts within the proposed

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
		from controlled areas, stationery sources, mobile sources, occupational exposure, material handling, demolition areas, and waste incineration, open burning of hazardous waste, or from cross-border. The regulation also requires that any anticipated excessive emissions be licensed.	project area during drilling, construction of main water pipes and therefore the regulation shall come in hand to guide air quality management standards as captured in the ESMP.
13.	EMCA Water Quality Regulations, 2006	Water quality regulations lay down the standards of domestic water supplied and waste water treatment. The regulations are meant for pollution control and prevention, and provide for the protection of water sources.	The proposed project shall ensure the quality of water supplied by the boreholes meet domestic water quality standards. Comprehensive water quality analysis including heavy metal tests shall be conducted before the water is allowed to be used by either human or livestock.
14.	The Environment and Land Court Act, 2011	This is an Act of Parliament formulated to give effect to Article 162(2) (b) of the Constitution; to establish a superior court to hear and determine disputes relating to the environment and the use and occupation of, and title to, land, and to make provision for its jurisdiction functions and powers, and for connected purposes. In this regard, those affected by various development ventures that are considered harmful to the environment have structures in place to seek justice, and in so doing, the environment will be safeguarded at all times.	In the event of any environmental sustainability dispute between NEMA and project contractor or NWWDA at implementation or WAJWASCO at operation, the Act will be triggered in resolving the issues for any aggrieved party. However, the project promotes alternative grievance resolution with the courts being the last resort.
15.	The Physical and Land Use	The Act provides for planning	The development of the boreholes has

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
	Planning Act, 2019	and controlling for physical development in the country in general. The Act read together with the county government Act 2012 will assist in synchronizing the national, local and project physical planning, controlling for any possible conflicts.	been synchronized with local development needs where the boreholes shall supply water to the existing county market and the school in additional to access by the local people.
16.	Occupational Safety and Health Act, 2007	The Acts aim to ensure the safety, health, and welfare of persons at work and non-workers as well as cushion workers against loss of income or livelihood due to occupational accidents or diseases.	The Act shall be applied for the safety of workers and the general public to be ensured during project implementation (*Drilling and construction of water distribution lines)*, operation, and decommissioning phases. Some of the requirements of the Act have been incorporated in the ESMP
17.	Public Health Act, 1986 (Cap 242 Revised edition 2012)	The Act addresses matters of sanitation, hygiene, pollution and general environmental health and safety which are directly related to water pollution and contamination.	The Act shall be applied to ensure that all sanitation, development of the boreholes and management of the water meets public health requirements.
18.	Malaria Prevention Act (Cap 246)	The act provides for prohibition of propagating the breeding of malaria vectors or spreading of malaria due to project related activities.	The proposed project area in general records cases of malaria which may increase with the introduction of the project. The design and operation activities of the project should not encourage breeding of malaria vectors through water stagnation areas due to leakages. Though the soils of the project area were noted to be sandy and highly porous
19.	The National Gender and Equality Commission Act 2011	The Act seeks to promote gender equality and prohibit any form of discrimination against any; women, men, persons with disabilities, the youth, children, the elderly, minorities, and marginalized	That Act will guide particularly during the project's construction and Operation phase to ensure equal access to water and opportunities for all persons including men, women, girls and boys.

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
		communities/individuals.	
20.	Sexual Offences Act, 2006	This Act protects people and employees from any unwanted sexual attention or advances by staff members. This act ensures the safety of women, children, and men from any sexual offences, including rape, defilement, and indecent acts.	This legislation will govern the code of conduct of the Contractor's staff and provide repercussions of any wrongdoing. The sexual offense act, 2006 supports the Kenya Employment Act of 2007 that a worker should not be harassed sexually to receive preferential treatment at the workplace or detrimental treatment on present or future employment
21.	HIV and AIDS Prevention and Control Act, 2006	This is an Act of Parliament to provide measures for the prevention, management, and control of HIV and AIDS, to provide for the protection and promotion of public health, and for the appropriate treatment, counseling, support, and care of persons infected or at risk of HIV and AIDS infection, and for connected purposes.	Requirements of the Act will ensure that the contractor makes provision for VCT services for employees and locals where appropriate and promotes public awareness. This will go a long way in ensuring stigmatization of HIV and AIDS is reduced as well as managed during the construction period. The project ESMP budget has provided for sensitization and awareness.
22.	The Children Act, 2001	This Act protects the welfare of children within the Country. The Act identifies Children as a person below the age of 18 years old and protects them from exploitation. Of particular importance to this project is section 10, which protects the child from: • Economic exploitation. Any work that interferes with his/ her education or is harmful to the child's health or physical, mental,	The Act shall be applied to regulate any kind of engagement or employment of underage to the project activities on site. No person without national identity card or any other document distinguishing adults and underage shall be allowed to work on site.

No.	LEGAL INSTRUMENT	OBJECTIVES	APPLICATION TO PROJECT
		spiritual, moral, or social development.	
23.	Work Injury Benefits Act, (2007)	This provides compensation to employees for work-related injuries and diseases contracted in the course of employment.	Requirements of the Act will be applied to ensure that income for workers on the project is assured even where they are not able to work for some reasons related to working conditions while still under contract.
24.	Employment Act 2007	The main Objectives of the Act is to improve the working condition of employees and protecting their welfare as well as that of the employer	The Act shall be applied to protect workers against; discriminations, sexual harassment, forced labour, protection of wages, employment relations, settlement of disputes and protection of rights and duties in employment.
25.	The Wildlife Conservation and Management Act, 2013	The Act provides for protection, conservation and management of wildlife in Kenya to ensure utilization of wildlife resources on a sustainable basis. The activities of any development shall not in any way impact on the habitat of wildlife whether under protected areas or in communities	The Act will ensure wildlife conservation and reduced human-wildlife conflicts in the project area particularly during project implementation and operation when wildlife may be watering at the livestock watering troughs during droughts.

3.2.3 World Bank Safeguards Operational Policies (OP)

The proposed drilling of the exploratory boreholes falls under the World Bank's support to the government through investment lending towards improving water supply and sanitation facilities with a focus on the coastal and north eastern regions, along with strengthening sector institutions to deliver improved services under WSDP project. The proposed drilling of the exploratory boreholes and the construction of the main water transmission will trigger the World Bank's Safeguards Policies applicable to the project which are mandatory. And all applicable Kenya regulations on construction, environmental,

labor, water, air, occupational health and safety, and others which are required for the environmental and social due diligence, of the borehole drilling, construction of the main water transmission and operation phase of the project. Table 3-3 captures the Bank's safeguards policies triggered under WSDP and the proposed drilling of exploratory boreholes. The instruments herein are a requirement to inform better management of the environment alongside country environmental management laws (EMCA CAP 387).

Table 3-3: Applicable World Bank Safeguards Policies for WSDP and Proposed Exploratory Boreholes

CODE	NAME OF THE POLICY	OBJECTIVES	APPLICATION TO PROJECT
OP 4.01	Environmental Assessment	To ensure that environmental and social considerations are integrated into WSDP and drilling of exploratory boreholes project's decision-making process. The aim is to enhance positive impacts and mitigate negative impacts of the project.	The policy is triggered under WSDP project and drilling of exploratory boreholes sub-project. The policy informed ESIA preparation for boreholes to guide on enhancing positive impacts of the project and mitigating negative ones.
OP 4.04	Natural Habitat	To promote environmentally sustainable development through enhancing the conservation, maintenance and protection of natural habitats and their associated ecosystem services and products for human wellbeing and sustainable social development.	The policy is triggered under WSDP project but not for exploratory boreholes. The proposed boreholes locations site locations are at highly modified environment which is an urban developed area. Neither will the construction activities directly or indirectly affect natural habitats.
OP 4.11	Physical Cultural Resources	To preserve and conserve artifacts or sites of cultural significance for human well being	Although the policy is triggered under WSDP as a project, for the exploratory boreholes sub-project is not. Boreholes site location is not of any known cultural significance (one is located in county livestock market and the other in the school compound). However, chance find procedure shall be used during the drilling of the borehole, in the event that

			any cultural artifacts are found on site.
OP 4.10	Indigenous Peoples	To foster participatory design and implementation of project activities in a manner that respects the rights of indigenous people, their dignity and way of life. And to preserve cultural uniqueness so that they receive culturally compatible social and economic development to mitigate against any adverse impacts of development process.	The policy is triggered under WSDP project and Ademasajida exploratory borehole. The project area is generally categorized as marginalized and the proposed project will enhance the livelihood of the local community members. The project shall enhance water supply to the local community. And will not in any way influence the way of living for the local community.
	World Bank Environment, Health and safety guidelines	The proposed sub-project under WSDP triggers: environment, health and safety issues, and considerations of the general as well as water and sanitation guidelines shall come in hand to guide on the best course of action.	The contractor to provide borehole completion report of which the Chemical analysis report forms part. On the hand, chlorination shall be undertaken as is in the norm in the project operation and maintenance phase. Other requirements of the guidelines have been incorporated into the ESMP
	World bank policy on access to information, 2010	The World Bank policy on access to information sets out the policy of the World Bank on public access to information in its possession. This Policy supersedes the World Bank Policy on Disclosure of Information, and took effect on July 1, 2010. The Policy is based on five principles which include: Maximizing access to information, Setting out a clear list of exceptions, Safeguarding	In disclosing information related to member countries/borrower in the case of documents prepared or commissioned by a member country/borrower the bank takes the approach that the country/borrower provides such documents to the Bank with the understanding that the Bank will make them available to the public.

	the deliberative process, Providing clear procedures for making information available and Recognizing requesters' right to an appeals process.

3.3 Project Institutional Framework

Table 3-4 highlights the key regulatory institutions that shall be involved in the management of the project activities during implementation and operation phases. Therefore, coordination and consultations shall be required at different levels depending on the activity at hand.

Table 3-4: Regulatory Institutional Framework

No.	INSTITUTION	RESPONSIBILITY
1.	*Water Resource Authority (WRA)*	The Authority develops principles, guidelines and procedures for the allocation of water resources, use of water resources, manage the water resources, assess and re-assess water resources potential, receive and determine applications for abstraction permit for water use, monitor and enforce conditions attached to the permit for water use. The authority will also regulate and protect water resource quality in the proposed project area. The exploratory boreholes shall also be under the Authority as an institution mandated to monitor ground water aquifers. Therefore, the proposed boreholes shall be co- managed by WRA for collection of monitoring data and WAJWASCO for water provision.
2.	Wajir County Government	The County government Act 2012 sets the development agenda in the Counties by indicating the functions of the devolved system. Water services provision is a devolved function and the development proponent (NWWDA) will be required to work with the county governments to realize the implementation of the proposed plan. Therefore, County Government will support the project proponent to ensure smooth implementation of the project through provision of various permits, wayleave or land for the boreholes and the associated water transmission facilities.
3.	*Water Services Regulatory Board*	Shall monitor compliance to standards at design, construction, operation and maintenance of the water facilities of the proposed project. After project implementation, the board will determine and prescribe the standards for provision of water services as well as evaluate and recommend water tariffs for the proposed project where need be.
4.	*Northern Water Works Development Agency*	The agency will provide technical services and capacity building to Wajir County Government and water service provider (WAJWASCO) as such services shall be required. The agency in addition will liaise the national aquifer monitoring agency (WRA) and the service provider (WAJWASCO) for the purpose of managing the boreholes.

5.	*WAJWASCO*	The existing Ademasajida and Arbajahan water supply schemes were reported to be under management of WAJWASCO. The water utility company is the main water service provider in Wajir County'Arbajahan and Habaswein/Ademasajida area. The project shall therefore be operated by WAJWASCO for service provision or as shall be agreed with the community. WAJWASCO will be responsible for overall implementation of the ESMP recommendations during operation phase of the project.
6.	*National Environmental Management Authority*	The authority through the county office shall be in charge of Overall management and co-ordination of all matters relating to the environment impacts of the project in the proposed development area through the County Director of the Environment. NEMA will review the ESIA SPR/ESMP report and issue license
7.	*Interior and coordination of national government (County Commissioner)*	The County Commissioner's office shall come in hand to resolve any emerging conflicts between borehole water users in the event of such arising during project operation. The office shall also resolve strive among the locals and any visiting groups accessing water during drought periods. This is anticipated during influx of communities from other areas seeking livestock watering during droughts
8.	*The National Land Commission*	The institution will resolve land adjudication issues including land registration and management for the proposed project facilities whenever need arises.
9.	*Directorate of Occupational Safety and Health Services*	Registration of the construction sites and commissioned water project as workplaces. Enforce occupational safety and health act requirements

Table 3-5 highlights the key project implementing and operation institutional framework that shall be involved in implementation and supervision of safeguards triggered by the project activities during the implementation and operation phases to ensure that they meet safeguards requirement. Therefore, coordination and consultations shall be required at different levels depending on the activity at hand.

Table 3-5: Project Implementation and Operation Institutional Framework

No.	INSTITUTION	RESPONSIBILITY
1.	County Government of Wajir	• The County government through WAJWASCO shall oversee boreholes operation for the sake of community water provision services
2.	WRA	• WRA will manage Merti aquifer water resources monitoring data collection and analysis for the purpose of sharing at national and trans-boundary level. • WRA will manage the aquifer water resources through borehole works

		permitting, collecting monitoring data on the quality and quantity of the water resources of the borehole.
3.	NWWDA	• Oversee the implementation of the project • NWWDA will be responsible for contracting the works, and overseeing the appointed contractor, including the overall implementation of the ESMP recommendations during construction phase of the project.
4.	Project Supervising Engineer	• PE shall link the construction team and project coordinator and acting as client representative on site by supervising the drilling and construction contractor. • Oversee the implementation of safeguards management plans on site and report on implementation progress • Ensure prompt reporting of any serious incidents on site to the relevant authorities and to the Bank and follow up on detailed investigations and remedial actions as applicable.
5.	WSDP-NWWDA Safeguards Specialists	The safeguards specialists shall be part of the project implementation supervision and shall; • Ensure construction activities are carried out in line with national laws, World Bank safeguards operational policies and safeguards instruments (ESMP) prepared under the project. • Prepare training materials and carry out technical trainings on environmental and social safeguards requirements to the contractor. • Review Contractor ESMP and ensure all safeguards issues are accurately addressed as per project design and project ESMP provisions, and provide expert guidance/advice to the project implementing committee site meeting. • Ensure relevant environmental safeguards requirements are included in construction contract. • Conduct independent/impromptu supervision and/or inspections of construction site to verify the compliance levels with the relevant safeguards instruments and Environmental, social, Health and Safety (ESHS). • Collect data on project environmental impact, compliance, Grievance Redress Mechanism functionality and utilization, and keep records of environmental supervision of the project activities on site. • Prepare safeguards monitoring report and input to project progress reports.
6.	*Project Implementing Contractor*	• In liaison with the project engineer to ensure acquisition of all statutory permits or licenses required for any activities at the drilling and construction site • Prepare and implement an incidence response plan, grievance redress mechanism, as well as maintain the accident/incidence records and GRM logs while on drilling and construction site. • Prepared a C-ESMP, ESHS plan and solid/Waste water management plan during drilling in compliance with ESMP, National laws and World Bank safeguards operational policies. The contractor shall be required to implement and comply with the requirements of the approved documents. • Keep a daily diary of safeguards implementation and complies activities at the

drilling site.

3.4 Construction Supervision, Monitoring and Reporting

Safeguards tools have been prepared to assist in implementing environmental management and sustainability requirements on the project. Several institutions as captured on Table 3-5, will play differing roles as indicated. The ESMP in this report and the C-ESMP to be prepared by the contractor shall serve to ensure that the contractor observes his obligations of implementing the requirements of the ESMoP and ESMP as per National law and World Bank requirements. Reporting exploratory implementation activities shall be done at several levels. The supervising engineer shall be in charge of the daily reporting on site, on behalf of the client (NWWDA) as captured under Table 3-5. The engineer shall in consultation with the contractor team prepare all the required reports including site meeting minutes and submit to the client.

The progress reports prepared shall be on monthly and quarterly basis. The client (NWWDA) including the project engineer and environment and social safeguards consultant shall review the reports and submit to the World Bank for comments and approvals, where necessary. Project implementation team shall also conduct quarterly monitoring visits to advice on the progress of the project. The World Bank team on the other hand shall be conducting semi-annual monitoring mission to advice on the implementation progress. The supervising consultants shall on a daily basis supervise the implementation of the CESMP, ESMP and ESMoP. The client's Environmental safeguards consultant shall also conduct regular and impromptu monitoring to ensure that all the requirements of the World Bank and National laws are adhered to as captured in the ESMP and ESMoP.

3.5 Contract Management, Administration and Conflict Resolution

The supervising engineer overseeing the works shall be in charge of managing the project contract on behalf of the client (NWWDA). Before the commencement of the construction activities, there shall be clarification of supervision and monitoring procedures and responsibilities, once the contractor is procured. The requisite instruments including a monitoring indicator checklist shall be prepared and aligned to site-specific C-ESMP that shall be prepared by the contractor. The supervising engineer in addition shall be responsible for resolving any emerging contractual conflicts between the client (NWWDA) and the contractor. The engineer shall advice the client on the necessary actions that shall be required. Disputes shall be settled amicably through a mutual engagement process that shall be specified in the contract. However, if any dispute arises related to the contract cannot be resolved amicably among the aggrieved parties, the matter maybe referred to a competent adjudication/arbitration person or institutions in accordance to national laws related to contract management. The identification of an institution or person or procedure agreed upon by the aggrieved party shall be guided by dispute settlement clauses in the contract.

4 BASELINE CONDITIONS AND PUBLIC PARTICIPATION

4.1 Over View

This chapter describes the existing environmental and social baseline conditions within the proposed drilling of exploratory boreholes and the associated facilities' Area of Interest (AOI). The conditions described include physical environment, biological environment and socio-economic setting within the AOI.

4.2 Project Location

4.2.1 Admesajida

The proposed drilling of 2 exploratory boreholes for monitoring of Merti aquifer and supply of community water at Ademasajida are located in Wajir County, Wajir West Sub-County and within Ademasajida ward. The boreholes shall be drilled one at Waso girl's primary school and the other at the existing Habaswein Ademasajida livestock market in Ademasajida sub-location within Ademasajida location. Waso Girls Secondary school was noted to have an allotment letter and the school management authorized the drilling of the borehole within the school as per the minutes attached in annex IIB. The drilling of the borehole is located at one of the corners of the school at a distance of about 400m from the school administration block and the classes as indicated in Figure 4-1. The drilling site was also noted to be at about 250m from the playground.

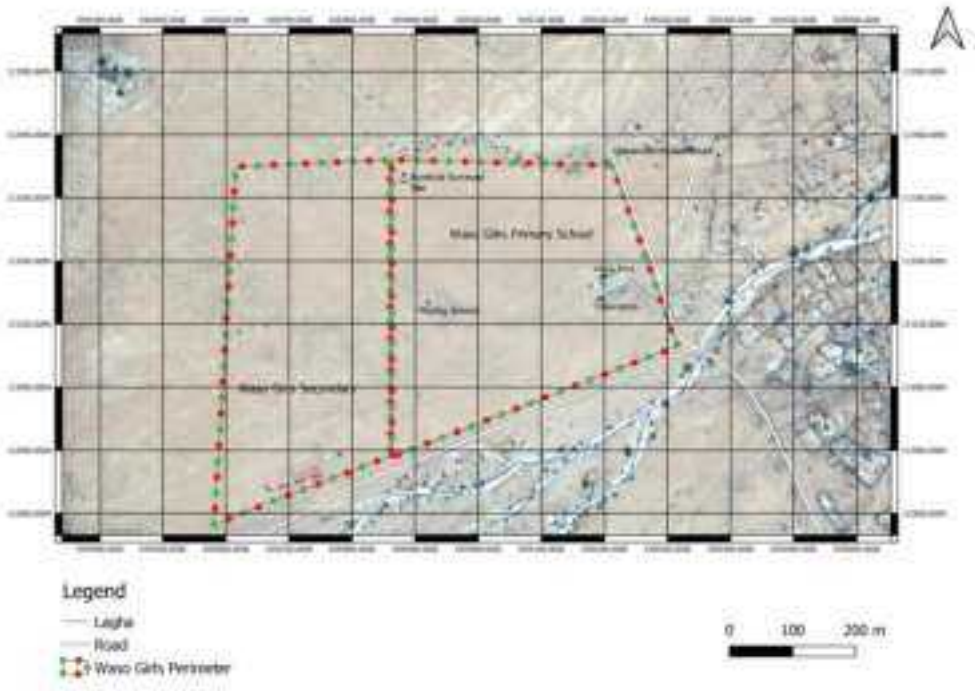
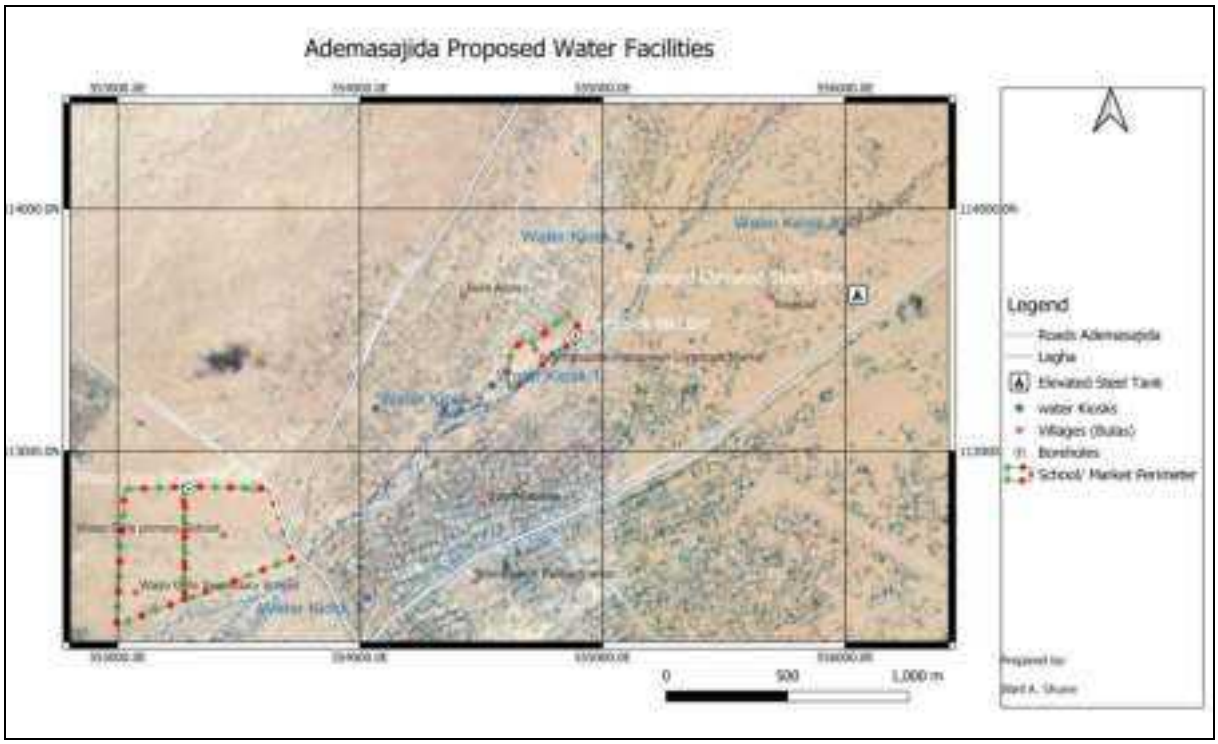


Figure 4-1: Location of the Borehole at Waso Girls Relative to School facilities

Ademasajida Livestock Market was reported to lack land documents and therefore the drilling of the borehole at the site was sanctioned by the community through community selected representatives, who signed the land resolution and consent permit allowing the construction of project facilities as attached in annex IIA. The selected representatives took the survey team along the pipeline routes, water kiosk and elevated steel tank location points. The location of the facilities at Ademasajida are as indicated in **Error! Reference source not found.**



4-2: Proposed Water Facilities at Ademasajida

4.2.2 Arbajahan

The proposed drilling of the 2 exploratory boreholes at Arbajahan is also located in Wajir County, Wajir West Sub-County and within Arbajahan ward. The boreholes shall be drilled one in Arbajahan primary school which shall serve both the school and the community at Arbajahan market centre. The borehole shall be equipped with an elevated steel tank and two water Kiosks to serve the community. Arbajahan primary school was also noted to have an allotment letter and the school management authorized the drilling of the borehole within the school as per the minutes attached in Annex IID. The drilling site of the borehole is located at one of the corners of the school at a distance of about 100m from the school staff quarter, 200m from the girls' dormitory, 250 from the school playground and around 350m from the nearest class as indicated in Figure 4-3.

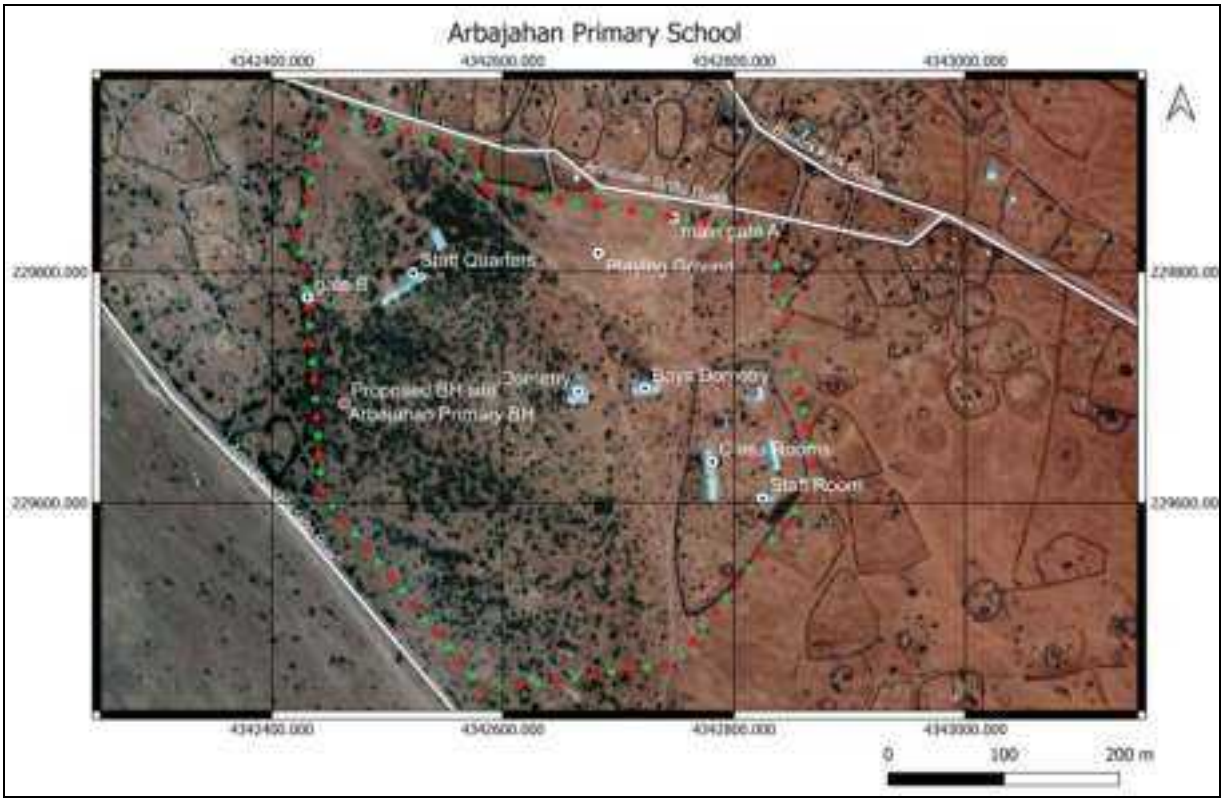


Figure 4-3: Location of Arbajahan Primary School relative to school facilities

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The locations of the facilities at Arbajahan were as indicated in Figure 4-4.

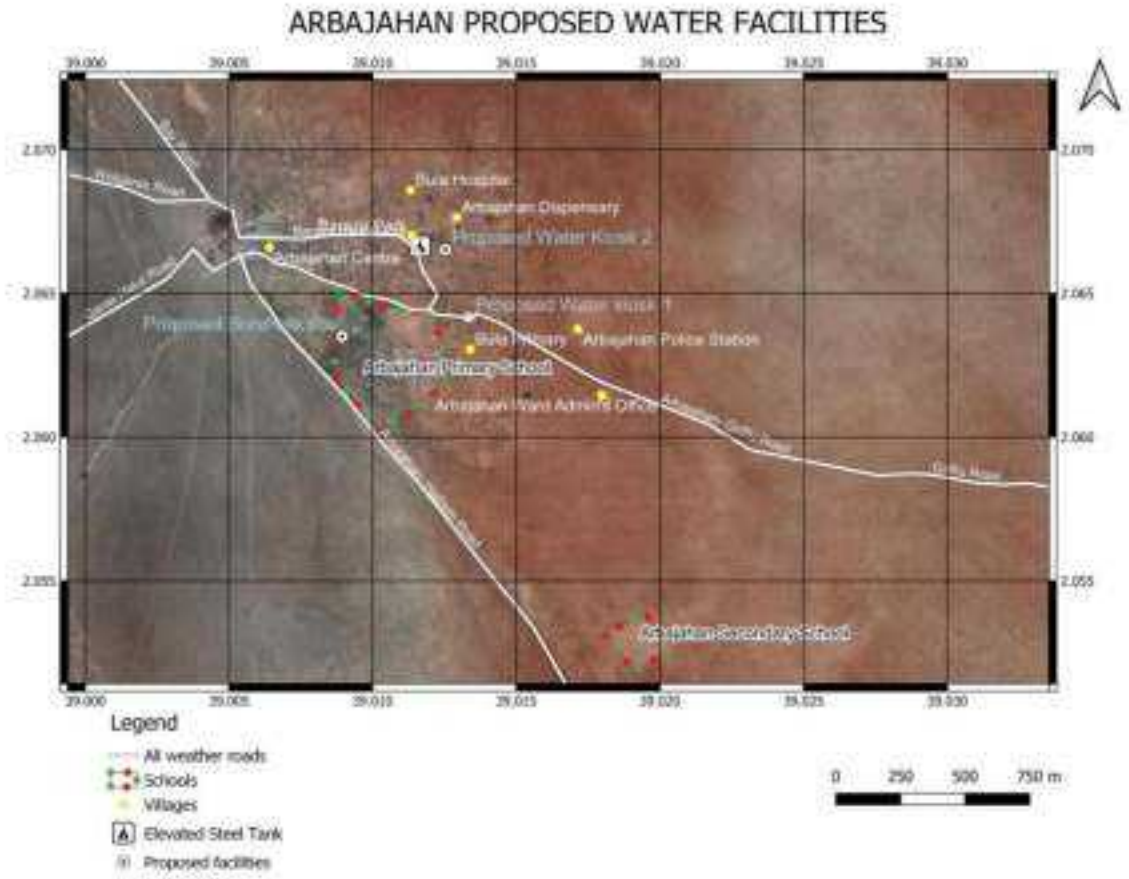

Figure 4-4: Location of Water Facilities at Arbajahan

The second borehole shall be drilled at Bula Madina which is located 9.5km south of Arbajahan centre. According to the proposed works contract this borehole is not meant to be equipped. However, based on community consultations and the anticipated future discussions between the Bank and the client, the borehole may be equipped with solar, inverter, submersible pump a rising main, two (2) cattle troughs, a water kiosk with a roof slab for purposes of hoisting a $10m^3$ plastic Tank for Bula Madina centre. Similarly, there shall be a plastic tank on a raised steel girder for the school. Construction of these facilities was sanctioned by the community through community selected representatives, who signed the land resolution and consent permit allowing the construction of project facilities as attached in annex IIC. The elected representatives took the survey team along the pipeline routes, water kiosk and the proposed storage.

The borehole and the proposed facilities are on community land and are as captured on Figure 4-5 below.

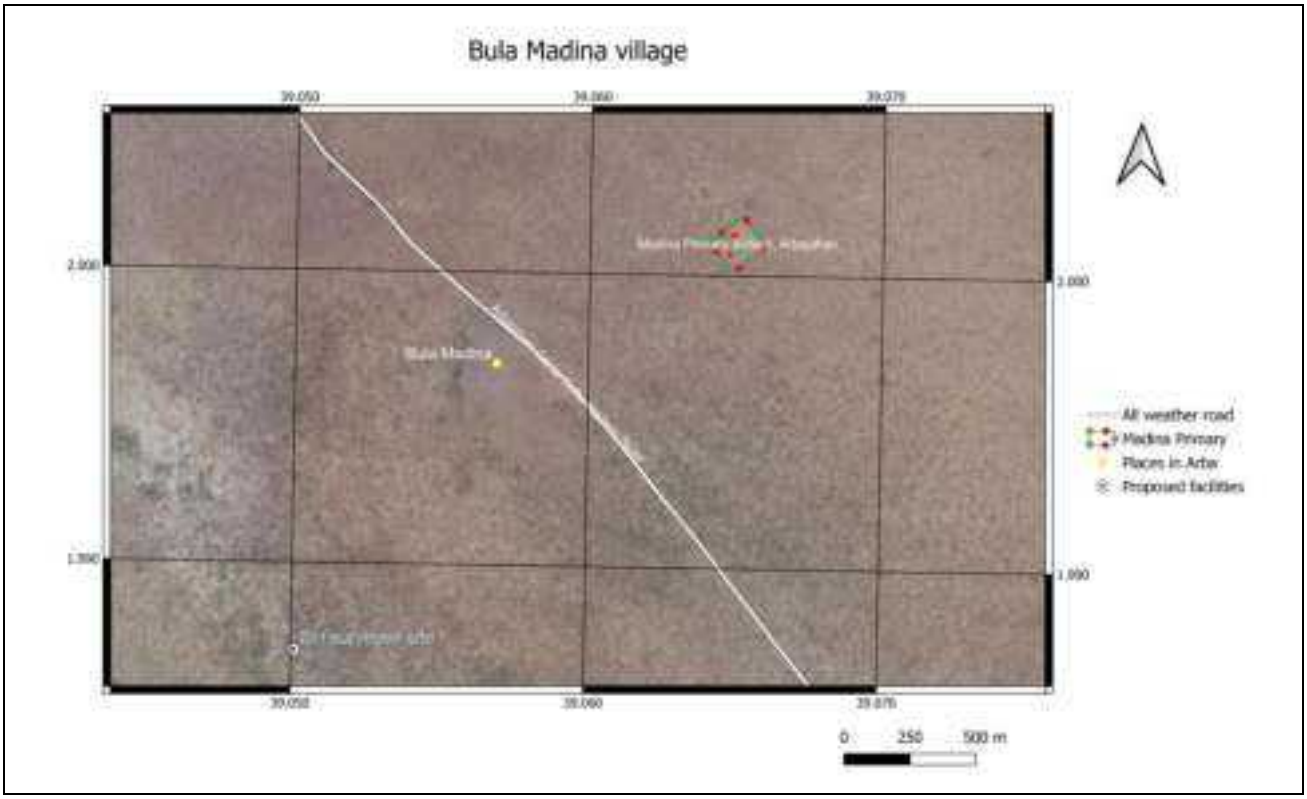

Figure 4-5: Image for Bula Madina Village

4.3 Physical Environmental Baseline Conditions

4.3.1 Climate and Weather Parameters

Satellite derived data for the proposed project area was used for the description of climate and weather patterns of the project area. Data from Climate Hazards Center Infrared Precipitation with Station data (CHIRPS) was used to estimate rainfalls within Ademasajida and Arbajahan areas using the coordinates of the proposed project area. The study team acquired weather and climatic satellite spatial data for temperature, wind speed, relative humidity and radiation from FAO CLIMWAT data base accessed (July 2021).

4.3.1.1 Rainfall

Wajir County generally experiences semi-arid climatic conditions. Satellite derived precipitation from Habaswein weather station *(Climate Hazards Center Infrared Precipitation with Station)* for the past 40 years spanning between the years 1981-2019, the project area coordinate points were used to determine general monthly rainfall distribution and annual rainfall amount in the proposed project area. The project area usually experiences a bi-modal rainfall pattern with relatively high rainfalls under the long rains

being experienced between Match and May compared to the short rains received between October and December as indicated on Figure 4-6 The figure also shows that July and August are the driest month with less than 1mm while April seems to be the wettest month of the year, within the proposed project area. The average annual rainfall within the project area was noted to be about 218mm.

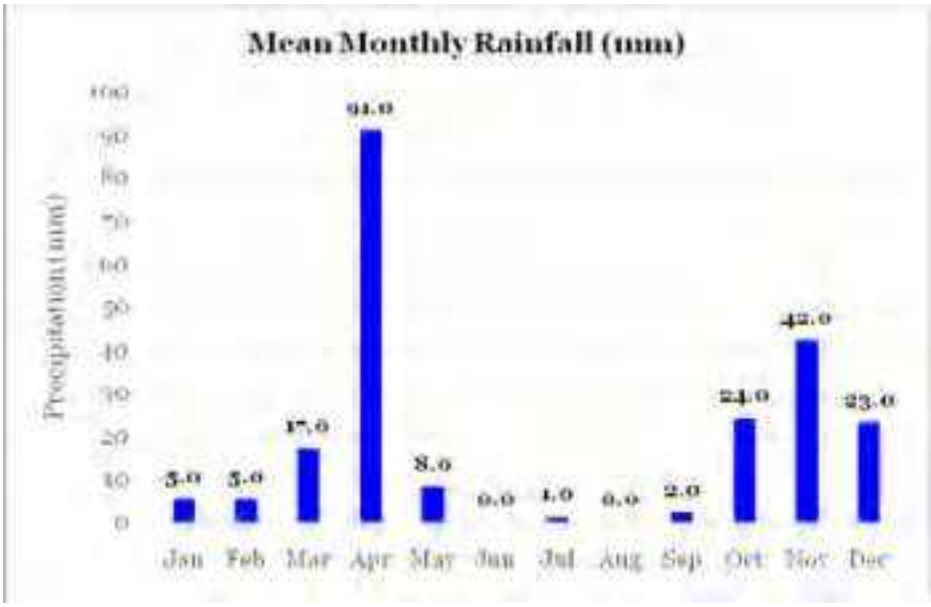

Figure 4-6: Mean Monthly Rainfall *source (CHIRPS data base July 2021)*

4.3.1.2 Temperature

Satellite derived temperature data for the same point and over the same period as indicated in the previous section (4.3.1.1) above was used to compute the air temperature within the project site. The temperature data analysis in the area as indicated in Figure 4-7 shows that March is the warmest months with an average temperature of 29.7˚C while August with an average temperature of 27.6˚C was the coldest. However, the average annual temperature in the project area was noted to be 28.56˚C. The welfare of the workers who will be implementing the project need to be considered by the contractor to reduce the impacts of high temperature by ensuring sufficient provision of drinking water to avoid cases of dehydration.

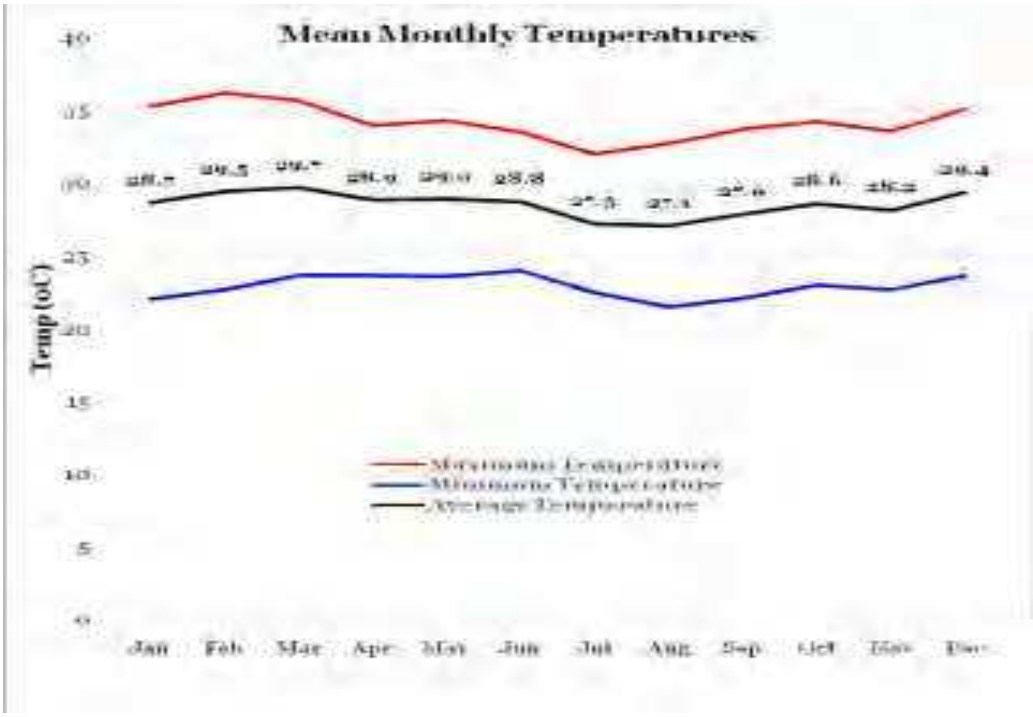

Figure 4-7: Average Monthly Temperatures *source: Habaswein weather station (FAO CLIMWAT database July 2021)*

4.3.1.3 Relative Humidity

The average monthly relative humidity within the project Area of Interest (AOI) is about 61.58%. This is comparatively low if compared with most parts in the country. Seasonal mean monthly values fluctuate between 55% in February to 65% in April, October, November and December as shown on Figure 4-8. The highlight on relative humidity within the project area is significant given the high solar radiation within the proposed project area that shall lead to increased sweating among the workers on site. Relative humidity (RH) directly influences the amount of moisture that is evaporated from the skin of workers to the atmosphere. The proposed project area also experiences relatively high winds that shall increase the rate of moisture being carried from the skin. The low relative humidity will be a nuisance to the contractor's team, hence the need to provide enough water to compensate for the loss through sweat.

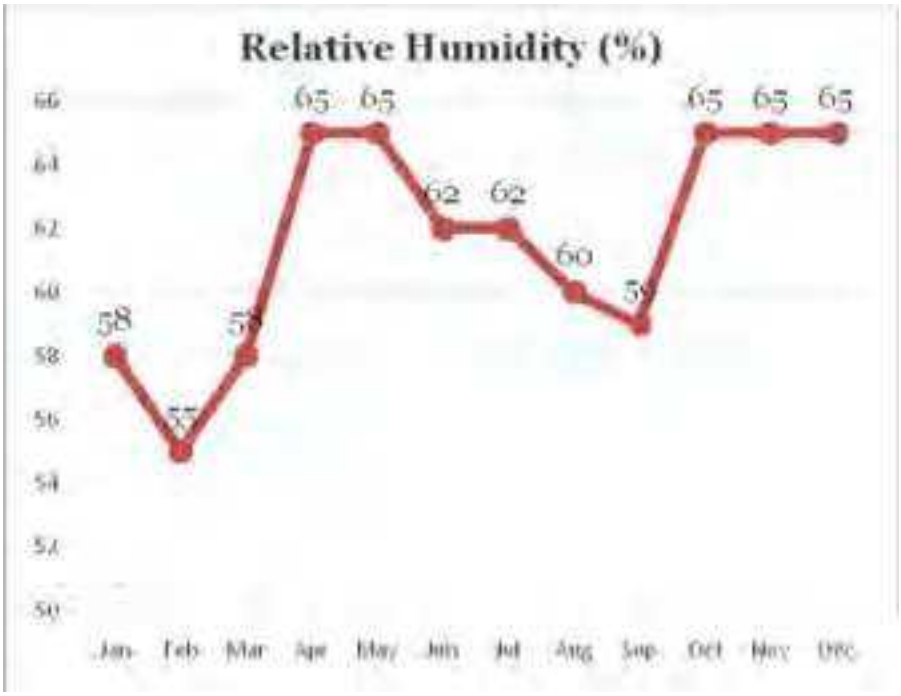

Figure 4-8: Relative Humidity *source: Habaswein weather station (FAO CLIMWAT database July 2021)*

4.3.1.4 Wind Speed

The satellite data for wind speed indicated that average monthly wind velocity experienced in the project area is about 2.37m/s with the lowest wind speed of about 2.00m/s being experienced in January, March, April and December while the highest is 3.00m/s occurring in August as indicated in Figure 4-9. Wind speeds influence the subsequent changes in the rate of heating, evaporation, transpiration and the microclimate within the working area. The wind speed in addition may cause soil erosion affecting air quality status on site for the workers and the general community health given the lack of ground cover vegetation. The high wind speed within the proposed project area shall be carrying the particulate matter from drilling site dispersing to long range areas. The proposed project implementation can capitalize on the months of low wind speeds. The wind speeds generate a force that will influence the elevation steel tank and it positioning.

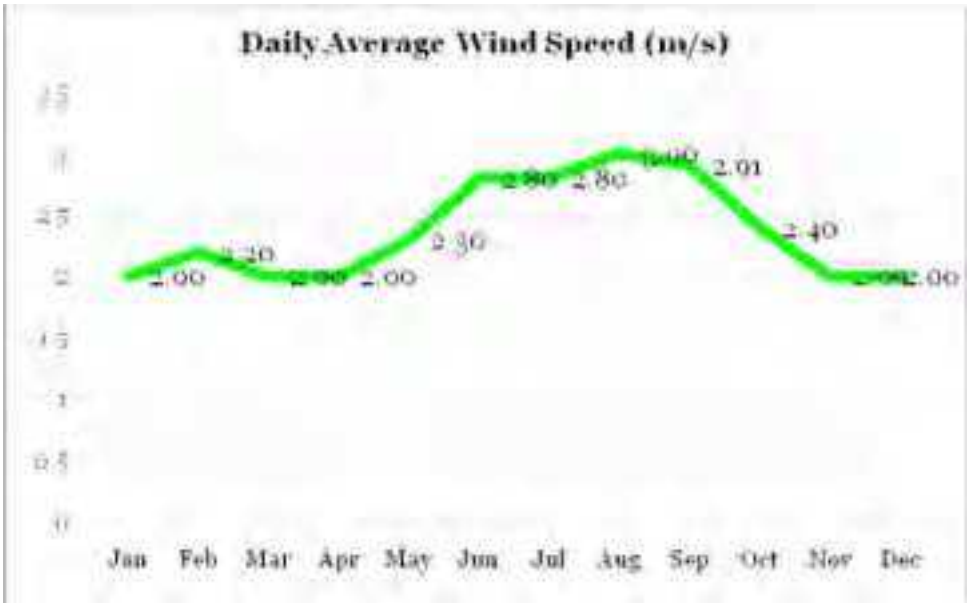

Figure 4-9: Daily Wind Speed *source: Habaswein weather station (FAO CLIMWAT database July 2021)*

4.3.1.5 Radiation

The proposed project area experiences an average monthly radiation of about 20.76 Rad (MJ/m^2/day) with the maximum radiation of 24.9 Rad (MJ/m^2/day) occurring in the month of February and a minimum of 18 Rad (MJ/m^2/day) being experienced in the month of August as indicated in Figure 4-10. Solar radiation consists of different light frequencies that can pose a health hazard especially to workers exposed to the sun for long hours with the eyes and the skin bearing the greatest brunt. There will be need therefore for the project implementing agencies to take this into consideration during the construction period. However, the generally high radiation is significant for the solar system that shall power the boreholes.

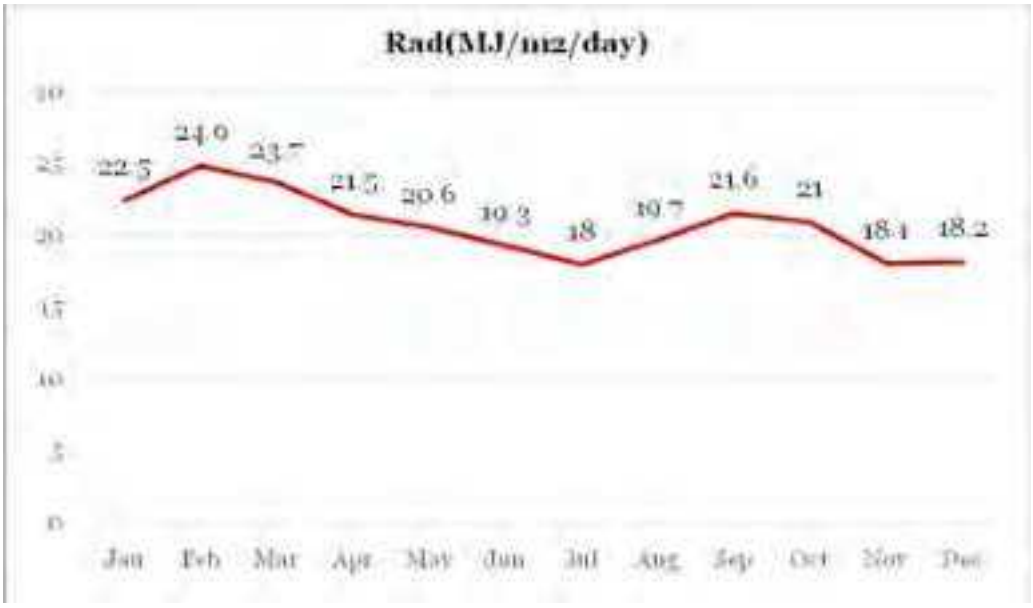

Figure 4-10: Average daily radiation *source: Habaswein weather station (FAO CLIMWAT database July 2021)*

4.3.2 Hydro-Geological Survey

Geophysical survey investigation was conducted to inform the selection of the drilling of the 4 boreholes 2 No. in Ademasajida and a similar number in Arbajahan. Indicated in here is a summary of findings in the hydro-ge0logical reports in annex V

4.3.2.1 Physiography

The area stands at an average altitude **of 230-245** meters above sea level within a gently dipping terrain punctuated with several ant hills and flood plains both on the south eastern and north western flanks.

4.3.2.2 Geology and Stratigraphy

The area comprises sedimentary rock units exhibiting continuous flow of water from one point to another in the subsurface. These are mainly Mio-Pliocene sediments that include fine and medium, as well as coarse sandstones. The sandstones, gravels, grits, and weathered limestone storing juvenile water in the subsurface appears to have enjoyed subsequent replenishment from the flow inferred as originating from the River Ewaso/Laghdera course. There may also be some carbonates which are fairly fractured and possess water at the shallow depths, though fairly mineralized, via the fractures and karstification veins. Water also forms at the contact points between the carbonates and the coarse siliciferous sediments. However, the massive subsurface laminar flow of the Merti aquifer (through the Laghdera seasonal stream) dilutes any salinity that may be carbonate-derived in the aquifers. Overall water quality is thus much positively impacted on. Thus, groundwater in the upper sediments shall enjoy annual precipitation recharge through direct infiltration, while the deep-seated zones shall be recharged via regional flow aided by the karstification channels and plate tectonics in the Jurassic – cretaceous period.

The rocks in Arbajahan are all of sedimentary origin. The oldest rocks consisting of the Meta-sediments of the Triassic age. These rocks include grits and sandstones, and red sandy soils. These rocks exhibit considerable variation in thickness, extent and lithologic characteristics that suggest rapid deposition of detritus materials derived from the erosion of adjacent areas of older sandstones or limestone. The rocks likely to be encountered in the investigated area are discussed below from the youngest to the oldest.

4.3.2.3 Hydrology and Structural Geology

Recharge Mechanisms within the Aquifer Systems

Evidences abound of jointing and fracturing of the carbonate sediments on the surface, alluding to intense forces of fracturing, carbonation and quaternary tectonic faulting. Much of the south westerly -north easterly directed stress fields helped sculpture the terrain into its present geological state. Owing to the relatively high fractions of clays in then beds, there is no sufficient time available for maximum river bed infiltration into the sub surface zones lying on the adjacent sides of the river course. However, there are areas that were exceptionally karstified and fractured within the carbonate beds. These are the zones that store water upon seepage into their aquifer sediments systems alongside recharging the adjacent sub surface storage systems via the Darcyan flow mechanics.

Drainage

The general drainage pattern in the area is from North West to South East. The Lagh Dera (Ewaso Ngiro) river emanating from the Aberdares and Mt.Kenyahas some tributaries surface flow through this area, although it is believed to flow underground into the Indian Ocean. Owing to the relative flat nature of the terrain in Admesajida, there is flood rampancy. The permanent civil structures on the ground need to stand the risk of destruction added to the occasional loss of lives for both livestock and human persons. Most of the housing units are constructed through shrubs and dry acacia trees locally available, lightening the task of evacuation in the event of impending flood disasters. The schools nearby are built in flood free areas and this is a factor that suits drilling in the area as the well shall be free from floods.

4.3.3 Waste Generation and Management

Waste management whether liquid, solid or in gaseous form is critical in maintaining environmental integrity of an area. The main source of litter noted in the project area during field survey was solid waste from household consumption and commercial activities. Though the County Government provides the services of waste management, there was evidence of inadequacy in waste management. Haphazard littering and wind dispersal of waste in the environment were observed as shown on Plate 4-1 and Plate 4-3. The residents cope with the inadequate waste collection challenge through burning in compounds or along the streets as highlighted in Plate 4-2 below Waste burning enhances pollutant dispersal to the environment and if not well handled, can be a cause of environmental degradation to the air, biological diversity, water sources and the soils. Animals were also noted picking through the waste along Arbajahan market as highlighted in Plate 4-4 Although generation of waste is anticipated during project implementation and operation, most of it is expected to be recycled as back filling with an exception of

waste associated with the contractor's camp or leakage and spillage from the drilling rig. But despite this and given the size of the proposed project, it is not envisioned to be a menace in the project area.

Plate 4-1: Haphazard Waste Disposal in Ademasajida

Plate 4-2: Waste burning as a management Strategy at Ademasajida

Plate 4-3: Haphazard Waste Littering at Arbajahan market

Plate 4-4: Donkeys picking through waste at Arbajahan Market

4.3.4 Excessive Noise and Vibrations

Noise pollution possesses both auditory and non-auditory effects on the exposed population. The proposed project area is predominated by both commercial and residential tenements. Autoric shaw, motor vehicles running engines plying Modogashe-Wajir highway and hooting are the main sources of noise within the general project area for admesajida. Others include noise from public address systems in mosques, hawking at livestock market, general conversations and advertisements. However as one moves away from the market centre the noise level reduces as the anthropogenic activities also reduces. The main noise receptors at Waso girls' primary school are the pupils at the school and neighbouring residents. For the livestock market, the receptors shall be the traders and the residents who live near the market. Arbajahan market centre is more of a rural setting than an urban area. The area was noted to be characterized by low volumes of human activities. The main sources of noise noted were general conversation and from livestock. Similar to Ademasajida, as one move away from the market centre the noise level reduces as the anthropogenic activities also reduces. There were no major noise receptors other than the local residential areas and the pupils at Arbajahan Primary where one of the boreholes shall be drilled. It is anticipated that the borehole drilling rig shall lead to increased noise levels within the proposed project area. The distances from the borehole to the nearest facilities was as indicated in section 4.2 of this report. However, given the drilling duration, the noise impact is anticipated to be temporal.

4.3.5 Air quality

Air pollution at Ademasajida market centre was noted to be mainly associated with pollutants generated from automobile emissions, haphazard burning of waste at residential areas and particulates from moving vehicles or wind action on the unimproved roads at the market centre and its environs. Air pollution at Arbajahan market centre in addition to the mentioned air pollution sources was noted to be mainly associated with pollutants generated from livestock movement during watering as indicated in Plate 4-5. Both areas have no ground cover vegetation and the soils is bare prone to wind actions. The gaseous and particulates pollutants are anticipated to increase with the proposed project activities though insignificantly particularly from mud particulate matter from the drilling rig and movement of construction vehicles. The degradation of air quality has a direct impact on both public health and climate change effect. Monitoring of air quality is a concern in Kenya and NEMA has prepared air quality regulations. Particular concern is about the anticipated increase in exhaust fumes from moving automobile, construction machines and equipment during construction periods. The loose soil particles from the excavated pipe laying trenches combined with the high wind speed observed within the project area are anticipated to be a menace during project construction period. However, given the volume of the proposed works, with proper mitigation measures the pollution effect is not anticipated to be a challenge.

Plate 4-5: Dust generated through movement of livestock

Plate 4-6: Absence of ground cover vegetation

4.4 Biological Environmental Baseline Conditions

4.4.1 Flora and Fauna

According to key informant interview, the proposed project area falls within semi-arid region which is under Agro-ecological zone VI. Such areas are typically characterized by low annual rainfall of between 200-300mm as indicated in section 4.3.1.1. The typical predominant natural vegetation in such zones includes short grasses with small leaved thorny trees and bushes. However, this was not the case at present within the proposed project area, due to the high modification of the local environment by human settlement and livestock grazing activities which were noted to be the main land use within Ademasajida and Arbajahan market centres. The dominant vegetation within Habaswein town is *Prosopis juliflora* and *Acacia* trees along the laggah that passes through the area. Similarly, the dominant vegetation within the Arbajahan market centre is *Prosopis juliflora and* acacia trees as one move away from the market on the western side. The area used to be a free-range wildlife roaming area but due to settlement, the wildlife is confined to the outskirts of the market centres as one move away from the market to the interior. The main wildlife type observed were antelopes, ostrich and dikdik.

4.4.2 Invasive Species Management

The main invasive plant species observed in the proposed project areas of interest was *Prosopis juliflora (*Mathenge*)* as indicated Plate 4-7 andPlate 4-8. The observation made showed that the spread of *mathenge* plant within proposed project area is influenced by anthropogenic activities particularly livestock movement, construction activities and human settlement. There is a potential of exacerbating the spread of the plant during project construction and operation activities, along the water pipe line routes and animal watering areas. The plant poses a risk to the water pipe and the roots can cause damage to the water infrastructure. The risk of spread is posed by the potential of being dispersed by construction equipment that shall be used during project implementation in the event of contamination. There is need

therefore to ensure that equipment to be used for the drilling and construction works are free from any alien plant materials and soils which may contain seeds of alien species. Although the risks are moderate based on the observations made in the immediate surroundings of the project site, there is need for continued vigilance by the contractor and the local community who will work on the project, due to the potential of the plant to damage the water transmission main/distribution infrastructure in the event of contamination of the pipeline routes.

Plate 4-7:: Prosopis Julflora growing at Arbajahan Fresh Product Market at Baraza Park

Plate 4-8: Prosopis Juliflora at the Existing Borehole at Arbajahan

4.4.3 Natural Habitats

The proposed project area is a modified habitat with the original vegetation having been cleared for development. The modification has been mainly through developing more of the built environment with Habaswein market centre being a significant urban area within Wajir County. Most of the vegetation observed within the proposed area is *Acacia tortilis* and the *Prosopis juliflora* being the most dominant. However invasive species Mathenge (*Prosopis juliflora*) seems to be a dominant colonizing plant in some parts of the town.

Similar observations were noted at Arbajahan with the original vegetation having been cleared for development and as a result of livestock management, within the area being a watering point. The modification has been mainly through settlement and grazing of livestock. Most of the vegetation observed within the proposed area were *Acacia Senegal* as indicated in Plate 4-9 and Plate 4-10. However invasive species Mathenge (*Prosopis juliflora*) seems to be a dominant colonizing plant in most parts of Arbajahan market centre.

Plate 4-9: Acacia Family Vegetation at Arbajahan

Plate 4-10 : Acacia Tree with photo taken at Arbajahan.

4.4.4 Visual Impacts

The proposed project area is more of a flat land with short scattered shrub trees of acacia family. The general project area was noted to be a modified habitat with more of the original vegetation acacia trees having been cleared. The project area is a build environment with settlement and for commercial purpose as indicated in Plate 4-11 and Plate 4-12. The introduction of the project facilities therefore is not anticipated to impact on the landscape scenery of the project area of interest. However, the elevated steel water tanks are expected to be an exception, due to the steel material of the elevated tanks not being consistent with the background scenery. The proposed construction of elevated steel water tank shall ensure constant water supply with sufficient flow pressure to a wider area by gravity. Despite this, it can be compensated by planting of vegetation consistent with the site around the storage area or use of hue consistent with the background.

Plate 4-11: Arbajahan main street

Plate 4-12: Some of the Buildings in Ademasajida

4.5 Socio-Economic Baseline Conditions

4.5.1 Administrative units

The proposed drilling of 2 exploratory boreholes for monitoring of Merti aquifer and supply of community water at Ademasajida is located in Wajir County, Wajir West Sub-County and within Ademasajida ward. The 2 No. Boreholes at Ademasajida shall be drilled one at Waso girl's primary school and the other at the existing Habaswein Ademasajida livestock market in Ademasajida sub-location within Ademasajida location, while those at Arbajahan shall be drilled at Bula Madina and the second at Arbajahan primary School. Land within the project area is under community land tenure and therefore, the community selected representatives assisted the survey team to identify the location points of the project facilities; boreholes points, elevated steel tanks points, water kiosk location points, distribution pipeline route and livestock watering trough points. However, the land from the Arbajahan and Waso girls' primary school were noted to be owned by the schools and through school management they allowed for the drilling of the boreholes as captured in annexes IIB &D. The selected community representative participated in the signing of the land resolution and consent permit forms which were as indicated in annex IIA&C, permitting the construction of the proposed project components. During Baraza meetings, the community members indicated that the project will serve communities even from outside the project area from neighbouring villages and the 2 wards in general, especially watering of livestock during droughts.

4.5.2 Demographic Characteristic of the Project site

4.5.2.1 Population Levels

According to housing and population census of 2019, the population for Ademasajida location indicated that the male population is slightly higher at 55.67% than female population which was 44.33%[2] consistent with Ademasajida sub-locations. However, the data at Lagdima sub-location shows the opposite with female being 51.55% and male at 48.45%. The population and housing census further indicated that the location has a total of 3,240 households with an average household size of 8.6 persons per household. The population for Arbajahan location indicated that the male population is slightly higher at 58.34% than female population which was 41.66% consistent with Arbajahan sub-locations. However the data at Kara sub-location shows similar results though the percentages were slightly higher with male being 64.2% and female at 35.8%. The population and housing census further indicated that the location has a total of 1,298 households with an average household size of 7.8 persons per household which was noted to be consistent in the sub-location. Household survey findings on the other hand showed that the proposed project area has a household size of 10.6 persons per household. According to household survey findings shown in Table 4-1, 57.14% of those interviewed were male and 42.86% were female at Arbajahan and for Admesajida, 63.63% of those interviewed were male and 36.37% were female which could be an indicator of how patriarchal the decision making could be among the locals.

Table 4-1: Gender of Respondents

No	Gender of Respondent	Percentages (%) for Arbajahan	Percentages (%) for Ademasajida
1.	Female	42.86	36.37
2.	Male	57.14	63.63
	Total	**100**	**100**

4.5.2.2 Household Characteristics

Household survey results indicated that all respondents interviewed reported being married. The information is indicative of the nature of household headship, though baraza discussions reported some households to be headed by vulnerable and marginalized individuals/persons. The 2019 housing and population census indicated that Ademasajida sub-location had the highest number of households (1320) targeted by the project in Ademasajida location. The household survey results for Arbajahan indicated that most respondents interviewed reported being married as highlighted in Figure 4-11. The information is indicative of the nature of household headship, though community baraza discussions reported some households to be headed by vulnerable and marginalized individuals/persons. The 2019 housing and

[2] *Kenya Population and Housing Census 2019: Volume II: Population by County and Sub-County*

population census data showed that Arbajahan sub-location had the highest number of households (872) targeted by the project in Arbajahan location.

Figure 4-11: Status of Household Heads

4.5.2.3 Literacy levels

Literacy levels within the general Wajir West Sub-County is relatively higher compared to the rest of the County with Habaswein having the highest literacy level followed by Wajir East sub-county. The national average was 82.8% based on the 2019 census, Wajir County was 21.34% and Wajir West Sub-county had at least 19.5% of the population having attained a form of formal education. It was noted that males in the sub-county had a slightly higher literacy levels than females at 57.12% and 42.87% respectively. About 79.5% of the population does not have any form of formal education in Wajir West County, with majority observed to be women at 50.94% compared to men at 49.06%. The majority of those with formal education have a form of primary education at 57.54%, secondary levels at 22.05%, 3.16% for tertiary, 1.36% university and 5.20% had other form of literacy either adult basic literacy or mudras. There was high gender disparity among those who have attained tertiary level of education with males consisting 69.18% compared to 30.82% who were women. The literacy level figures at national, Wajir County and Wajir West Sub-county were as shown on Table 4-2[3].

[3] *The data shown on the table was extracted from 2019 Kenya population and housing census Volume IV specifically table 2.4*

Table 4-2: Literacy Level Attained in Wajir West Sub-County

	Level of Literacy	Male	Female
National	82.8%	50.06%	49.96%
Wajir County	21.34%	58.12%	41.87%
Wajir West Sub-County	19.5%	57.12 %	42.87%
Pre-Primary level attained in Wajir West Sub-county	10.34%	49.72%	50.28%
Primary level attained in Wajir West Sub-county	57.54%	54.54%	45.46%
Secondary level attained in Wajir West Sub-county	22.05%	64.78%	35.2%
Tertiary College level attained in Wajir West Sub-county	3.16%	69.18%	30.82%
Universe College level attained in Wajir West Sub-county	1.36%	68.42%	31.58%
Other form of literacy level attained in Wajir West Sub-county	5.20%	56.66%	43.34%

However household survey findings as indicated in Figure 4-12 shows that literacy levels within the project area was about 54.54%, with majority of respondents reporting attaining primary level education at 27.27% of those interviewed. There is an observed consistency between the census and household survey information which shows that primary level education is the most attained followed by secondary and tertiary education. The existence of such a relatively high literate population (including females) implies the potential availability of human capital (labour force), for effective participation in management of the proposed project as well as participation in maintenance and operation of water facilities to be implemented under the proposed project facilities.

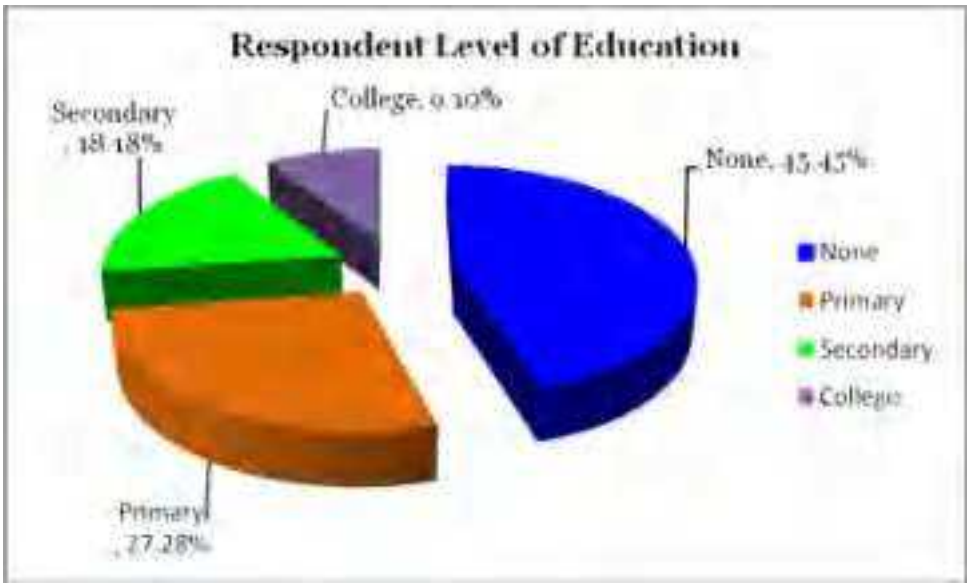

Figure 4-12: Respondents Level of Education

Household survey findings in Arbajahan as indicated in Figure 4-13 shows that literacy levels within the project area was about 52.38%. Education levels reported attained by household survey respondents were

only of primary and secondary level. The majority of respondents with a form of formal education reported attaining primary level education at 33.33% as indicated on Figure 4-12. There is an observed consistency between the census and household survey information which shows that primary level education is the most attained. The existence of such a relatively high literate population (including females) implies the potential availability of human capital (labour force), for effective participation in management of the proposed project as well as participation in maintenance and operation of water facilities to be implemented under the proposed project facilities.

Figure 4-13 : Respondent Level of Education

4.5.3 Social Amenities and physical infrastructure

4.5.3.1 Project Area Accessibility

Generally Ademasajida market centre is linked through a road network. The main road is Modogashe-Wajir road which is murram graded as indicated in images in section 4.2. Waso Girls can be access through Admesajida Hadado road, at approximately 800m of Modogashe Habaswein road. Arbajahan centre on the other hand is located 160km to the North-West of Habaswein via the Habaswein-Arbajahan road. Similarly, Arbajahan is connected to Wajir town via Griftu for a distance of about 140km long.

4.5.3.2 Communication Network

The project area and its immediate environs were generally noted to have adequate communication network relative to other areas particularly the rural as one move away from the town centre. Development in communication network in an area has an influence on the level of awareness among the local population. Findings from observations, key informant interview and focused group discussion shows wireless communication is the main mode of communication in the proposed project area as indicated in Plate 4-13 from Arbajahan. The major mobile network coverage for three communication companies Safaricom, Airtel and telecom were reported to receive signals within the project area, but due to the strong Safaricom signal reception, it was reported to be the most popular among the locals. The 2019 population and housing census data indicate that about 21.8% of the population in Wajir West sub-

county uses mobile phones, and it appears like more women own phones compared to men at 22.8% to 21%. Access to communication services particularly to mobile phones is critical for communication and also money transfer during project operation. The findings further show that 5.8% of the population use internet men accessing at 6.4% and women 5% but interesting is that only 2.2% of the population own a computer or a laptop. This indicates that of the 5.8% who use internet majority could be accessing the internet using the mobile devices which further shows the significance of communication through mobile phones.

Plate 4-13: Communication mast at Arbajahan market

4.5.3.3 Industries and Trade

The type of industrial development in an area suggests the level of consumption, employment and pollution levels particularly from effluents. The proposed project area does not have any industrial activities as was reported during community baraza discussions and key informant interviews. The volume of trading within Habaswein market was however noted to be relatively high, with the market being a net consumer of products. The town is a stopover for those connecting mainly from Garissa to Wajir towns. The main industrial activities observed were jua Kali artisans and services with motorbike repair being the most obvious. Industry and trade development in an area is among the proxy indicators of the potential demand for water services as well as potential source of waste water.

The volume of trading within Arbajahan market was however noted to be relatively low, with the market being a net consumer of products. The main industrial activities observed were jua Kali artisans and services with motorbike repair being the most obvious. Industry and trade development in an area is among the proxy indicators of the potential demand for water services as well as potential source of waste water. Availability of adequate and reliable water is critical to industrial growth in an area.

4.5.4 Land Use and Ownership

4.5.4.1 Land use Pattern

Land in the project areas was observed to be generally used for livestock grazing, public land hosting public offices, settlement and for limited subsistence agricultural activities away from the market as was

reported during community meetings. The settlements were noted to be clustered around trading centres. This seemed to be influenced by availability of water services. Livestock grazing area become predominant as one moves away from the trading centres. According to key informant interview and community baraza findings, land in the project area is community land and those who own land at the trading centre only have letters from the chief authorizing them to own the land. It was reported that it's the elders who allocate land based on clans and family allocation. Land use information is significant in providing a view of the main economic activities within the proposed project area and it also provides an indication of whether the proposed project activities are in tandem with the general land use.

4.5.4.2 Land Tenure Status

Land is a factor in the implementation and operation of the proposed project and resolution of any emerging conflicts related to land will require consultations among various stakeholders. Land in Kenya is generally classified as public, private or community land. Key informant interview findings revealed that land within the proposed project area is unregistered community land held on behalf of the community by Wajir County Government. The administration of land issues within the project area is through community structures by clan elders.

i. Land Adjudication in Ademasajida Area

Although individual households in Ademasajida seemed to own plots, the land is yet to be subdivided and allotted to individual community members. The adjudication of land issues is through a council of clan elders, and the community members reported of having no land documentation. However key informant interview indicated that the plots along the high (Modogashe-Wajir) have allotment letters which were issued under the former county council. The right to access land is therefore managed and adjudicated through a council of elders from different clans residing in the area. The local people were reported to have the right to access land. A meeting was therefore held as shown in 4-14 at the livestock market and community members who attended the meeting elected 5 representatives to represent the community. The local community through elected representatives, whose names appear in the minutes of the meeting attached in annex IIIA, ratified the drilling of the borehole at the current Habaswein Ademasajida livestock market though signing of land resolution and consent forms as attached in annex IIA permitting the construction of project components. The selected community representatives together with the survey team walked along the proposed water distribution pipeline as indicated Plate 4-15, proposed water kiosks and elevated steel tank location point. The pipeline was found clear and shall be along the existing access roads within the proposed project area.

4-14: Community Members Following meeting proceedings at Ademasajida

Plate 4-15: Transect Walk along the Proposed Pipeline route Ademasajida

Waso girls' primary school was reported to have an allotment letter for the land as indicated in annex IIB. The school board of management as shown in Plate 4-16, agreed for the borehole to be drilled in the school for the purpose of serving the school and the community in general. The documentation of agreement authorizing the location of the borehole in the school is as indicated in annex IIB. The county livestock market as shown in Plate 4-17 was reported to belong to the county government and the department of livestock as the custodian, however the department was noted to lack documentation at the time of the study. The land for the livestock market was considered community land since the department of livestock does not have any documentations. In the event of subdivision, public land will therefore be held by the County Government in trust for the people resident in the project area but administered by the National Land Commission.

Plate 4-16: Waso Girls' Primary School Board Members

Plate 4-17: Livestock Market at Habaswein

ii. Land Adjudication in Arbajahan Area

Although individual households seemed to own land parcels at Arbajahan market, the land is yet to be subdivided and allotted to individual community members. The apportioning of land to individuals is through the clan elders and the community members do not have any documentation. The right to access land is therefore managed and adjudicated through elders from different clans. The local community members were reported to have the right to access land. The community members through elected representatives signed the land resolution and consent forms as attached in annex IIC, permitting the construction of project components, the 2No. Boreholes, 1 No elevated Steel Tank, wayleave for the pipeline and the location of water kiosks. The consultations to sign land resolution and consent permit was held at the ward administration office as indicated in Plate 4-18. The elected community members together with the area chief and the ward administrator walked along the proposed pipeline and showed where the kiosks and the elevated steel tank was to be located as shown in Plate 4-19. The minutes of the discussions were as attached in annex IIA. This was done with the understanding that the borehole at Arbajahan primary school shall supply water to the users of the market which currently do not have a sustainable water supply. The laying of the main transmission pipeline is proposed to be along the existing access roads. During the survey, the consultations with the community were done to identify the pipeline route and water kiosk points. The community elected representatives guided the survey team by walking along the proposed routes which were noted to be clear. The challenge noted was that most of the purported access roads are not surveyed and it's not clear whether after land registration they will remain so. However in the event of land registration and subdivision in Wajir County, public land shall be held by the County Government in trust for the people resident in the project area but administered by the National Land Commission.

Plate 4-18: Community Representative during signing of the land resolution and Consent permits

Plate 4-19: Community Representatives with the survey team at one of the Kiosks Location

4.5.5 Water Coverage

4.5.5.1 The Main Water Sources

Ground water is the main water source within the project area. The local community during baraza meeting in Ademesajida reported drawing its water from 4 sources, 3 of which are boreholes drilled by NWWDA, and handed over to WAJWASCO and the fourth source is private boreholes. The WAJWASCO boreholes are the community's primary source of water and they include one in Habaswien at the sub-county HQ, the second in Bula Qasad or the old Hadado Borehole and the other is the Qulqul (plenty water) Borehole. The community reported coping by buying water with total expenditure on a 200 litre container costing Kshs 200. The water is transported by donkey carts as shown in Plate 4-20 and tuktuk as shown in Plate 4-21. The water sources were reported to be insufficient and unreliable because of several challenges as highlighted in annex III. It was also reported that some of the borehole water is piped as was observed during baraza meeting. Household survey findings indicated that communal stand pipes were the most common as well as through water kiosks.

Plate 4-20: Donkey Cart for Transporting Water.

Plate 4-21: Autorick shaw (tuktuk) for transportation of water

The community in Arbajahan reported to draw water from 2 main sources namely Arbajahan boreholes 1 and 2. The two boreholes were said to serve many people from nearby manyattas and villages as well as two nearby schools, Arbajahan primary and secondary schools which were reported to draw water from the two boreholes and supplied using water bowsers as indicated in Plate 4-22. The Villagers water livestock at the said Arbajan market centre as indicated in Plate 4-23.

Plate 4-22: Water Bowser at Arbajahan Market

Plate 4-23: Watering Livestock at the Existing Community Borehole

The community reported coping by buying water transported through trekking to water sources as shown in Plate 4-24 and donkey carts as shown in Plate 4-25. The water sources were reported to be insufficient and unreliable because of several challenges as highlighted in annex III during community Baraza discussions.

Plate 4-24: One of the Girls Fetching Water at Arbajahan

Plate 4-25: Transporting Water for Long Distances using Donkeys at Arbajahan

It was also reported that some of the borehole water is piped as was observed during community baraza meeting. Household survey findings in Arbajahan indicated that communal stand pipes were the most common as well as through water kiosks as indicated in household survey results in Figure 4-14.

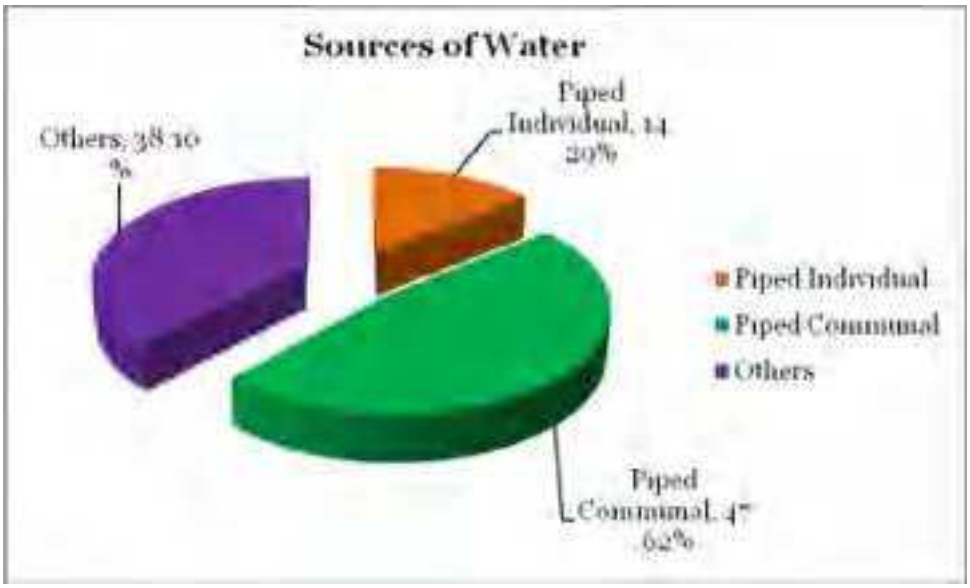

Figure 4-14: Main Water supply Source to households in Arbajahan

4.5.5.2 Water Source Reliability

The existing water supply system was reported not reliable at the time of the study based on the duration of supply in a given area. The reliability of a water source to a consumer on the other hand is a significant indication of effectiveness in provision of water supply services and efficiency of the system. Household survey findings on respondents' perception on the reliability of main water source indicated that 61.90% felt the current water sources were reliable while 38.1%% indicated it was unreliable as noted in Figure 4-15. Findings from both key informants and focused group discussion further revealed that water supply in the area was affected by cases of breakdown of generator, nonpayment of electricity, lack of fuel, break down of borehole pump or inadequate power from solar panel. Sources such as rain harvesting and laggahs though supplement the supply, were reported to be affected by variation in weather patterns hence affecting consumers. This indicates the urgency and need for the proposed project interventions to stabilized water supplies to the residents of the area.

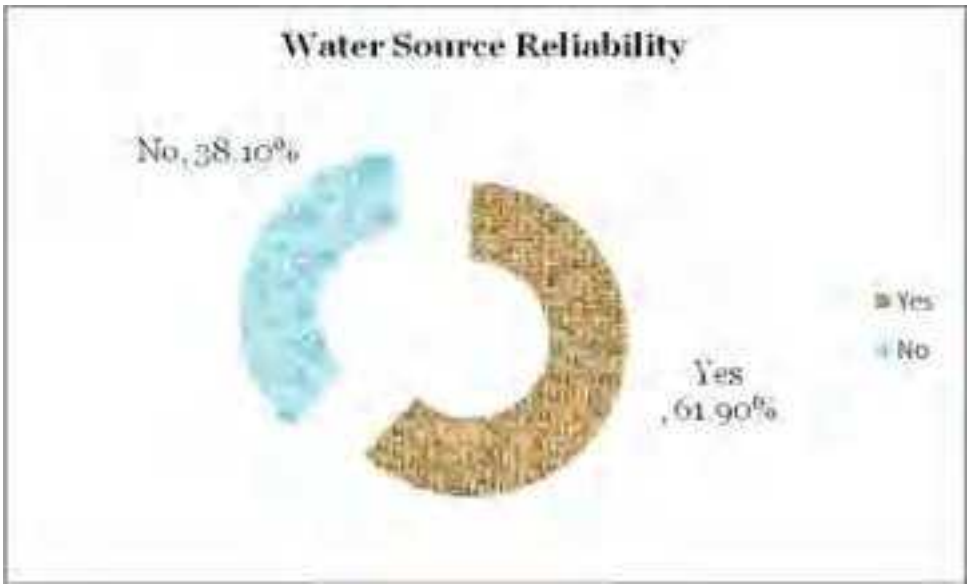

Figure 4-15: Water Source Reliability in

4.5.6 Sanitation Coverage

Provision of sanitation services for adequate treatment and disposal of human waste remains very vital in prevention of water borne diseases. Access to improved sanitation services in sub-Sahara Africa remains very low at 30%[4]. Yet this is a region where hygiene awareness and practices are equally poor. Access to improved sanitation services in Kenya also remains low at 31%[5] and Wajir County at about 5%[6]. Poor sanitation services affect children the most and are linked to cases of diarrhea. According to the 2019 Kenya population and housing census, most residents of Wajir County us open bush as the main mode of human waste disposal at 57.1% followed by pit latrine at 18.7%. Household survey findings at Ademasajida market centre indicated all those who participated in the survey reported that pit latrine is the main mode of human waste disposal. The findings could be influenced by the urban setting of the project area and the high density of settlements. Household survey findings at Arbajahan market centre indicated all those who participated in the survey reported that pit latrine is the main mode of human waste disposal as indicated in Figure 4-16. The findings seem to be contrary to the census data which could be influenced by the market setting of the project area and the high density of settlements.

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4 *WHO/UNICEF Joint Monitoring Programme for water supply, sanitation and Hygiene (2019): Progress on Household drinking water, sanitation and hygiene/2000-2017*

5 *Kenya Population and Housing Census 2019: Volume IV: Population by County and Sub-County*

6 2019 Kenya population and Housing Census Vol. IV: Distribution of population by Socio-Economic Characteristics

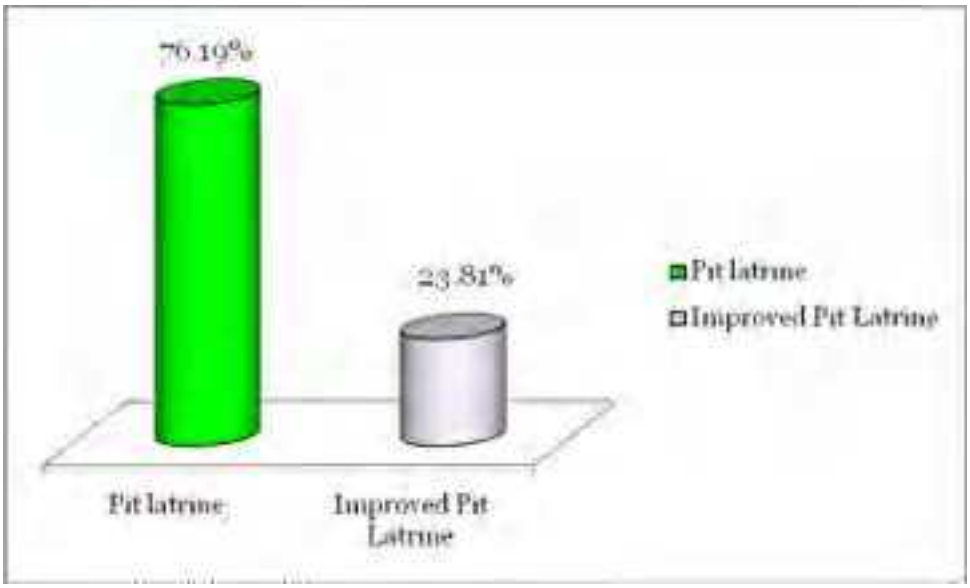


Figure 4-16: Means of Human Waste disposal

4.5.6.1 Cases of Waterborne Diseases

Cases of water related diseases in households are good indicators of hygiene awareness levels and the quality of water sources as well as a pointer of the impacts of existing human waste management practices to the environment. The household survey therefore sought to assess the safety of current water sources by determining reported recent cases of diarrhea and perceived causes. The survey findings at Ademasajida indicated that all respondents did not report cases of waterborne diseases in the recent past which can be an indication of the safety of the water sources even at household level.

The survey findings in Arbajahan indicated that 76.19% of respondents did not report cases of waterborne diseases in the recent past as highlighted in Figure 4-17, which can be an indicator of the safety of the water sources. About 23.81% of the respondents reported having cases of diarrhea at least among one of the family members. However, the study did not attempt to establish whether the cause of diarrhea cases was as a result of contaminated water, since contaminated food could also have been the cause. Community Baraza discussions indicated that water pans and laggahs are among the sources of water yet in Wajir County open/bush defecation is one of the main modes of human waste disposal which could be a source of contamination for surface water sources.

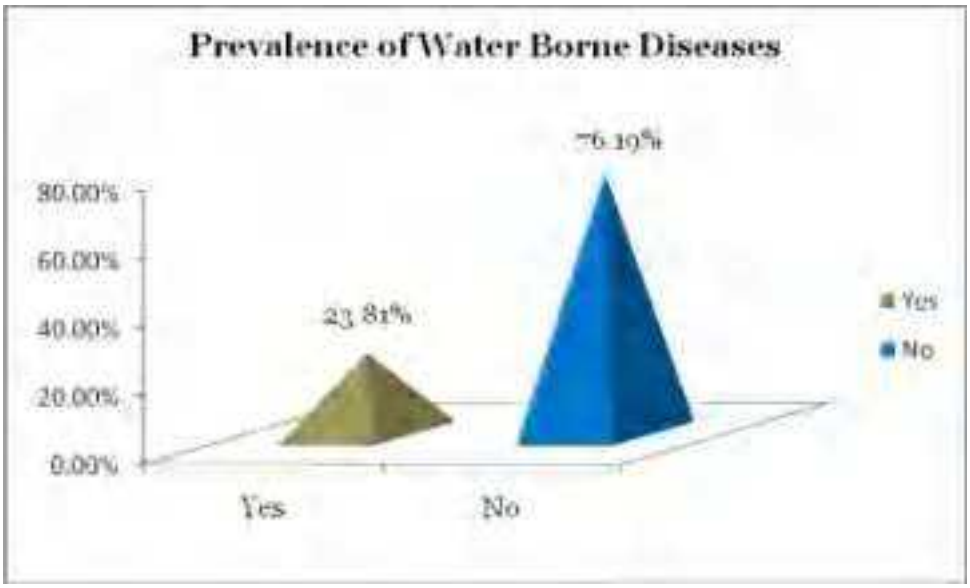


Figure 4-17: Reported Cases of Water Borne Diseases

4.5.7 Vulnerable and Marginalized Persons

Vulnerable and marginalize individuals are an important segment of the population and Kenya's constitutions provide deliberate measures to improve the conditions of such groups in the society. The Water Act 2016 also recognizes the access to safe and clean water as a human right. The proposed project also needs to take deliberate measures to improve the accessibility of these groups of individuals to services for a decent living standard. The Focus Group Discussions and Key Informant Interviews revealed several vulnerable and marginalized persons/individual among the population in the proposed project area including; the elderly, children, persons with disability, widows, very poor, orphans and youth. According to 2019 housing and population census, 0.4% of the population in Wajir West sub-county was reported to have a form of disability ranging from visual, hearing, communication, self care, cognition and mobility. However, it was apparent from the baraza meeting that vulnerable and marginalized formal groups or associations were not present within the proposed project area but rather integrated in other community interest groups. In spite of this, the project provides an opportunity for the living standards of such special groups to be improved. Access to water services being a human right under Kenyan constitution, WAJWASCO should make deliberate efforts to ensure the VMGs access water services.

4.5.8 Cultural Heritage and Properties

The proposed project area is predominantly inhabited by the Somali people who constitute of over 99% of the local population. Arbajahan location is mainly occupied by the Degodia and Ademasajida the Ajuran clan. The Somali people are culturally governed by council of elders who manages and resolves conflicts among community members. The local community is religious especially with over 98.97% being Muslims and less than 1.5% being of other faith in the general Wajir county. The local people are usually

pastoralists and business people with limited practice of crop farming activities partly contributed by the weather patterns and the soils. Given the low volume of works, the proposed project will not influence the cultural behavior of the local people neither anticipated to make any changes to their present traditions. The proposed provision of water services are in existence in the area and the area is an already build environment. It is anticipated that with sustained provision of water services, there could be change of land use in some parts of the areas to accommodation facilities. Since the project is not anticipated to conflict with the cultural practices of the local people, they shall contribute towards its sustainability.

4.5.9 Demand and Support of the Project

The viability and sustainability of a project is depended on the demand for the services and support by the local people. In light of this, the household survey sought to determine the views of respondents on the drilling of the proposed borehole for water supply to the community. First, the assessment team sought to understand whether community members were aware of the project in the first place. And the results finding from Ademasajida indicated that most of the respondents 81.82% were aware of the proposed drilling of the boreholes while the findings in Arbajahan showed that the community were not aware as indicated by 71.3% by NWWDA as highlighted in Table 4-3. The findings in Ademasajida could have been influenced by the hydrological survey which occurred before the study and the community must have been sensitized about the proposed project. Similar sensitization and awareness is required at Arbajahan. Being aware of the project and supporting the implementation of the project are altogether different and the study sought to establish whether the project beneficiaries support the implementation of the proposed project. The findings showed that all those interviewed felt the project should be implemented as depicted in Table 4-4. The results seem to indicate that most community members were aware of the project and willingness to support the project implementation.

Table 4-3: Level of Community Awareness about the Proposed Project

Awareness of the proposed Project	Percentage (%) from Ademasajida	Percentage (%) from Arbajahan
Yes	81.82	28.57
N0	18.18	71.43

Table 4-4: Level of Willingness to Support Project

Community willingness to support the project	Percentage (%) from Ademasajida	Percentage (%) from Arbajahan
Yes	99.9	99
N0	0.1	1

4.5.10 Willingness to Pay for the Services

The proposed project shall serve the local community and it is anticipated that the community members shall be called upon to contribute towards the operation and maintenance through paying for the water

services. This shall be after the implementing agency (NWWDA) hand over the project to WAJWASCO through the County government for operation. With this understanding, the ESIA survey team sought to determine the readiness and willingness of the community to pay for the water services as way of sustaining the project. All the respondents interviewed showed willingness and readiness to pay for the services. The observations could have been influenced by the high cost of accessing water. Consultation findings as captured in annex III indicated that the community members will save a lot of money on the cost of water if the project is implemented and part of the savings can be used to pay for the services. The readiness to contribute is a pointer to how important the project is to the community and the possibility of project sustainability. The findings from community baraza meetings on the form of contribution towards project activities revealed that community members were not only willing to contribute financially but materially, security wise, conflict resolution, reporting of bursts and leakages, intellectually/advice wise and labour wise. During baraza discussions with community members, it was apparent that the livelihood of the local people in the area is dependent on business, farming, pastoralism, casual labourers, formal employment and few reported being on pension. This was an indication of the project beneficiaries being in a position to pay for the services.

4.5.11 Community Anticipated Impacts of the Project

Findings from Household survey and Baraza meeting showed that local people were expecting the project to have impacts including; creation of temporal employment, tree growth within homestead, creation of markets for project construction materials, faster growth of Ademasajida urban center, easy and faster Access to water, improved livestock production, increased access to clean water and improved sanitation, reduced cost of water and improved water reliability. Likewise, the household survey and Baraza meeting findings in Arbajahan showed that local people were expecting the project to have impacts including; reduced distance travelled to fetch water, stabilized water supply, creation of temporal employment, tree growth within homestead, creation of markets for project construction materials, faster growth of Arbajahan market center, easy and faster access to water, improved livestock production, increased access to clean water and improved sanitation, reduced cost of water and improved water reliability.

5 PUBLIC PARTICIPATION AND CONSULTATIONS

5.1 The Consultative Process Adopted

The environmental survey team recognized the significance of the assignment findings to intended users and in this regard, considered active involvement of all the project stakeholders. To attain this objective, the consultant adopted a participatory approach in the identification of environmental and social impacts that are related to the project cycle. Several methods were used to engage stakeholders in the process of capturing their views and concerns on the proposed project during data collection. The levels of project stakeholder engagement during data collection approaches and procedures were through household questionnaire data collection, key informant interview with selected leaders and through community Baraza meeting.

5.2 Key Informant Interviews

In order to provide adequate basis for triangulating the household survey, community Baraza meeting data findings and Water Service provider-WAJWASCO, the consultants' study team members carried out Key Informant Interviews (KIIs) by collecting information from key county government officers regarding the study area and the proposed services. However, it was limited due to the low risk level of the proposed project and selection of the key informants was based on their relevance to the baseline socio-economic and the general study objectives. Data was captured using KII guides. The informants were therefore purposively selected including the area chief, the ward administrator, the administration of Waso Girls primary school where one of the boreholes shall be drilled and officials from WAJWASCO. The finding of what was discussed already is part of the discussions in Chapter 4 of this report.

5.3 Household Data Collection

Primary data collection was as indicated in sections 1.6 which was through using both quantitative and qualitative techniques depending on the target respondents. The quantitative data was collected through a semi-structured household questionnaire targeting individual household heads. The enumerators were from NWWDA as captured in Plate 5-1, using digital data collection platform. The content focus of the tool was about current sources of water, coverage and reliability, safety, treatment, uses, sanitation services, awareness about the project, willingness to pay for the new services, support for the project and the anticipated impacts of the project. The findings of household survey form most parts of the report.

Plate 5-1: One of the enumerators collecting data digitally at Ademasajida Market.

5.4 Community Baraza Meetings

5.4.1 Ademasajida Community Baraza

The community meeting (baraza) was held in addition to Key informant interviews and household survey as a means of seeking the opinion of community members regarding the proposed project. The 2 baraza meetings were organized by the area chief in consultation with the village elder Ademasajida and was held on 28th of July 2021 as indicated in Plate 5-2 and Plate 5-3 and on 8th of March 2022 at the project site as indicated in Plate 5-4 and Plate 5-5. Community members were invited to participate in the meeting as indicated in the attendance list in annex IVA.

Plate 5-2: Area Chief Addressing the Community baraza meeting.

Plate 5-3: The elders following Community Baraza proceedings.

Plate 5-4: Community Members Following Discussions at Ademasajida Livestock Market

Plate 5-5: The consultant Leading discussions during the meeting

The public consultation was in 2 separate meetings one for men and the other with women, all in the presence of the area chief and some selected elders. The EIA assessment team presented the objective and the scope of the project. The participants were taken through the environmental and social impact assessment process. The aim was to get input and concerns that need to be considered in the ESIA project report, during implementation and operation of the project facilities. From the findings of the discussions in the meeting, it was apparent that the project was welcome and timely by the community members. The meeting discussions were guided by a Baraza guide that had been prepared by the assessment team and some of the observations made by the participants were as captured and summarized in annex IIIA. Table 5-1 highlights the summary of issues raised and the response.

5.4.2 Arbajahan Community Meetings

The community baraza was held in addition to Key informant interviews and household survey as a means of seeking the opinion of community members regarding the proposed project. 3 taraza meetings were held in the area, The first baraza was organized by the area chief in consultation with the village elder at Arbajahan and was held on 29h of July 2021, the second consultative was done on 25th of November 2021 indicated in Plate 5-6 and Plate 5-7and the 3rd on 7th 0f March 2022 at the project site as shown in Plate 5-8 and Plate 5-9. Community members invited to participate in the first meeting were as indicated in the attendance list in Annex IVB. The meeting focus was on the impacts of the project on the community members. The second meeting consisted of elders as listed in annex IIIB, who participated in the deliberation to donate the land for the proposed project facilities.

Plate 5-6: One of the Elders during community consultations

Plate 5-7: Some of the Elders who participated in the meeting

Plate 5-8: Participants Voting for the community Representatives

Plate 5-9: One of the Community Elders Contributing during the meeting

The public consultation was conducted at 2 separate meetings one for the community members to identify the impacts of the project to the local community members and the other with local leadership and the community elders for signing of voluntary land donation forms. The EIA assessment team in the first meeting presented the objective and the scope of the project. The participants were taken through the environmental and social impact assessment process. The aim was to get input and concerns that need to be considered in the ESIA project report, during implementation and operation of the project facilities. From the findings of the discussions in the meeting, it was apparent that the project was welcome and timely by the community members. The meeting discussions were guided by a Baraza guide that had been prepared by the assessment team and some of the observations made by the participants were as captured in detail in annex IIIB. Table 5-1 highlights the summary of issues raised and the response.

Table 5-1 : Summarry of Public consultation issues raised and the Response

Key Issues Raised	Responses
Clarity on whether there was a connection between the proposed community project and the long-term water solution for Wajir project.	It was clarified that though it is within the same package, they are separate and if the consultant who was to be on board establishes the need to drill the boreholes in Ademasajida, then the community will be consulted to give their opinion or if the water shall be from Tana River then similar consultations shall be conducted. It was also noted that it is not necessarily that the boreholes shall be drilled in the area, it could be anywhere including Arbajahan along the Merti aquifer but the exact point shall be guided by the coming study.
Why the drilling to go 350m yet community get water at a depth of 100	The project coordinator clarified that the 2 boreholes shall assist the government to collect data on the condition of the

to 200m	general aquifer health (recharge and abstraction levels). And that was the reason it would be deeper for better study of the aquifer
Question on whether the community welcome the project or not.	The two exploratory boreholes to be drilled for the community at Admesajida without any conditions attached. That the community was willing to have a discussion with the consultant who will be studying the options to supply water to Wajir from Ademasajida.
Transparency in allocation of job opportunities/outsider's infiltration for labour/ employment	A local committee will be formed and a transparent recruitment process initiated. Locals will be prioritized for jobs.
Noise pollution during construction work	The contractor will abide by EMCA– Noise and excessive vibration pollution control generation 2009, legal notice No. 61
Excitement among women about provision of water	This will save time spend on searching for water on other income generating activities and the focus on studies by the girl child.
Spread of disease like COVID 19,	Contractor to strictly adhere to the COVID-19 protocol measures.
HIV and AIDS and other communicable diseases	Provision of condoms to the workers. Sensitization of the workers and the community against the risk of contracting diseases like HIV AIDS Sensitize workers and the surrounding communities on awareness, prevention and management of HIV/AIDS.

6 POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS

6.1 Overview

This chapter highlights impacts of the proposed development; positive and negative impacts of the project as well as description of control measures to mitigate against deleterious effects of the project as captured in Table 7-1, Table 7-2 and enhancing measures to achieve more positive impacts.

6.2 Positive Impacts of the Proposed Project

The implementation of the proposed project is anticipated to have overall positive impacts particularly on health and sanitation as well as economic status of the residents within the area of interest. But of significance is the generation of monitoring data that shall be used to study and monitor the hydraulics of Merti aquifer. Some of the positive impacts are;

- Creation of temporary employment opportunities at the construction site. The local people during community consultations reported anticipating for creation of employment at the construction site from the opportunities presented by the project activities. It was observed by the community that local youth should be given priority for any opportunities either at the construction phase of the project or during the operation of the proposed water system.
- Tree growth within homestead: The locals expressed the need to plant some trees within homesteads for cooling purpose and inadequate water was reported as a limiting factor. But with the implementation of the project there will be a possibility of planting and watering of trees within compounds.
- Creation of markets for project construction materials: It was evident from the discussions with the community that there shall be creation of markets for project construction materials which should be sourced locally from those who can supply.
- Faster growth of the local urban centre: The urban centre within the project area will experience faster growth due to availability of water for construction as well as for hospitality industry business. Local people expressed their frustrations during focused group discussions of water being the limiting factor for construction development particularly of guest houses as it's very expensive to buy water.
- Easy and faster Access to water: It was apparent during the study that local people sometimes travel long distances up to 6Km for domestic water supply. Portable water sources are limited in most parts of the study area. Implementation of the project will provide an opportunity to improved access to water hence reducing time and distance travelled to fetch the commodity particularly by women and the girl child.
- **Livestock production:** Availability of water will improve livestock watering and productivity in the area hence contributing to improvement in both household income and nutritional security. The local people reported drought as one of those factors that affect livestock production but with availability of sustainable source of water, the impacts will be reduced.
- **Stable Income:** the local people participating on the project are anticipated to experience increased and stabilized household income from livestock due to selling of animal products throughout the

seasons. It was apparent that during droughts they hardly make any sales due to loss of livestock and reduced milk production.

- Increased access to clean water and improved sanitation to the local population that shall impact on personal and food hygiene and decline in cases of water-borne diseases.
- Increased revenue to WAJWASCO who will distribute water at a fee
- The women reported the project's possibility of improving opportunity to develop Kitchen gardening and pastoral potential through small domestic vegetable gardens and general improvement of animal health.
- **Reduced cost of water:** The locals anticipate the reduction in the cost of water, who reported paying a lot of money in buying and transporting water on Tuktuk (auto rickshaw) at a cost of Kshs. 250 for a 200 litre container.
- **Improved Water Reliability:** The proposed additional water sources will improve the reliability of the existing supply where locals reported delays and sometime failure of borehole pumps due to occasional reduction in solar energy due to cloud cover.
- Improved living conditions through elimination of water fetching chores for women and children who can then focus on income-generating activities and education respectively, in view of the time saved as a result of the water supply sources being closer and more reliable.
- The vulnerable groups in the community make tremendous physical and financial efforts to access portable water. They often resort to unsafe sources to obtain this valuable commodity therefore the project will come in hand to improve access to safe source. Hence access to adequate drinking water in terms of quality and quantity will improve resorting to the often-unsafe sources.
- **Reduce child mortality**: Access to clean water is also anticipated to reduce the mortality rate, particularly among children, and helping to increase life expectancy within the environs of the proposed project area.

6.3 Negative Impacts of the proposed Project

The proposed project focuses on the drilling of 4 boreholes, construction of 2 No. elevated steel water tank, construction of 5 No. water kiosks, 2 No. livestock watering points, fencing of 4 No. borehole sites, laying of 6.5km of pipeline transmission mains, construction of 2 No. cattle troughs and installation of solar panels. The implementation and operation of the proposed project activities is anticipated to results to negative impacts highlighted below;

- **Public Safety:** Public safety issue are anticipated to arise during borehole drilling, at construction site, movement of machines and equipment to and from site, movement of construction vehicles and possibility of the elevated still tank falling/collapsing during operation due to high wind force in the area or for some other reasons affecting general public and even livestock. The risks may be higher for the works to be undertaken within Waso girls' primary school with children potentially being exposed to injury or exploitation.
- **Air quality:** It is anticipated that exhaust fumes and dust emission will be generated during drilling and construction works of the proposed borehole facilities.

- **Excessive Noise and Vibrations.** Drilling rig is anticipated to generate high level of noise impacting mainly workers working on rig. Noise shall also be from movement of contraction vehicles on site.
- **Occupational Health and Safety (OHS):** Occupational Health and Safety (OHS). Accidents may occur on site causing injuries during implementation of the project works affecting the workers,
- **Solid waste generation:** The proposed project activities are anticipated to lead to increased generation of solid waste. The main source of waste shall be the contractor's camp, construction waste, drilling mud and soil cuttings during the laying of main transmission pipes and water kiosk construction. It is anticipated that increase of economic activities within the project area due to availability of water shall also come with increased waste generation during project operation phase.
- **Spread of invasive species:** The proposed project area was noted to be infested with *Prosopis Juliflora* which is most likely to spread during project implementation by constriction equipment and operation by livestock while watering. Spread of invasive species is often associated with loss of indigenous species, injury to animal and local people.
- **Water loss:** There shall be water losses occasioned by leakage in the water transmission pipeline this will lead to increased abstraction, reduced supply and increase in cost of operation and maintenance. Water loss is mainly anticipated from burst of water transmission pipelines, vandalism and damages from movement of livestock in the area.
- **Spread of livestock pest and diseases:** Spread of livestock pest and diseases. Due to convergence of several livestock at the same watering point, especially visiting livestock may lead to infections and spread of pest and diseases.
- **Conflict among water resource users:** It is anticipated that use and management of the water resources may lead to conflicts especially during dry periods when neighbouring communities or clans will be seeking refuge for watering of livestock. Conflicts between community members and outsiders from neighbouring villages during droughts are the main concern.
- **Loss of aesthetic value:** The introduction of elevated steel tank is anticipated to be an introduction of foreign objects inconsistent with the surrounding landscape which may be deemed to lead to loss of aesthetic value.
- **Leakage and spillage:** Leakage and spillage from the contractor's machines and equipment is anticipated at the site during borehole drilling and construction of the associated facilities.
- **Increase in waste water:** Test pumping of the borehole shall lead to high waste water depending on the quality of water struck. However, this shall be temporal and restricted at project implementation phase. As a rule of thumb, about 75 % of domestic water supplied is anticipated to be released in the environment as waste water and it is conventional that there should be a mechanism of collecting or managing the waste water. Similarly, the proposed project is anticipated to lead to increased waste water at operation phase of the project yet the area does not have waste water management system.

- **Soil erosion:** Movement of livestock at watering points during operation of the boreholes shall lead to loosening of soil particles exposing soil to wind action. The proposed project area was noted to have high wing action. Excavations of 1000 m for the main transmission are also anticipated to loosen the soils.
- **Spread of COVID-19 among the workers at construction sites.** The virus is highly infectious and there are high chances that it could spread at the work place in the event of an infection on the work site.
- **Spread of COVID-19 amongst community members during consultations**. During the consultation processes the virus can spread among the local community due to infections resulting from the project related activities.
- **Spread of HIV/AIDS:** If any local person engages with a worker sexually there could be a possibility of infection in the event of an infected party. Therefore, it will be advisable to take precautions because the impacts take long and it may be hard to link the HIV/AIDs infection to the course**.**
- **Gender Equity, Sexual Harassment and abuse amongst workers in the workplace**: due to vulnerability of women, they could be taken advantage of in order to receive what is due to them or favours. This could occur due to differentiation in power or economic status.
- **Gender-based violence at community level:** This may occur due to the cash flow within the community and among the locals creating differentiation in economic power.
- **Sexual exploitation and abuse (SEA):** Under working environment, women may be taken advantage and offer sexual favours in order to receive or access that which is rightfully theirs.
- **Child Labour and Protection:** Due to provision of cheap labour and differentiation in bargaining power, the underage workers may be offered employment in the project leading to exploitation and child abuse.
- **Effects of Immigrant workers**: Due to long working relationship between the contractor and workers, there is possibility of the contractor coming to site with workers which may deny the locals employment opportunities even for skills which are locally available.

Table 6-1: Proposed Mitigation Measures for Negative Impacts during Project construction phase

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
1.	**Occupational Health and Safety (OHS).** Occupational Health and Safety (OHS). Accidents may occur on site causing injuries during implementation of the project works affecting the workers	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated volume of contractor machines and vehicles on site	▪ Contractor to develop a site safety action plan detailing safety equipment to be used, emergency procedures, restriction on site, frequency, and personnel responsible for safety inspections and controls. This shall be ready and approved by the supervising engineer before commencing of the proposed works ▪ Train workers on safety and first aid skills before commencing works ▪ Ensure safety of the construction workers by putting first aid facility and injury reporting mechanism ▪ Provide appropriate personal protective equipment (PPE) to workers and training on appropriate use. *(Reflective jackets, helmets, face masks, ear plugs gloves, safety boots, etc.)* ▪ There should be adequate provision of the requisite sanitation facilities for human waste disposal ▪ Recording of all injuries that occur on site in the incident register, corrective actions for their prevention are instigated as appropriate. ▪ The contractor is required to have WIBA insurance policy to compensate workers in the event of injuries. ▪ Provide clean drinking water for the workers to mitigate against dehydration. ▪ Have an understanding with a nearby health facility for emergency cases on-site before decisions are made. ▪ Awareness creation and training of workers on safety and first aid skills. ▪ Adherence to Covid-19 rules as provided by the ministry of health and the bank with provision of easily accessible and adequate covid-19 PPE all persons on site. The specific action to be captured in the contractor ESMP. ▪ Training of workers on covid-19 rules and requirements.

			▪ As applicable, only qualified personnel shall be allowed to operate construction/drilling equipment
2.	**Public Safety** Public safety issue are anticipated to arise during borehole drilling, at construction site, movement of machines and equipment to and from site, movement of construction vehicles and possibility of the elevated steel tank falling/collapsing during operation due to high wind force in the area or for some other technical reasons.	**Impact is moderate** The impact is temporal and will be of local scale given the volume of works, anticipated contractor machines and vehicles on site. And with quality workmanship, there is no reason for collapsing of the elevated steel tank.	▪ Ensure the safety of residents by providing safety signs at strategic places around the access roads. ▪ hording off working sites to protect the public or unauthorized persons ▪ use of signs and warnings on sites with high risks especially at the elevated tank and drilling rig sites ▪ Reduce unnecessary speeding of construction vehicles to control for accidents from the movement of pedestrians or livestock in the area. ▪ Digging and channeling all drilling mud and test pumping waste water in protected pits to control for use by the public or livestock. ▪ Locating of the steel tank away from any areas with busy human activities or dwelling place. Ensure quality assurance by the supervising engineer for the structural installations ▪ Controlling for air and noise pollution levels to protect the public. ▪ Liaise with the Waso school administration to sensitize pupils on potential safety hazards at the drilling site within the school compound ▪ Contractor workers to signing a code of conduct to protect school pupils. ▪ The borehole drilling works to commence during school holidays. ▪ The contractor to consider having an entrance near the borehole drilling point which is away from the school administration. ▪ The contractor to consider using an entrance near the borehole that is away from the pupils play area. ▪ Discourage children to play or watch the equipments while on site.
3.	**Air quality** It is anticipated that exhaust fumes and dust emission will be generated during drilling and construction works of the proposed borehole and the associated water supply facilities.	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated contractor machines and vehicles on site	▪ Workers to use masks when working in dusty conditions. ▪ The community members to be discouraged from going to site to watch construction activities ▪ Consider shielding wind impacts during drilling to reduce mud particulate matter being blow away if it's in the direction of settlement. ▪ Reduced speeding on the dusty roads by the construction vehicles ▪ Construction vehicles to have catalytic devices to ensure complete burning of waste gases, ▪ use of clean petroleum that is low in Sulphur, lead or other pollutants, ▪ proper servicing of vehicles and Construction machines ▪ Use all means possible including spraying of water to suppress dust if

			considered to be a menace at excavation sites.
4.	**Excessive Noise and Vibrations.** Drilling rig is anticipated to generate high level of noise impacting mainly workers working on rig. Noise shall also be from movement of construction vehicles on site	**Impact is Moderate** The impact is temporal and will be of local scale given the volume of works, anticipated number of contractor machines and vehicles on site. However, water drilling rig generates high amount of noise and given the amount of hours the workers spent on site could have significant impacts.	▪ The community members to be discouraged from going to site to watch drilling/construction activities ▪ Machines and equipment to be fitted with silencer/muffler devices where possible, ▪ Using equipment and machines with low noise emission. ▪ switching off vehicles and machines when not in use, ▪ avoiding unnecessary hooting, ▪ Workers to be provided with personal protection equipment earplugs. ▪ Reduce working hours for the workers on site during drilling by having working shifts ▪ machines to be serviced to reduce generation of noise and vibrations, ▪ the noisy activities should be restricted during daytime ▪ Ensure that NEMA noise and Vibration standards are observed in all project activities. ▪ Training/sensitization/awareness on use of PPEs and personal safety measures. ▪ The drilling activities to be done only during day time ▪ Liaising with the school management on scheduling of drilling activities, especially noisy operations, to ensure least disturbance to school activities
5.	**Solid waste generation** The main source of waste shall be the contractors camp, construction waste, drilling mud and soil cuttings	**Impact is low** The volume of works are low and the team onsite is also anticipated to be small	• Reuse of all soil cuttings from the excavation works • Proper disposal of waste from the contractors camp • Disposing off contaminated soils in cutting pit if volumes are low. • The contractor to develop site specific incident management or response plan in the evident of hazardous waste contamination *(used tyres, Oil and Fuel filters*). • Preparation of waste management plan to guide waste management and disposal activities, ensuring segregation of the wastes generated.
6.	**Spread of invasive species.** Spread of invasive species, loss of indigenous species, injury to animal and local people	**Impact is Moderate** *Prosopis juliflora* was noted in the project area and can easily be spread due to project related activities. Once the project site is infested with the invasive	• Regular monitoring of the project site for the spread of alien plant growth and in the event of such observation, to take remedial action. • Raw materials used for construction such as sand and rocks should be sourced in areas where there are no invasive species. • Equipment required for the construction works should be clean and free from any alien plants and mud which may contain seeds or tuber of alien species. • Care should be taken while working along areas with invasive species to

		species, it will be hard to control.	reduce spread. • Control of livestock movement into the project area from infested areas • Create awareness among the local community on management of the spread of the invasive species. • Employing relevant management practices e.g uprooting young plants or burning to control the spread of the plant.
7.	**Leakage and spillage** Leakage and spillage of grease, oils or fuel from the contractor's machines and equipment is anticipated at the site during borehole drilling and construction of the associated facilities.	**Impact is low** The low volume of works is anticipated to attract a low number of machines	• In the event of hazardous waste leakage or spills, engage authorized waste handlers to dispose contaminated soils. • Disposing of contaminated soils in cutting pit if volumes are low. • Use of NEMA licensed waste handlers to dispose in licensed disposal areas. • Development of site-specific incident management or response plan. • Taking all measures possible to reduce any spillage
8.	**Spread of COVID-19 During construction at work sites**	**Minor** Construction works are anticipated to take a short period due to the low volumes of works and the government has put in place measures to vaccinate the population. However, in the event of infection, the virus has a potential of spreading quickly therefore the impacts are anticipated to be minor.	• The Contractors will develop standard operating procedures (SOPs) for managing the spread of Covid-19 during project execution and submit them for the approval of the Supervision Engineer and the Client, before mobilizing to site. The SOPs shall be in line with the World Bank guidance on COVID-19, Ministry of Health Directives and site-specific project conditions; • Mandatory provision and use of appropriate Personal Protective Equipment (PPE) shall be required for all project personnel including workers and visitors; • Avoid concentrating more than 15 workers at one location. Where two or more persons are gathered, maintain social distancing of at least 2 meters; • All workers and visitors accessing worksites every day or attending meetings shall be subjected to rapid Covid-19 screening which may include temperature check and other vital signs; • The project shall put in place means to support rapid testing of suspected workers for Covid-19; • Install handwashing facilities with adequate running water and soap, or sanitizing facilities at entrance to work sites including consultation venues and meetings and ensure they are used;

			• Ensure routine sanitization of shared social facilities and other communal places routinely including wiping of workstations, door knobs, hand rails etc.
9.	**Spread of COVID-19 amongst community members during consultation processes**	**<u>Minor</u>** Construction works are anticipated to take a short period due to the low volumes of works and reduced community consultation with most having been done at project design stage.	• Electronic means of consulting stakeholders and holding meetings, shall be encouraged, whenever feasible. One-on-one engagements for the PAPs while observing social distance and adhering to PPE wearing shall be enforced; • Avoid concentrating more than 15 community members at a venue. Where two or more participants are gathered, maintain social distancing of at least 2 meters (6 feet); • The team carrying out engagements within the communities on one-on-one basis will be provided with appropriate PPE for the number of people and stakeholders they intend to meet. • Use traditional channels of communications (TV, newspaper, radio, dedicated phone-lines, public announcements and mail) when stakeholders do not have access to online channels or do not use them frequently. Ensure to allow participants to provide feedback and suggestions. • Hold meetings in small groups, mainly in form of FGDs if permitted depending on restrictions in place and subject to strict observance of physical distancing and limited duration. • In situations where online interaction is challenging, disseminate information through digital platform (where available) like Facebook and WhatsApp & Chart groups. • Ensure online registration of participants, distribution of consultation materials and share feedback electronically with participants.
10.	**HIV/AIDS** If any local person engages with a worker sexually there could be a possibility of infection in the event of an infected party. Therefore it will be advisable to take precautions because the impacts take long and it may hard to link the HIV/AIDs	**Low** Drilling and construction works are anticipated to take a short period due to low volumes of project works. Therefore the impacts are anticipated to be low	• Promote HIV/AIDS prevention messaging • Install HIV testing services at the construction site • Support infected workers with ARVs • Peer counseling services at the site

	infection to the course.		
11.	**GBV: Sexual exploitation and abuse (SEA)**	**Low** Construction is anticipated to take short period due to the low volumes of work. Therefore the impact is anticipated to be low	• Develop and implement a SEA management action plan with an Accountability and Response Framework as part of the ESMP. The SEA action plan will follow guidance on the World Bank's Good Practice Note for Addressing Gender-based Violence in Investment Project Financing. • The SEA action plan will include how the project will ensure necessary steps are in place for: • Prevention of SEA: including CoCs and ongoing sensitization of staff on responsibilities related to the CoC and consequences of non-compliance; project-level IEC materials; • Response to SEA: including survivor-centred coordinated multi-sectoral referral and assistance to complainants according to standard operating procedures; staff reporting mechanisms; written procedures related to case oversight, investigation and disciplinary procedures at the project level, including confidential data management; • Engagement with the community: including development of confidential community-based complaints mechanisms discrete from the standard GRM; mainstreaming of PSEA awareness-raising in all community engagement activities; community-level IEC materials; regular community outreach to women and girls about social risks and their PSEA-related rights; • Management and Coordination: including integration of SEA in job descriptions, employments contracts, performance appraisal systems, etc.; development of contract policies related to SEA, including whistle-blower protection and investigation and disciplinary procedures; training for all project management; management of coordination mechanism for case oversight, investigations and disciplinary procedures; supervision of dedicated PSEA focal points in the project and trained community liaison officers.
12.	**Gender-based violence at community level**	**Low** Construction is anticipated to take short period due to the low	• The contractor will implement provisions that ensure that gender-based violence at the community level is not triggered by the Project, including:

		volumes of work. Therefore the impact is anticipated to be low	• Effective and on-going community engagement and consultation, particularly with women and girls; • Review of specific project components that are known to heighten GBV risk at the community level, e.g.; community level water management, representation or related economic activities etc. • Specific plan for mitigating these known risks, e.g. sensitization around gender-equitable approaches to employment, representation, management, school pupils etc • The contractor will ensure adequate referral mechanisms are in place if a case of GBV at the community level is reported related to project implementation.
13.	**Gender Equity, Sexual Harassment and abuse amongst workers in the workplace**	**Low** Construction is anticipated to take short period due to the low volumes of work. Therefore the impact is anticipated to be low	• The contractor should prepare and enforce a No Sexual Harassment and Non-Discrimination Policy • The contractor should strive for an equitable distribution of employment opportunities between men and women. • Provision of gender disaggregated bathing, changing, sanitation facilities • Whenever harassments are recorded on site, the contractor should ensure prompt and effective remedial action • The employees should be trained and sensitized on appropriate behaviour
14.	**Child Labour and Protection**	**Low** Construction is anticipated to take short period due to the low volumes of work. Therefore the impact is anticipated to be low	• Ensure no children are employed on site in accordance with national labour laws. This can be done through incorporating prohibitive provisions in the code of conduct and also having the recruitment policies that prohibits child labour. • Ensure that any child sexual relations offenses among contractors' workers are promptly reported to the police.
15.	**Effects of Immigrant workers**	**Low** Construction is anticipated to take short period due to the low volumes of work. Therefore, the impact is anticipated to be	• Contractor should use the local workforce as much as possible (preference to local community members on skills locally available). • Effective community engagement and strong grievance mechanisms on matters related to labour • All workers to sign an employment contract including a Code of Conduct

		low	governing appropriate behaviour • The workforce should be sensitized to local social and cultural practices and be educated on the expected behaviour and conduct • Contractor should prepare and enforce a No Sexual Harassment and Non-Discrimination Policy • Contractor should prepare and implement a gender action plan • The contractor as part of the C-ESMP will Prepare Management Plan (LMP) that included mandatory requirement to procure all unskilled (and as much as possible, semi-skilled) labour as well as locally available materials from the local community while ensuring equal pay for equal work for men, women and people with disability
16.	**Grievance Redress** The local community, contractor, client (WAJWASCO) or any other aggrieved party due to project activities need to be aware of the structures of expressing their grievances	**Low** Drilling and construction are anticipated to take short period due to the low volumes of work. Therefore, the impact is anticipated to be low	• Establish community grievance committees at the project site • Ensure contractor staff grievance and complaint handling structures are established.

Table 6-2: Mitigation Measures for Negative Impacts during Project Operation Phase

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
1.	**Public Safety** Public safety issue are anticipated to arise if the elevated steel tank fall/collapses during operation due to high wind force in the area or	**Impact is moderate** The impact is temporal and will be of local scale and given quality workmanship, there is no reason for collapsing of the elevated steel	• Design and construction quality assurance shall be put in place • Locating of the steel tank away from any areas with busy human activities or dwelling place. • Fencing off the steel tank area within a safe radius and in the event of the tank falling to be within the fenced area. • Deterring any livestock or human activities under the elevated tank tower to avoid weakening the base

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
	for some other technical reasons.	tank.	• Regular monitoring and maintenance of ware and tare of the tank and the tower structure
2.	**Over Exploitation of the water aquifer**	**Impact is low** there is a possibility of cumulative over exploitation of the aquifer particularly during implementation of the borehole field for Wajir town bulk water project	• Adhere to the amount of water allocated in the authorization/water abstraction permit by WRA. • Monitor water levels • promote efficiency in water use among the beneficiary communities • Conduct regular borehole discharge and water quality analysis
3.	**Occupational health and safety**	**Impact is low** The impact is temporal and will be of local scale given the volume of works during operation and maintenance phase of the project	• Develop and enforce standard safety procedures for operation and maintenance activities • Provide personal protective equipment to operation and maintenance workers. • Recording all injuries that occur on-site to workers while doing their daily duties in the incident register, corrective actions for their prevention should be initiated as appropriate. • Creation of awareness and training of workers on site safety and first aid skills. • Hiring employees with proper qualifications for specialized and risky tasks during operation and maintenance of borehole. • Adherence to Covid-19 rules as provided by the ministry of health and the WHO while conducting daily duties. • Training of workers on covid-19 rules and requirements.
4.	**Increase in waste water** Waste water is anticipated to be generated, since as a rule of thumb about 75% of water supplied is discharged in the environment as waste water.	**Impact is low** The impact is anticipated low given the population of the area, the water evaporation rate and the type of soils with high infiltrations which may reduce the	• Create awareness on reusing waste water for kitchen gardening or tree planting • WAJWASCO to consider construction of waste management and treatment system in the long-term.

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
		flow or stagnation of such waste water.	
5.	**Water Loss** There shall be water losses occasioned by leakage in the water transmission pipeline or due leakage from the elevated tank this will lead to increased abstraction, reduced supply and increase in cost of operation and maintenance. Water loss is mainly anticipated from burst of water transmission pipelines, vandalism and damages from movement of livestock in the area	**Impact is Minor** Leakages in the system and deliberate vandalism of the pipeline for livestock watering or from the elevated steel tank.	• Use of water meters in strategic sections of the system network to audit loses in the system to reduce NRW. • Proper coordination and provision of pipe burst reporting mechanism among the local community. • Adequate maintenance and prompt response to reported bursts or leakages. • Use of quality piping materials and control of pressure in the network. • Creation of awareness on water conservation among employees of water service provider and the local community members. • Provision of gate valves at strategic points to reduce waste after bursts on sections of the line and reduce pressure in the system • Installation of automated leak detection by monitoring deviation in water pressures from the norm if possible. • Sensitization and awareness creation among the community against vandalizing the pipeline for livestock watering • Deep trenching of the transmission pipes to avoid damages by moving livestock. • Provision of livestock watering points at strategic areas in the event of detecting vandalism due to livestock watering • Regular monitoring for leakage and maintenance of the steel tanks. • Awareness for community members to use waste water for tree planting instead of treated water.
6.	**Spread of livestock pest and diseases** Spread of livestock pest and diseases. Due to convergence of several livestock at the same watering point, especially visiting	**Impact is minor** The impact is considered to be minor	• Frequently monitoring livestock pest and diseases particularly during droughts • vaccination of livestock during drought periods • To quarantine livestock from infected areas from watering or moving to project area • Frequent spraying or treating of livestock by the local community members

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
	livestock may lead to infections		
7.	**Increased grievances** Grievances are anticipated to increase between community members and outsiders from neighbouring villages during droughts.	**Impact is minor** The Local community has a well-organized grievance redress mechanism through elders. The impacts are considered to be minor since local people respect elders and are bound by decision made by the elders.	• Consider agreeing on guidelines regulating the access to water resources by the various interest groups. • The elders to work with the office of county commission to resolve any perceived conflicts from other pastoralists accessing water resources in the project area particularly livestock watering points. • WAJWASCO to develop and implement a grievance redress structure during project operation. • WAJWASCO to sensitize relevant project stakeholders on the Grievance redress structure developed.
8.	**Loss of aesthetic value** The introduction of elevated steel tank is anticipated to be an introduction of foreign objects inconsistent with the surrounding which will lead to change in landscape.	**Impact is low** The towering of the steel tank above objects in the area shall impact on Aesthetic value of the area	• Planting of vegetation consistent with site area, around the tank and borehole area. • Use of materials with a hue consistent with the background of the project site. • Back filling all soil excavations and removing any obsolete objects on site.
9.	**Soil erosions** Movement of livestock at watering points during operation of the boreholes shall lead to loosening of soil particles exposing soil to wind action.	**Impact is minor** Although the land topography within the project site is more flat with sandy soils as well as the area experiencing low rains, the number of livestock especially goats is high. The wind action in the area is substantial and the soil is bare without vegetation cover. It is therefore anticipated that	• Planting vegetation to reduce wind erosion. • to dig shallow pits and channeling storage tank cleaning water to soak slowly to avoid surface runoff during regular cleaning of the tank, of algae and cumulated silt as part of operation and maintenance exercise.

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
		more loosening of soil particles by livestock movement at the water points shall be significant.	

Table 6-3: Mitigation Measures during decommissioning

No	ANTICIPATED NEGATIVE IMPACTS	IMPACT RATING	MITIGATION MEASURES
1.	**Occupational Health and Safety (OHS).** Occupational Health and Safety (OHS). Accidents may occur on site causing injuries during decommissioning of the project works affecting the workers	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated, the number of persons on site, most of the waste is anticipated to be inert, volume of contractor machines and vehicles on site	▪ The decommissioning contractor to develop a site safety action plan detailing safety equipment to be used, emergency procedures, restriction on site, frequency, and personnel responsible for safety inspections and controls. This should be ready and approved by the supervising engineer before commencing of the proposed works ▪ Train workers on safety and first aid skills before commencing the decommissioning works ▪ Ensure safety of the decommissioning workers by putting first aid area and injury reporting mechanism ▪ Provide appropriate personal protective equipment (PPE) to workers and training on appropriate use. *(Reflective jackets, helmets, face masks, ear plugs gloves, safety boots, etc.)* ▪ There should be adequate provision of the requisite sanitation facilities for human waste disposal ▪ Recording of all injuries that occur on site in the incident register, corrective actions for their prevention are instigated as appropriate. ▪ The contractor is required to have WIBA insurance policy to compensate workers in the event of injuries. ▪ Provide clean drinking water for the workers to mitigate against dehydration. • Have an understanding with a nearby health facility for emergency cases on-site

			before decisions are made. • Adherence to Covid-19 rules as provided by the ministry of health and WHO with provision of easily accessible and adequate covid-19 PPE all persons on site. The specific action to be captured in the contractor ESMP. ▪ Training of workers on covid-19 rules and requirements.
2.	**Public Safety** Public safety issue are anticipated to arise during demolition of structures, at construction site, movement of machines and equipment to and from site and movement of contractor vehicles ferrying waste.	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated number of contractor machines and vehicles on site.	• Ensure the safety of residents by providing safety signs at strategic places around the access roads. • hording off working sites to protect the public or unauthorized persons • Reduce unnecessary speeding of contractor vehicles to control for accidents from the movement of pedestrians or livestock in the area. • Controlling for air and noise pollution levels to protect the public.
3.	**Air quality** It is anticipated that exhaust fumes and dust emission will be generated during structures' demolition activities.	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated number of structures anticipated for demolition, contractor machines and vehicles on site	• Workers to use masks when working in dusty conditions while demolition of structures. • The community members to be discouraged from going to site to watch the decommissioning activities. • Reduced speeding on the dusty roads by the decommissioning vehicles. • Decommissioning vehicles to have catalytic devices to ensure complete burning of waste gases, • use of clean petroleum that is low in sulphur, lead or other pollutants, • proper servicing of vehicles and machines • Use all means possible including spraying of water on structures to suppress dust if considered to be a menace at decommissioning sites.
4.	**Excessive Noise and Vibrations.** Movement of machines is anticipated to generate noise impacting mainly workers working at the decommissioning site. Noise	**Impact is low** The impact is temporal and will be of local scale given the volume of works, anticipated number of contractor machines and	• The community members to be discouraged from going to site to watch decommissioning activities • Machines and equipment to be fitted with silencer/muffler devices where possible, • Using equipment and machines with low noise emission. • switching off vehicles and machines when not in use, • avoiding unnecessary hooting, • Workers to be provided with personal protection equipment earplugs and anti-vibrating gloves.

	shall also be from movement of construction vehicles on site	vehicles on site.	• machines to be serviced to reduce generation of noise and vibrations, • the noisy activities should be restricted during daytime • Ensure that NEMA noise and Vibration standards are observed in activities. • Training/sensitization/awareness on use of PPEs and personal safety measures.
5.	**Solid waste generation** The main source of waste shall be the demolition waste.	**Impact is low** The volume of works are low and the number and size of the structures to be decommissioned are low	• Compacting any excavated areas while removing dilapidated pipes. • Proper disposal of waste from the contractors camp • Disposing off contaminated soils in cutting pit if volumes are low. • The contractor to develop site specific incident management or response plan in the evident of hazardous waste contamination *(used tyres, Oil and Fuel filters*). • Preparation of waste management plan to guide waste management and disposal activities.
6.	**Leakage and spillage** Leakage and spillage from the contractor's machines and equipment is anticipated at the site during borehole drilling and construction of the associated facilities.	**Impact is low** The low volume of works anticipated to attract a low number of machines	• In the event of hazardous waste leakage or spills, engage authorized waste handlers to dispose contaminated soils. • Disposing of contaminated soils in cutting pit if volumes are low. • Use of NEMA licensed waste handlers to dispose in licensed disposal areas. • Development of site specific incident management or response plan. • Taking all measures possible to reduce any spillage
7.	**Covid-19** In the event that one of the contractor's workers has covid-19 virus then it can spread so fast between workers and any other person who come in contact with infected persons. There is also a possibility of the community members to infect workers	**Impact is low** The decommissioning works are anticipated to take a short period due to the low volumes of works and the government has put in place measures to vaccinate the population.	• The Contractors will develop standard operating procedures (SOPs) for managing the spread of Covid-19 during project execution and submit them for the approval of the Supervision Engineer and the Client, before mobilizing to site. The SOPs shall be in line with the World Bank guidance on COVID-19, Ministry of Health Directives and site-specific project conditions; • Mandatory provision and use of appropriate Personal Protective Equipment (PPE) shall be required for all project personnel including workers and visitors; • Avoid concentrating more than 15 workers at one location. Where two or more persons are gathered, maintain social distancing of at least 1.5 meters; • Install hand washing facilities with adequate running water and soap, or sanitizing facilities at entrance to work sites including consultation venues and meetings and ensure they are used; • Ensure routine sanitization of shared social facilities and other communal places routinely including wiping of workstations, door knobs, hand rails etc.;

7 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

7.1 Over view

This chapter captures the environmental and social management mitigations for the anticipated negative impacts. The ESMP highlights the impacts, receptor, proposed mitigation measures, institution responsible for the mitigation, frequency and the budget. Table 7-1 and Table 7-2 below show the anticipated impacts, proposed mitigation measures, the institutions responsible, the period within the project life cycle when the action is to be undertaken and estimated possible cost of the action.

Table 7-1: Environmental and Social Management Plan (EMSP) at Constrution Phase

NO	ASPECT	POTENTIAL IMPACT	RECEPTOR	MITIGATION MEASURES	RESPONSIBILITY	FREQUENCY	BUDGET (KES)
1.	**Occupational Health and Safety (OHS).**	Injury and Accidents	workers	▪ Contractor to develop a site safety action plan detailing safety equipment to be used, emergency procedures, restriction on site, frequency, and personnel responsible for safety inspections and controls. This should be ready and approved by the supervising engineer before commencing the works ▪ Train workers on safety before commencing works ▪ Ensure safety of the construction workers by putting first aid area and injury reporting mechanism ▪ Ensure compliance to Occupational Safety and Health Act Cap. 514 and its Subsidiary Legislations. ▪ Provide appropriate personal protective equipment (PPE) to workers and training on appropriate use. *(Reflective jackets, helmets, face masks, ear plugs gloves, safety boots, etc.)* ▪ There should be adequate provision of the requisite sanitation facilities for human waste disposal ▪ Recording of all injuries that occur on site in the incident register, corrective actions for their prevention are instigated as appropriate. ▪ The contractor should consider having WIBA insurance policy to cushion self and workers against loss of income in an	Contractor and supervising consultant	Throughout implementation period	400,000

				accident on site. ▪ Provide clean drinking water for the workers to mitigate against dehydration			
2.	**Public Safety**	Injury and accidents	Community members and Livestock	• Ensure the safety of residents by providing safety signs at strategic places around the access roads. • hording off working sites to protect the public or unauthorized persons • use of signs and warnings on sites with high risks especially at the elevated tank and drilling rig sites • Reduce unnecessary speeding to control for accidents from the movement of pedestrians or livestock in the area. • The elevated water tank to be installed a safe distance from human activities or property. • The design and construction of the elevated steel tank to consider the changes in wind force in the area.	The design team, Supervising engineer and the contractor	Once at design and installation	Part of construction cost
3.	**Air quality**	Air quality degradation	Community and workers	• Workers to use masks when working in dusty conditions. • The community members to be discouraged from going to site to watch construction activities • Consider shielding wind impacts during drilling to reduce mud particulate matter being blow away if it's in the direction of settlement. • Reduced speeding on the dusty roads • Construction vehicles to have catalytic devices to ensure complete burning of waste gases, • Use of clean petroleum that is low in sulphur, lead or other pollutants, • proper servicing of vehicles and Construction	The contractor and supervising engineer	Throughout implementation period	200,000

				machines • Use all means possible to suppress dust if considered to be a menace during excavations			
4.	**Excessive Noise and Vibrations.**	Psychological nuisance and damage to hearing	Workers and community members	• The community members to be discouraged from going to site to watch drilling/construction activities • Machines and equipment to be fitted with silencer/muffler devices where possible, • Using equipment and machines with low noise emission. • switching off vehicles and machines when not in use, • avoiding unnecessary hooting, • Workers to be provided with personal protection equipment earplugs. • Reduce working hours for the workers on site during drilling by having working shifts • machines to be serviced to reduce generation of noise and vibrations, • the noisy activities should be restricted during daytime • Ensure that NEMA noise and Vibration standards are observed in all project activities. • Training/sensitization/awareness on use of PPEs and personal safety measures.	Project supervising engineer	Throughout implementation period	100,000
5.	**Solid waste generation**	Littering environment and contamination	Water, air, soils, Flora, Fauna and Local communities	• Reuse of all soil cuttings from the excavation works • Proper disposal of waste from the contractors camp • Disposing off contaminated soils in cutting pit if volumes are low. • The contractor to develop site specific incident management or response plan in the evident of	Contractor and supervising Engineer	Throughout implementation period	Part of construction cost

				hazardous waste contamination *(used tyres, Oil and Fuel filters*). • Preparation of waste management plan to guide waste management and disposal activities.			
6.	**Spread of invasive species.**	Loss of indigenous species and injury	Indigenous plants, local people and livestock	• Raw materials used for construction such as sand and rocks should be sourced in areas where there are no invasive species. • Equipment required for the construction works should be clean and free from any alien plants and mud which may contain seeds or tuber of alien species. • Care should be taken while working along areas with invasive species to reduce spread. • Create awareness among the local community on management of the spread of the invasive species.	Contractor and supervising engineer	Throughout implementation period	200,000
7.	**Introduction of foreign objects**	Loss of aesthetic value	Intrinsic value of local environment	• Planting of vegetation consistent with site area, around the borehole site area. • Use of materials with a hue consistent with the background of the project site. • Back filling all soil excavations and removing any obsolete objects on site.	Contractor, Project Supervising Engineer	Once	Part of construction cost
8.	**Leakage and spillage**	Contamination and pollution	Soil, water, plants and air	• In the event of hazardous waste leakage or spills, engage authorized waste handlers to dispose contaminated soils. • Disposing off contaminated soils in cutting pit if volumes are low. • Use of NEMA licensed waste handlers to dispose in licensed disposal areas. • Development of site specific incident management or response plan. • Taking all measures possible to reduce any spillage	Contractor and supervising engineer	Regularly as required	Part of construction cost

9.	**Soil erosions**	Air quality degradation	Workers and community members	• Consider using human labour to excavate pipe laying trenches • Back filling and compacting the soils • provision of alternative livestock watering points • Planting vegetation to reduce wind erosion. • Timing the implementation to avoid wet seasons. • Discouraging communities from grazing around the project area and livestock watering point.	Supervising engineer and contractor	Regularly	Part of construction
10.	**Covid-19** *Spread of COVID-19. During construction at work sites*	Infection or loss of life	workers and members of the public	• The Contractors will develop standard operating procedures (SOPs) for managing the spread of Covid-19 during project execution and submit them for the approval of the Supervision Engineer and the Client, before mobilizing to site. The SOPs shall be in line with the World Bank guidance on COVID-19, Ministry of Health Directives and site-specific project conditions; • Mandatory provision and use of appropriate Personal Protective Equipment (PPE) shall be required for all project personnel including workers and visitors; • Avoid concentrating more than 15 workers at one location. Where two or more persons are gathered, maintain social distancing of at least 2 meters; • Install hand washing facilities with adequate running water and soap, or sanitizing facilities at entrance to work sites including consultation venues and meetings and ensure they are used; • Ensure routine sanitization of shared social facilities and other communal places routinely including wiping of workstations, door knobs, hand rails etc.;	Supervising Engineer and Contractor	Daily	400,000

11.	Spread of COVID-19 amongst community members during consultation processes	Infection or loss of life	Community members	• Electronic means of consulting stakeholders and holding meetings shall be encouraged, whenever feasible. One-on-one engagements with stakeholders while observing social distance and adhering to PPE wearing shall be enforced; • Avoid concentrating more than 15 community members at a venue. Where two or more participants are gathered, maintain social distancing of at least 1.5 meters (5 feet); • The team carrying out engagements within the communities on one-on-one basis will be provided with appropriate PPE for the number of people and stakeholders they intend to meet. • Use traditional channels of communications (TV, newspaper, radio, dedicated phone-lines, public announcements and mail) when stakeholders do not have access to online channels or do not use them frequently. Ensure to allow participants to provide feedback and suggestions. • Hold meetings in small groups, mainly in form of FGDs if permitted depending on restrictions in place and subject to strict observance of physical distancing and limited duration. • In situations where online interaction is challenging, disseminate information through digital platform (where available) like Facebook and WhatsApp & Chat groups. • Ensure online registration of participants, distribution of consultation materials and share feedback electronically with participants.	Supervising Engineer and Contractor Stakeholder Engagement expert / Communications Expert.	Daily	400,000
12.	**HIV/AIDS**	Infections	• Workers and general	• Promote HIV/AIDS prevention messaging • Install HIV testing services at the construction site	Contractor and	Weekly	100,000

			public	• Support infected workers with ARVs • Peer counseling services at the site	Supervising Engineer		
13.	**GBv/SEA**	Injury and Psychological	Vulnerable persons in the community.	• Ensure clear human resources policy at the site against sexual harassment that is aligned with national law • Integrate provisions related to sexual harassment in the employee COC • Ensure appointed human resources personnel to manage reports of sexual harassment according to policy • The Contractor shall require his employees, sub-contractors, sub-consultants, and any personnel thereof engaged in the drilling works to individually sign and comply with a Code of Conduct with specific provisions on protection from sexual exploitation and abuse	Local leaders, contractor, supervising engineer and NWWDA, GBV Expert, Local CBO/NGO	Daily	200,000
14.	**Grievance Redress**	conflict between affected parties	all project stakeholders	• Establish community grievance committees at the site • Ensure contractor staff grievance structures exist	Local leaders, contractor, supervising engineer and NWWDA	Daily	200,000

Table 7-2: Environmental and Social Management Plan (ESMP) at Operation Phase

NO	ASPECT	POTENTIAL	RECEP	MITIGATION MEASURES	RESPONSI	FREQUEN	BUDGE

		IMPACT	TOR		BILITY	CY	T
8.	**Occupation health hazards**	Accidents and Injuries	Workers	• Ensure compliance to Occupational Safety and Health Act Cap. 514 and its Subsidiary Legislations standards. • Provide personal protective equipment to operation and maintenance workers. • Recording all injuries that occur on-site to workers while doing their daily duties in the incident register, corrective actions for their prevention should be initiated as appropriate. • Cordoning off working sites to protect the public or unauthorized persons during repair and maintenance of the different project utility systems on site • Creation of awareness and training of workers on site safety and first aid skills. • Hiring employees with proper qualifications for specialized and risky tasks during operation and maintenance of the various utility systems. • Adherence to Covid-19 rules as provided by the ministry of health and the WHO while conducting daily duties. • Training of workers on covid-19 rules and requirements.	WAJWASCO	Regularly	Part of operation cost
9.	**Spread of invasive species.**	Loss of indigenous species and injury	Indigenous plants, local people and livestock	• Regular monitoring of the project site for the spread of alien plant growth and in the event of such observation. • Care should be taken while working along areas with invasive species to reduce spread. • Control of livestock movement into the project	WAJWASCO and local communities	Regularly	Part of operation cost

				area from infested areas • Provision of Livestock watering points away from project site • Create awareness among the local community on management of the spread of the invasive species. • Employing relevant management practices e.g uprooting young plants or burning to control the spread of the plant.			
10.	**Water Loss**	Over abstraction, reduced supply and increase in cost of operation and maintenance	community members, livestock and aquifer	• Use of water meters in strategic sections of the system network to audit loses in the system to reduce NRW. • Proper coordination and provision of pipe burst reporting mechanism among the local community. • Adequate maintenance and prompt response to reported bursts or leakages. • Use of quality piping materials and control of pressure in the network. • Creation of awareness on water conservation among employees of water service provider and the local people. • Provision of valves at strategic points to reduce waste after bursts on sections of the line and reduce pressure in the system • Installation of automated leak detection by monitoring deviation in water pressures from the norm if possible. • Sensitization and awareness creation among the community against vandalizing the pipeline for livestock watering • Deep trenching of the transmission pipes to avoid damages by moving livestock.	WAJWSCO and Community Members/Water users	Regularly as shall be required	Part of operation cost
11.	**Spread of**	Loss of livestock	Livestock	• Frequently monitoring livestock pest and diseases particularly during droughts	County government	At operation and particularly	Part of

	livestock pest and diseases			• vaccination of livestock during drought periods • To quarantine livestock from infected areas from watering or moving to project area • Frequent spraying or treating of livestock by the local community members	department of livestock and Community members	during droughts when there is influx of livestock	operation cost
12.	**Conflict among water resource users**	Strife Among local communities.	Local community and visiting members	• Agreeing on guidelines regulating the access to water resources by the various interest groups. • The elders to work with the office of county commission to resolve any perceived conflicts from other pastoralists accessing water resources in the project area particularly livestock watering points.	WAJWASCO, elders and County Commissions office	Regularly	Part of operation phase
13.	**Increase in waste water**	Contamination and pollution	Local people, water course and soils	• Create awareness on reusing waste water for kitchen gardening or tree planting • Do not allow any livestock to drink water during test pumping before the quality is ascertained. • Create awareness and sensitization among the locals on the possibility of risks posed by test pumping water to livestock. • WAJWASCO to consider construction of waste management and treatment system in the long-term.	WAJWASCO and Local Communities	Regularly as required	Part of Operation cost

8 ENVIRONMENTAL AND SOCIAL MONITORING PLAN (ESMoP)

8.1 Over View

This chapter captures the environmental and social monitoring indicators for the anticipated negative impacts. The preparation of the plan was informed and guided by the indicators that were anticipated in WSDP project Environmental and Social Management Framework 2017. The environmental team proposes eleven (11) impact items, indicated in Table 8-1 as significant for monitoring by the various stakeholders.

Reporting on implementation activities of the exploratory boreholes shall be done at several levels. The supervising engineer shall be in charge of the daily reporting on site on behalf of the client (NWWDA). The engineer shall in consultation with the contractor team prepare all the required reports including site meeting minutes and submit to the client. The progress reports prepared, incorporating ESMP implementation status, shall be on monthly and quarterly basis. The client (NWWDA) including the project engineer and social safeguards consultant shall review the reports and submit to the World Bank.

Further to regular reporting, all ESHS incidents, accidents, dangerous occurrences including occupational diseases shall be promptly reported to the respective regulatory institution in the prescribed manner and template outlined in DOSH ML/DOSH/FORM 1 and further to the World Bank in line with the requirement of the Occupational Health and Safety Act (OSHA) 2007, EMCA 1999 and its 2015 revisions, and World Bank EHS guidelines. Investigation shall be conducted, and a corrective action plan developed for every reportable incident to prevent recurrence.

Table 8-1: Environmental and Social Monitoring Plan (ESMoP)

PARAMETER/ ACTIVITY	LOCATION	MEANS OF MONITORING	FREQUENCY	RESPONSIBLE AGENCY	
				IMPLEMENTED BY	SUPERVISED BY
Occupational Health and Safety	Construction site	Visual inspection of first aid area, injury reporting mechanism, WIBA insurance policy, appropriate use and wearing of PPE, training programs for workers, health and safety plan prepared for site, clean drinking watering points, housekeeping on site and at the contractor's camp. safety training certificates, gloves, earplugs, safety boots, reflector jackets, drinking water, nose mask, helmet, overall, sanitation facilities, anti-vibrating gloves	Daily	Contractor	Project engineer
COVID-19 spread among workers	Construction and at operation phase	appointing covid-19 champion or marshal, regular fumigation of shared area and shared tools, sanitizing and hand washing area and facilities, isolation area, covid-19 PPE, visual inspection of social distance	weekly	Contractor	project supervising engineer
COVID-19 spread among community members during consultations	at construction	appointing covid-19 champion or marshal, regular fumigation of shared area and shared tools, sanitizing and hand washing area and facilities, isolation area, covid-19 PPE, visual inspection of social distance	regularly based on the consultation sessions	contractor , Supervising Engineer and NWWDA, Stakeholder Engagement expert/ Communications Expert	project supervising engineer
Public health and safety	Areas surrounding the constructi	Visual inspection of site for; safety signs at strategic places, cordoned off working sites to protect the public or unauthorized	Weekly	Contractor	Project engineer

	on site.	persons, usage of signs and warnings on sites with high risks, low speeding of construction vehicle, safe distance of elevated steel tank from human activities and consideration of wind action, quality assurance recors. No of reported injuries and accidents and No. of grievances reported			
Visual/ aesthetic Impacts	Construction site and project operation	Visual inspection of neatness of the site, No of disturbed sites successfully restored Quality of restored sites/landscapes backfilling of soil cuttings	Quarterly	Contractor	Project engineer
Leakages and spills	Contractor yard, drilling site and construction site	Visual inspection of hazardous waste leakage or spills to soils on site, records of cutting pits for disposed of contaminated soils, Developed site-specific incident management or response plan.	Weekly	Contractor	Project engineer
Noise and vibrations	Drilling and construction site	Use equipment with low noise levels or fitted with mufflers. Visual inspection of site for use of PPE, use of sound proof materials, notices to public on noisy drilling activities, restricting noisy activities day time, records of sensitization and regular measurement of noise levels through mobile phone gadgets.	Weekly	Contractor	Project engineer
Air quality	Drilling/construction site and along construction vehicle movement routes	Physical inspection of vehicles records to ensure meets emission requirements, Use of masks while working in dusty conditions, members of the public on site watching, shielding wind impacts during drilling, low speed of construction vehicle, catalytic devices on vehicle and suppress dust	Daily	Contractor	Project engineer

Waste generation	Drilling/construction site	Visual inspection of; sanitation facilities for human waste management, amount of waste correctly disposed, Visual inspection of haphazard littering, practicing of waste avoidance, reduction, reuse and recycle, designated waste transfer stations onsite, documented approved waste dumping site, presence and compliance to implementations of site-specific waste management plan.	Monthly	Contractor	Project engineer
Conflict among water resource users	Operation site and livestock watering points	Guidelines regulating access to water resources by the various interest groups. meeting held by elders to resolve conflicts over water access	Annually	Ministry of Interior and Coordination of National Government	Deputy county Commissioner
Spread of livestock pest and diseases	Livestock Watering troughs	Monitoring livestock pest and diseases, vaccination of livestock quarantine livestock, spraying or treating of livestock.	Annually	Ward department of livestock	Sub county livestock department
HIV/AIDS prevalence	Construction site	HIV/AIDS prevention and awareness campaign; as well as HIV/AIDS testing facilities and clinic at the site	Weekly	Contractor	Project engineer
GBV/SEA risks /Child labour	Construction site	Training of all workers at the construction site and signing of code of conduct prohibiting GBV/SEA/Child labour prevention	Weekly	Contractor	Project engineer
Labour and employment-related issues	Construction site and contractor's office	Physical counts and inspection of records on; No. of locals employed on the project from the employment records. No. of Grievance recorded from employees and how they were addressed	Weekly	Contractor	Project Engineer/ WAJWASCO

The estimated total cost for the implementation of the ESMP and ESMoP is 2.2 Million. However, the actual costs for construction phase ESMP shall be prepared by the contractor and captured in the C-ESMP. The project's Bid Documents will incorporate the Environment, Social Health and Safety Provisions discussed under this ESMP. The Project Contract Document shall include provisions for the contractor preparing and implementing site specific Construction Environment and Social Management Plan (C-EMSP).

9 CONCLUSION AND RECOMMENDATIONS

9.1 Conclusion

Wajir town remains plagued with challenges of sustainable water sources for social and economic development of the rapidly expanding town. The Government of Kenya through a World Bank financed credit under WSDP is making concerted efforts to ensure that sustainable water sources to Wajir town are identified. Merti aquifer is one of the key long-term sources that were identified through a series of studies that were conducted by Earth Water Limited and Zamconsult Consulting Engineers Ltd. The findings of the studies indicated that the potential well field supplying water to Wajir town from Merti aquifer could either be at Ademasajida or Arbajahan. The aquifer is of trans-boundary significance and therefore, there was a need to collect data on the impacts of water extraction for supply to the town. In this regard, it has been proposed to drill 4 No. exploratory boreholes, 2 No. at Ademasajida and 2 No. at Arbajahan for the purposes of monitoring the aquifer water quality and quantity for sustainable extraction. The 2 boreholes at Ademasajida shall be drilled one at existing Ademasajida Habaswein Livestock market at Ademasajida Township and at Waso Girls primary school which is adjacent to the Waso Girls secondary school. The boreholes at Arbajahan shall be at Bula Madina settlement and at Arbajahan primary schools.

The community at Ademasajida reported to draw its water from 4 sources, 3 of which are boreholes drilled by NWWDA, and handed over to WAJWASCO and the fourth source is private boreholes. The WAJWASCO boreholes are the community's primary source of water and they include one in Habaswien at the sub-county HQ, the second in Bula Qasad or the old Hadado Borehole and the other is the Qulqul (plenty water) Borehole. The water sources were reported as insufficient and unreliable. Due to inadequate water supply to the project area, the local people reported incurring high costs of accessing water resources which was reported to be around Kshs 200 for every 200L tank. Some of the participants reported spending up to 25,000 kshs per month depending on water use.

The main source of water for the community at Arbajahan is 2 boreholes drilled by NWWDA but operated by WAJWASCO. The boreholes were reported to serve the community within a radius of about 10Km, mainly for livestock watering and for domestic use. The yield of the boreholes the area was reported to be about 14m^3/hour but in spite of the relatively high yields, the local community members experiences low solar energy due to cloudy days or month that reduces the pumping, forcing the local community to use diesel generator though expensive for the community. The community reported high demand for the water leading to long queues with some community members traveling for long distances to access the commodity. The community members in addition expressed the concerns for the leaking storage tanks which leads to a lot of wastage. Inadequate water supply in the area was attributed to; relying on solar and with low solar energy at the time of the study, there was not enough energy to pump the water. Occasional pump failures which take long to be repaired, there was an existing borehole not fitted with a pump and thus does not supply water to the community; private boreholes' owners sometimes not willing to share or even sell their water. The challenges of inadequate water supply have led to the community members receiving water after every 3 days which is not sufficient. It was indicated

that those with young children bear the brunt the most, inadequate water for washing hands during this covid-19. Pandemic, slow development of the town and though locals want to do development (construction), it's limited by availability of water.

The implementation of proposed project is therefore anticipated to address these challenges by increasing water supply to the local population but of significance to collect data that shall be used to monitor the Merti aquifer for sustainable utilization of the resource. Such monitoring system does not exist anywhere along the aquifer at least in Kenya and this shall provide an opportunity for transboundary data sharing in additional to national data. The proposed project shall therefore provide water to the local community from 2 No boreholes of the proposed 4 exploratory boreholes in the area. The project scope in general shall consist of drilling 4 No. boreholes, lying of 6.5km of pipeline distribution mains, 5 water kiosks, fencing of the 4 boreholes, 2 livestock watering troughs at Bula Madina and 2 No elevated steel tank. The proposed project area showed characteristics of modified habitat mainly due to anthropogenic activities related but not limited to residential settlements and commercial activities represented by the livestock market and the educational land use as for the case of Waso and Arbajahan schools. The environmental and social assessment findings indicated that the project impacts are of low impacts. The implementation of the project therefore is not anticipated to significantly influence the physical and social environment. It was further noted that the anticipated impacts shall be of low magnitude due to the size of the project and with mitigation measures having been proposed in this report.

9.2 Recommendations

Drilling and development of the proposed exploratory boreholes together with the water supply facilities is anticipated to have negative impacts socially and to the physical environment. In spite of the anticipated environmental and social impacts, with proper mitigation measures, the project is environmentally viable. The environmental assessment team proposes the implementation of the project with the following recommendations which need to be considered;

- The project proponent NWWDA to ensure full implementation of ESMP and ESMoP proposals during implementation stage while Wajir County Government through WAJWASCO to do so during operation and decommissioning stages of the project as will be required.
- The project's bid documents shall incorporate the Environment, Social Health and Safety Provisions discussed under the ESMP in this report. The works contract document shall also include provisions for the contractor preparing and implementing site specific Construction Environment and Social Management Plan (C-EMSP)
- The contractor should not allow any use of the water particularly test pumping water before conducting water quality tests and found fit for consumption, which could not be curtained at the time of this study.
- The project implementing agency, contractor and the supervising engineer to ensure that ministry of health and World Bank covid-19 guidelines are implemented to the latter at the project site during construction period and that all the workers commit to observing the rules.

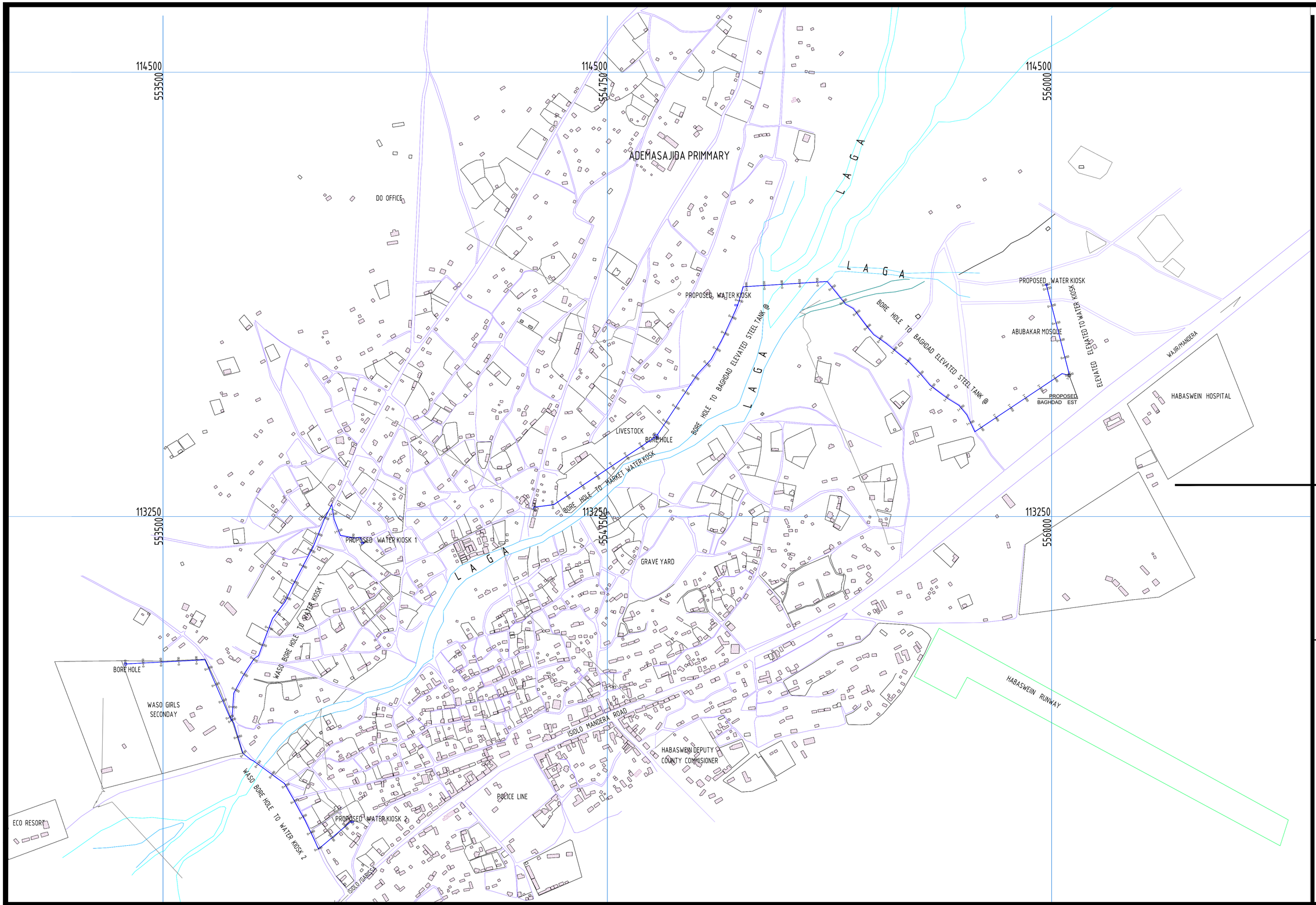
- Deliberate (affirmative action) measures to be taken by the proposed project to consider connecting vulnerable and marginalized individual to water within the project area or ensuring provision of water kiosks is near dwelling of such groups and making the commodity affordable.
- The project in addition to consider supplying water to social amenities such as schools and dispensaries observed within the project area.

REFERENCES

1. Evaluation, monitoring and modelling of Merti aquifer Study Reports by Earth Water Limited dated 2017 and funded by World Bank.
2. Feasibility study and preliminary design of water supplies for Wajir town water Masterplan (Zamconsult Consulting Engineers Ltd, 2017), funded by World Bank.
3. GoK (2017): Environmental and Social Management Framework for Water and Sanitation Development Program (WSDP). Ministry of Water and Irrigation State Department of Water, February 2017.
4. Kenya gazette Legal Notice No. 101 Environmental Impact Assessment and Audit Regulations 2003. Government printers, Nairobi
5. Kenya gazette supplement Acts 2000, Environmental Management and Coordination Act CAP 387. *Government printer, Nairobi*
6. Kenya gazette supplement Acts Occupation Health and Safety (2007) government printer, Nairobi.
7. Kenya gazette supplement Environmental Management and Coordination (Water Quality) Regulations, 2006.
8. Kenya gazette supplement Environmental Management and Coordination (Waste Management) Regulations, 2006.
9. Kenya Population and Housing Census 2019: Volume 1: Population by County and Sub-County.
10. Kenyan New Constitution, 2010.
11. The Physical and Land Use Planning Act, 2019, Kenya gazette supplement No. 129 (Acts No. 13).
12. The Public participation Act 2016, Kenya gazette supplement No. 175 (senate bills No. 15) *Government printer, Nairobi.*
13. The water Act 2016, Kenya gazette supplement No. 164 (Acts No. 43).
14. UNISDR Guidance note on Recovery: Livelihood. https://www.unisdr.org/files/16771_16771guidancenoteonrecoveryliveliho.pdf
15. Wajir County Integrated Development Plan 2018-2022
16. Water Resources Management rules 2007

I. PROPOSED PROJECT LAYOUT, DRAWINGS AND DESIGN

IA. Layout for Ademasajida Community Water Distribution System

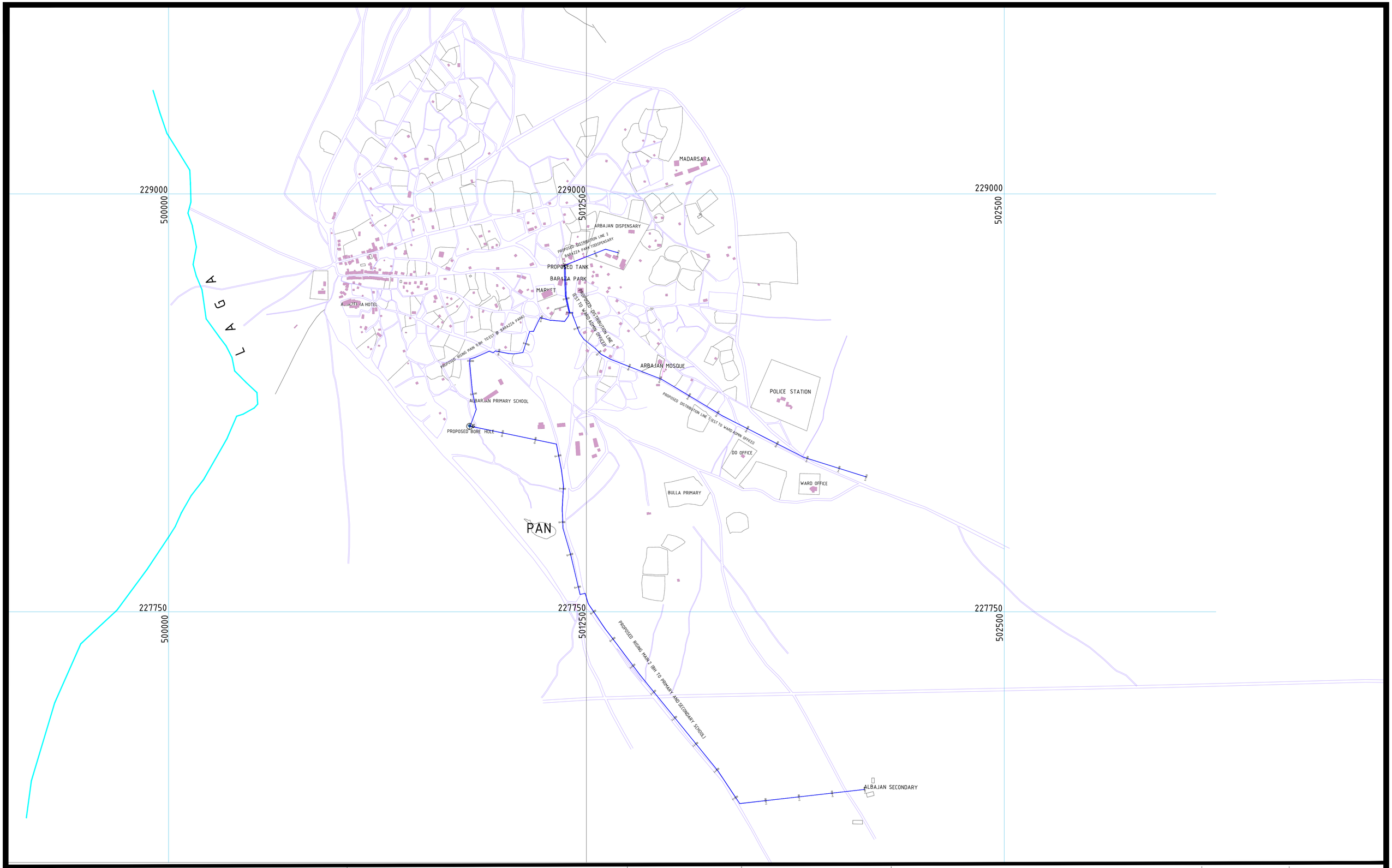


LEGEND

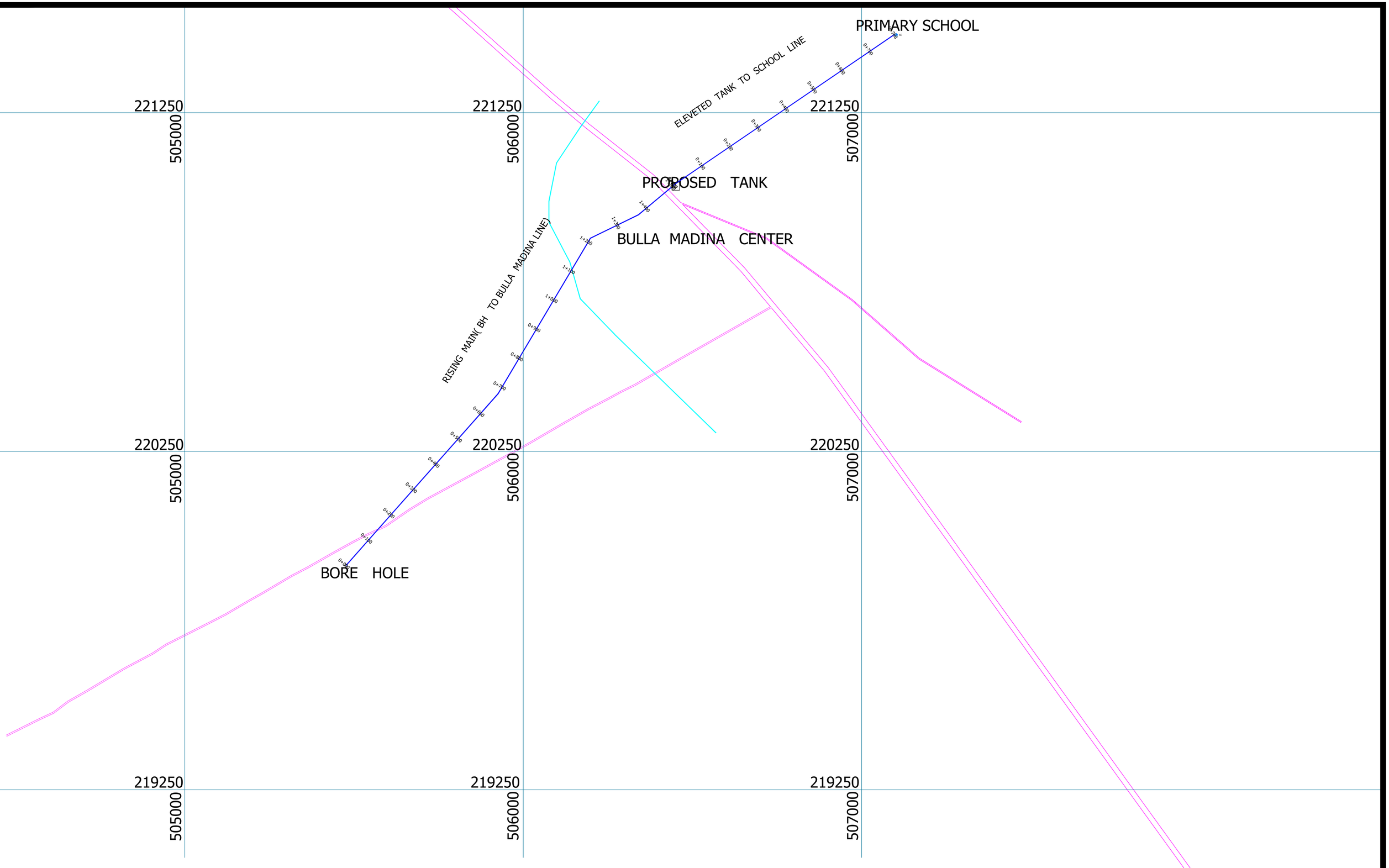
- EXISTING MURRAM ROAD
- EXISTING DWELLINGS
- SPILLWAY
- CONTOURS
- EXISTING FENCE-LINE
- INLET CHANNELS

CLIENT	**CONSULTANT**	**DESIGNED BY:**	G.NYASAGARE	**PROJECT TITLE**	**SCALE:** AS SHOWN
REPUBLIC OF KENYA NORTHERN WATER WORKS DEVELOPMENT AGENCY NPO BOX 495 ,GARISSSA	REPUBLIC OF KENYA NORTHERN WATER WORKS DEVELOPMENT AGENCY NPO BOX 495 ,GARISSSA	**SURVEYED BY:**	G.N.	PROPOSED AUGUMENTATION OF ADEMASIJIDA WATER SUPPLY	**DATE:** MARCH . 2022
		DRAWN BY:	S.MAINA.		Drg. No. SN/01-01 / **SHEET** 001
		APPROVED BY:	ENG S.NDUNGU	**DRG. TITTLE:** PAN LAYOUT	

IB. Layout for Arbajahan Community Water Distribution System

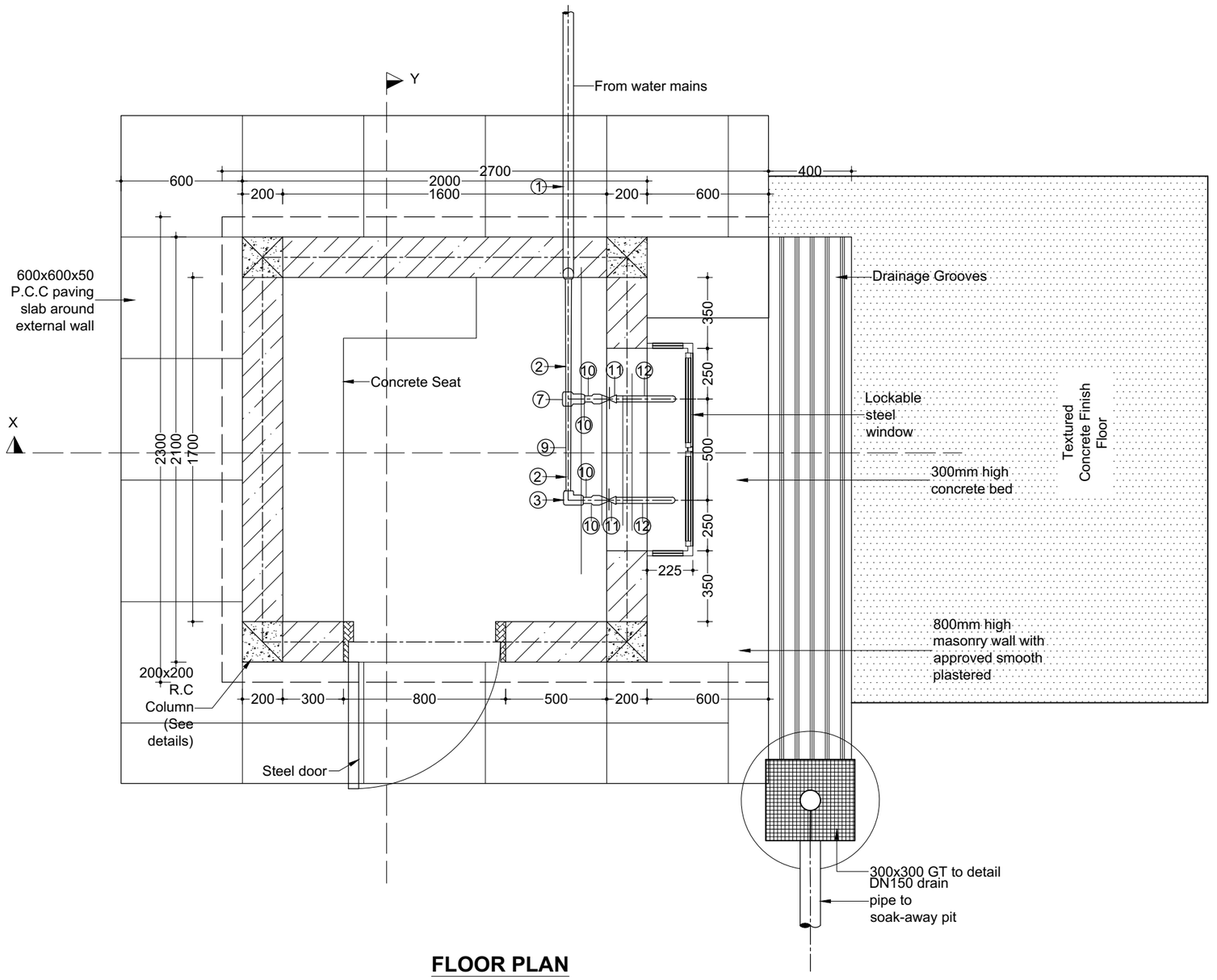


CLIENT	**CONSULTANT**	**DESIGNED BY:**	**G.NYASAGARE**	**Project Title:**	**Scale:**	**As shown**
REPUBLIC OF KENYA NORTHERN WATER WORKS DEVELOPMENT AGENCY NPO BOX 495 ,GARISSSA	REPUBLIC OF KENYA NORTHERN WATER WORKS DEVELOPMENT AGENCY NPO BOX 495 ,GARISSSA	**SURVEYED BY:**	**S. MAINA.**	PROPOSED AUGUMENTATION OF ALBAJAN WATER SUPPLY	**Date:**	**MARCH . 2022**
		DRAWN BY:	**G.N**		**Drg. No. 1/001**	**SHEET 1 OF 1**
		APPROVED BY:	**ENG. NDUNGU**	**DRG. TITTLE:** PAN LAYOUT		



CLIENT	**CONSULTANT**	DESIGNED BY:	G.NYASAGARE	**Project Title:**	Scale:	As shown
REPUBLIC OF KENYA NORTHERN WATER WORKS DEVELOPMENT AGENCY NPO BOX 495 ,GARISSSA	REPUBLIC OF KENYA NORTHERN WATER WORKS DEVELOPMENT AGENCY NPO BOX 495 ,GARISSSA	SURVEYED BY:	S. MAINA.	PROPOSED BULLA MADINA WATER SUPPLY	Date:	MARCH . 2022
		DRAWN BY:	G.N		Drg. No. 1/001	SHEET 1 OF 1
		APPROVED BY:	ENG. S NDUNGU	Drg. Title: BULLA MADINA LAYOUT PLAN		

IC. Project Facilities Drawings and Design



FLOOR PLAN
Scale 1:25 (A3)

NOTES:

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9. All materials are subject to Engineer's approval before use.

CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

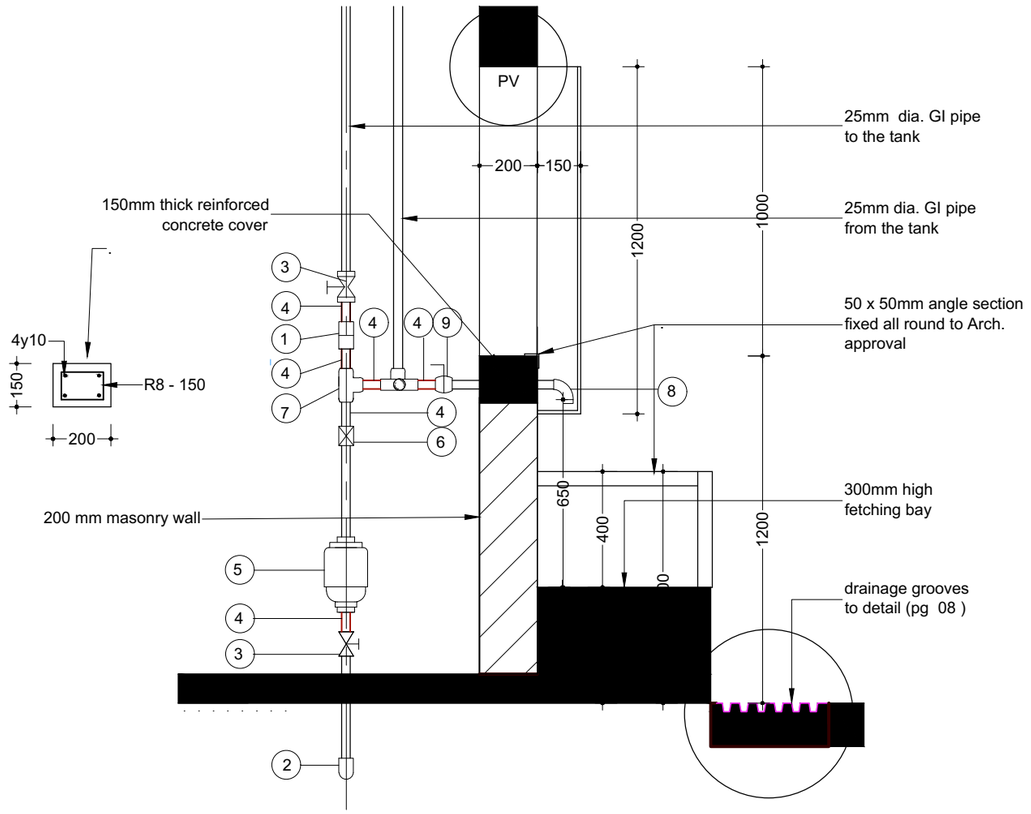
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

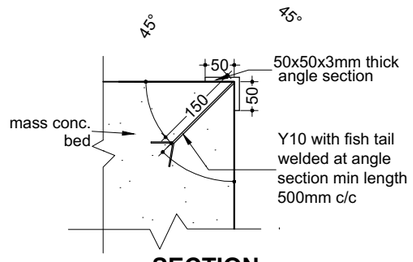
STANDARD WATER KIOSK (ARCHITECTURAL PLAN)

DRAWING DETAILS:

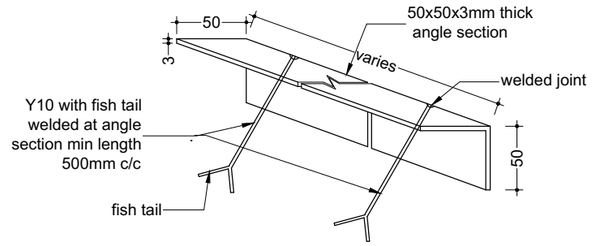
Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	1 of 16
Drawing No:	NWWDA/WSDP/001



DETAIL C
Scale 1:20



SECTION
Scale 1:10



AXONOMETRIC VIEW SHOWING ANGLE SECTION ANCHORING DETAIL
Scale 1:10 (A3)

ITEM NO.	DESCRIPTION (ALL 25NN DIA)	UNIT)	QTY
1	Galvanised Iron Union	No.	3
2	Galvanised Iron Elbows	No.	3
3	Galvanised Iron Gate Valve (Pegler)	No.	2
4	Galvanised Iron Nipples	No.	11
5	Water Meter	No.	1
6	Non Return Valve	No.	1
7	Galvanised Iron Equal Tee	No.	5
8	Galvanised Iron Bend	No.	4
9	Ball Cock Water Taps	No.	3
10	Galvanised Iron Long Thread Nipples	No.	2
17	Galvanised Iron Black Nuts	No.	4
12	Galvanised Iron Class B Pipe (per metres)	No.	4
13	Boss white (400g)	No.	3
14	Temp Thread	LM..	2

N.T.S

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

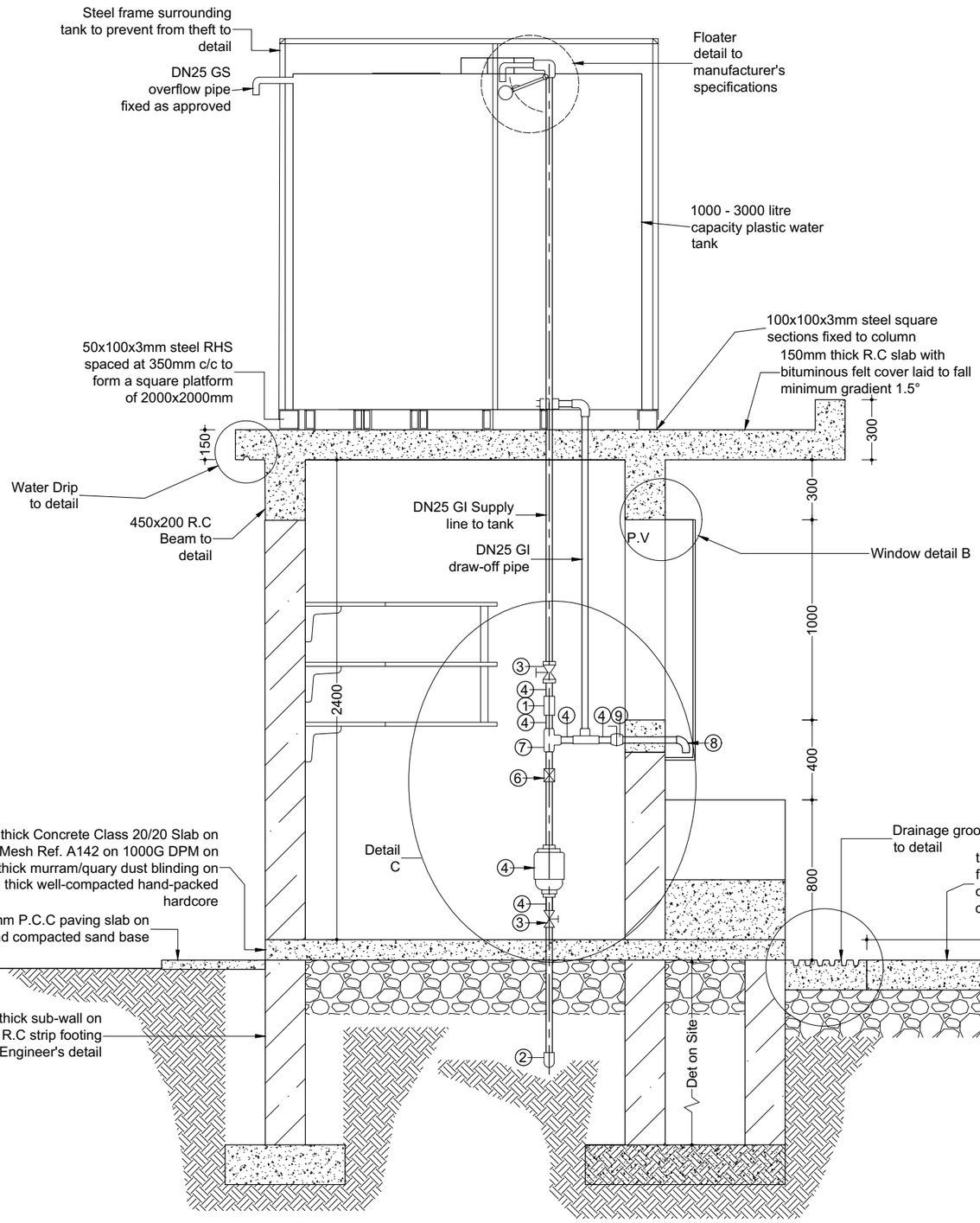
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

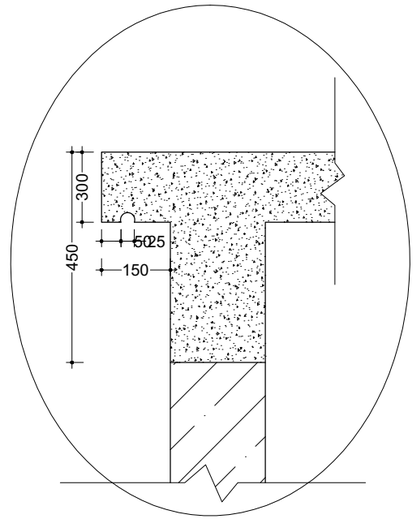
STANDARD WATER KIOSK TYPE 1 (PLUMBING DETAILS)

DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	12 of 16
Drawing No:	NWSDWASP/001



SECTION X-X
Scale 1:25(A3)



WATER DRIP DETAIL
Scale 1:25

NOTES:

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

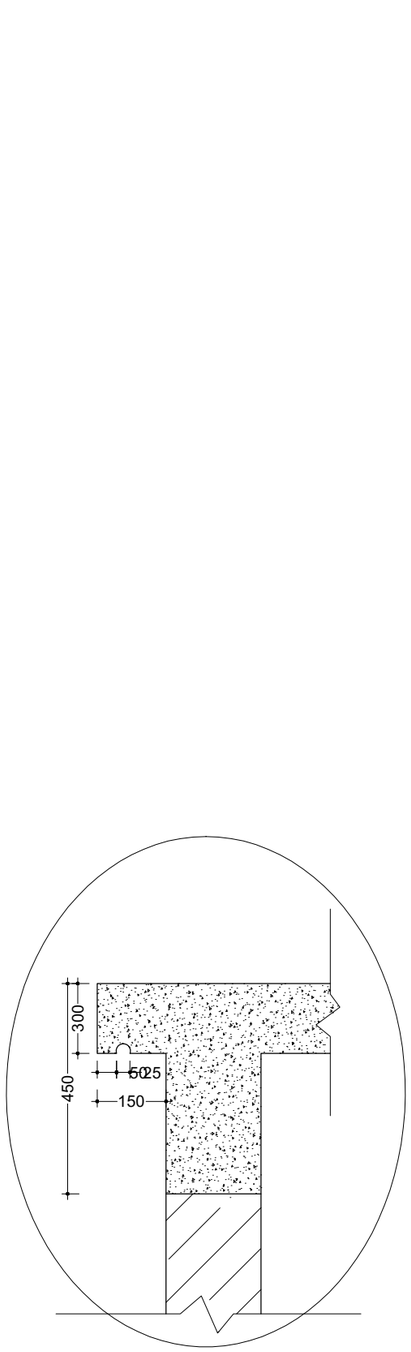
ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

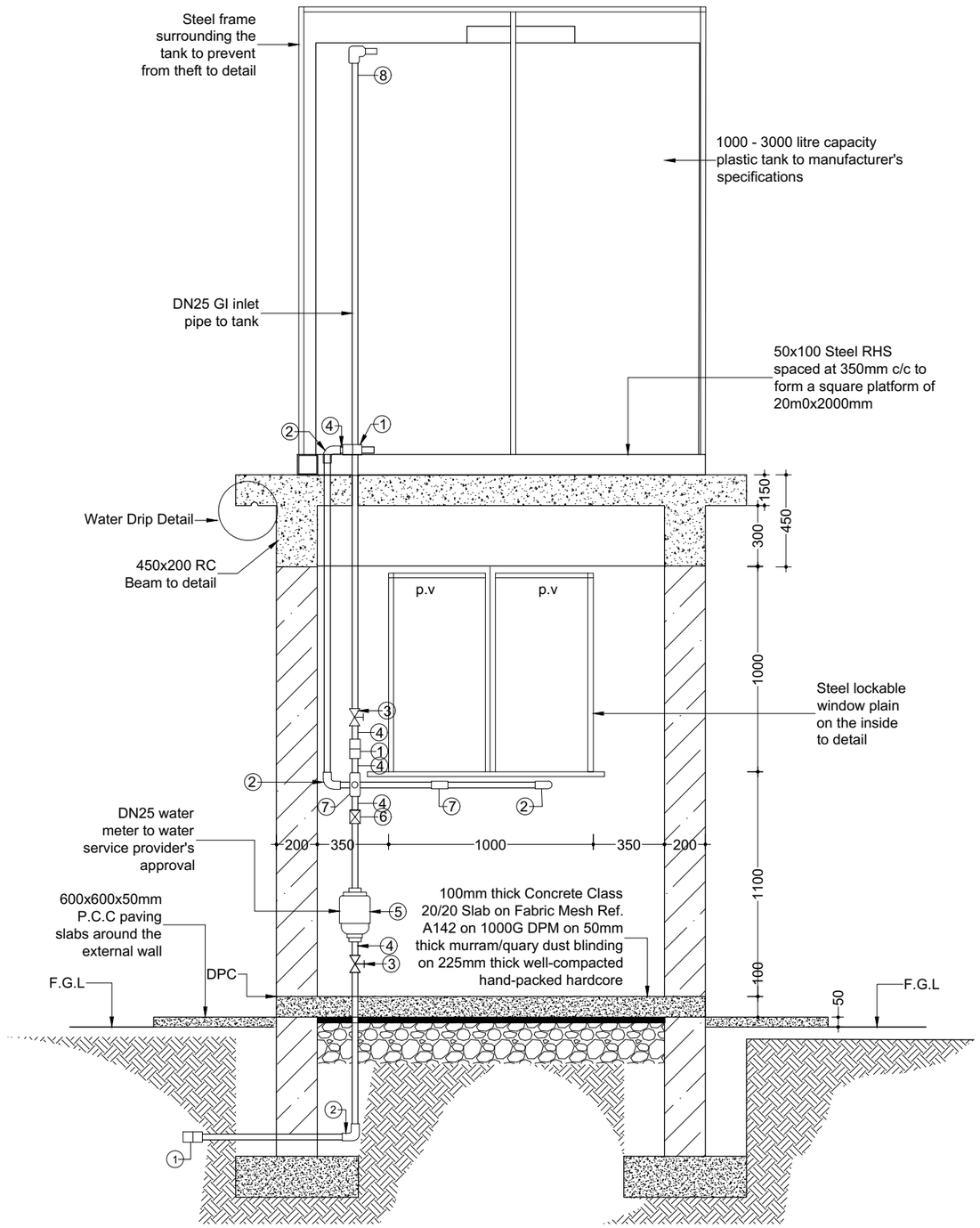
DRAWING TITLE:

STANDARD WATER KIOSK (SECTION X-X)

DRAWING DETAILS:	
Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	6 of 16
Drawing No:	NWWDA/WSDP/001



WATER DRIP DETAIL
Scale 1:25 (A3)



SECTION Y-Y
Scale 1:25

NOTES:

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

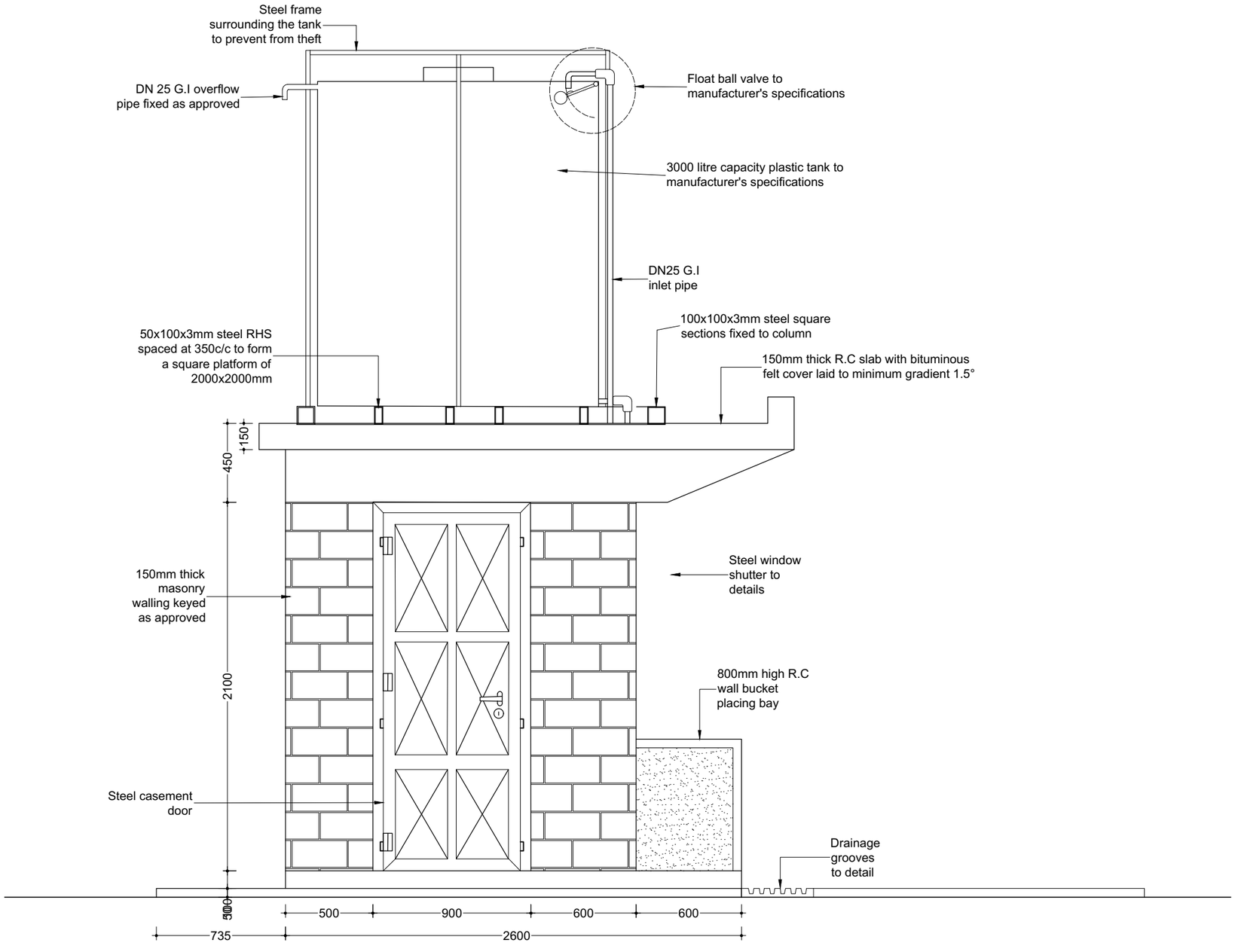
ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (SECTION Y-Y)

DRAWING DETAILS:	
Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	7 of 16
Drawing No:	NWWDA/WSDP/001



SIDE ELEVATION

Scale 1:25 (A3)

NOTES:

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

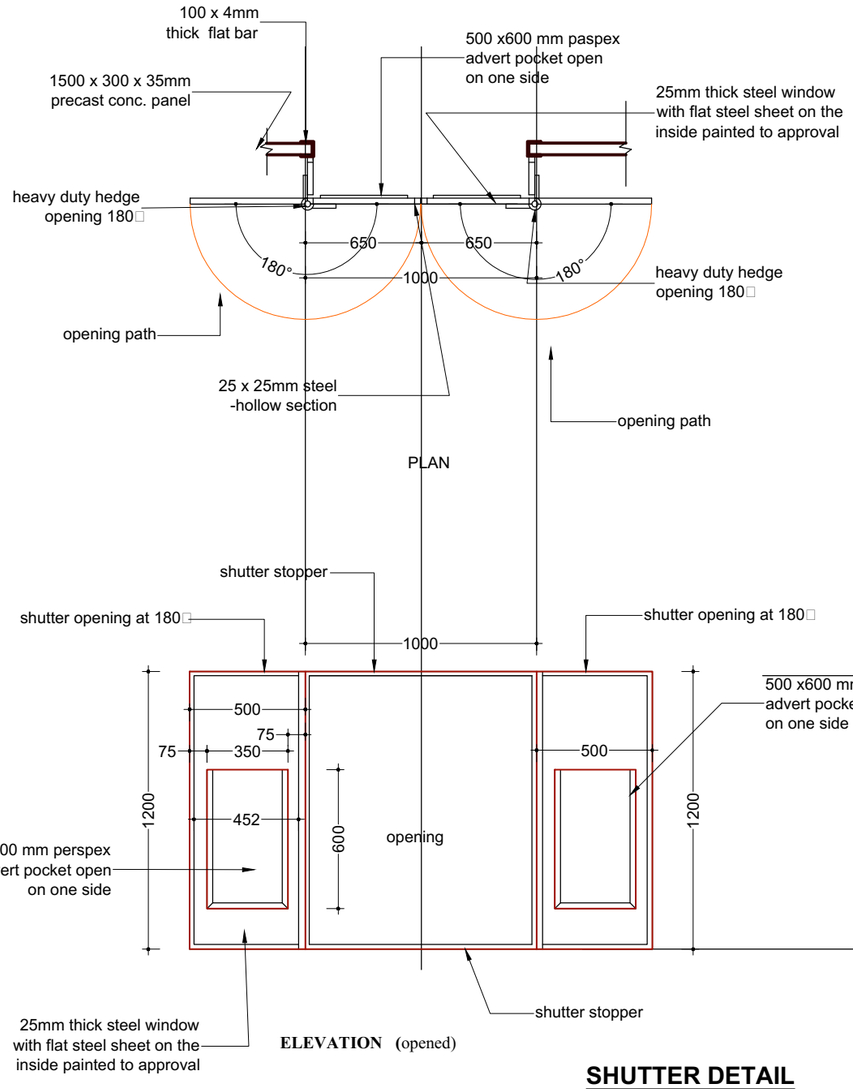
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

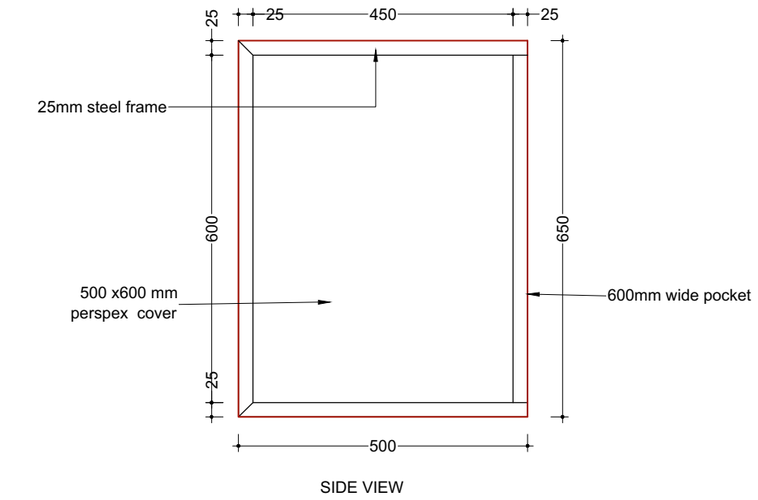
STANDARD WATER KIOSK TYPE 1 (SIDE ELEVATION)

DRAWING DETAILS:

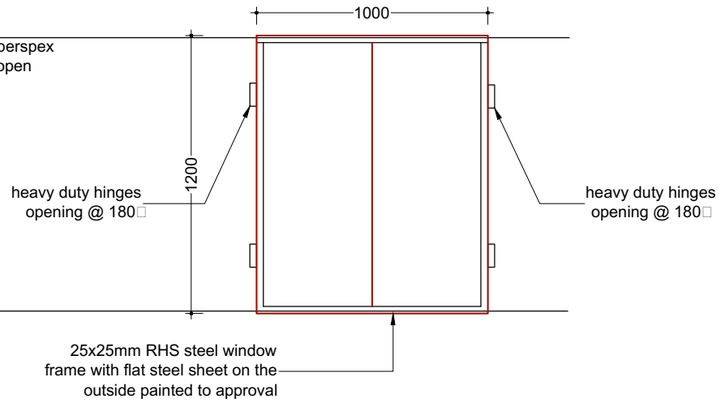
Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	3 of 16
Drawing No:	NWWDA/WSDP/001



SHUTTER DETAIL



ADVERT POCKET DETAIL



ELEVATION (closed)

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

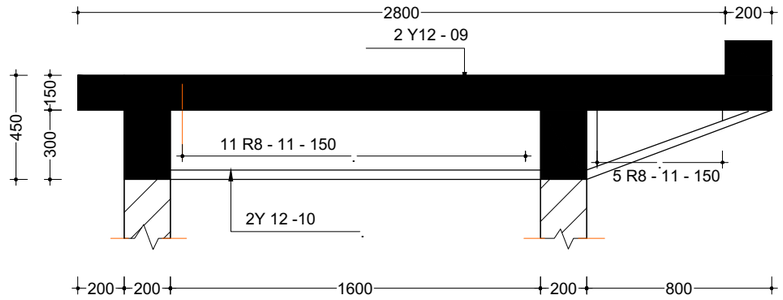
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (WINDOW DETAILS)

DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	14 of 16
Drawing No:	NWWDA/WSDP/001



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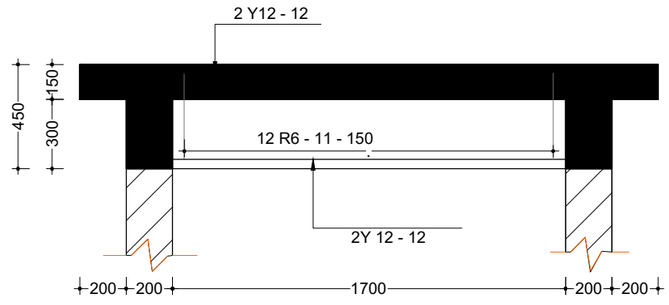
Scale 1:25



BEAM B 2 No.
Scale 1:25

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (BEAM DETAILS)

DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	9 of 16
Drawing No:	NWWDA/WSDP/001

Item	Description	Bar type	Bar mark	Shape	Dimensions (mm)				Length (mm)	Number	Total length (mm)
					A	B	C	D			
1	Beams	Y12	09	A B A	100	2750			2950	2	5,900
		Y12	10	A B C	100	1975	850		2925	2	5,850
		R 8	11	A B	150	400			1200	45	55,000
		Y12	12	A B A	100	2050			2250	8	18,000

Length of bar is estimated to be 12,000mm

Item	Description	Bar type	Bar mark	Shape	Dimensions (mm)				Length (mm)	Number	Total length (mm)
					A	B	C	D			
1	Slab	Y10	13	C D A B A	100	2,450	1000	1000	5150	16	74,400
		Y10	14	C D A B A	100	2,900	1000	1600	5700	12	68,400
		Y10	15	B		2,200			2200	19	41,800

Length of bar is estimated to be 12,000mm

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

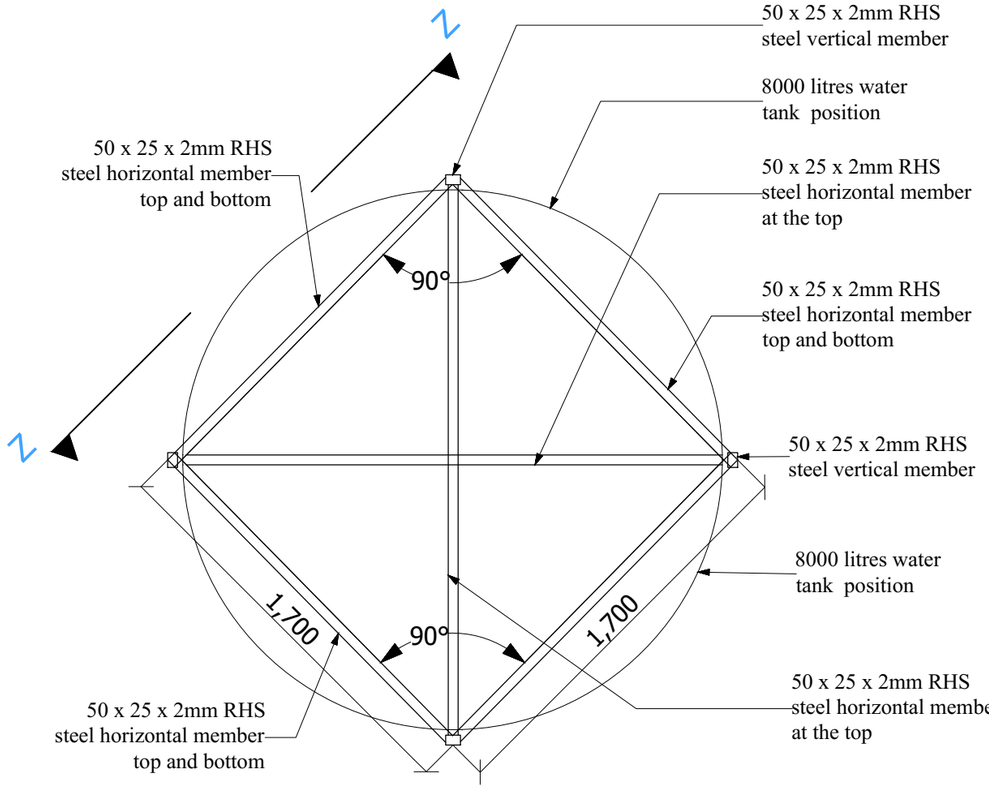
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

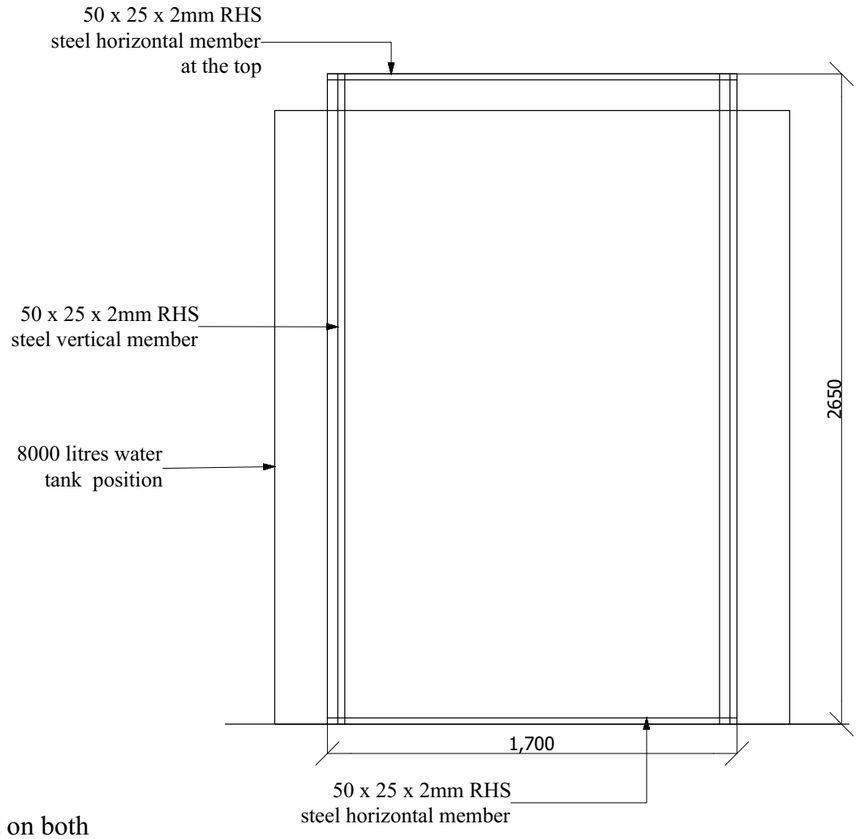
STANDARD WATER KIOSK TYPE 1 (BEAMS & SLAB BAR SCHEDULE)

DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	11 of 16
Drawing No:	NWWDA/WSDP/001



TOP VIEW



SIDE VIEW X -X

NB the cage to be used on both 8000ltrs and 5000ltrs tanks

STEEL CAGE DETAIL

N.T.S

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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

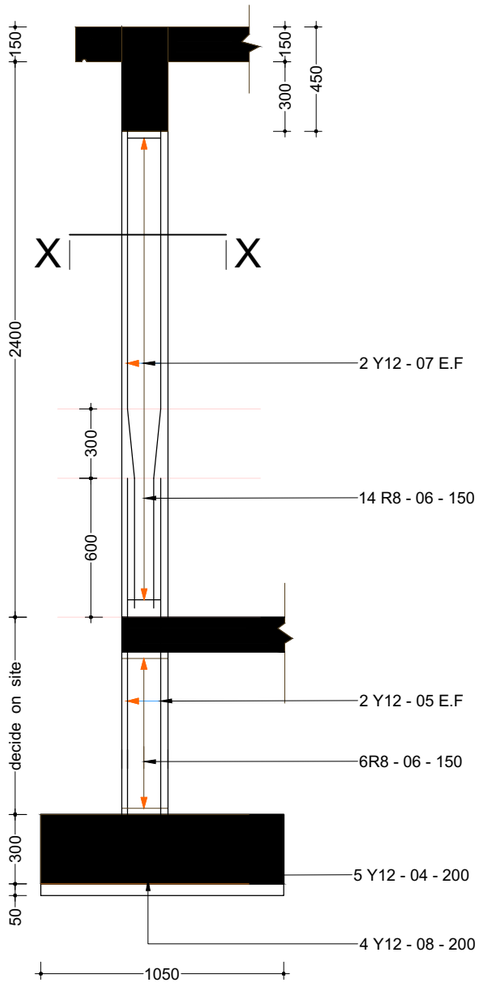
DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (GAGE DETAILS)

DRAWING DETAILS:

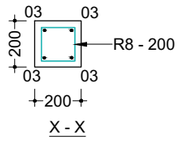
Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	16 of 16
Drawing No:	NWWDA/WSDP/001

D:\GEOFFREY PERSONAL LAPTOP\Geoffrey Hard Disc 2019\Wassip\WSDP\Exploratory Boreholes\Exploratory boreholes\NWWDA-WSDP-WS-001_Standard Water Kiosks.dwg <Cage Details> Tue, 31 Aug 2021 - 01:44pm User

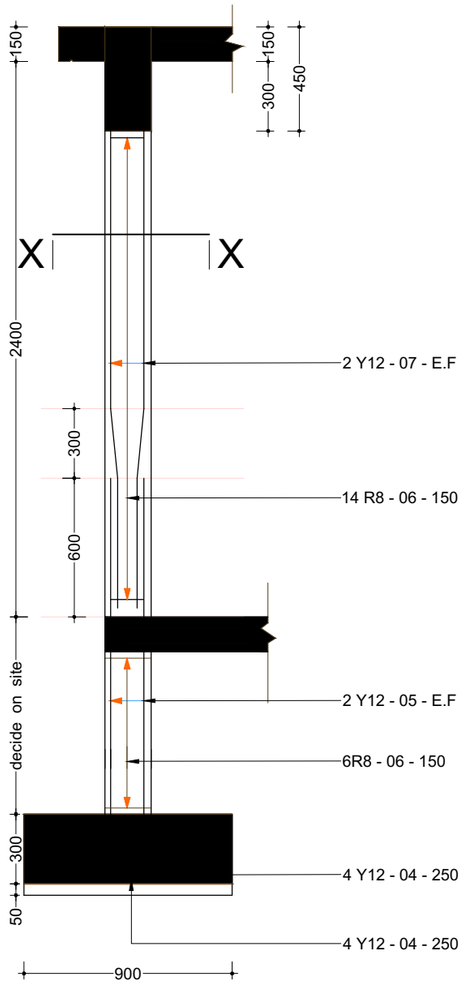


DETAIL FOR COLUMN & COL. BASE SHOWN THUS D 2No.

Scale 1:25



X - X



DETAIL FOR COLUMN & COL. BASE SHOWN THUS C 2No.

Scale 1:25

NOTES:

1. All dimensions are in millimeters unless specified otherwise.
2. All dimensions to be read and confirmed before construction begins and any discrepancy reported to Engineer.
3. Foundation depths to be determined on site but to hard stratum and approved by Engineer on site.
4. All concrete works to be class 20/25.
5. All steel reinforcement to BS4449.
6. Form-work to be fair-finished.
7. Drains under buildings and driveways to be encased in at least 150mm thick concrete.
8. Foundation trenches and concrete works to be treated with approved anti-termite chemical with at least 10 year guarantee.
9. All materials are subject to Engineer's approval before use.

CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

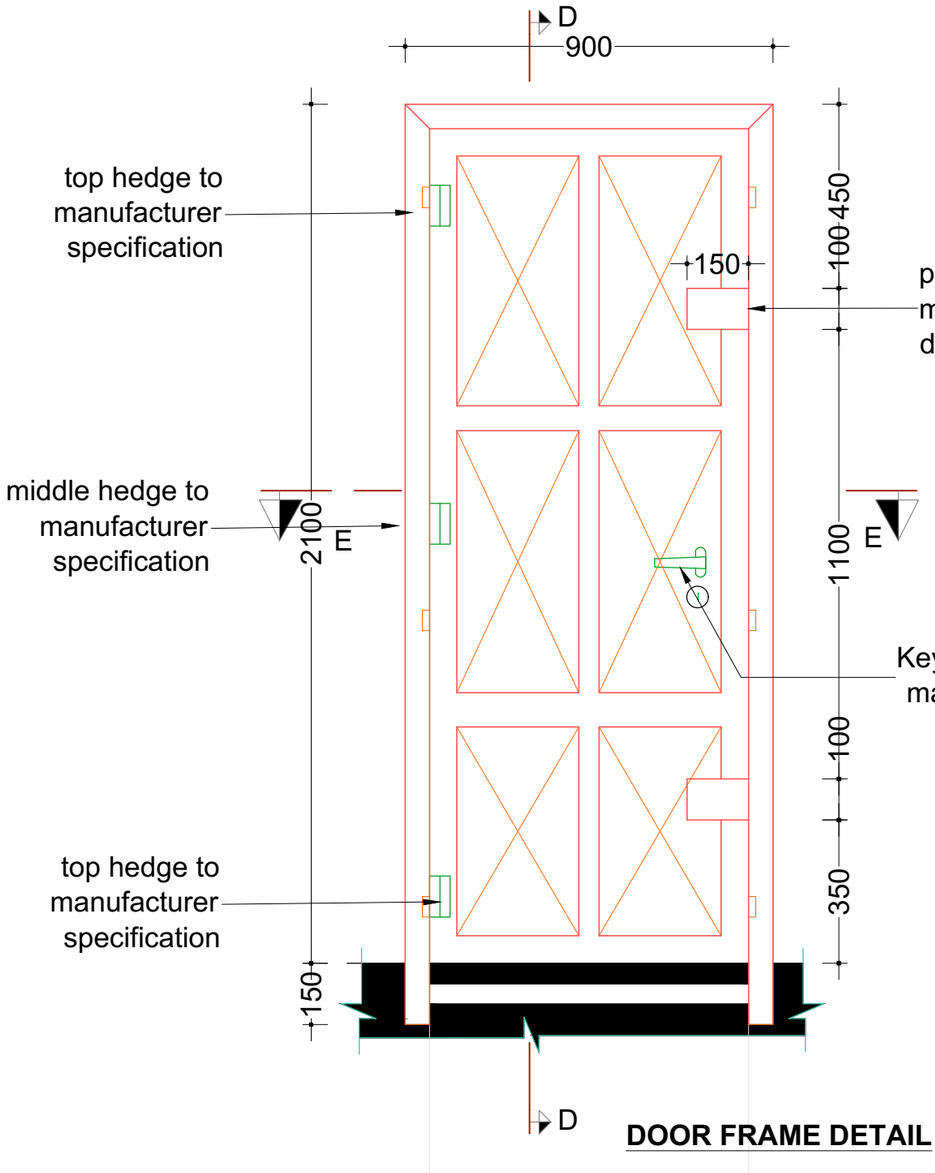
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

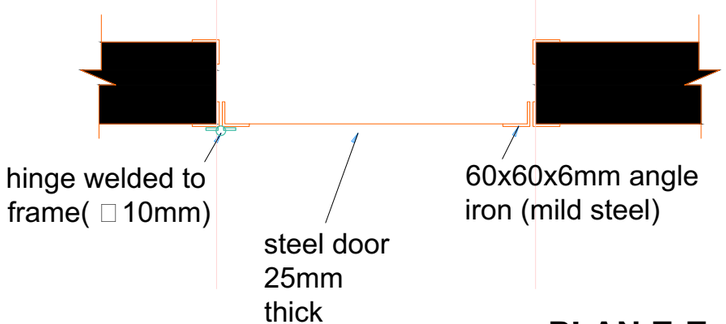
STANDARD WATER KIOSK TYPE 1 (COLUMN DETAILS)

DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	8 of 16
Drawing No:	NWWDA/WSDP/001

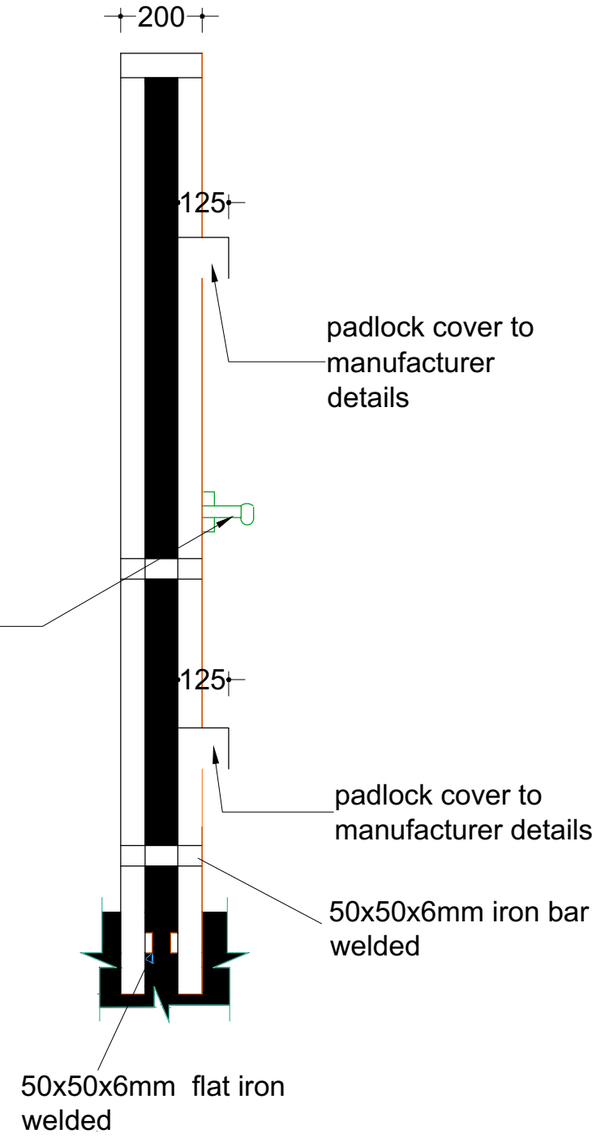


DOOR FRAME DETAIL



PLAN E-E

N.T.S



SECTION D-D

NOTES:

1. All dimensions are in millimeters unless specified otherwise.
2. All dimensions to be read and confirmed before construction begins and any discrepancy reported to Engineer.
3. Foundation depths to be determined on site but to hard stratum and approved by Engineer on site.
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6. Form-work to be fair-finished.
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8. Foundation trenches and concrete works to be treated with approved anti-termite chemical with at least 10 year guarantee.
9. All materials are subject to Engineer's approval before use.

CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

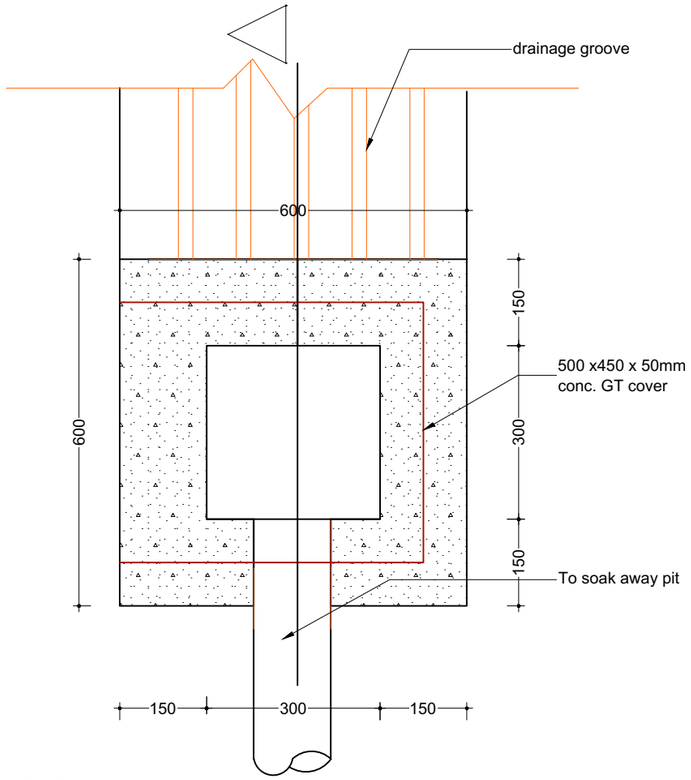
DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (DOOR DETAILS)

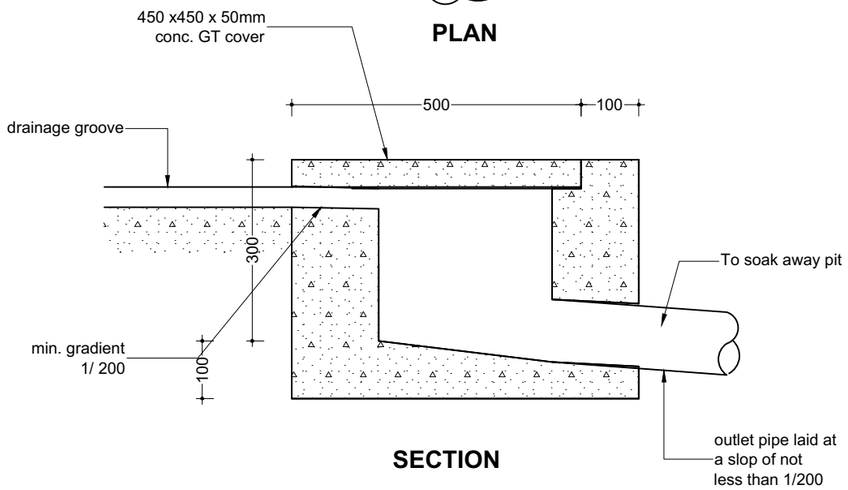
DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	15 of 16
Drawing No:	NWWDA/WSDP/001

D:\GEOFFREY PERSONAL LAPTOP\Geoffrey Hard Disc 2019\Wassip\WSDP\Exploratory Boreholes\Exploratory boreholes\NWWDA-WSDP-WS-001_Standard Water Kiosks.dwg <Door Details> Tue, 31 Aug 2021 - 01:44pm User

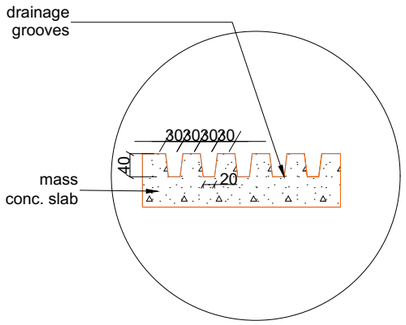


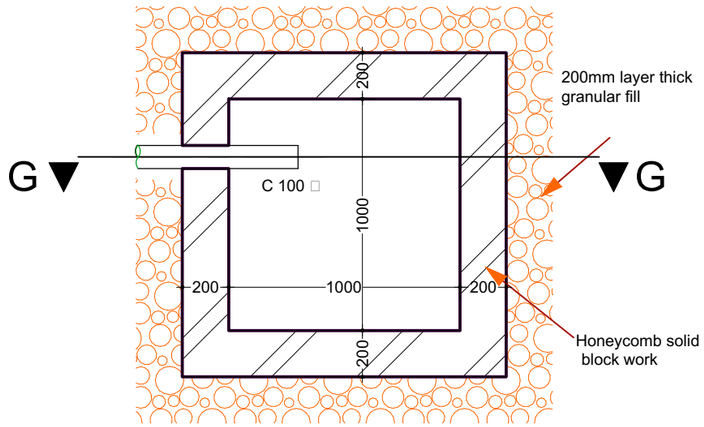
PLAN



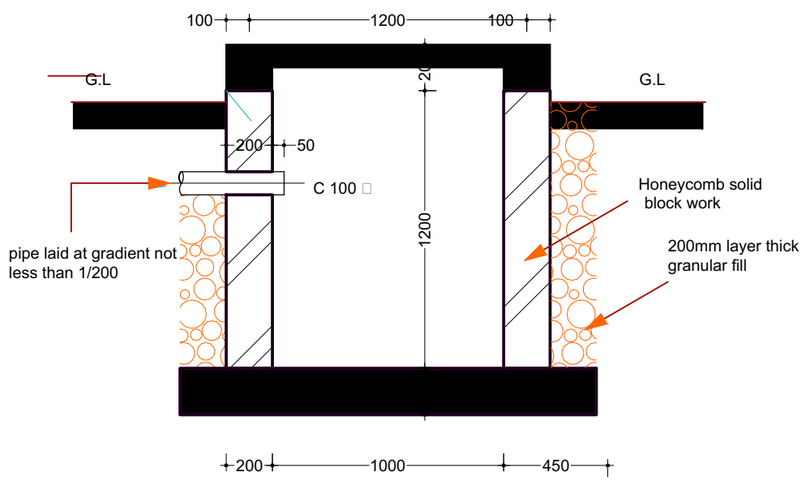
SECTION

GT DETAIL
Scale 1:10 (A3)





SOAK PIT PLAN



LONGITUDINAL SECTION THROUGH SECTION G-G SOAK AWAY DETAIL
Scale 1:25 (A3)

NOTES:

1. All dimensions are in millimeters unless specified otherwise.
2. All dimensions to be read and confirmed before construction begins and any discrepancy reported to Engineer.
3. Foundation depths to be determined on site but to hard stratum and approved by Engineer on site.
4. All concrete works to be class 20/25.
5. All steel reinforcement to BS4449.
6. Form-work to be fair-finished.
7. Drains under buildings and driveways to be encased in at least 150mm thick concrete.
8. Foundation trenches and concrete works to be treated with approved anti-termite chemical with at least 10 year guarantee.
9. All materials are subject to Engineer's approval before use.

CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

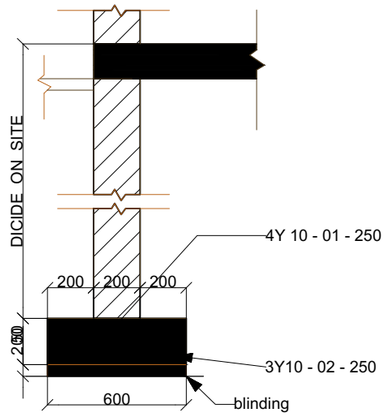
ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

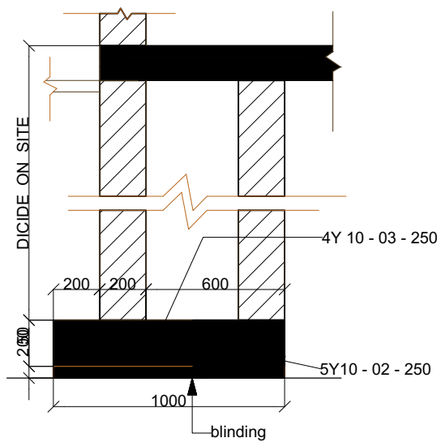
STANDARD WATER KIOSK TYPE 1 (DRAINAGE DETAILS)

DRAWING DETAILS:	
Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	13 of 16
Drawing No:	NWWDA/WSDP/001



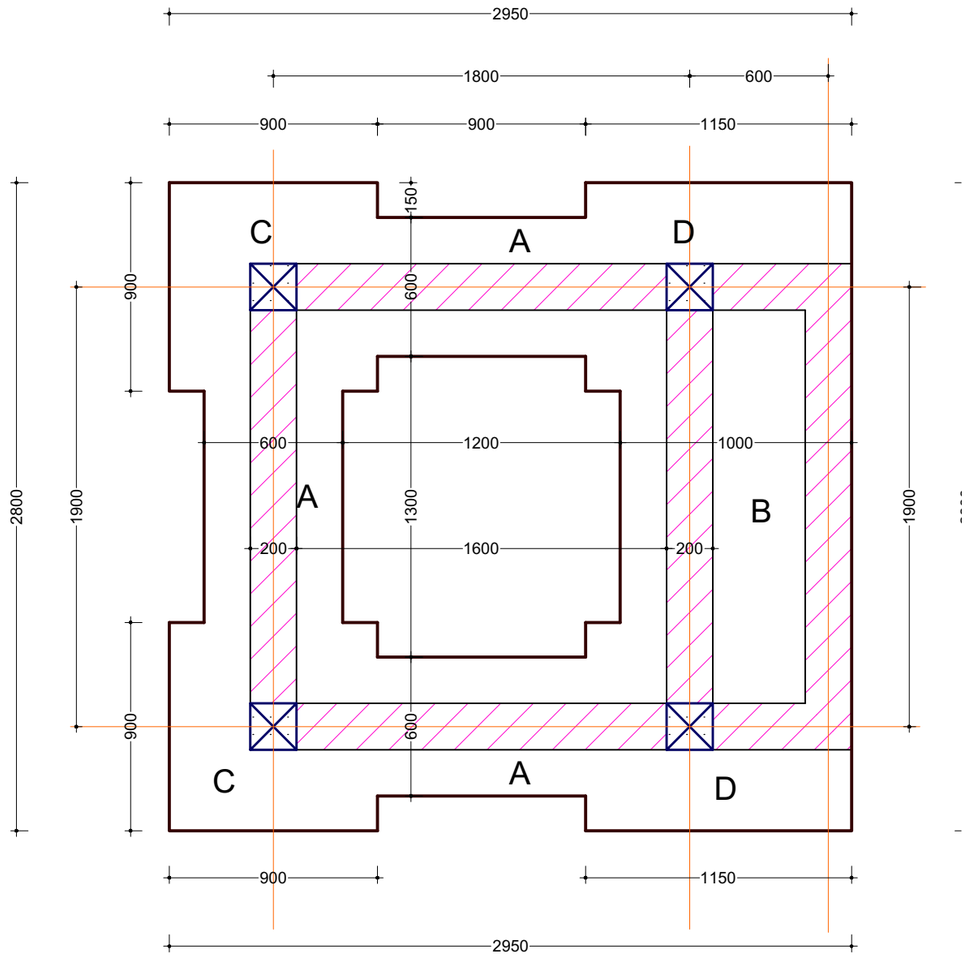
DETAIL FOR STRIP FOOTING SHOWN THUS A

Scale 1:25



DETAIL FOR STRIP FOOTING SHOWN THUS B

Scale 1:25



FOUNDATION PLAN

Scale 1:25

NOTES:

1. All dimensions are in millimeters unless specified otherwise.
2. All dimensions to be read and confirmed before construction begins and any discrepancy reported to Engineer.
3. Foundation depths to be determined on site but to hard stratum and approved by Engineer on site.
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5. All steel reinforcement to BS4449.
6. Form-work to be fair-finished.
7. Drains under buildings and driveways to be encased in at least 150mm thick concrete.
8. Foundation trenches and concrete works to be treated with approved anti-termite chemical with at least 10 year guarantee.
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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

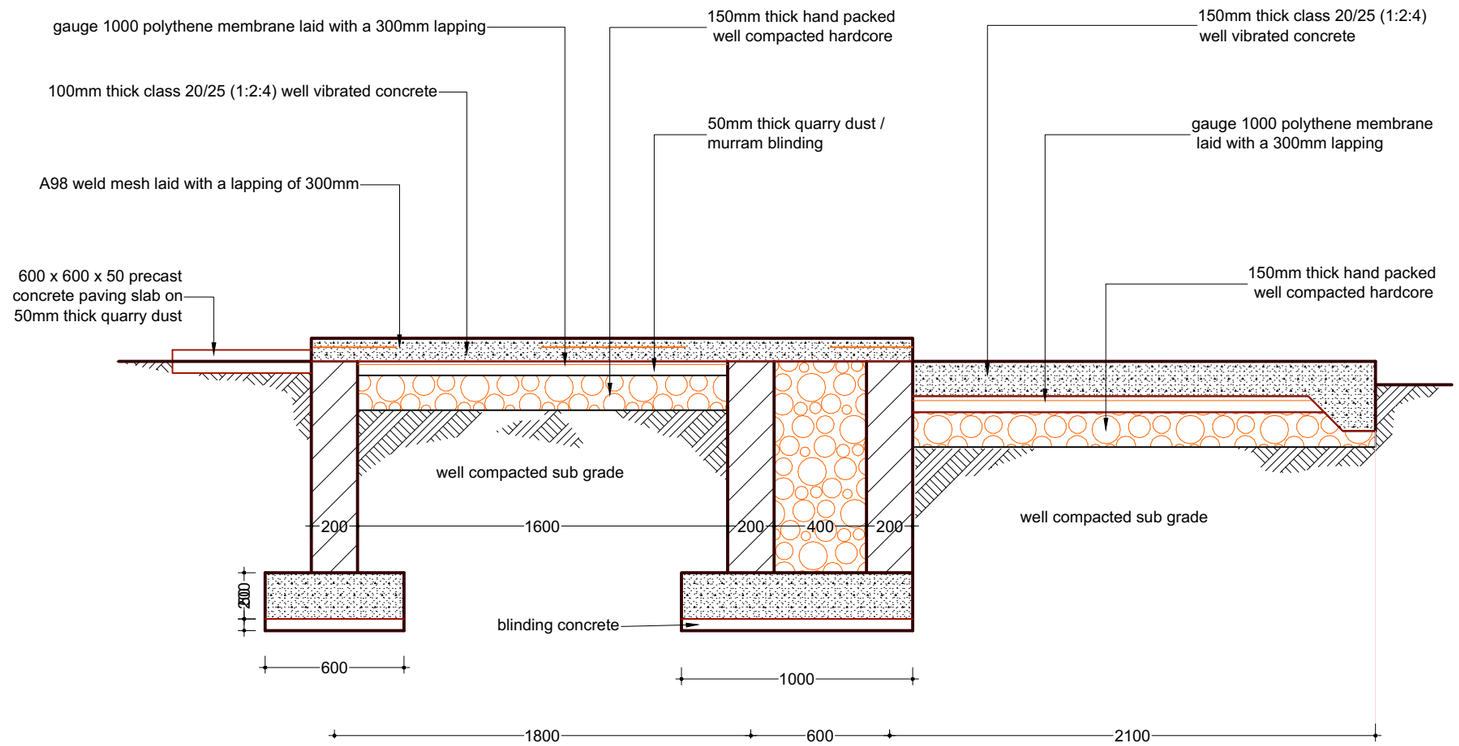
ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (FOUNDATION LAYOUT)

DRAWING DETAILS:	
Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	4 of 16
Drawing No:	NWWDA/WSDP/001



FOUNDATION SECTION
Scale 1:25

NOTES:

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2. All dimensions to be read and confirmed before construction begins and any discrepancy reported to Engineer.
3. Foundation depths to be determined on site but to hard stratum and approved by Engineer on site.
4. All concrete works to be class 20/25.
5. All steel reinforcement to BS4449.
6. Form-work to be fair-finished.
7. Drains under buildings and driveways to be encased in at least 150mm thick concrete.
8. Foundation trenches and concrete works to be treated with approved anti-termite chemical with at least 10 year guarantee.
9. All materials are subject to Engineer's approval before use.

CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (FOUNDATION SECTION)

DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	5 of 16
Drawing No:	NWWDA/WSDP/001

Item	Description	Bar type	Bar mark	Shape	Dimensions (mm)				Length (mm)	Number	Total length (mm)
					A	B	C	D			
1	Foundation Footing	Y10	01	A B A	100	500			700	18	56700mm
		Y10	02	B		2000			2000	14	28,000mm
		Y10	03	A B A	100	1050			1250	7	8750mm

Length of bar is estimated to be 12,000mm

Item	Description	Bar type	Bar mark	Shape	Dimensions (mm)				Length (mm)	Number	Total length (mm)
					A	B	C	D			
1	Columns	Y12	04	A B A	100	800			1000	26	26,000
		Y12	08	A B A	100	1050			1250	10	10,000
		Y12	05	A B	300	1800			2100	16	33,600
		R 8	06	A B	100	100			500	80	40,000
		Y12	07	A B C D	100	1500	300	600	2500	16	40,000

Length of bar is estimated to be 12,000mm

NOTES:

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4. All concrete works to be class 20/25.
5. All steel reinforcement to BS4449.
6. Form-work to be fair-finished.
7. Drains under buildings and driveways to be encased in at least 150mm thick concrete.
8. Foundation trenches and concrete works to be treated with approved anti-termite chemical with at least 10 year guarantee.
9. All materials are subject to Engineer's approval before use.

CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

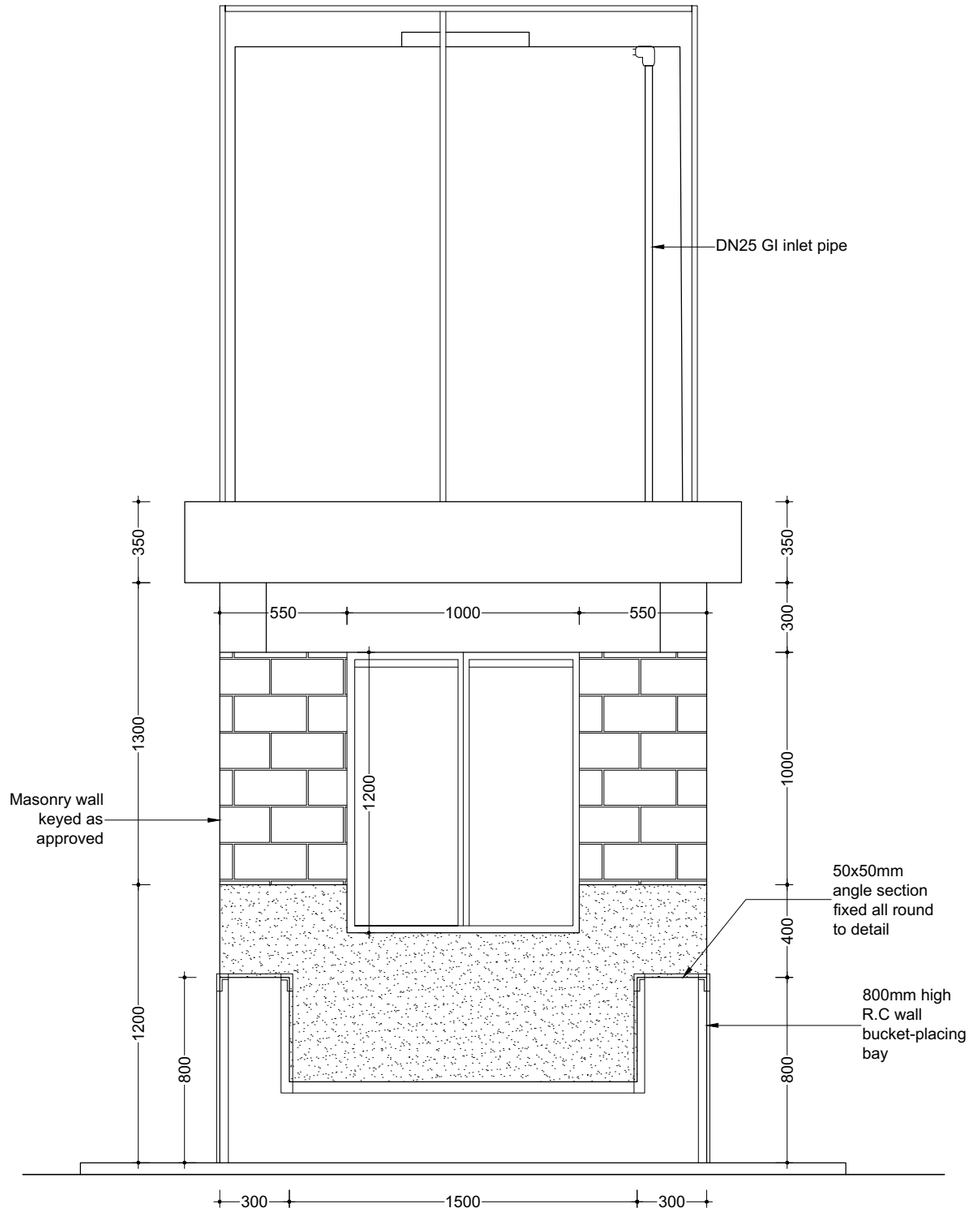
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (FOUNDATIONS & COLUMN BAR SCHEDULE)

DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	10 of 16
Drawing No:	NWWDA/WSDP/001



FRONT ELEVATION
Scale 1:25 (A3)

NOTES:

1. All dimensions are in millimeters unless specified otherwise.
2. All dimensions to be read and confirmed before construction begins and any discrepancy reported to Engineer.
3. Foundation depths to be determined on site but to hard stratum and approved by Engineer on site.
4. All concrete works to be class 20/25.
5. All steel reinforcement to BS4449.
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CLIENT

NORTHERN WATER WORKS DEVELOPMENT AGENCY

PROJECT:

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

CONSTRUCTION OF ADMESAJIDA AND ARBAJAHAN WATER SUPPLY PROJECT

ENGINEER:

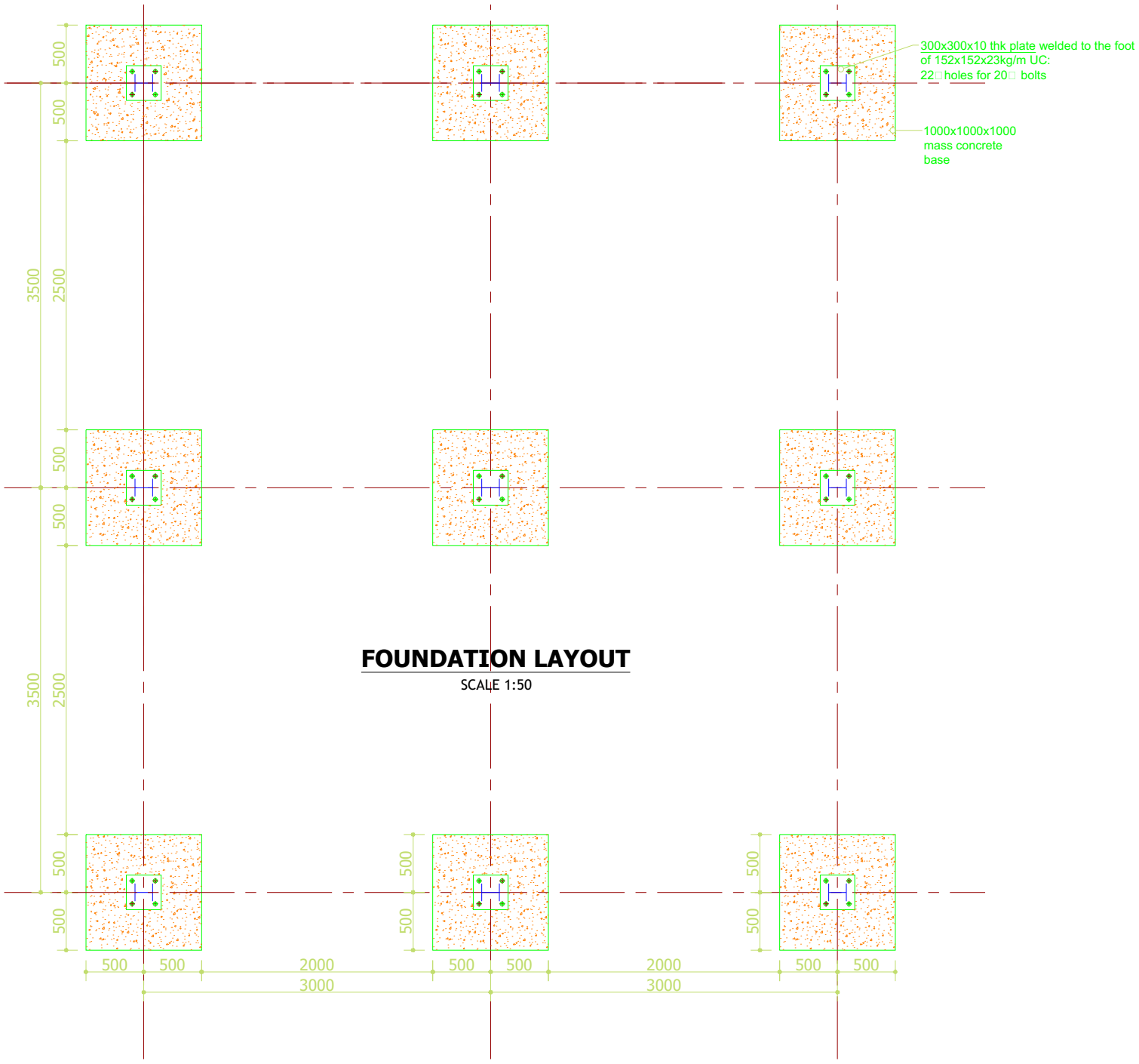
TECHNICAL SERVICES MANAGER
NORTHERN WATER WORKS DEVELOPMENT AGENCY

DRAWING TITLE:

STANDARD WATER KIOSK TYPE 1 (FRONT ELEVATION)

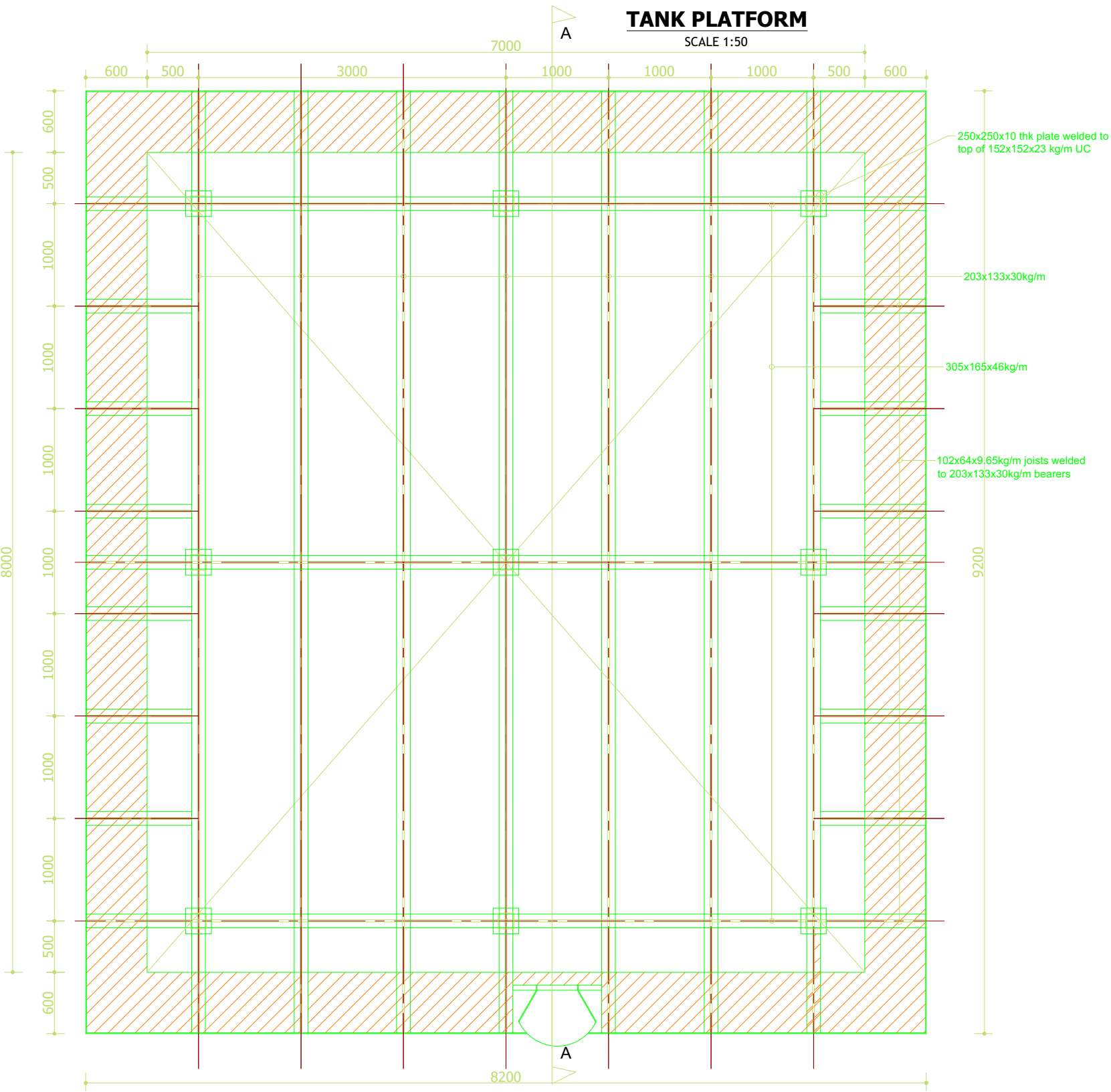
DRAWING DETAILS:

Designed by:	Drawn by:
Eng. Peter Ouma	Kurgat D.K.
Revised by:	Approved by:
	Eng. J. Loveday
Scale:	Date:
As Shown	
Sheet No:	2 of 16
Drawing No:	NWWDA/WSDP/001



FOUNDATION LAYOUT

SCALE 1:50



TANK PLATFORM

SCALE 1:50

NOTES

1. Read this drawing in conjunction with relevant G.A., Services and Architectural drawings. Any descrepancy to be reported to the Engineer.
2. All dimensions are in millimetres unless specified otherwise.
3. All levels are indicated in m unless specified otherwise.
4. All structural concrete to be Class 25 (1:1.5:3) unless stated otherwise.
5. Minimum cover to all reinforcement to be:
   Columns (main bars) = 40mm
   Foundations = 50mm
6. Maximum tolerance on concrete cover is +/- 5mm.
7. All high tensile (Y) and mild steel (R) bars to be in accordance with BS 4449
8. Structural Steel to comply with BS 5950 and Bolts to be Grade 4.8
9. Only figured dimensions to be read, **no scaling** is allowed on this drawing.
10. Nominal aggregate size to be 20mm.
11. Assumed Ground bearing capacity for foundations=200KN/m²

REV	REVISIONS		SIGN	DATE	APPROVED
D	EST Foundation plan	BY	Muturi	30/05	
	resized and redrawn	CHECKED		2016	
C		BY			
		CHECKED			
B		BY			
		CHECKED			
A		BY			
		CHECKED			

Structure Type:

100m³ ELEVATED STEEL TANK

Client:

The Chief Executive Officer
Northern Water Works Development Agency
P. O. Box 495-70100,
GARISSA

Project:

WATER AND SANITATION DEVELOPMENT PROJECT

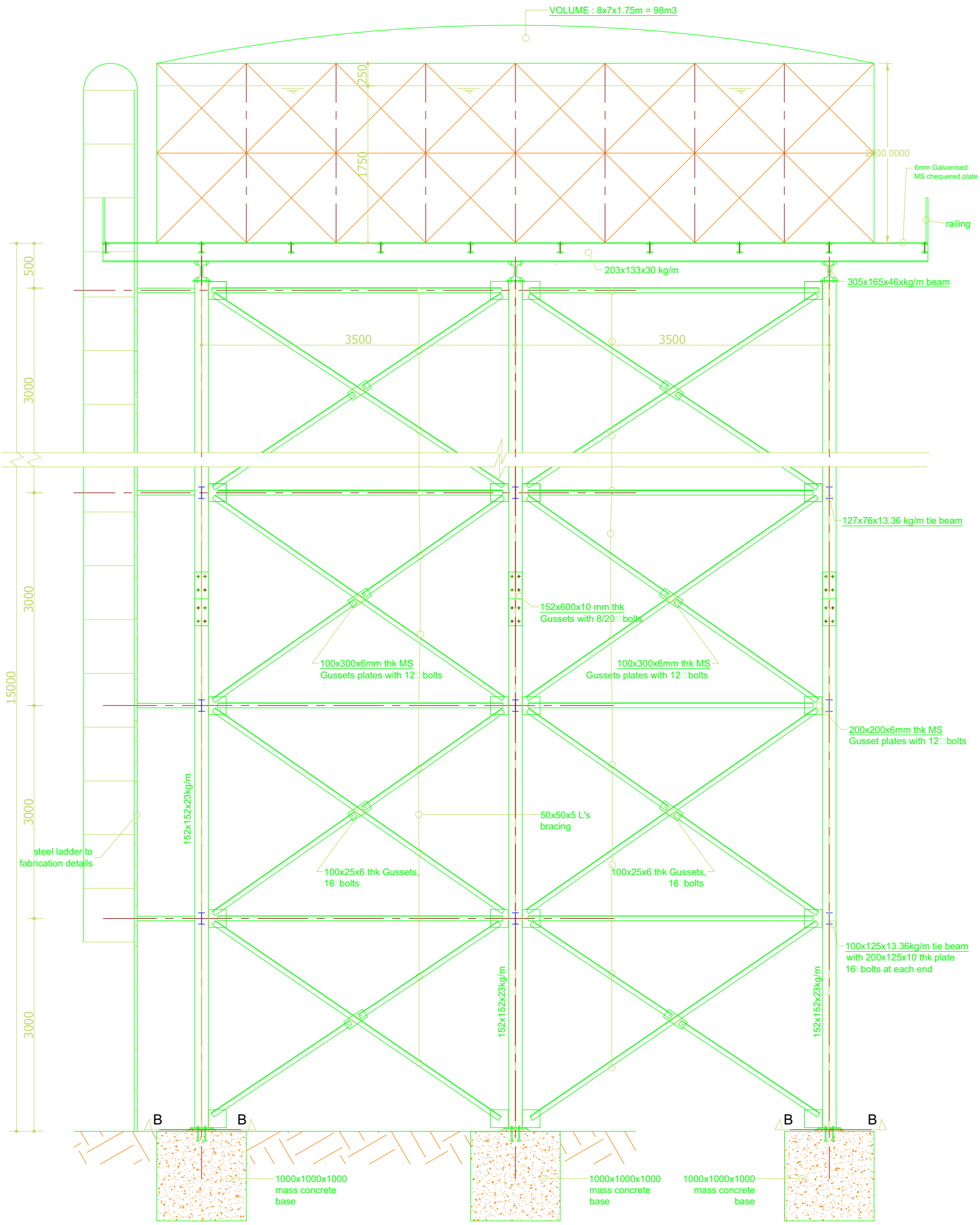
ENGINEER:

The Technical Services Manager
Northern Water Works Development Agency
P. O. Box 495-70100,
GARISSA

Drawing Title:

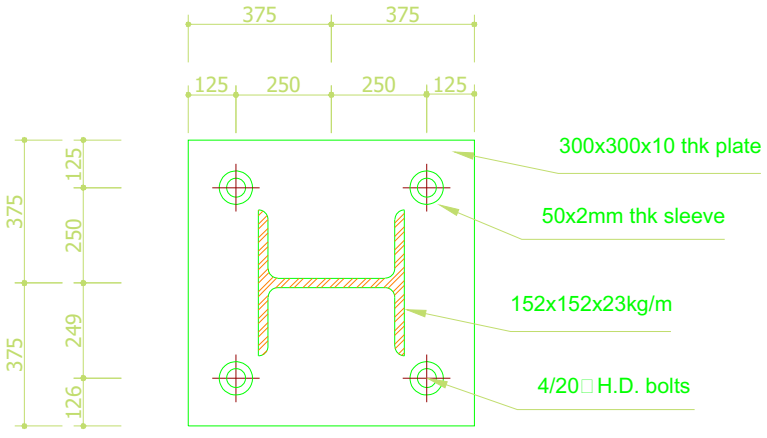
TANK FOUNDATIONS AND PLATFORM

Designed by C.K.O	Drawn by J. Muturi
Checked by Eng Nderi	Approved by
Scales AS SHOWN	Date: August 2021
Job No.	Sheet 1 of 2
P STATUS	DRAWING No. **NWWDA/WSDP/002** REV



SECTION A-A

SCALE 1:50



SECTION B-B

NOTES

1. Read this drawing in conjunction with relevant G.A., Services and Architectural drawings. Any descrepancy to be reported to the Engineer.
2. All dimensions are in millimetres unless specified otherwise.
3. All levels are indicated in m unless specified otherwise.
4. All structural concrete to be Class 25 (1:1.5:3) unless stated otherwise.
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   Columns (main bars) = 40mm
   Foundations = 50mm
6. Maximum tolerance on concrete cover is +/- 5mm.
7. All high tensile (Y) and mild steel (R) bars to be in accordance with BS 4449
8. Structural Steel to comply with BS 5950 and Bolts to be Grade 4.8
9. Only figured dimensions to be read, **no scaling** is allowed on this drawing.
10. Nominal aggregate size to be 20mm.
11. Assumed Ground bearing capacity for foundations=200KN/m²

REV	REVISIONS		SIGN	DATE	APPROVED
D	EST Foundation plan	BY	Muturi	30/05	
	resized and redrawn	CHECKED		2016	
C		BY			
		CHECKED			
B		BY			
		CHECKED			
A		BY			
		CHECKED			

Structure Type:

100m³ ELEVATED STEEL TANK

Client:

The Chief Executive Officer
Northern Water Works
Development Agency
P. O. Box 495-70100,
GARISSA

Project:

WATER AND SANITATION DEVELOPMENT PROJECT

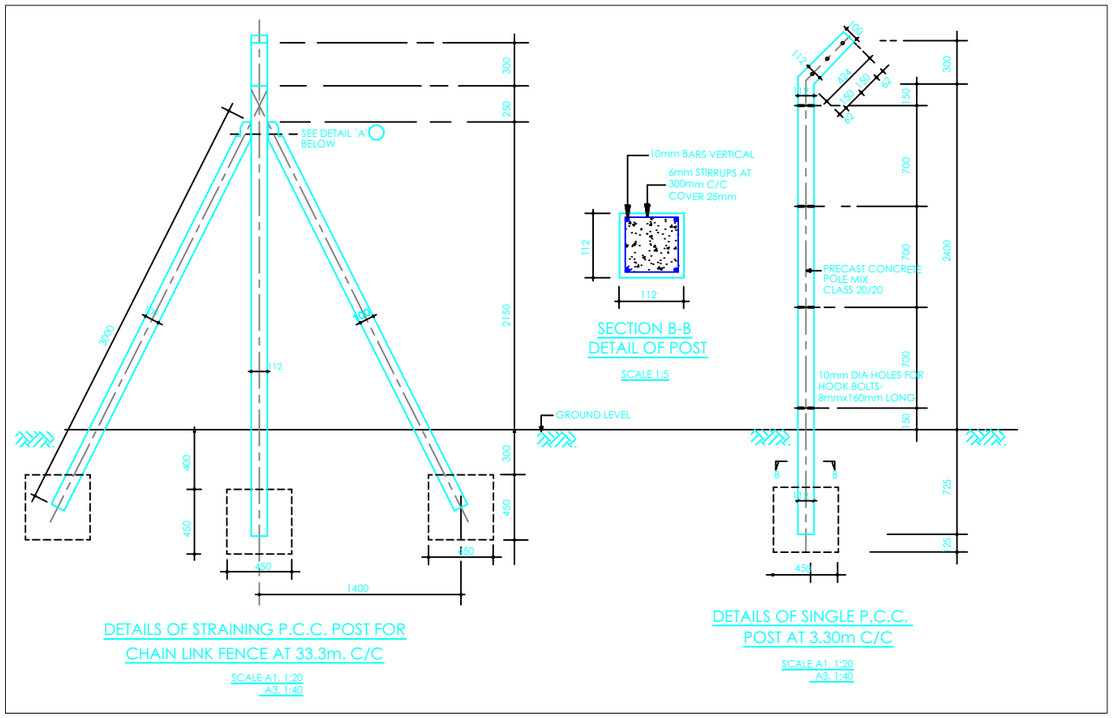
ENGINEER:

The Technical Services Manager
Northern Water Works
Development Agency
P. O. Box 495-70100,
GARISSA

Drawing Title:

STEEL TANK ELEVATION AND BASE PLATE DETAILS

Designed by	C.K.O	Drawn by	J. Muturi
Checked by	Eng Nderi	Approved by	
Scales AS SHOWN		Date:	May 2016
Job No.		Sheet 2 of 2	
P STATUS	DRAWING No.	**NWWDA/WSDP/002**	



DETAILS OF STRAINING P.C.C. POST FOR CHAIN LINK FENCE AT 33.3m. C/C

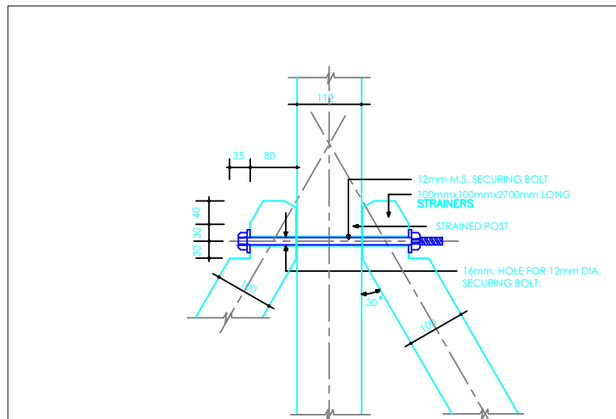
SCALE A1. 1:20
A3. 1:40

SECTION B-B
DETAIL OF POST

SCALE 1:5

DETAILS OF SINGLE P.C.C. POST AT 3.30m C/C

SCALE A1. 1:20
A3. 1:40



DETAIL 'A'

SCALE A1. 1:5
A3. 1:10

NOTES

a) APPROXIMATELLY EVERY 10th POST TO BE STRAINED
b) POST TO BE AT 3300mm CENTRES
c) TOP OF ALL POSTS TO BE KEPT IN UNIFORM LINE.
d) CONCRETE MIXES FOR:
   1. POSTS CLASS 20/20
   2. STRAINER POSTS CLASS 20/20
   3. FOUNDATION BLOCK CLASS 15/20 CONC.
e) CHAIN LINK TO BE IN GAUGE 12 GALVANISED STEEL WIRE.
f) STRAINING WIRES TO BE 12 GAUGE GALVANISED STEEL PLAIN WIRES.
g) WIRES ON CRANK TO BE 12 GAUGE GALVANISED STEEL BARBED WIRE.
h) ALL STRUCTURAL OPENING DIMENSIONS TO BE CONFIRMED ON SITE BEFORE COMMENCING ANY FABRICATION
i) STRAINING WIRES TO BE FIXED TO POST WITH GALVANIZED HOOK BOLTS 8mm DIA.x60mm LONG
j) WHERE THE POST ENCROACHES ON PRIVATE LAND THE FENCE SHOULD BE ERECTED WITH CRANK POINTING TOWARDS THE SITE.

K) ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
L) C/C = CENTRE TO CENTRE.
M) CTs. = CENTRES.
N) M.S = MILD STEEL.
O) P.C.C = PRECAST CEMENT CONCRETE.

REV	REVISIONS	SIGN	DATE	APPROVED
D	FENCE	BY		
		CHECKED		
C		BY		
		CHECKED		
B		BY		
		CHECKED		
A		BY		
		CHECKED		

PROJECT
WATER AND SANITATION DEVELOPMENT PROJECT

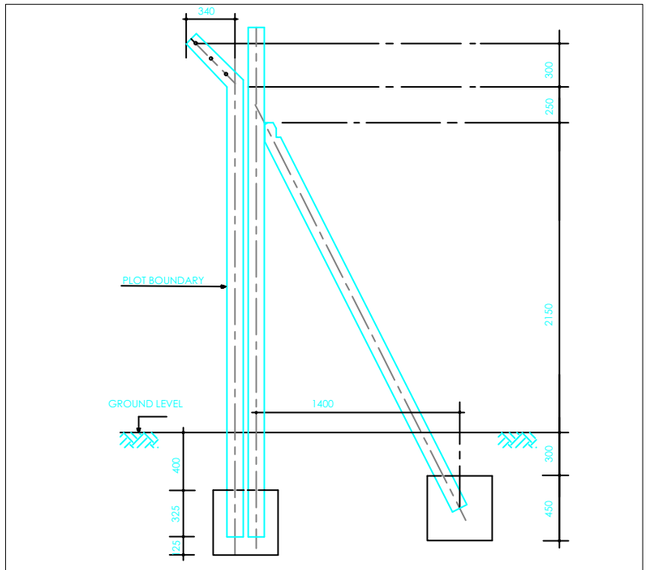
Client:
Northern Water Services Board
P. O. Box 495-70100,
GARISSA

Northern Water Development Agency
P. O. Box 495,
Garissa

Specific Project:
WAJIR W/S PROJECT EXPLORATORY BOREHOLES

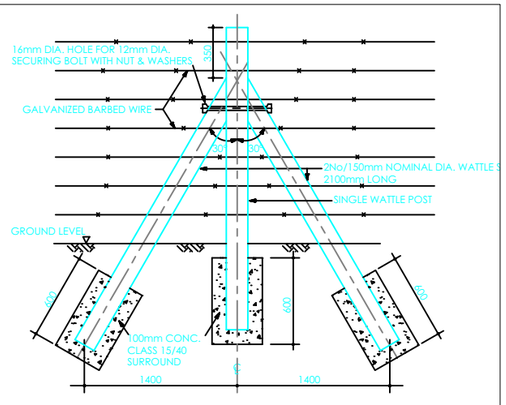
Engineer
The Technical Services Manger
Northern Water Works Development Agency
P. O. Box 495,
Garissa

Drawing Title:
FENCE DETAILS



DETAILS OF CORNER POSTS

SCALE A1. 1:20
A3. 1:40

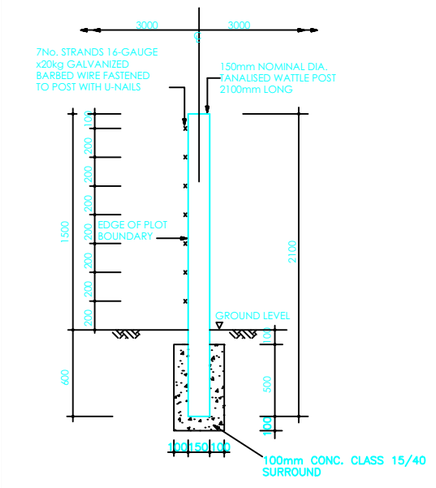


TYPICAL FRONT ELEVATION - STAYED POST
(STAYS TO BE PROVIDED AT 30000mm c/c AND AT CORNERS)

(N.T.S)

NOTES

a) ALL CORNER POSTS AND EVERY 10 SINGLE POST TO HAVE 2No. STAYS
b) POSTS TO BE AT 3000mm CENTRES
c) TOP OF ALL POSTS TO BE KEPT IN UNIFORM LINE
d) EXTENT OF FENCING SHOWN ON THE LAYOUT PLANS
e) N.T.S = NOT TO SCALE
F) ALL DIMENSIONS IN mm



TYPICAL END ELEVATION - SINGLE POST
(TO BE PROVIDED AT 3000mm CENTRES)

(N.T.S)

Surveyed by G. Nyasagare	Drawn by G. Nyasagare
Checked by Eng Nderi	Approved by
Scales 1:1000	Date: June 2021
Job No.	Sheet
P STATUS	DRAWING No.NWWDA/WSDP/003 REV

II. PROJECT IMPLEMENTATION SITE LAND OWNERSHIP DOCUMENTATION

IIA: Land Resolution and Consent form Permit for Ademasajida Livestock Market

COMMUNITY LAND RESOLUTION AND CONSENT FORM FOR LAND USAGE PERMIT No.

ITEM	DESCRIPTION
Project name	WATER AND SANITATION DEVELOPMENT
Name of Investment	EXPLORATORY BOREHOLES
Detailed specifications of investment	MERTI AQUIFER STUDY
Project Location:	ABEMACASA
GPS coordinates and measurement of affected area (m2)	Lat, Long: 1.023934, 39.494806 UTM: 37 554784.6064 113179.61N 37N Affected Area: 0.98 ha
Total area belonging to the community (km²). Please specify under the "Description" column whether it is equivalent to the "catchment area".	1,0579 Km²
Description of impacts	
Specifically, impacts on assets:	
• Trees that will be destroyed	NONE
• Fruit Trees	NONE
• Trees used for other economic or household purposes	NONE
• Mature forest trees	NONE
• Others	N/A
Any other assets that must be moved or will be lost in order to implement the project. If any, please indicate the cost and source of valuation.	N/A
Eventual owner of the land after licence granted for temporary use	WASNACTO

BACKGROUND

Northern Water Works Development Agency (NWWDA) as the project implementing agency and Wajir Water and Sewerage Company (WAJWASCO) as the project operating party will be granted permission in form of a Licence by the Community to use the project area defined in this Community Land resolution and Consent form for Land Usage Permit.

For this reason, we agree to the following terms of agreement.

TERMS OF LICENCE AGREEMENT

This agreement is between ___ Community (the "Community") represented by the undersigned, the Northern Water Works Development Agency (NWWDA) as the project implementing agency, P.O Box 495 Garissa and Wajir Water and Sewerage Company (WAJWASCO) as the project operating party of P.O Box 708 - 70200 WAJIR.

WHEREAS

i. Community Consultations were held on ..... to which all residents of the investment area (specify) ..... were involved (Annex of list of members consulted)

ii. Community representatives were duly nominated, who shall represent the interests of the Community under this agreement and subsequent engagements in this regard. That the following issues under this agreement were discussed and the residents and regular users of this land are in unanimous agreement to grant to northern water works development agency and wajwasco a licence over communal land measuring 0.98 hectors.

iii. Location of the investment details in the map (Annex 3) for purpose of that the land be utilised as the site of the proposed Drilling and equipping of 3 boreholes, Elevated Steel Tank, Water Transmission Mains, Water Kiosks and ancillary works.

iv. The community Land Resolution and Consent form for Land Usage Licence No. ..... and all annexes hereto form part of this agreement.

The Community Represents;

1. We are aware that the land set aside for the investment is community land and no one is claiming individual ownership, because it belongs to the Community, and no alternative claims will be made at a later date on the land.

2. We have all agreed unanimously that the project implementation should continue.

3. We all shall strive to peacefully resolve any conflicts with other communities concerning the investment.

4. We shall all strive to peacefully resolve any conflict arising out of the investment facility following due process provided by the laws of Kenya.

5. The land to be granted for temporary use was identified in consultation with all residents and users (Lary) of the land.

6. We all understand the likely impacts of proposed investment on the licenced land. That include: ---------- N/A ----------

7. We all agreed on this investment and land usage permit / licence without coercion, manipulation, or any form of pressure on the part of public or traditional authorities.

8. We have been informed that we are entitled to request monetary or non-monetary benefits as consideration for the licence, as per World Bank Operational Policy, but have agreed that granting this licence is not conditional upon receiving monetary considerations.

9. We understand that we will have to pay a fee to use water from the borehole, which fee can be adjusted from time to time.

10. We confirm that granting a licence over the project affected land will not adversely affect the livelihoods of occupiers and regular users of the land

11. If any structure will be moved or any access to land is limited as a result of the sub-project, support will be promptly provided by NWWDA to the affected individual or family so their livelihoods are not adversely affected.

12. That the project affected land is free of any encumbrances or encroachment and its ownership is not contested.

13. We understand that any other costs associated to the licence (such as taxes, registration fees, measurement costs, documentation and notarial fees as relevant), will be covered by NWWDA.

14. We understand that granting this licence means that it will be a legally binding arrangement in which WAJWASCO will have full control of the licensed land for the period of the investment operation and NWWDA during project implementation.

Representation by **NWWDA and WAJWASCO:**

a) We understand that the project-affected land is unregistered community land under the laws of Kenya.

b) We understand that this is a licence for use of the project-affected parcel of land, and this licence does not confer proprietary interest over the land.

c) the exploratory borehole at Livestock Market ... shall be equipped for the purpose of supplying water to the community through kiosks and livestock watering point as in kind compensation for drilling the exploratory boreholes.

d) We confirm we will use the granted parcel of land only for the purpose of investment described in on the form and attached to this agreement.

e) 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).

In witness therefore.

1. WAJWASCO
   MANAGING DIRECTOR
   Name : Ali Bashane .... Signature/stamp: ....

2. DIRECTOR COMPANY SECRETARY
   Name : .... Signature/stamp: ....

3. NWWDA
   Ag. CHIEF EXECUTIVE OFFICER (CEO)
   Name : Andrew Ragge .... Signature/stamp: ....

4. COMMISSIONER OF OATH
   Name : .... Signature/stamp: ....

THE COMMUNITY

Those signing below have been recognized as community representatives by all community members and verified by the County Commissioner in a letter dated

S/No.	Name	Village/Location	ID/No.	Signature
1.	Milgo Omar Mohamud	Dejiyar	24328920	[signature]
2.	Habiba Mohamud	Bagdad		[signature]
3.	Abdighani Sahal Adan	Bagdad	23812400	[signature]
4.	Mohamed Kafi Maalim	Qasab	23358308	[signature]
5.	Mohamed Osman Dagane	Sarman	1265699	[signature]

Witnessed on this ...8th... Day of ...MARCH... in the Year...2022...: by:

1. Deputy County Commissioner

Name	ID/No	Signature & R/Stamp
MICHAEL ODUWA	26663915	[signature] [stamp: DEPUTY COUNTY COMMISSIONER, PRIVATE BAG - WAJIR]

2. Area Chief

Name	ID/No.	Signature & R/Stamp
Osman Hassan Ali	22357806	[signature] [stamp: CHIEF ... LOCATION]

3. Ward Administrator

Name	ID/No.	Signature & R/Stamp
Ahmed Adan Abdullahi	22847559	[signature] [stamp: WARD ADMINISTRATOR ADEMASAJIDA WARD WAJIR WEST P. O. Box 9-70200 WAJIR Date:]

4. **Land Registrar/adjudication officer**

Name	ID/No.	Signature & R/Stamp
MAHAMUD KASAM ???	6253040	[signature and stamp]

5. **County Government (Physical Planning Department)**

Name	ID/No.	Signature & R/Stamp
E. N. MUGERU	2844592	COUNTY PHYSICAL PLANNER WAJIR COUNTY P.O. Box 70200 WAJIR Date: [signature]

6. **County Ministry Relevant to the project e.g. Water/Livestock Production etc.**

Name	ID/No.	Designation	Signature & R/Stamp
Mohamed Farah	8761417	Director Water	[signature] MOHAMED FARAH COUNTY DIRECTOR WATER SERVICES

7. **County Project Team Leader**

Name	ID/No.	Signature & R/Stamp
Ali Bashane	13403911	[signature] WAJIR WATER & SEWERAGE CO. LTD MANAGING DIRECTOR P.O. BOX 703-70200, WAJIR

QAHAARKA BULSHADA EE DHULKA IYO FOOMKA OGOLAANSHAHA ISTICMAALKA DHULKA. LAMBARKA-----

Qodob	Faahfaahinta
Magaca mashruuca	NCDP
[illegible]	EXPLORATORY BOREHOLES
Faahfaahin dheeri ah oo ku saabsan maalgelinta	DEEP AQUIFER STUDY
Goobta mashruuca?	ADENYA-SAJIBA
GPS: Xiriirinta iyo cabirka deegaanada waxyeelada qaadan (m2)	Lat, long: 1.023950, 39.494225 UTM: 554954.686E, 113190.61N 37N Affected Area: 0.2 ha
Baaxadda deegaanka bulshada lasiiinayo (km2) Fadlan ku cadee faahfaahinta hoose haddii ey jiraan tahay "meesha biya qabadka". Faahfaahinta aasmeynta	1,059.1 Km²
Si gaar ah u sharaxaynta hantida: Geedaha lega yaabo in la burburiyo • Geedaha qodhaxta • Geedaha loo isticmaalo dhaqaala ahaan oroo ujeeduoyin guriga ah • Geedaha waaweyn ee keymaha • Kuwa kale	 NONE NONE NONE N/A
Haddii ka sta mu kale oo la qaaday ama lumay si mashruuca loo fuliyo. Haddii ey jirto, fadlan cadee qiimaha iyo cidda waxyeelo eysay.	N/A
Milkiilaha rasmiga ah ee dhulka kadib magacda isticmaal ku tooshiigan uh.	N/A
Tirada Ulsha biya lacag la'aan ah la siinaya.	NAIWASCO

Gundhig

Wakaaladda Horumarinta Hawlaha Biyaha ee Waqooyiga (NWWDA) oo ah wakaaladda mashruuca fulinaysa iyo Shirkadda Biyaha iyo bulaacadaha ee Wajeer (WAJWASCO) oo ah wakaaladda ka hawlgelinta mashruucan waxay kaa ogolaan doonaan qaab shati ah oo ay bulshadu ku isticmaali karto goobta mashruuca ee lagu qeexay go'aankan dhulka beesha iyo foomka oggolaanshaha Isticmaalka Dhulka

Si daa awgeed, waxaan ogolnahay eray bixinta heshiiska soo socda.

Eray bixinta heshiiska ruqsada

Heshiis kan waxaa dhex dhexeeyan bulshada ___Ademasajida___ (Bulshada ?), oo metalaysaan dadka hoos ku saxiixan iyo Wakaaladda Horumarinta biyaha ee waqooyiga oo ah wakaaladda fulinta mashruuca, cinwaankeedu yahay 495-garissa, iyo shirkadda wajeer ee biyaha iyo bulaacadaha (WAJWASCO) oo ah hay'adda hawlgelinta mashruuca, cinwaankeedu yahay 708-70200 wajeer.

Halka

i. Wada hadal bulsho ayaa lagu qabtay ....7/3/22...... taas soo dhamsan dadka deegaanka mas'uuliyiin (xaqagaaye) oo ....Ademasajida Location........ay ka qaybgaleen (lifaaqa liiska xubnaha la tala geliyay)

ii. Wakaaladda beesha ayaa si sax ah loo magacaabay, kuwaas oo matali doona xubnaha beesha ka qaybgalka heshiiskan iyo ka qaybgalka xaga [illegible] bulshada ee laxaariira mashruucan. qodobadan hoose ka xusan oo heshiiskan ayaa laga wada hadlay oo dhul oo deegaanka iyo dadka sida joogtada ah u isticmaala dhulkan ay si wada jir ah ugu heshiiyeen in la ruqseeyo Wakaaladda Horumarinta Hawlaha Biyaha ee Waqooyiga iyo shirkadda biyaha iyo bulaacadda wajeer dhulka oo [illegible] dara cabirkisu yahay......0.98..ha

iii. Goobta maalgelinta waxay ku faahfaahsantahay khariidadan (lifaaqa 3) si loogu isticmaalo dhulka sida goobta hortiisay in laga fuliyo dhismaha labo ceel biyood, dhismaha taangi saxe, dhismaha kiyoosyadaa biyaha, dhismaha tuboonyinka biyaha iyo dhismaha dhaanka xoolaha

iv. Qeexaarka dhulka culsha iyo foomka oggolaanshaha isticmaalka dhulka lambar.......................... iyo dhammaan lifaaqyada halkan ku qoran aya qeyb ka ah heshiiskan

Bulshadu waxa ay metelaysaa:

1. Waxaan dhammaan qirsaynaa in dhulka loo qoondeeyay maalgelinta uu yahay dhul bulsho, mana jiro cid gaar u sheegan karta milkiyadiisa sabab too ah waxaa iskale bulsheeda, mana jirto sheega sheeyin hore oo shaqsi mardaaba uu saameyn karo.

2. Waxaan dhammaan si wadajir ah ku ogolaanay in mashruucan fulintiisu ay socoto.

3. Waxaan dhammaanteen ku dadaali doonaa in si nabad ah aan ku xalino qilaaf kasta oo ka yimaada bulshooyinka kale ee maalgelintan ay quseyso.

4. Waxaan dhammaanteen ku dadaali doonaa in aan si nabad ah ku xalino qilaaf kasta oo ka soo baxa goobta maalgelinta iyada oo la raacayo nidaamka qawaaniinta Kenya.

5. Dhulka la bixinayo si ku meel gaar ah ee isticmaalka waxaa lagu xadidayaa iyada oo la tixgelinayo dhammaan dadka dhulka degan iyo isticmaalayaasha (haddii ey jiraan).

6. Waxaan dhammaanteen fahamsanahay saameynta soo ka gulka ah oo maalgelinta la soo jeediyay u uku yeelan karo dhulka la bixiyay. Waxaana ka mid ah: -- N/A --.

7. Waxaan dhammaanteen waafaqsanay maalgelintan iyo ruqsada isticmaalka dhulka iyadoo aysan jirin cadaadis, awood, ama wax cadaadis ah oo la saaray oo kaga yimid masuuliyiinta dowlada ama dhaqanka.

8. Waxaan dhammaanteen nagaan wargeliyay in aan xaq u leenahay in aan dalbano faa'iido lacageed ama faa'iido aan lacag aheyn taa soo u dhigeenta ruqsada si waa faqaan siyaasada shaqa gelinta ee bangiga adduunka, laakiin waxaan waafaqnay in bixinta ruqsadu aysan ku xirneyn helitaan lacag.

9. Waxaan fahamsanahay in aan lexin doono lacag si aan u isticmaalno biyaha ceelka, lacagta waa la bedeli kaaraa waqti kasta.

10. Waxaan xaqiijineynaa in bixinta ruqsada ee dhulka mashruucan saameynta ku leeyahay aysan sixun u saameyn doonin nolosha dadka deganka ah iyo kuwa sida joogtada ah u isticmaala dhulka.

11. Hadii dhismo la rabo ama qeyb kamid mashruuca uu xadido dhul, waxa taageero degdeg ah wakaalada horumarinta biyaha waqooyi u fidin doonta qofka ama qoyska ay dhibaatadu saamaysay si aanay nolashoodu saamayn xun ugu yeelan.

12. Dhulka mashruucu saameeyey waa ka xor xad-gudub iyo lahaansha lagu muransanyahay.

13. Waxaan fahamsanahay in kharash kasta oo ku baxa la xidhiidha sharciga (sida xasiinta, khidmadaha diiwaangelinta, kharashyada canbarka, dukumentiyada iyo khidmadaha notarai sida ay khuseyso), ay daboolidoonto Wakaalada Horumarinta Hawlaha Biyaha ee Waqooyiga(NWWDA)

14. Waxaan fahamsanahay in bixinta shuruudaha ay ka dhigan tahay in uu noqon doono hab sharci ah oo ay WAJWASCO si buuxda u maamusho dhulka sharciga leh muddada hawlgalka maalgashiga iyo Wakaalada Horumarinta Hawlaha Biyaha ee Waqooyiga (NWWDA) inta laga jiro hergelinta mashruuca.

Waxaa mathalaya NWWDA iyo WAJWASCO

a) Waxaan fahamsanahay in dhulka mashruucu saameeyay uu yahay dhul bulsho oo aan ka diiwaan gashaneyn sharciga Kenya.
b) Waxa aanu fahansanahay in karsi yahay sharciga isticmaalka dhulalka uu saameeyay mashruucu, sharcigaanina waa sha mud bixinaya milkada dhulka

c) Ceeska loogu talagalay ceel barista ama xafiinta ee kuyela [illegible] .... waa in loo qalabeeyaa bulshada tusaale ahaan ujeedada tahay in bulshada laga siiya siyo masjid ama iyo meelaha xoolaha laga waraabiyo si ay magdhow ahaan uga helaan

d) Waxa aanu xaqiijinay in aanu u isticmaali doono dhulka ujeedada maalgashiga kaliya ah oo lagu talagalay foomka kuna hilaaqan heshiiskan

e) Waxaan xaqiijinay in xogta kore ay run tahay iyo in aan go'aansanay in aan u hoggaansamno dhammaan shuruudaha heshiiska. (Fadlan ku lifaaq qoraalada shirka bulshada oo ay ku jiraan xaashida xaadirinta oo saxeexan iyo sawirada kulanka)

Oo mergaati ka yihiin,

1. AGASIMAHA MAMULKA

SHIRKADA BIYAHA IYO BULACDA WAJEER(WAJWASCO)

Magaca: Ali Bashane saxiixa iyo shaabad: ....

2. XOGHAYAHA SHIRKADA WAJWASCO.

Magaca: ....Omar...... saxiixa iyo shaabad: ....

3. KUSIMAHA MADAXA FULINTA

WAKAALLADDA HORUMARINTA BIYAHA EE WOQOOYIGA(NWWDA)

Magaca: Abdiwali.......Rage.........saxiix iyo shaabad: ....

4. MARQAATI

QAREEN AMA GARYAQAAN

Magaca .... shaabadda iyo saxiixa: ....

Bulshada

Dadka hoos ku saxiixan waxa loo aqoonsaday inay yihiin wakiilo dhammaan xubnaha beesha mathalaya, waxaana ku caddeeyey Guddoomiyaha Gobolka warqad ku taariikhaysan.

S/lambar.	Magaca	Xaafadda/ deegaanka	Lambarka aqoonsiga.	Saxiixa
v.	Abdigadafi Saban	Bagdad	2388900	
vi.	Mohamed Kafo	Qalab	23358368	
vii	Habiba Mohamed	Bagdad		
viii.	Mohamed Osman	Saman	1265699	
ix.	Milgo Omar Mohd	Bojiyare	24388920	

Waxaa marqaati ah .... maalinta .... sanadka.....................:

1. Gudoomiyaha ismaamulka

Magaca	Lambarka aqonsiga	Saxiixa iyo shaabadda
Michael Obulwa	20663...	2022

2. Gudoomiyaha waaxda

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
Osman Hassan Ali	2335...	

3. Maamulaha laanta

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
Ahmed Adan Abdullah	22897...	

4. Diiwaan hayaha dhulka/ sarkaalka xukunka

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
Mahamud Kasai M.	003304...	

5. Ismaamulka gobolka (waaxda qorsheynta)

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
E N Muchiri	21846...	

6. Wasaaradda ismaamulka ee ey quseyso mashruuca tusaale biyaha iyo xoolaha IWM

Magaca	Lambarka aqonsiga	Saxiixa iyo shaabadda
Mohamed Farah	876147	

7. Horjoogaha mashruuca ismaamulka

Magaca	aqonsiga/lambar	Saxiixa iyo shaabadda
Ali Bashane	134391...	

IIB: Land Documentations for Waso Girls

WASO GIRLS BOARD OF MANAGEMENT MEETING HELD ON 9TH /8/2021 IN THE STAFFROOM AT 4.00PM

MEMBERS PRESENT

HASSAN ABDIKARIM-CHAIRMAN
ABDOW ABDULLAH-SPECIAL INTEREST GROUP
HALIMA O MOHAMED-SECRETARY
RUKIA ALI-(PWD)
SULTAN ALI-MEMBER
FATUMA DAUD-MEMBER
HABIBA HASSAN-MEMBER
ISMAIL ABDIKADIR-MEMBER
SAUDA ABDULLAH-MEMBER
ABDINOOR ABDI-MEMBER
ABDIAZIZ GABOW-D/HEADTEACHER
HAFSA ABDIKADIR-HEADGIRL

ABSENT WITH APOLOGY

OSMAN MADOBE
SH MOHAMUD HUSSEIN

AGENDA

PRAYER

1. DRILLING OF BOREHOLE
2. A.O.B

MIN/001/PRAYER

The meeting was opened by Headteacher and assigned Mr Abdiaziz to led prayer.The Headteacher welcomed the board of management for the meeting.

MIN/002/DRILLING OF BOREHOLE

Waso Girls primary/secondary and local community at large experienced shortage of water over the years due to that Waso Girls primary board members agreed on drilling of borehole within Waso Girls pry compound that will supply water to Waso Girls pry/sec and local communities at large. The board members also decided that the borehole should be out of bounds for domestic animals.

Boards also requested for well equipped water storage, solar panel and taps for Waso Girls pry

MIN/003/A.O.B

No any other business the meeting was closed with word of prayer from Mr Abdiaziz

Halima Omar

Headteacher

HEAD TEACHER
WASO GIRLS PRY SCHOOL

Date

COUNTY COUNCIL OF WAJIR

Serial No. 1560

P.O. Box 9, Wajir
Tel: (046) 421027

Our Ref: NO. ADA/WGPS/002

Date: 22/01/2013

To: KIASO GIRLS PRIMARY SCHOOL
P.O. BOX 53-7024
HARAKA ESTATE

Dear Sir/Madam,

RE: ALLOCATION OF A PLOT.

1. I have the pleasure to inform you that you have been allocated plot No. ADA/WGPS/0.2 size (approximate) 200ACRES at ADEMASAJIDA Township of ADEMASAJIDA Location/Ward,
Vide The Town Planning, Markets and Works Committee meeting held on 13/09/2011 under minutes NO. 16/03/2011 and adopted by Full Council Meeting under minutes NO. 13/03/2011 held on 15/07/2011
2. You are required within (30) days from the date of offer to pay the following fees to the Council to signify your acceptance, failure to which the offer shall be nullified.

(i)	Application Fees	Kshs.	500/=
(ii)	Land acquisition Fees	Kshs.	2000/=
(iii)	Survey Fees	Kshs.	
(iv)	Showing Fees	Kshs.	
(v)	Administration Fees	Kshs.	1500/=
(vi)	Annual Rates on demand	Kshs.	
(vii)	Other Fees	Kshs.	
	TOTAL	Kshs.	4000/=

3. The Land and Building shall only be used for the purpose described in the Application Form for the plot and any change of user must be approved by the Council. Any development on the said plot must be in accordance with the Council By-Laws and any other Laws in the Land.
4. You will be required to develop the plot within Twenty Four (24) months. Failure to develop the plot within the stipulated period the Council will reposes the plot and re-allocate to deserving residents.
5. Upon payment of the above fees the Council will arrange to show you the plot on the ground.
6. Please read the special conditions listed overleaf and abide yourself to the aforementioned conditions.
7. Further, this letter of offer must be attested by the County Clerk by appending his/her signature with the authority of the Council Seal.

COUNTY CLERK
COUNTY COUNCIL OF WAJIR

(See Over Leaf)

IIC: Land Resolution and Consent form Permit for Arbajahan Community

COMMUNITY LAND RESOLUTION AND CONSENT FORM FOR LAND USAGE PERMIT No.

ITEM	DESCRIPTION
Project name	WATER AND SANITATION DEVELOPMENT
Name of investment	EXPLORATORY BOREHOLES
Detailed specifications of investment	MERTI AQUIFER STUDY
Project Location:	ARBAJAHAN
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Total area belonging to the community (km²). Please specify under the "Description" column whether it is equivalent to the "catchment area".	563.8 Km²
Description of impacts	
Specifically, impacts on assets:	
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• Fruit Trees	NONE
• Trees used for other economic or household purposes	NONE
• Mature forest trees	NONE
• Others	N/A
Any other assets that must be moved or will be lost in order to implement the project. If any, please indicate the cost and source of valuation.	N/A
Eventual owner of the land after licence granted for temporary use	NAWASCO

BACKGROUND

Northern Water Works Development Agency (NWWDA) as the project implementing agency and Wajir Water and Sewerage Company (WAJWASCO) as the project operating party will be granted permission in form of a licence by the Community to use the project area defined in this Community Land resolution and Consent form for Land Usage Permit.

For this reason, we agree to the following terms of agreement.

TERMS OF LICENCE AGREEMENT

This agreement is between Ifo Arbajahan Community (the "Community") represented by the undersigned, the Northern Water Works Development Agency (NWWDA) as the project implementing agency, P.O Box 495 Garissa and Wajir Water and Sewerage Company (WAJWASCO) as the project operating party of P.O Box 706 - 70200 WAJIR.

WHEREAS

i. Community Consultations were held on ...7th August 2020... to which all residents of the investment area (specify) ...Arbajahan location... were involved (Annex of list of members consulted)

ii. Community representatives were duly nominated, who shall represent the interests of the Community under this agreement and subsequent engagements in this regard. That the following issues under this agreement were discussed and the residents and regular users of this land are in unanimous agreement to grant to northern water works development agency and wajwasco a licence over cumulative land measuring 1.84 hectors.

iii. Location of the investment detailed in the map (Annex 3) for purpose of that the land be utilized as the site of the proposed Drilling and equipping of 2 boreholes, Elevated Steel Tank, Water Transmission Mains, Water Kiosks and auxiliary works.

iv. The community Land Resolution and Consent form for Land Usage Licence No. ---------- and all annexes hereto form part of this agreement.

The Community Represents;

1. We are all aware that the land set aside for the investment is community land and no one is claiming individual ownership, because it belongs to the Community, and no alternative claims will be made at a later date on the land.

2. We have all agreed unanimously that the project implementation should continue.

3. We all shall strive to peacefully resolve any conflicts with other communities concerning the investment.

4. We shall all strive to peacefully resolve any conflict arising out of the investment facility following due process provided by the laws of Kenya.

5. The land to be granted for temporary use was identified in consultation with all residents and users (if any) of the land.

6. We all understand the likely impacts of proposed investment on the licenced land. That includes: ..... N/A .....

7. We all agreed to this investment and land usage permit / licence without coercion, manipulation, or any form of pressure on the part of public or traditional authorities.

8. We have been informed that we are entitled to request monetary or non-monetary benefits as consideration for the licence, as per World Bank Operational Policy, but have agreed that granting this licence is not conditional upon receiving monetary considerations.

9. We understand that we will have to pay a fee to use water from the borehole, which fee can be adjusted from time to time.

10. We confirm that granting a licence over the project-affected land will not adversely affect the livelihoods of occupiers and regular users of the land.

11. If any structure will be moved or any access to land is limited as a result of the sub-project, support will be promptly provided by NWWDA to the affected individual or family so their livelihoods are not adversely affected.

12. That the project affected land is free of any encumbrances or encroachment and its ownership is not contested.

13. We understand that any other costs associated to the licence (such as taxes, registration fees, reinstatement costs, documentation and notarial fees as relevant), will be covered by NWWDA.

14. We understand that granting this licence means that it will be a legally binding arrangement in which WAJWASCO will have full control of the licensed land for the period of the investment operation and NWWDA during project implementation.

Representation by NWWDA and WAJWASCO:

a) We understand that the project-affected land is unregistered community land under the laws of Kenya.

b) We understand that this is a licence for use of the project-affected parcel of land, and this licence does not confer proprietary interest over the land.

c) the exploratory borehole at---Adeejaban Primary -- shall be equipped for the purpose of supplying water to the community through kiosks and livestock watering point as in-kind compensation for drilling the exploratory boreholes.

d) We confirm we will use the granted parcel of land only for the purpose of investment described in on the form and attached to this agreement.

e) 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)

In witness thereof,

1. WAJWASCO
MANAGING DIRECTOR
Name: ALI BASHAWE Signature/stamp: .....

2. DIRECTOR COMPANY SECRETARY
Name: ..... Signature/stamp: .....

3. NWWDA
Ag. CHIEF EXECUTIVE OFFICER (CEO)
Name: Andrew Kage Signature/stamp: .....

4. COMMISSIONER OF OATH
Name: ..... Signature/stamp: .....

THE COMMUNITY

Those signing below have been recognized as community representatives by all community members and verified by the County Commissioner in a letter dated

S/No.	Name	Village/Location	ID/No.	Signature
1.	BOGOR ALI MUSE	ALBAJAHAN	02178[illegible]	
2.	SUGULE MOHAMED ABDI	ARBAJAHAN	05465435	
3.	ABDI DUNTO HARSI	BULLA MADINA	05452647	
4.	MARYAM MURAW ABDI	ARBAJAHAN	34927705	
5.	RAHMA ABDILLE MAALIM	ARBAJAHAN	34030071	

Witnessed on this 7TH Day of MARCH in the Year 2022 by:

1. **Deputy County Commissioner**

Name	ID/No.	Signature & R/Stamp
SAMUEL KIMANI	15702581	

2. **Area Chief**

Name	ID/No.	Signature & R/Stamp
IBRAHIM HUSSEIN DAUD	20992279	

3. **Ward Administrator**

Name	ID/No.	Signature & R/Stamp
SHUKRI OSMAN ELMI	29158923	

4. **Land Registrar/adjudication officer**

Name	ID/No.	Signature & R/Stamp
MAHAMUD KASAH M.	0053040	[signature]

5. **County Government (Physical Planning Department)**

Name	ID/No.	Signature & R/Stamp
J. H. MUCHEW	8184692	[signature] COUNTY PHYSICAL PLANNER WAJIR COUNTY P.O. Box 9 - 70200, WAJIR Date:

6. **County Ministry Relevant to the project e.g. Water/Livestock Production etc.**

Name	ID/No.	Designation	Signature & R/Stamp
Mohamed Farah	8761417	Director Water	[signature] MOHAMED FARAH COUNTY DIRECTOR WATER SERVICES

7. **County Project Team Leader**

Name	ID/No.	Signature & R/Stamp
ALI BASHANE	13403913	[signature] WAJIR WATER & SEWERAGE CO. LTD MANAGING DIRECTOR Date:

QARAAFKA BULSHADA EE DHULKA IYO FOOMKA OGOLAANSHAHA ISTICMAALKA DHULKA. LAMBARKA-----

Qodob	Faahfaahinta
Magaca mashruuca	WATER & SANITATION DEPT (WSD)
Magaca maalgelinta	EXPLORATORY BOREHOLES
Faahfaahin dheeri ah oo ku saabsan maalgelinta	MERTI AQUIFER STUDY
Goob'ta mashruuca?	AREA LAMAN
GPS Xiriirinta iyo cabirka deegaanada waxyeelada gaartay (m2)	[illegible] Affected Area = [illegible]
Baaxadda deegaanka bulshada loodahay (km²). Fadlan ku cadee faahfaahinta hoosteeda haddii ey la mid tahay "bogga hoya qabadka".	563.8 Km²
Faahfaahinta saan eynta	
Si gaar ah sawaynta cantida: Geedaha laga yaabo in la burburiyo.	
• Geedaha guduarta	NONE
• Geedaha loo isticmaalo dhuqaala shaan ama ujeedooyin guriga ah	NONE
• Geedaha waaweyn ee keymaha	NONE
• Kuwo kale	N/A
Haddii dhismo ee kale oo la qaaday ama rentay si mashruuca loo fuliyo. Haddii ey jiro, fadlan cadee qiimaha iyo cidda wax siimeysay.	N/A
Milkiilaha rasmiga ah ee dhulka kadib rugaada isticmaal ama meel gaar ah.	N/A
Tirada kiiska biyo lacag la'aan ah la siinaya.	WATWASCO

Gundhig

Wakaaladda Horumarinta Hawlaha Biyaha ee Waqooyiga (NWWDA) oo ah wakaaladda mashruuca fulinaysa iyo Shirkadda Biyaha iyo bulaacadaha ee Wajeer (WAJWASCO) oo ah wakaaladda ka hawlgalisa mashruuca waxa loo ogolaan doonaa qaab shati ah oo ay dulsaaradu ku isticmaali karto goobta mashruuca ee lagu qeexay gal'aankan dhulka beesha iyo foomka oggolaanshaha Isticmaalka Dhulka.

Si dee awgeed, waxaan ogolanshay eray bixinta heshiiska soo socda.

Eray bixinta heshiiska ruqsada

Heshiis aan waxa ina dhexeeyaa bulshada ___Arbajahan___ (Bulshada ?), ee metalayaan dadka hoos ku saxiixan iyo Wakaaladda horumarinta biyaha ee waqooyiga oo ah wakaaladda fulinta mashruuca, cinwaankeedu yahay 495-garissa, iyo shirkadda wajeer ee biyaha iyo bulaacadaha (WAJWASCO) oo ah hay'adda hawlgelinta mashruuca, cinwaankeedu yahay 705-70200 wajeer.

Halka

i. Waqtiga iyo lo'oo ayaa lagu qeexay ...7/8/22....... ilaa soo dhamaan dhulka loogu asaaska mashruuca (magaceeda) ee ......Arbajahan.....location.............ay kageyb galeen (lifaaqa hiska xulashada 'ala geliyay)

ii. Wakiilsoa beesha ayaa si sax ah loo magacaabay, kuwaas oo matali doona xubnaha beesha ku qeybgalka heshiiskan iyo ka qeybqalka xaga arrimaha bulshada ee ilaalinta mashruucan. godobadan hoos ku xusan ee heshiiskan aya lagu wada habay oo dadka deegaanka iyo dadka sida joogtada ah u isticmaala dhulkan oo si wadajir ah ugu heshiiyeen in loo raqeeyo Wakaaladda Horumarinta Hawlaha Biyaha ee Waqooyiga iyo shirkadda biyaha iyo bulacda wajeer dhulka aan kilkishu daro cabirkiisu yahay-----434 km

iii. Goobta masalpelinta waxey ku fashfaaseentshay khariidadka (lifaaqa 3) si loogu isticmaalo dhulka sida goobta loo hindisay in lagu fuliyo dismaha labaa ceel biyood, dismaha taangi saare, dismaha kiyoosyada biyaha, dismaha tuboonyinka biyaha iyo dismaha dareeka xoolaha.

iv. Qaraarka dhulka bulsha iyo foomka ogolaanshaha isticmaalka dhulka lambar------ ------------------- iyo dhammaan lifaaqyada halkan kogoran aya qeyb ka ah heshiiskan.

Bulshadu waxa ay metelayaa:

1. Waxaan dhamaan qireynaa in dhulka loo qoondeeyay maalgelinta uu yahay dhul bulsho, mana jiro cid gaar u sheegan karta milkiyadiisa sabab loo ah waxaa iska leh bulshada, mana jirto sheega shooyin kale oo sheegasi mardanba uu sameyn karo.

2. Waxaan dhamaan si wadajir ah ku ogolaanay in mashruucan loo fuliyo sidii uu socoto.

3. Waxaan dhamaanteen ku dadaali doonaa in si nabad ah aan ku xalino qilaaf kasta oo ka yimaada bulshooyinka kale oo maalgelintan ay quseyso.

4. Waxaan dhamaanteen ku dadaali doonaa in aan si nabad ah ku xalino qilaaf kasta oo ka soo baxa goobta maalgelinta iyada oo la raacayo nidaamka qawaaniinta Kenya.

5. Dhulka la lexinayo si ku meel gaar loogu isticmaalo waxaa lagu xadideyaa iyada oo la la wadaxaayo dhamaan dadka dhulka degan iyo isticmaalayaasha (Haddii ay jiraan).

6. Waxaan dhamaanteen fahansanahay saameynta suurta galka ah ee maalgelinta la soo jeediyay u ku yeelan karo dhulka la baxiyay. Waxaana ka mid ah: -- N/A -- .

7. Waxaan dhamaanteen waafaqsanay maalgelintan iyo ruqsada isticmaalka dhulka iyada oo aysan jirin qasab, awood, ama wax cadaadis ah oo la saaray oo kaga yimid masuuliyiinta dowlada ama dhaqanka.

8. Waxaan dhamaanteen nagula wargeliyay in aan xaq u leenahay in aan dalbano lacag dheeraad ah ama faa'iido aan lacag ahayn taa soo u dhiganta ruqsada si waafaqsan siyaasada shaqa gelinta ee bangiga adduunka, laakiin waxaan waafaqsanay in bixinta ruqsadu aysan ku xirnayn bixinta lacag.

9. Waxaan fahamsanahay in aan xaq u leenahay in aan dalban karno lacag si aan u isticmaalno biyaha ceelka, lacagta waa la bedeli karaa waqti kasta.

10. Waxaan xaqiijineynaa in bixinta ruqsada ee dhulka mashruucu saameynta ku leeyahay aysan sixun u saameyn doonin nolosha dadka deganka ah iyo kuwa sida joogtada ah u isticmaala dhulka.

11. Haddii ay jiraan wax qayb kamid ah mashruuca oo saddexdu dhul, waxa taageero degdeg ah Wakaaladda Horumarinta Biyaha Waqooyi u fidin doonta qofka ama qoyska ay dhibaatadu saamaysay si ay u noolaadaan saamayn xun ugu yeelan.

12. Dhulka mashruucu saameeyey waa kuxuu xadgudub iyo lahaansha laga muransanyahay.

13. Waxaan fahamsanahay in kharash kasta oo kale oo la xidhiidha shartiga (sida cashuurta, khidmadaha diiwaangelinta, kharashyada cabbirka, dukumentiyada iyo khidmadaha noocyo kale ah ay khuseeyaan), ay qaadi doonto Wakaaladda Horumarinta Hawlaha Biyaha ee Waqooyiga(NWWDA)

14. Waxaan fahamsanahay in bixinta shartigan ay ka dhigan tahay in uu noqon doono hab ahaan ah oo ay WAJWASCO si buuxda u maamusho dhulka shartiga leh muddada hawlgalka maalgashiga iyo Wakaaladda Horumarinta Hawlaha Biyaha ee Waqooyiga (NWWDA) inta laga jiro hergelinta mashruuca.

Waxaa mathalaya NWWDA iyo WAJWASCO

a) Waxaan fahamsanahay in dhulka mashruuca saameeyay uu yahay dhul bulsho oo aan ka diiwaan gashaneyn sharciga Kiinya.
b) Waxaan fahamsanahay in Sami yahay shariga isticmaalka dhulalka uu saameeyay mashruuca, shardigan ma aha mid bixinaya milkida dhulka

c) Ceelka ingutalagaaray ceel baraste ama sahminta ee kuyala [illegible] waa in loo qalabeeyaa bulshada taas oo qaadada tahay in bulshada laga qiya siya maqaarada iyo meelaha koolaba laga warsabiyo si ay maqdhow ahaan ugu helaan.

d) Waxaan ogolaanay in aanu u isticmaali doono dhulka qeedada maalgashiga kaliya oo lagu tilmaamay foomka kuna lifaaqan heshiiskan

e) Waxaan Xaqiiji in sagta kore ay run tahay iyo in aan go'aansaday in aan u noqonaysanu dhammaan shuruudaha heshiiska. (Fadlan ku lifaaq qoraalada shirka beesha oo ay ku jiraan xaashida xaadirinta oo saxeexan iyo sawirada kulanka)

Oo mergasta ka yihiin,

1. AGASIMAHA MAMULKA

SHIRKADA BIYAHA IYO BULACDA WAJEER(WAJWASCO)

Magaca: ALI BASHANE saxiixa iyo shaabad:

2. XOGHAYAHA SHIRKADA WAJWASCO.

Magaca: Ahmed Amed saxiixa iyo shaabad:

3. KUSIMAHA MADAXA FULINTA

WAKAALLADDA HORUMARINTA BIYAHA EE WOQOOYIGA(NWWDA)

Magaca: Andrew Rage saxiix iyo shaabad:

4. MARQAATI:

QAREEN AMA GARYAQAAN

Magaca shaabadda iyo saxiixa:

Bulshada

Dadka hoos ku saxiixan waxa ay aqoonsaday inay yihiin wakiilo dhammaan xubnaha beesha mathalaya, waxaana ku saddeeyey Guddoomiyaha Gobolka warqad ku taariikhaysan.

S/lambar	Magaca	Xaafadda/ deegaanka	Lambarka aqoonsiga.	Saxiixa
v.	BOGOR ALI MAISE	ABAKOREYAN	0219776	
vi.	SUGULE MOHAMED ABDI	ABAKOREYAN	0545185	
vii.	IDHAW DUNTO HIBSI	BULLA MADINA	0545264	
viii.	MARYAM NUR ROBLE FATIN	ABAKOREYAN	EH 92704	
ix.	RAHAL ABDILLE MAALIM	ABAKOREYAN	34030077	

Waxaa marqaati ah ...7..... maalinta ...March..... sanadka...2022............:

1. Gudoomiyaha ismaamulka

Magaca	Lambarka aqonsiga	Saxiixa iyo shaabadda
SAMWIL KAMAU	13768524	DEPUTY COUNTY COMMISSIONER WAJIR WEST SUB-COUNTY 08 MAR 2022

2. Gudoomiyaha waaxda

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
Ibrahim Hussein Ahmed	20592235	WAJIR COUNTY

3. Maamulaha laanta

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
SHUKRI OSMAN ALI	29158923	WAJIR COUNTY GOVERNMENT WARD ADMINISTRATOR ARBAJAHAN P.O. BOX 570700 WAJIR

4. Diiwaan hayaha dhulka/ sarkaalka xukunka

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
MAHAMUD KASAI M.	5053046	

5. Ismaamulka gobolka (waaxda qorsheynta)

Magaca	Lambarka aqonsiga.	Saxiixa iyo shaabadda
E. N MUCHEJU	21824622	COUNTY PHYSICAL PLANNER WAJIR COUNTY P.O. BOX 555 - 70200, WAJIR Date:

6. Wasaaradda ismaamulka ee ey quseyso mashruuca tusaale biyaha iyo xoolaha IWM

Magaca	Lambarka aqonsiga	Saxiixa iyo shaabadda
Mohamed Farah	8761417	COUNTY DIRECTOR WATER SERVICES

7. Horjoogaha mashruuca ismaamulka

Magaca	aqonsiga/lambar.	Saxiixa iyo shaabadda
Ali Bashir	B403915	WAJIR WATER & SEWERAGE CO. LTD. MANAGING DIRECTOR Date: 07/3/2022

IID: Land Documentations for Arbajahan Primary School

ARBAJAHAN PRIMARY SCHOOL,
P O BOX 281-70200,
WAJIR,
15TH MARCH 2022.

THE CHIEF EXECUTIVE OFFICER,
NORTHERN WATER WORKS DEVELOPMENT AGENCY,
P.O BOX 495-70100,
GARISSA.

Dear Sir/ Madam,

RE: BOREHOLE DRILLING AND WATER SUPPLY IN THE SCHOOL

The Arbajahan Primary School Management Committee held a meeting on 15th of March 2022 on the proposed drilling of an exploratory borehole in the school compound. This is after hydrogeological surveys and geophysical investigations were conducted in Arbajahan area, hence the spot surveyed in the school was found to be promising of a good yielding borehole.

The school highly welcomes the proposed drilling of the borehole within the school compound. This is attributed to the fact that the school and the surrounding Bula Primary Community has been experiencing perennial water shortages forcing students to walk distances in search of water during break time and lunch hours. The school is thus willing to allow the community and the nearby Arbajahan Secondary to access the water.

More importantly, the School Management Committeerequests that the school be supplied with piped water and storage tank as the existing concrete tank is not in use and irreparable.

We are looking forward to hear from you. Thank you.

Yours faithfully,

HEADTEACHER ARBAJAHAN PRIMARY SCHOOL P.O BOX 281, WAJIR
DATE.....

Abdirizack Adan Ali
Head Teacher

MINUTES OF THE ARBAJAHAN PRIMARY SCHOOL MANAGEMENT COMMITTEE MEETING CONCERNING THE DRILLING OF AN EXPLORATORY BOREHOLE IN THE SCHOOLHELD ON 15TH MARCH 2022 AT THE SCHOOL HALL AS FROM 10:00 A.M

MEMBERS PRESENT

1.	OSMAN	YUSSUF	CHAIRPESON
2.	ABDIKADIR	OMAR	P.T.A CHAIR PERSON
3.	ABDIRIZACK	ADAN	SECRETARY
4.	SAMAHAN	ABDI	MEMBER
5.	HUSSEIN	ABDI	MEMBER
6.	JELLE	DAKANE	MEMBER
7.	FATUMA	ADAN	MEMBER
8.	RASHID	ADAN	MEMBER
9.	FATUMA	NOOR	MEMBER
10.	HABIBA	HASSAN	MEMBER
11.	BISHAR	BUKUT	DEPUTY H/T
12.	KHEIROY	MOHAMED	MEMBER
13.	KASSIM	GABOW	MEMBER
14.	BISHAR	HUSSEIN	MEMBER

AGENDA

1. Preliminaries
2. Authority to Borehole drilling
3. Request of piping and tank installation in the school
4. Sharing water with the neighboring school community
5. AOB

MIN 1/3/2022: Preliminaries

The meeting was opened with a word of prayer from Kassim Gabow and thereafter the chairman welcomed members to the meeting.

MIN 2/3/2022: Permission to Drillingof the Borehole in Scholl

The Members present discussed and agreed togive a green light to Northern Water Works Development Agencyto drillthe borehole in the surveyed spot at the school compound. This will benefit the school and the nearby villages, hence greatly solving the permanent water scarcity in the area. It was also agreed that the request letter to be written as soon as possible for the same.

MIN 3/3/2022: Request for Piping and Water Tank in The School.

Further, the committee members requested that the school be provided with a water tank and connected with a water pipe. The existing concrete tanks cease to be functional hence the available PVC tank has a capacity of only 2500 liters which is too small.

MIN 4/3/2022: Sharing Water to The Neighbouring Community

Members agreed that the water to be shared with the neighbouring community upon completion.

MIN 5/3/2022: AOB

There beingno any other business the meeting was adjourned by a word of prayer from the Deputy Head Teacher Mr. Bishar Bukut.

This minutes was prepared by:

Name: ABDIRIBACK ADAN .... Signature............................

Designation... HT / Secretary ..... Date..... 15th March 2022

Confirmed by:

Name: Osman Yussuf .... Signature............................

Designation ... Chairman .... Date..... 15/03/2022 .....

HEADTEACHER
ARBAJAHAN PRIMARY SCHOOL
P.O. BOX ..., WAJIR
DATE.........

Serial No. 3059

P.O Box 9, Wajir
Tel: (046) 421027

COUNTY COUNCIL OF WAJIR

Our Ref NO. ARBAJ/APS/C2

Date 13/03/2013

To ARBAJAHAN PRIMARY SCHOOL
P.O.BOX 251-70200
WAJIR

Dear Sir/Madam,

RE: ALLOCATION OF A PLOT.

1. I have the pleasure to inform you that you have been allocated plot No. ARBAJ/APS/221 ARBAJAHAN Township size (approximate) 10 ACRES at ARBAJAHAN Township of ARBAJAHAN Location/Ward
Vide The Town Planning, Markets and Works Committee meeting held on 13/09/2011 under minutes NO. 16/03/2011 and adopted by Full Council Meeting under minutes NO. 13/03/2011 held on 16/09/2011

2. You are required within (30) days from the date of offer to pay the following fees to the Council to signify your acceptance, failure to which the offer shall be nullified

(i) Application Fees	Kshs	500/=
(ii) Land acquisition Fees	Kshs	2500/=
(iii) Survey Fees	Kshs	
(iv) Showing Fees	Kshs	
(v) Administration Fees	Kshs	2000/=
(vi) Annual Rates on demand	Kshs	
(vii) Other Fees	Kshs	
TOTAL	Kshs	5000/=

3. The Land and Building shall only be used for the purpose described in the Application Form for the plot and any change of user must be approved by the Council. Any development on the said plot must be in accordance with the Council By Laws and any other Laws in the Land.
4. You will be required to develop the plot within Twenty Four (24) months. Failure to develop the plot within the stipulated period the Council will repossess the plot and re-allocate to deserving residents.
5. Upon payment of the above fees the Council will arrange to show you the plot on the ground.
6. Please read the special conditions listed overleaf and abide yourself to the aforementioned conditions.
7. Further, this letter of offer must be attested by the County Clerk by appending his/her signature with the authority of the Council Seal.

COUNTY CLERK
COUNTY COUNCIL OF WAJIR

ADMINISTRATOR

Scanned with CamScanner

III. MINUTES FOR COMMUNITY BARAZA DISCUSSIONS

IIIA-Minutes for Ademasajida Public Participation and consultation

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

DRILLING OF 4NO EXPLORATORY BOREHOLES IN ADEMESAJIDA AND ARBAJAHAN IN WAJIR COUNTY

MINUTES OF COMMUNITY CONSULTATION FOR LAND USE CONSENT ON THE PIPELINE, WATER KIOSK LOCATION AND LIVESTOCK WATERING POINTS AT ADEMASAJIDA.

Community Consultation Discussion Held on Monday 8th March , 2022 at the Ademasajida livestock market, at 11:15am

ITEM NO.	MINUTES	ACTION / NOTE
	PRESENT The meeting was attended by participants from Ademasajida community, Northern Water Works Development Agency, safeguards specialist and the Assistant County Commissioner as per the attached signed list of attendee.	
	AGENDA 1) Introductions and Introductory Remarks 2) Consultant's introduction of the objectives of the assignment and briefing on how the discussions shall be conducted. 3) Community reactions, resolutions, and formation of a committee and defining its mandate. 4) AOB	
Min.1.0	**INTRODUCTIONS AND INTRODUCTORY REMARKS**	
	Members were welcomed to the meeting by the area chief, and the Assistant county commissioner who called the meeting to order. The Chief highlighted the objective of the gathering which was to get opinion from the community members on water distribution of the proposed exploratory borehole. The area chief also requested everyone to introduce themselves and later invited the visiting team to introduce themselves and guide the process of the meeting thereafter. After the introductions, the project coordinator who was part of the team visiting the community introduced himself and the team. He stated that the objective of the meeting was to identify and locate water distribution mains, conduct topographical surveys along the pipeline routes and the entire proposed water	

ITEM NO.	MINUTES	ACTION / NOTE
	infrastructure upon which community consent was to be sought for way-leaves.	
Min.2.0	**CONSULTANT'S INTRODUCTION OF THE OBJECTIVES OF THE ASSIGNMENT AND BRIEFING ON HOW THE DISCUSSIONS WAS TO BE CONDUCTED.**	
	The consultant started by stating that the present gathering was not to introduce anything that the community was not already aware of, he reminded the community that during the Environmental and Social Impact Assessment (ESIA) study, the community had agreed to allow the drilling of two exploratory boreholes at Hadado/Habaswein livestock market and Waso girls primary school which formed part of a larger study that shall eventually abstract water from the Merti aquifer to Wajir town. He also reminded the community that they had reached an agreement that one of the boreholes was to be equipped to supply water to the community. However, there had not been clear indication of the distribution mains as well as water collection points and that the World Bank had asked NWWDA to issue a stop order of the project until such details were provided. He noted that it was for this reason that the team was visiting, first to carry out topographical survey in order to provide a clear picture of the distribution mains, and secondly, to ask the community to provide consent on the way leaves and specific water collection points as well as animal watering points. The safeguards specialist also emphasized that a borehole without the distribution points would not be of much help to the community. He asked the community to provide direction on the way-leave, water kiosk points and animal watering points as they understood their needs. He also informed the community that the community shall agree and through appointing a 5-member committee, their representatives shall sign a land consent form that the way leave, the water kiosk points, and livestock watering points will not be personalized. He reminded them that they needed to be mindful in location selection so as not to affect any individual or communal property.	

ITEM NO.	MINUTES	ACTION / NOTE
Min.3.0	**COMMUNITY REACTIONS, RESOLUTIONS, FORMATION OF A COMMITTEE AND DETERMINING THE WAYLEAVE**	

Community deliberations

—The community reacted that they all had a need for water but some had a greater need than others.
—Community members agreed that water in Habaswein had been unevenly distributed.
—They reported that areas such as Baghdad and Bojia had no water.

Community Resolutions

—The community agreed to commit land for the way-leave, and water kiosks.
—They resolved that animal watering troughs were not necessary as these would complicate land matters. The community observed that it was easy to have people drawing water at certain points but animals would cause lots of inconveniences and would disturb the neighborhoods.
—The community requested NWWDA and World Bank to increase the distribution main from 1km to 5km in order to reach more people.
—The meeting requested that the number of kiosks be increased from 1 to 5.
—They agreed that the steel tank be located at Bula Baghdad and pipes connected to other places.
—The meeting also agreed to select representatives to help with the location of the wayleaves on the Elevated Steel Tank, the kiosks and the pipelines.
—They requested NWWDA and the World Bank to consider equipping the second borehole at Waso girls' primary school to supply the school and the neighborhoods. The project coordinator responded that NWWDA would submit their request to the Bank for consideration. However, he informed the community that the contract had provided for the equipping of only one borehole.

Formation of the committee and its mandate

The community agreed by consensus and appointed a committee of five members responsible for showing the way-leave and, locating the exact position of the kiosks.
The committee members include the following:

No.	**Name**	**Gender**	**ID number**

ITEM NO.	MINUTES	ACTION / NOTE

1.	Mr Abdigadafi Suyan Adan	Male	23818900
2.	Mr. Mohamed Kafia Mady	Male	23358368
3.	Mr. Mohamud Osman Dagane	Male	1265699
4.	Mrs. Milgar Omar Mohamud	Female	24388920
5.	Mrs. Hebiba Mohamud	Female	

They also agreed that the appointed committee will resolve any land and property matters should they arise in the process of laying water pipes as well during the construction of kiosks.

They also agreed to provide land for the way-leave, and water kiosks and that the committee on their behalf will sign the land consent forms.

After the meeting, the NWWDA surveyors undertook the topographical survey led by the community representatives.

Min.4.0 **AOB**

The community lamented why works had been stopped, they urged NWWDA to speed up the process and complete the drilling.

The minutes were prepared by Emmanuel Wafula Mukhwana
Project research assistant

Confirmed and Agreed Dated 8th March 2022.

Mr. Godfrey John Wabomba …… ……...
ESIA Lead Specialist

Mr. Osman Hassan Ali ……. ……..…..
Area chief- Ademesajida

Mr. Geoffrey Nyagasare ……. ……..
NWWDA-WSDP Project Coordinator

MINUTES OF COMMUNITY CONSULTATION BARAZA MEETING FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE PROPOSED DRILLING OF 2 EXPLORATORY BOREHOLES FOR MONITORING OF MERTI AQUIFER AND SUPPLY OF COMMUNITY WATER, UNDER WSDP PROJECT HELD ON THE 28TH OF JULY 2021 AT ADEMASAJIDA AT 4.45PM

PRESENT

The meeting was attended by participants from Ademasajida as per the attached signed list of in attendance.

AGENDA

1) Introductions and Introductory Remarks
2) Consultant's introduction of the objectives of the assignment and briefing on how the discussions shall be conducted.
3) Discussions on the different social baseline aspects and impacts of the project activities.

AOB

Min.1.0 INTRODUCTIONS AND INTRODUCTORY REMARKS

The discussion started with a word of prayer from one of the participants. Due to religious and cultural reasons, participants were separated according to gender and so discussions were held separately. Members were welcomed to the meeting by the area chief, who called the meeting to order. He stated the objective of the Baraza which was to get opinion from the community members on the impacts of the proposed 2 exploratory borehole projects to community members and the environment in general. The area chief informed the gathering that the survey indicated that the boreholes shall be drilled at the existing new Ademasajida Habaswein Livestock market at Ademasajida Township and Ademasajida Waso Girls primary which is adjacent to the Waso Girls secondary school. He then requested everyone to be attentive and be able to air their opinions and queries where necessary. The area chief also requested everyone to introduce themselves and later invited the visiting ESIA team members to introduce themselves and guide the process of the meeting thereafter.

After the participants introduced themselves mentioning their names and villages they come from, the project coordinator from NWWDA who was part of the team visiting the community introduced himself and allowed each of the ESIA team members to introduce themselves. The project coordinator then went ahead to explain the background of the project noting that, the proposed project is part of a larger study that shall eventually abstract water from Merti aquifer to Wajir town. The aquifer extends all the way to Somalia and has fresh water. The exploratory boreholes though shall supply water to the community, and will also assist in monitoring the aquifer condition by tracking the quantity and quality of fresh water availability even as NWWDA considers options for a long term water solution in Wajir County and the region at large. The project coordinator stated that the two boreholes would be drilled to a depth of about 350m deep and would supply the Ademasajida residents with water. He clarified that the aquifer has been discovered to have the potential to supply enough water over a long period. NWWDA

therefore would weigh the option of drilling more of such boreholes and transmitting the water to Wajir town based on the outcome of a series of studies that has been done and others to be done.

He observed that NWWDA was considering a number of alternatives including pumping water directly from Tana River to Wajir, and there is a consultant that is being procured to conduct a study on options to a cost effective, long term solution to water problems in Wajir. The background information by the project coordinator raised some queries among the elders of the community. The community sought clarity on whether there was a connection between the current project and the long-term water solution for Wajir project. It was clarified that though it is within the same package, they are separate and if the consultant who is on board establishes the need to drill the boreholes in Ademasajida, then the community will be consulted to give their opinion or if the water shall be from Tana River then similar consultations shall be conducted. It was also noted that it is not necessarily that the boreholes shall be drilled in the area, it could be anywhere including arbajahan along the merti aquifer but the exact point shall be guided by the coming study. Some of the meeting participants raised questions as to why the drilling would go that deep yet they get water at 100 to 200m in the area? The project coordinator clarified that the 2 boreholes shall assist the government to collect data on the condition of the general aquifer health (recharge and abstraction levels). After clarity on most of the queries by the project coordinator, it was agreed by the community elders that

- The two exploratory boreholes to be drilled for the community at Admesajida without any conditions attached.
- That the community was willing to have a discussion with the consultant who will be studying the options to supply water to Wajir from Ademasajida.

With these remarks the elders invited the lead ESIA expert to continue the sessions. The lead environmentalist introduced the main objective of the discussion, which was to establish existing conditions of the community before the project is implemented and the community to give opinion on the potential impacts of the proposed project.

Min.2.0 Activity process:

The environmentalist started by informing the participants about the ESIA and its main objective noting that the ESIA study basically is about establishing the existing water situation before the project is implemented in order to determine possible impacts of the project activities to the community and the environment in general. Such awareness will appropriate mitigation measures to some of the impacts which can be controlled and to monitor changes.

He observed that the environmental team was working under NWWDA to conduct the ESIA, emphasizing that it was a statutory requirement under the law. After implementation, the project would serve the community. Intervening in the earlier discussions, the consultant noted that another aim of the exploratory study was to monitor water recharge, abstraction and quality for a sustainable water solution and not necessarily transmitting water to Wajir. He emphasized that how we use water could affect others and there was need to check on that.

To comprehensively establish the baseline condition from a collective community perspective, the consultant stated that the discussions shall follow a structured way guided by a Community Baraza Guide (CBG). He hinted that most of the issues to be discussed form part of the household questionnaire which would to be administered to few randomly selected members of the community. He therefore requested the members to feel free and air their views as well as ask any other questions regarding the project.

Min.3.0. Discussions on the different social baseline aspects and impacts of the project activities

Source of water: The community reported to draw its water from 4 sources, 3 of which are boreholes drilled by NWWDA, and handed over to WAJWASCO and the fourth source is private boreholes.

Water reliability: The WAJWASCO boreholes are the community's primary source of water and they include one in Habaswien at the sub-county HQ, the second in Bula Qasad or the old Hadado Borehole and the other is the Qulqul (plenty water) Borehole. The water was sources were reported insufficient and thus unreliable. Each of the sources named was reported to pose some challenges.

Challenges:

- The water drawn from the borehole in Habaswein was considered costly due to a high cost of buying and transporting the water costing around Kshs 200 for every 200L tank and some families reported spending up to 25,000 kshs per month depending on water use.
- The second borehole was reported to use solar and with low solar energy at the time of the study, there was not enough energy to pump the water.
- Occasional pump failures were also reported to be a major challenge.
- The third borehole was reported not to be fitted with pumping mechanisms and thus does not supply water to the community.
- The community also reported that private boreholes' owners sometimes are not willing to share or even sell their water.
- Community members indicated that they receive water after every 3 days but the water is not sufficient. This they said it is a challenge especially for those with young children.
- The community does not have enough water for washing hands during this covid-19 pandemic because the water is very little.
- The elders reported that the town's underdeveloped infrastructure was due to shortage of water. Though locals want to do development, its limited by availability of water.

Coping mechanisms:

- The community members indicated that due to water scarcity, water uses are restricted to domestic use with the women specifying that they bath once in 3 days, wash only once a week.

- Women are forced sometimes to walk up to 6 km in search of water in order to supplement the shortage.
- As a way to cope with inadequate water supply, the community incurs an extra cost of buying water in order to supplement the shortage
- Due to the shortage, the community does not provide the luxury of water for hand washing during this covid-19 pandemic because the water is very little and regular handwashing is seen as wastage.
- The community also reported that they ration water for the animals.
- Used water was reported to water trees around the compound.

Water usage: The community in Admesajida reported two main uses of water namely:

- Domestic use - drinking, cooking, bathing and washing. Bathing and washing were said to be highly restricted. mothers said they only wash clothes once a week and those with children particularly found this problematic
- watering animals- Camel, Donkeys, Cattle, Goats and sheep

Water demand: The demand for water was apparent in the discussion, the community expressed a desire for more water and operationalizing of the existing boreholes to full capacity.

Willingness and ability to pay: The community made it clear that they wanted the boreholes drilled. They said it cost them around Kshs 200 for every 200L tank to supplement their water needs. They thus proposed that the income being spent on supplementing water would be more than enough to pay for water services.

Water quality and treatment: It was apparent from the discussion with community members that the existing water sources were safe, clean and fresh. No treatment was required.

Water related disease: The community reported that waterborne diseases were not a phenomenon of the area. They did not experience any.

Source of income: The two income sources were reported to be livestock, livestock products and business.

Income generating activities related to water: The meeting participants reported earning livelihood mainly from livestock and livestock products. They reported of selling their Camel cows and goats, meat as well as milk from camel cows and goats. These animals were reported to depend on water for their survival, however, with water rationing even to animals, the community reported a reduction in their income as well. The other sources reported were business especially Tuktuk business where such Tuktuks are used to ferry water, sand and other goods to supplement family income part of which is used to buy water.

Sanitation: The participants of the Baraza meeting reported using septic tanks and pit latrines for human waste disposal.

Role of the community: The members present in the meeting reported to be willing to contribute to the project. The reported form of contribution towards project activities showed that community members especially elders are willing to resolve any conflicts that may arise during project implementation. The youth were keen to contribute in terms of labour thereby find some employment to support themselves and their families.

Awareness of the project: Community members also reported to be aware of the proposed project and were in need of the project. The participants of the meeting expressed their willingness to support the implementation and operation of the project.

Vulnerable groups in the community: The main vulnerable groups mentioned to be present in the community were the elderly, persons with disability, widows, very poor, and the youth. The community said the project is a welcome idea for such people as it will reduce their stress of water sourcing.

Project Impact:

Positive impacts:

- The Drilling of the two boreholes at Adenasajida shall save the community from high water costs as a result of Tuktuk transportation.
- The boreholes will greatly reduce the time spent walking long distances in search of water.
- The women were excited that this will allow them spend some of their time on other constructive activities.
- Availability of water is anticipated to help the community water their animals and plants hence their nutrition and health will be enhanced. The women reported of having farms but lacked water to do the cultivation and were hoping the project will be of assistance.
- The project is anticipated to accelerate the growth of the township center with development of infrastructure once there is availability of water for construction.
- There will be planting of tree by the community for cooling of homes.
- Water for washing hands will be available preventing the covid 19 spread.
- Kitchen gardening will practiced and vegetables will be well-watered.
- Primary and secondary schools will have enough water for the students and the pupils.
- The community reported that having enough water supplies will make them feel good

Negative impacts:

The community does not anticipate negative impacts of water drilling, they prefer the advantages of the project over what would be negative impacts.

AOB

The women commented that many organizations had sought their opinions but little did come out of their suggestions. They requested the ESIA team to ensure that their views were considered and the project implemented with immediate effect. The lead environmentalist noted that the

ESIA was an important [illegible]

The minutes were prepared by Emmanuel Wafula
Project Research Assistant

Confirmed and Agreed Dated _____

CONFIRMED BY:

1. **Project Coordinator (Chairman)** Geoffrey Nyasagare — Signature [illegible] Date 29/07/2021
2. **Area Chief** Daud M. Muktar — Signature 29/07/2021 Date [illegible]
3. **Secretary (EIA expert)** Godfrey Wabomba — Signature _____ Date _____

IIIB-Minutes for Arbajahan Public Participation and consultation

WATER AND SANITATION DEVELOPMENT PROJECT (WSDP)

DRILLING OF 4NO EXPLORATORY BOREHOLES IN ADEMESAJIDA AND ARBAJAHAN IN WAJIR COUNTY

MINUTES OF COMMUNITY CONSULTATION FOR LAND USE CONSENT ON THE PIPELINE, WATER KIOSKS LOCATION AND LIVESTOCK WATERING POINTS AT ARBAJAHAN

Community Consultation Held on Monday 7th March, 2022 at Arbajahan ward administrator's office conference hall, at 10:30am.

ITEM NO.	MINUTES	ACTION / NOTE
	PRESENT The meeting was attended by participants from Arbajahan community, their leadership, Northern Water Works Development Agency (NWWDA) representatives and the safeguards specialist as per the attached signed list of in attendance.	
	AGENDA 1) Introductions and Introductory Remarks 2) Introduction of the objectives of the assignment and briefing on how the discussions shall be conducted. 3) Community reactions, resolutions, and formation of a committee and defining its mandate. 4) AOB	
Min.1.0	**INTRODUCTIONS AND INTRODUCTORY REMARKS**	
	The discussion started with a word of prayer from one of the participants. The Ward Administrator welcomed and thanked the community for their cooperation whenever called upon for community development activities. He also thanked Northern Water Works Development Agency (NWWDA) and the World Bank for considering them for the water project. He invited NWWDA to his area and informed the community that the objective of the gathering was to help identify water distribution mains wayleave for the proposed exploratory boreholes at Arbajahan. The ward Admin requested everyone to be attentive and be able to air their opinions and queries. He then invited NWWDA and Safeguards team for introductions and	

ITEM NO.	MINUTES	ACTION / NOTE
	guidance on the process of the meeting thereafter. The project coordinator introduced himself and his team. He stated that the objective of the meeting was to identify and locate water distribution mains, location of water kiosks, conduct topographical surveys along the pipeline routes and the entire proposed water infrastructure upon which community consent was to be sought for way-leaves. The coordinator apologized to the community for the repeat exercise occasioned by the Bank comments. The bank is interested in knowing the routes and location of the project infrastructure and whether the community has approved the location before the commencement of the works.	
Min.2.0	**CONSULTANT'S INTRODUCTION OF THE OBJECTIVES OF THE ASSIGNMENT AND BRIEFING ON HOW THE DISCUSSIONS WAS TO BE CONDUCTED.**	
	The coordinator explained to the community that the present meeting was an extension of earlier safeguards consultations and assessments on the two exploratory boreholes, conducted to identify the impacts to the Merti aquifer characteristics in an effort to find a lasting solution to the water problem in Wajir town. He reminded the community that as earlier agreed during the ESIA study consultations, one of the boreholes was to be equipped to supply water to the community. He thus informed the community that the present gathering was to determine the location of water kiosks and conveying of water from the borehole to be equipped, if drilled, and how the community will access the watering points. In addition to identifying these points, the coordinator informed the community that the surveyed borehole was located at Arbajahan primary school and the community was also making some requests on a number of items required. He proceeded to ask the community to discuss and clarify whatever matters were arising. The coordinator further informed the participants of the meeting that according to the current contract, only one (1)km of the distribution main was already in the contract in addition to $100m^3$ Elevated Steel Water Tank, one (1)	

ITEM NO.	MINUTES	ACTION / NOTE
	water kiosk and 2 livestock watering troughs. On his part, the safeguards specialist reminded the community that during the ESIA consultation process, the community had been promised one of the boreholes shall be equipped to serve their water shortage; however, he proceeded to note that the survey and land use consent had not been undertaken as appropriately and the wrong forms were signed and the bank had requested this to be corrected. To emphasize on the objective of the gathering, the safeguards specialist asked the community to deliberate on the said issues and appoint a 5-member committee that would help in marking what the community had agreed on regarding the way-leave, specific location of the Water kiosks, water storage facility as well as animal watering points. He noted that the 5 committee members would represent the community as signatories to the land consent forms to demonstrate community consent that such lands should be set aside for the said purpose. He asked the community to bear in mind that whatever location they propose should not be detrimental to the community, its members or the environment. To promote community participation in identifying the specific location, the consultant stated that the discussions shall follow a structured guide called Community Consultation Guide (CCG). He therefore requested the members to feel free to air their views as well as ask any other questions regarding the project.	
Min.3.0	**COMMUNITY REACTIONS, RESOLUTIONS, FORMATION OF A COMMITTEE AND DETERMINING THE WAYLEAVE**	
	Community deliberations —The community requested to be allowed to consult among the members before giving their resolutions. —They began by saying that they were "thirsty". They noted that this was a great opportunity for the community to supplement their existing water supply. They also thanked the World Bank, the government of Kenya and NWWDA for the opportunity. —The meeting established that there was no water in Arbajahan	

ITEM NO.	MINUTES	ACTION / NOTE
	primary and Arbajahan secondary schools yet the total enrollment of students in Arbajahan secondary school is 387 with 202 being girls, while Arbajahan primary has a population of 720 pupils in total. —The women noted that due to lack of water at Arbajahan hospital, the women who visited the health facility were required to carry water along. The same goes for the police cell and the police station. Other administrative institutions sited as lacking water connectivity included the ward administrator's office, and the police station. —The community also noted that the exploratory borehole will shorten the distance that a section of the community travels to access water. They also noted that the water project will reduce the time spent fetching water as several kiosks would be extended and evenly distributed. They proposed that NWWDA should not worry about the way leave and locations of the water kiosks —The community raised a concern that the proposed one km pipe mains, and two Water kiosks are not enough to quench their thirst. —The community observed that they were water stressed that one had to carry water to the cells in the case a family member was incarcerated, to the hospital whenever one was giving birth and also to the school for the school going children on a daily basis. **<u>Community resolutions</u>** —The community unanimously agreed to commit land for the Pipe mains, Elevated Steel Tank and water kiosks. —They requested NWWDA and World Bank to increase the distribution main as appropriate to take care on the needs. The project coordinator in response indicated that it's not a decision that can be made by NWWDA but a consultative process which need to be brought to the attention of the Bank and incase its accepted the community will be informed appropriately. —They requested that the existing water kiosks be rehabilitated, more built and water connected to each of the kiosks for ease of access. The project coordinator in response promised to capture the existing kiosks in the mapping process to so that something can be done about it. —They agreed that NWWDA should have the cattle troughs done at Madina and not in Arbajahan centre.	

ITEM NO.	MINUTES	ACTION / NOTE
	—They agreed that the locations pointed should allow water supply to key institutions especially the hospital, schools and other administrative institutions. The project coordinator informed the community that we only have a provision for 1km pipeline but survey shall be done to determine the length of the pipeline and then liaise with the bank for a possibility of financing under the proposed scope of works. —The meeting unanimously agreed that the second borehole be located at Bula Madina, and equipped to supply water to Madina primary school as well as the families in Bula Madina. The project coordinator reminded the community that according to the existing contract, its only one borehole that shall be equipped and the request needs to be brought to the attention of the bank before any conclusive decision is made. —The community members participating in the meeting requested that the water storage tanks be increased from 1 to 2 and that one be positioned at Barraza Park while the second to be positioned at Bula primary, pipes connected to different kiosks and institutions. All this was aimed to serve the large population of people tending to 8,500 people. The project coordinator observed that consultations shall be done with the bank for direction and the community will be informed appropriately depending on the outcome of the consultations. —They also requested that a women's group that grows vegetables and other horticultural products be considered for a water tank and connected to water. **Formation of the committee and its mandate** —By consensus, the community agreed to appoint a committee of five (5) members who were to be responsible for taking the survey team along the pipe mains, Elevated Steel Tank and water kiosks. The appointment of the committee members was based on representation of the 2 water supply areas namely Arbajahan market and Bula madina, as well as the clans and sub-clans representations. The names and Identification Numbers (ID) of those appointed were as listed in the table below:	

No.	Name	Gender	ID number
1	Bogor Ali Muse	Male	0217786
2	Sugule Mohamed Abdi	Male	0545435
3	Idhow Dunto Hirsi	Male	0545264

ITEM NO.	MINUTES	ACTION / NOTE

4	Maryam Nurrow Roble	Female	8492705
5	Rahai Abdille Maalim	Female	34030071

—The meeting also agreed that with the exception of the position of the water tank, the committee was mandated to identify the specific position the kiosks and point out the way-leave for piping.

—It was also agreed that the appointed committee will resolve any land and property matters should they arise in the process of laying water pipes as well during construction of kiosks.

—The community also mandated the committee to sign on their behalf the land consent forms.

—After the meeting, the NWWDA surveyors undertook the topographical survey led by the community representatives.

Min.4.0 **AOB**

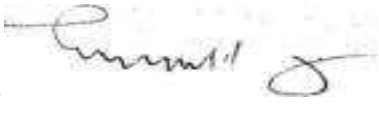
The community complained that there were too many meetings without actions. They said all they need is water and urged NWWDA and the World Bank to speed up and provide water for them

The minutes were prepared by Emmanuel Wafula Mukhwana
Project research assistant

Confirmed and Agreed Dated ……7th March 2022

Mr. Godfrey John Wabomba ……  ……...
ESIA Lead Specialist

Mr. Ibrahim Hussein Daud …… 
Area chief- Arbajahan

Mr. Geoffrey Nyagasare …  ….
NWWDA-WSDP Project Coordinator

MINUTES OF COMMUNITY CONSULTATION BARAZA MEETING FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE PROPOSED DRILLING OF 2 EXPLORATORY BOREHOLES FOR MONITORING OF MERTI AQUIFER AND SUPPLY OF COMMUNITY WATER, UNDER WSDP PROJECT HELD ON THE 29TH OF JULY 2021 AT ALJAZEERA HOTEL AND LODGE 10:30 AM

Present

The meeting was attended by Arbajahan residents as referenced in the attached signed list of in attendance.

Agenda

1) Introductions and Introductory Remarks
2) Consultant's introduction of the objectives of the assignment and briefing on how the discussions shall be conducted.
3). Discussions on the different social baseline aspects and impacts of the project activities.
AOB

Min 1.0 Introductions and Introductory Remarks

The community Baraza in Arbajahan started with a word of prayer from one of the participants. Members were welcomed to the meeting by the chairperson of the village who, in the absence of the chief had been delegated to mobilize together with and moderate the community. The elder called the meeting to order at 10:30 am and invited the ESIA team to introduce themselves and state the objectives of their visit.

The NWWDA engineer and project coordinator, Mr Geoffrey….. who was part of the team explained the background of the project. He elaborated that NWWDA intended to drill two monitoring boreholes in the area to carry out an exploratory study on the expansive Merti aquifer with the support of the World Bank. The aim of the study he stated was to find a lasting, cost effective, fresh water solution to water problems in Wajir town which studies have indicated has a stressful water situation. The coordinator explained to the community that NWWDA was considering a number of options to achieve this goal, one of which was to understand the amount of water available in the said aquifer and its sustainability in order to make a decision on the shortest possible, route of supplying water to Wajir town. Other options mentioned include drilling water in Ademasajida town. The coordinator then told the community that the team that had visited sought opinion from community members on the impacts of the proposed exploratory boreholes on the community and the environment in general. Hence requested everyone to be attentive and be able to air their opinions and queries where necessary.

The brief by the coordinator raised some issues and questions that the community needed clarified. Some of the issues raised include the following:

- The community was concerned that they received water from two earlier drilled boreholes but it was not enough for the community, how then could they supply the water to Wajir when they needed more?

- There was a request made by the community that the boreholes are not handed over to WAJIWASCO, but rather the community is given the management of the two boreholes.
- The community also raised a concern whether NWWDA and the World Bank could consider laying pipes and erecting a 70,000 litre tank for the nearby town and schools since these too did not have water supply placing extra stress on the current boreholes.
- They also expressed concern that the current tank they were using was leaking and had been repaired thrice, they therefore sought assistance to repair or replace it with a new tank.
- The community wondered whether it was possible for the community to change the site of the proposed boreholes.
- And whether a community 8km away could also be considered for borehole drilling since young children from this community walked long distances to fetch water at the two boreholes.

After a brief deliberation and clarification among community members, and between the team, the following responses were given by both the project coordinator and the environmental expert.

- That changing the site of the boreholes would be considered if the community agreed so through a formal request. However that changing site would also require another Geo-survey to determine the new locations water viability.
- That piping and a tank would mean an extra cost on the project which was not part of the study. The coordinator however assured the community that he had taken note of their concerns.

With those clarifications made, the community invited the ESIA team leader to guide the process of collecting views. The lead environmentalist Mr. Wabomba introduced his team and the main objective of the discussion, which was to establish existing water situation before the implementation of the project and opinion on the impacts of the project.

Min.2.0 Activity process

The consultant, after thanking the community for allowing the discussions, observed that the ESIA team was visiting to conduct the ESIA for NWWDA. He explained that the ESIA is a statutory requirement under the law. The environmentalist further informed the participants that the ESIA was about establishing the existing water situation before the project is implemented in order to determine possible impacts of the project activities to the community and the environment in general. Such awareness would appropriate mitigation measures to some of the impacts which can be controlled. But since some of the impacts take a long time to be realized, the baseline information could be used at a later stage to monitor changes and any information hitherto shall be used as a case study to inform other similar schemes elsewhere in the county or country.

To comprehensively establish the baseline condition from a collective community perspective, he stated that the discussions shall follow a structured way guided by a Community Baraza Guide (CBG). He hinted that most of the issues to be discussed form part of the household

questionnaire which was to be administered to few randomly selected community members. He therefore requested the members to feel free and air their views as well as ask any other questions regarding the project.

Min.3.0 Discussions on the different Social Baseline aspects and impacts of the Project Activities

Source of water: The community reported to draw water from 2 main sources namely Arbajahan boreholes 1 and 2. The two boreholes were said to serve many people from nearby manyattas and villages as well as two nearby schools, Arbajahan primary and secondary schools which were reported to draw water from these two boreholes using water bowsers. The Villagers water livestock at the said Arbajan market centre

Main source of water: The 2 WAJWASCO boreholes are the community's primary source of water and they include.....

Water Reliability: The estimated yield of the boreholes was said to be approximately 14m^3. The community reported that the boreholes never run dry but are stressed by the growing demand for water hence taking long hours.

Challenges:

- The main challenge reported by the community in Arbajahan was low solar energy which forced the residents to incur extra costs for buying, fueling and maintaining a generator pump.
- Another challenge was the high demand for water placed on the two boreholes by livestock, schools and communities hence taking long queues to fetch water.
- Occasional pump failures were also reported to be a major challenge.
- The existing storage tank had a leakage, the community mentioned that they had repaired it thrice but in vein.
- The community does not have enough water for washing hands during this covid-19 pandemic because the water is very little.

Coping mechanisms:

- The community reported that solar energy is the main source of energy for pumping water, however, the solar energy was reported insufficient to pump enough water to meet the growing demand, and hence the community had bought a pump that would help pump the water in order to maintain the water supply.
- The community members indicated that due to water scarcity, water uses are restricted to domestic uses and watering animals.
- Due to the shortage, Arbajahan community does not provide the luxury of water for hand washing during this covid-19 pandemic because the water is very little and regular handwashing is seen as wastage.

Water usage: Like the community in Arbajahan reported two main uses of water namely,

- Domestic use - drinking, cooking, bathing and washing
- watering animals- Camel, Donkeys, Cattle, Goats and sheep

Water demand: According to the community in Arbajahan, demand for water is growing each day. The situation is made worse by the nearby manyattas and school that do not have water. The participants therefore reported that they needed more water. They preferred one of the boreholes to be taken to one of the nearby manyatta that is about 2km from Arbajan market centre.

Willingness and Ability to pay: The participants of the meeting expressed their willingness to support the implementation and operation of the project. They pledged their readiness to maintain the project for sustainability.

Water quality and treatment: The community made it clear during the discussions that the existing water sources were safe, clean and fresh.

Water related disease: Arbajahan community reported not to experience water related diseases

Source of income: The meeting participants reported earning their livelihood mainly from sell of livestock and livestock products. The community mentioned milk, and meat as the sources of income from animal products but such income was insufficient for daily sustainability of their families. Instead, the community reported to sell animals such as goats, sheep or cows for minor expenses such as contributions to repair a malfunctioning pump, house daily expenses or minor sicknesses in the household. Major expenses such as paying of school fees and foodstuff was catered for by selling the large animals specifically camel.

Income generating activities related to water: The meeting participants reported earning livelihood mainly from livestock and livestock products. They reported of selling their Camel and goats, meat as well as milk from Camel and goats. These animals they said depend on water for their survival.

Sanitation: The participants reported using pit latrine and soak pits for human waste disposal at arbajahan market centre. The community mentioned that due to collapsing of the pits whenever it rained, they reinforced the pits using bricks and cement.

Role of the community: The members present in the meeting reported to be willing to contribute to the project. The elders reported their willingness to resolve any conflicts arising during project implementation. The youth pledged to support the project by providing labour and security for equipment.

Awareness of the project: Arbajahan community confessed being aware of the project since they are the ones who located the sites that had been surveyed. They were thankful that they had been considered since they needed the project.

Vulnerable groups in the community: The main vulnerable individuals and persons mentioned during the discussion as present in the community were the elderly, persons with disability, widows, very poor, and the youth.

Project impact:

Positive impacts:

Planting of trees to cool homes was reported to be a direct benefit if the two boreholes if are drilled in the area. This they said will enhance the environment as the community reported it will reduce wind storms also.

It was reported by the community that they had no kitchen gardens because of the low water supply. Drilling of the two boreholes would therefore supplement water supply and hence kitchen gardens would be made possible.

The community also said that the many people who draw water from the community boreholes would not spend long hours waiting for water.

Children in nearby schools would concentrate more on schooling if the water was sufficient.

Negative impacts:

The community does not anticipate negative impacts of water drilling, they prefer the advantages of the project over what would be negative impacts.

Community Suggestions:

The community suggested that NWWDA considers supplying the nearby town, schools and community with water either by laying pipes to the town or changing the location of one of the boreholes.

The community also asked NWWDA not to drill the boreholes and place them under WAJIWASCO, instead they asked that the boreholes be handed over to the community for maintenance and management. It was made clear during the meeting that WAJIWASCO are the institution in charge of water services and it's a discussion that can be picked up by the company.

AOB. The lead environmentalist advised the community to voice their concerns in a formal way since the Geo-survey had already been carried out with the advise of the community to decide the current project sites. He also promised to capture their concerns in his report. There being no other mawers the meeting was closed with a word of prayer from one of the participants

The minutes were prepared by Emmanuel Wafula
Project Research Assistant

Confirmed and Agreed Dated _____ _____

CONFIRMED BY:

1. Project Coordinator (Chairman) Geoffrey Nyasagare Signature.....

Date .....

2. Name:.....

Signature.....

Designation.....

Date .....

3. Secretary (EIA expert) Godfrey Wahomba

Signature. .....

Date .....

IV. ATTENDANCE LIST FOR COMMUNITY BARAZA MEETINGS

IVA-Attendance Lists for Ademasajida Public Participation and consultation

WORLD BANK GROUP

COMMUNITY CONSULTATION ATTENDANCE LIST FOR THE DISTRIBTION LINE WAY-LEAVE, WATER KIOSK LOCATION AND LIVESTOCK WATERING POINTS IDENTIFICATION FOR THE PROPOSED COMMUNITY WATER PROJECT UNDER EXPLORATORY BOREHOLE DRILLING AT ADMESAJIDA.

PROJECT AREA Admesajida VENUE Livestock Market DATE 02/03/2022

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COMMUNITY CONSULTATION ATTENDANCE LIST FOR THE DISTRIBTION LINE WAY-LEAVE, WATER KIOSK LOCATION AND LIVESTOCK WATERING POINTS IDENTIFICATION FOR THE PROPOSED COMMUNITY WATER PROJECT UNDER EXPLORATORY BOREHOLE DRILLING AT ADMESAJIDA.

PROJECT AREA ...Ademasajida... VENUE ...Livestock Market... DATE ...[illegible]/03/2022

No.	NAME	DESIGNATION/ORGANISATION	TELEPHONE	ID NO.	SIGNATURE
1.	Osman Salat	Youth	[illegible]	[illegible]	[signature]
2.	Abdi Kassim	Elder	[illegible]	[illegible]	[signature]
3.	Nassir Abdi	Elder	[illegible]		[signature]
4.	Abdullahi Abdi	Elder	[illegible]	[illegible]	[signature]
5.	Mohamed Kafin	Elder	[illegible]	[illegible]	[signature]
6.	Abdiqadir Saidan	Youth	[illegible]	[illegible]	[signature]
7.	Mohamed Hakeem	Elder	[illegible]	[illegible]	[signature]
8.	Aden Abdullahi Hassan	Youth	[illegible]	[illegible]	[signature]
9.	Said Abdullahi Aliyu	Youth	[illegible]	[illegible]	[signature]
10.	Halima Gille Noor	Youth	[illegible]	[illegible]	[signature]
11.	Nuria Bike Jelle	Youth	[illegible]	[illegible]	[signature]
12.	Mohamed Ahmed Mohd	Elder	[illegible]	[illegible]	
13.	Emmanuel Lihudo M.	Sociologist	[illegible]	[illegible]	[signature]
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WORLD BANK GROUP

COMMUNITY BARAZA ATTENDANCE LIST FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE PROPOSED EXPLORATORY BOREHOLES UNDER WAJWASCO, UNDER UNDER WSDP PROJECT.

PROJECT AREA .....**VENUE** .....**DATE**.....

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WORLD BANK GROUP

COMMUNITY BARAZA ATTENDANCE LIST FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE PROPOSED EXPLORATORY BOREHOLES UNDER WAJWASCO, UNDER UNDER WSDP PROJECT.

PROJECT AREA ..... **VENUE** ..... **DATE** .....

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WORLD BANK GROUP

COMMUNITY BARAZA ATTENDANCE LIST FOR ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF THE PROPOSED EXPLORATORY BOREHOLES UNDER WAJIWASCO, UNDER UNDER WSDP PROJECT.

PROJECT AREA .....**VENUE** .....**DATE**.....

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IVB-Attendance Lists for Arbajahan Public Participation and consultation

REPUBLIC OF KENYA

WORLD BANK GROUP

Attendance List for Community Baraza

LIST OF KEY INFORMANTS CONSULTED DURING ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED EXPLORATORY BOREHOLES UNDER WAJIWASCO, UNDER WSDP PROJECT

COUNTY....WAJIR.......PROJECT....WSDP.......LOCATION/WARD....Aljazeera Arbajahan lodge....Date....29/7/2021

No.	NAME	ORGANISATION	DEPARTMENT	DESIGNATION	TELEPHONE	SIGNATURE
1.	Suleiman Abey				0727180811	[signature]
2.	Dakane Abey				07[illegible]	[signature]
3.	Mohamed Mohamud				0722323878	[signature]
4.	Abdille Issack				0706743029	[signature]
5.	Ahmed Hassan				0720443602	[signature]
6.	Osman Yussuf				0722617235	[signature]
7.	Abdikadir Omar				0721111169	[signature]
8.	Ahmed Bashir				07297726	[signature]
9.	Omar Yusuf				0720231822	[signature]
10	Rashid Hassan				072109164	[signature]
11	Dakane Yakub				0714446067	[signature]
12	Omar Galane				0799371543	[signature]
13	Kahiye Abdurahi				07[illegible]	[signature]
14	Habiba Doli					
15	Abdia Hire				0707983326	[signature]
16	Sahara Abdirahman					[signature]
17	Fatuma Osman				0701984867	[signature]

REPUBLIC OF KENYA

WORLD BANK GROUP

List of Community Members

~~LIST OF KEY INFORMANTS CONSULTED~~ DURING ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED EXPLORATORY BOREHOLES UNDER WAJIWASCO, UNDER WSDP PROJECT

COUNTY: WAJIR PROJECT: WSDP LOCATION/WARD: Mforeson lodge Date: 29/7/2021

No.	NAME	ORGANISATION	DEPARTMENT	DESIGNATION	TELEPHONE	SIGNATURE
1.	Kayra Korow				—	[signature]
2.	Batula Sheik				0728467033	[signature]
3.	Dakane Mohamed				—	[signature]
4.	Abdia Ali					[signature]
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COMMUNITY CONSULTATION ATTENDANCE LIST FOR THE DISTRIBUTION LINE WAY-LEAVE, WATER KIOSK LOCATION AND LIVESTOCK WATERING POINTS IDENTIFICATION FOR THE PROPOSED COMMUNITY WATER PROJECT UNDER EXPLORATORY BOREHOLE DRILLING AT ARBAJAHAN

PROJECT AREA ....ARBAJAHAN.............VENUE WARD ADMIN'S OFFICE....DATE 7th/March/2022

No.	NAME	DESIGNATION/ORGANISATION	TELEPHONE	ID NO.	SIGNATURE
1.	Mohamed Abdullahi	Principal Arbajahan Sec.	0723622593	2272677	[illegible]
2	Abdikadir Omar Elmi	Elder	0721[illegible]	0216140	[illegible]
3.	Absolom Mwanyanyi	Incharge Arbajahan police post	0712434493	2[illegible]20027	[illegible]
4.	Ibrahim Hussein Said	Chief Arbajahan	0707426774	20992279	[illegible]
5.	Ahmed Adan Guile	Elders	0729777316[illegible]		
6.	[illegible] Dewow Ahmed	Elders	0725681851		[illegible]
7.	Abdikadir Dahir Sheikh	Elder	0729[illegible]4436	6825706	[illegible]
8.	[illegible] Hassan Dupten	Elder	0726433860	05[illegible]264	[illegible]
9.	Yussuf Hussein Mohamed	Elder	0715[illegible]7[illegible]9	[illegible]	[illegible]
10.	Shariffa Omar Abdi				
11.	Fatuma Adan [illegible]				
12.	Fatuma Hussein Osman				
13.	Dahira Bakow Adan				
14.	Sharifa Osman Hussein				
15.	Fatuma Hussein Ahmed				
16.	Fatuma Jimale Bare				
17.	[illegible] Ali [illegible]		0702591091	2597[illegible]	[illegible]
18.	Hussein Sharif Ahmed	Elder	07[illegible]	[illegible]	[illegible]
19.	Ahmed Mohamed [illegible]	Elder			
20.	[illegible] Hussein Mohamed	Elder		02[illegible]70	

WORLD BANK GROUP

COMMUNITY CONSULTATION ATTENDANCE LIST FOR THE DISTRIBUTION LINE WAY-LEAVE, WATER KIOSK LOCATION AND LIVESTOCK WATERING POINTS IDENTIFICATION FOR THE PROPOSED COMMUNITY WATER PROJECT UNDER EXPLORATORY BOREHOLE DRILLING AT ARBAJAHAN.

PROJECT AREA ARBAJAHAN **VENUE** WARD ADMIN'S OFFICE **DATE** 7th/March/2022

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V. HYDRO-GEOLOGICAL SURVEY REPORT

NORTHERN WATER WORKS DEVELOPMENT AGENCY (NWWDA)

WATER AND SANITATION DEVELOMENT PROJECT

ADEMASAJIDA BOREHOLES

HYDROGEOLOGICAL SURVEY REPORT

JUNE, 2021

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EXECUTIVE SUMMARY

NWWDA with support from the World Bank through the WSDP project is implementing among other the Wajir long term Water Supply Project. The proposed source of water is from the Merti aquifer preferably at Arbajaan or at Ademasajida.

As a prerequisite of embarking on this massive project, NWWDA is planning to undertake four (4) exploratory boreholes in the two likely water source areas as mentioned above. As it is always the norm, NWWDA has undertaken a gyeophisical survey investigation in two proposed water areas. The findings for Admesajida are as presented in this report.

Adamasajida, is located some 110 kilometers away from Wajir Towm in Wajir County.
quarters, in the Republic of Kenya.

Importance of the exploratory boreholes-

The two wells shall be primarily for exploration and later on monitoring purposes. and both shall be drilled up to a maximum depth of 350m bgl. The boreholes shall be drilled using mud-rotary method owing to the deconsolidated nature of the aquifer material. The finishing diameter shall be ten inches. The finished well shall be fitted with a piezometer to aid aquifer abstraction monitoring.
The proposed boreholes were sited at the coordinates which are tabulated in the table 1 below

Table 1: Coordinates of the selected sites

SNo	Longitude	latitude	Elevation	Site Name
1	554983	113185	233	VES-001
2	554993	113189	240	VES-002

Findings of the Survey

The surveys concludes that there is no risk of getting dry or saline borehole in study area. The community has welcomed the project whole heartedly and both sites recommended were located in areas where the area chief had agreed with the community. There shall thus be no land dispute coming up.

Recommendations of the Geologist

The geologist recommends that two boreholes be drilled and operated by the existing Water user Committees with an MoU from WAJIWASCO.

Scope of Project

The project shall entail drilling and equipping, as well as fitting monitoring devices in the borehole to aid the task of monitoring. This shall be a piezometer. This shall be or the two boreholes located more than 700m apart at places. The pumpage envisaged is hybrid, so that both solar and genset shall be needed, per borehole. A pump house shall therefore be required to house the genset. Furthermore, the area will be fenced off and gated

Cost of Drilling and Equipping

The cost of drilling the well at approximately Kshs 20,000 per meter shall be approximated at Kshs 7,000,000 o USD 70,000 for a depth of 350m bgl.

GLOSSARY OF TERMS

Term	Description
Alluvium	General Term for detrital material deposited by flowing water.
Aquiclude	An impermeable geological formation or structure, which transmits little or no water.
Aquifer	A geological formation or structure which stores and transmits water and which is able to supply water to wells, boreholes or springs.
Conductivity	Transmissivity per unit length (m/day).
Consolidated	Said of a deposit that has become firm and coherent (as opposed to *unconsolidated*).
Development	In borehole engineering, this is the general term for procedures applied to repair the damage done to the formation during drilling. Often the borehole walls are partially clogged by an impermeable "wall cake", consisting of fine debris crushed during drilling, and clays from the penetrated formations. Well development removes these clayey cakes, and increases the porosity and permeability of the materials around the intake portion of the well. As a result, a higher sustainable yield can be achieved.
Evaporation	Loss of water from a land area through transpiration from plants and evaporation from the surface.
Hydrogeological	Those factors that deal with subsurface waters and related geological aspects of surface waters.
Infiltration	Process of water entering the soil through the ground surface.
Piezometric level	An imaginary water table, representing the total head in a ~confined aquifer, as defined by the level to which water would rise in a well.
Porosity	The portion of bulk volume in a rock or sediment that is occupied by openings, whether isolated or connected.
Recharge	General term applied to the passage of water from surface or subsurface sources (e.g. rivers, rainfall, and lateral groundwater flow) to the aquifer zones.

LIST OF ABBREVIATIONS

GWL	Groundwater Level
NWWDA	Northern Water Works Development Authority
ASL	Above Sea Level
WaSSIP	Water and Sanitation Improvement Project
WRA	Water Resources Authority
WSDP	Water and Sanitation Development Project
VES	Vertical Electrical Sounding
WAJWASCO	Wajir Water and Sewerage Company

1. INTRODUCTION

1.1. Background Information

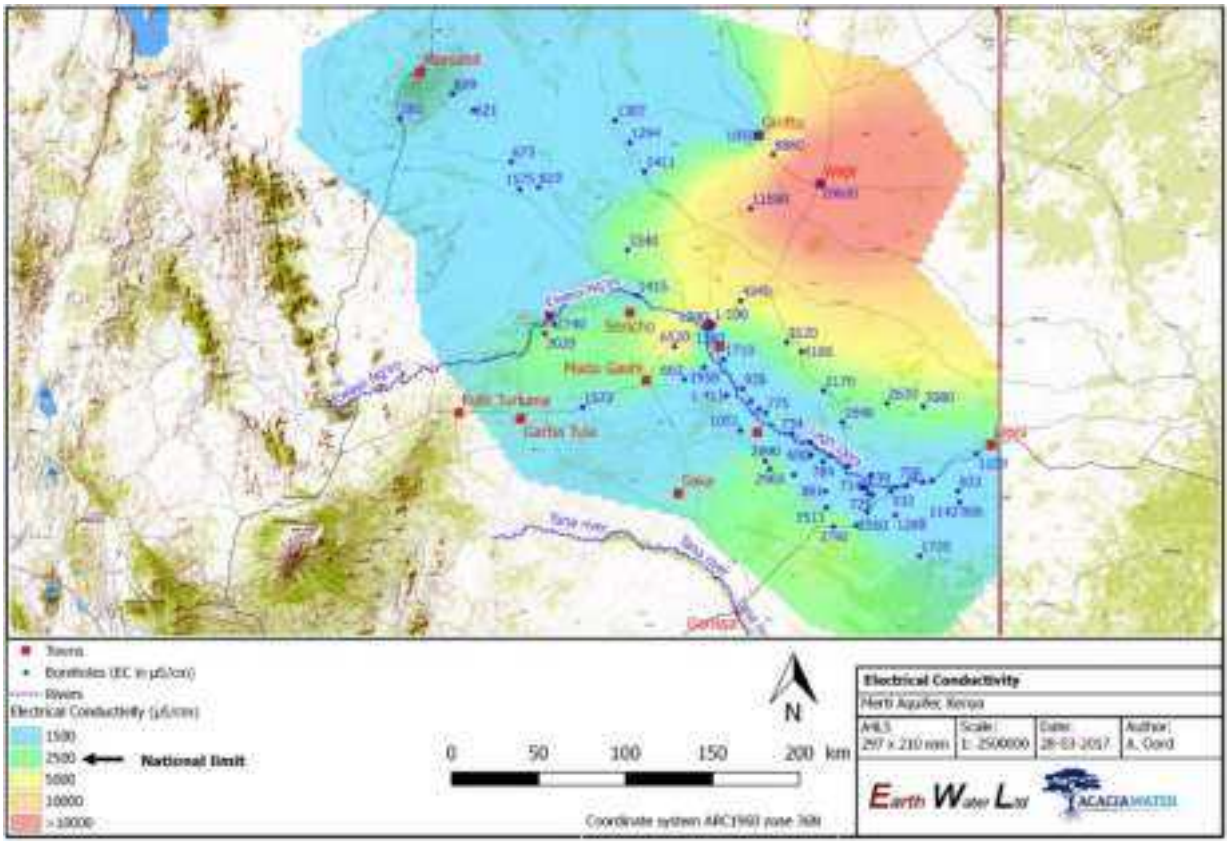
Northern Water Works Development (NWWDA) with support from World Bank through the WSDP project is implementing among other Wajir long term Water Supply project. The proposed source is from the Merti Aquifer prefaerably at Arbajaan or at Admesajida.

Merti aquifer is a transboundary aquifer which traverses four counties, namely Isiolo, Marsabit Wajir and Garissa. It flows across the border into Somalia. There have been fears of aquifer depletion by both Kenyan and Somalia residents. The basis of this worry is that there has been no deliberate study to comprehensively install monitoring devices on the wells existing on either side of the two nations. The present task is meant to address these concerns by establishing a borehole to be used for exploratory purposes which entail drilling, equipping and monitoring of the wells. In the event that the exploratory wells provide positive conclusive information indicating viability of the aquifer, the water body shall be, in future be developed for pumpage to Wajir town as a long term solution to the water scarcity in Wajir town. The map here under shows the Merti aquifer in Kenya and the areas where the wells have been developed.

1.1.1. Proposed Source of Water for Wajir Town

There is a proposal to obtain water from either Admesajida or Arbajahan centres both of which are in the Merti aquifer. This project for supplying water to to Wajir town is thought to serve as a lasting solution to the perennial water scarcity not only in Wajir town but the near bycentres as well.. This cannot happen overnight when insufficient data exists to help quantify abstraction levels, at present, to help make informed decisions on whether or not such an undertaking will be viable. To that effect, two exploratory boreholes have been proposed in the Arbajahan and Ademasajida area. The monitoring of the abstraction and well hydraulics will aid in generating knowledge to help understand the levels of vulnerability of the Merti aquifer.

Figure 1: Map of Merti Aquifer Distribution of Electrical Conductivity



1.1.2. Proposed long-term water supply options to Wajir Town

The Water supply Masterplan report (Zamconsult, 2017), reviewed five different options for supplying Wajir town with potable water to meet the immediate (year 2022), intermediate (year 2032) and ultimate (year 2042) water demands. The five sources studied include one surface water option (Tana River) and the following four groundwater/boreholes options namely; Hadado, Chandarua, Arbajahan and Ademasajida areas. More details are provided in Table 2 below.

Table 2: Water Supply options for Wajir

S/N	Water Source option	Quantity	Water Quality	Distance in Km	Source elevation m amsl	Highest Crest (m)	End elevation m amsl	Elevation difference (m)
1	Tana to Wajir Town	Sufficient	Fresh Turbid	240	196	355	260	(+) 159
2	Arbajahan to Wajir Town	Sufficient ($70m^3$/hr/well)	Fresh Clear	135	343	356	260	(+) 12
3	Chandarua to Wajir	Sufficient ($70m^3$/hr/well)	Hard Clear	94	288	none	260	(-) 26
4	Hadado to Wajir Town	Sufficient ($70m^3$/hr/well)	Hard Clear	76	264	none	260	(-) 4
5	Ademasajidato Wajir Town	Sufficient ($70m^3$/hr/well)	Fresh Clear	103	232	306	260	(+) 74

Figure 2: water supply options to Wajir Town

1.1.3. Previous Studies

A dozen of studies have been carried for water and sanitation both for Wajir Town and many other areas in the county. Key among those studies are the following;

- Feasibility study and preliminary design of water supplies for Wajir town water Masterplan (Zamconsult Consulting Engineers Ltd, 2017), funded by World Bank.
- Preparation of sanitation master plans, feasibility studies and preliminary designs for Wajir and Daadab towns (Mangat I.B. Patel & Partners, 2017), funded by World Bank.
- Detailed design report for immediate urgent works – faecal sludge management for Wajir project area (Mangat I.B. Patel & Partners, 2017), funded by World Bank.
- Evaluation, monitoring and modelling of Merti aquifer Study Reports by Earth Water Limited dated 2017, funded by World Bank.

Since the years 2008 to 2020, a lot of surveys and successful drilling of boreholes in the study area have been undertaken by the present researcher, at Habaswein, Griftu, Eldas, Tulatula, Hadado, Barmish, Qara, Lagha Dima, Biliki, and Chandarua.

The present study borrows heavily from previous work done in then Merti aquifer area by several authorities, whose work is briefly highlighted hereunder.

Earth Waters Limited & Acacia Water (2020) undertook Groundwater Mapping and Assessment for Wajir County, in an exercise funded by the Ministry of Water and Sanitation, Nairobi headquarters. This was an extensive study in Wajir County, which mapped and assessed groundwater hydrology through identification of aquifers and determination of their characteristics, GW quality analysis, recharge, Isotope analysis, flow and storage and compilation of GW database and aquifer model for the county. The models thus prepared have been of immense help in the present study. The other study looked at for the present task is also took place in 2018 Wajir County and was funded by the Millennium Water Alliance (Kenya) and Caritas (Kenya).

In partnership with Acacia Water (Netherlands) a situational assessment of water demand and access was carried out in a 3R/MUS in Wajir County. This project was funded by Millennium Water Alliance through CRS (Kenya) in partnership with Caritas (Kenya). This study was carried out with the aim of recommending on the possible areas where water conservation and buffering can be carried out with particular emphasis on the 3-R (Recharge, Retention and Re-use) approach in Marsabit and Wajir Counties. The actual implementation is yet to hit the ground for a take-off, so when actual work begins, then present study team would deduce more info and apply the same, where relevant, to understand the Merti aquifer abstraction and hydraulics.

A study was also undertaken in 2012 (Earth Water Limited (2012), Merti Aquifer Study; UNHCR). This project was commissioned by the UNHCR in collaboration with Neuchatel University (Switzerland) to undertake preparatory work involving the overall independent assessment of the existing boreholes in the Merti Aquifer domain and an online web-based assessment strategy elaborated by UNHCR and Neuchatel University (Switzerland) which will allow the prioritization of those boreholes that need to be equipped with monitoring devices. The study aimed to address critical water management issues related to the Merti Aquifer (Kenya). The study was carried out using a combined field-based and numerical model approach. This was a novelty in the Merti aquifer study and analysis of data, and really helped understand the dynamics of Merti hydraulics.

Then came the comprehensive study in 2017-Earth Water Limited (2017), Evaluation, Monitoring and modelling of the Merti Aquifer which was funded by World Bank through the Coast Water Services Board. The objective was to assess and evaluate groundwater availability and use, review groundwater monitoring data and develop a groundwater utilization and management model of Merti Aquifer. GW is the main source of water for the area accounting for over 90% of the water sources. 203 boreholes and 30 shallow wells were identified, out of these, a total of 142 boreholes and 16 shallow wells were operational. Several anomalies like inexplicable temperature extremes were witnessed in certain boreholes and the study was meant to help understand the underlying reasons. The Water Resources Authority also commissioned a study in 2016 on surface and groundwater sources, WRA (2016). The title of the study was Surface and Groundwater Resources Assessment for Decision Making (MTAP II).This was a Water Resources Assessment study undertaken in Wajir County implemented by WRMA under an MOU signed between State Department of Devolution in the Ministry of Devolution and

Planning and WRMA in respect of activities within the Mid – Term ASAL Programme 2 (MTAP II) financed by GoK and Denmark.

1.1.4. Findings of the Merti Aquifer Study by Earth Water Ltd

According to the Merti study report of 2017 (Earth water limited (K)), the issue of continued and increased groundwater abstraction from the aquifer lies in the uncertainty of the presence of brackish or saline water at greater depths than currently exploited. From the model simulations it was established that if no saline water is found at approximately 350 m below the surface level in the high potential zone, the risk of increased salinity of the abstracted water is very low in the coming 50 years. Shallower occurrence of brackish water could lead to rapid increase in salinity of the abstracted water (within several decades). In the present study, the Ademasajida and Arbajahan borehole sites show promise of fresh water in the 200m-320m depth brackets as the resistivities seem to suggest freshness.

1.1.5. Findings By the NWWDA Geologist

According to the NWWDA Geologist Mr Amimo, Biliki borehole which is located between Ademasajida and Arbajahan posts resistivity values of 18.5OhmM and 19.5OhmM, at 200m and 250m respectively. The water is fresh. Therefore the aquifer water quality at the spots surveyed and recommended, which have resistivity range of greater than 21 OhmM, will definitely be good.

The spots surveyed for exploratory wells should be drilled to a depth of at least 350 m in the areas pegged and shown to both chiefs –of Arbajahan and Ademasajida. Up-coning is ruled out as the radii of the selected spots are over 700m away from any existing wells.

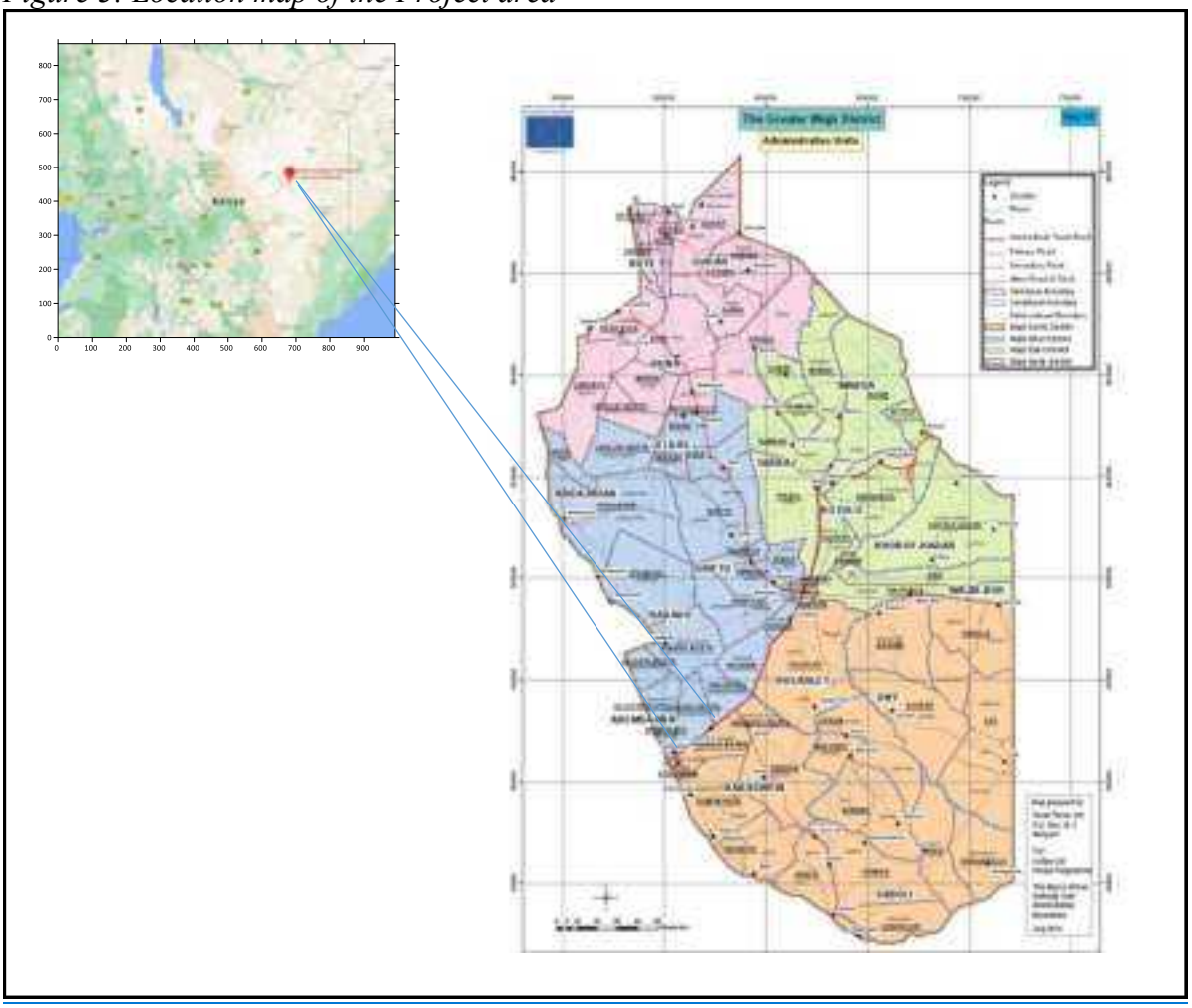
1.2. Objectives of the study

This is a technical project meant to enhance the monitoring of the Merti aquifer hydraulics, recharge and abstraction impacts of the reservoir, as well also assist the locals meet the deficit in water demands. The borehole will be developed upon drilling completion and should be preferably encased with steel iron castings. Once the productivity of the borehole has been determined, a suitable submersible pump will be installed to pump water into the proposed storage tanks. The schematic design and the detailed itemization for the proposed borehole shall be the subject of phase two work for the planning and designing unit, but will be predicated on the borehole performance in terms of aquifer yields and recharge. In case the yield will be too low for a submersible motor powered pumpage, a hand pump or windmill driven pump system is suitable as well.

1.3. Location

The project area lies in North eastern province within Wajir West subcounty, and is located on the western conclaves of the Habaswein Township. The area is defined by longitudes and latitudes STATED, at an altitude of approximately 231-245m above sea level. Zero-degree dipping sediments litter the terrain alongside few anthills, and these units are of the of Miocene Pliocene age, which are the predominant geology of the Merti aquifer.

Figure 3: Location map of the Project area



1.4. Hydrogeology of Area

1.4.1. Geology and Stratigraphy

The Adamasjida Ward comprises sedimentary rock units exhibiting continuous flow of water from one point to another in the subsurface. These are mainly Mio-Pliocene sediments that include both fine and medium, as well as coarse sandstones.

The topography is undulating dotted with several light toned/ dark anthills which are clayey rich, and support vegetations that comprise mainly thorny shrubs, undergrowths and acacia family trees.

The sandstones, gravels, grits, and weathered limestone storing juvenile water in the subsurface appears to have enjoyed subsequent replenishment from the flow inferred as originating from the River Ewaso/Laghdera course.

There may also be some carbonates are fairly fractured and possess water at the shallow depths, though fairly mineralized, via the fractures and karstification veins. Water also forms at the contact points between the carbonates and the coarsesiliciferous sediments. However, the massive subsurface laminar flow of the Merti aquifer (through the Laghdera seasonal stream)

dilutes any salinity that may be carbonate-derived in the aquifers. Overall water quality is thus much positively impacted on, thus.

Groundwater in the upper sediments shall enjoy annual precipitation recharge through direct infiltration, while the deep-seated zones shall be recharged via regional flow aided by the karstification channels and plate tectonics in the Jurassic – cretaceous period. Evapo transpiration rates of up to 2,000mm per annum over shadow the annual rains of up to 500mm per annum. The project area has numerous plants of the xerophytic order.

1.4.2. Physiography

The area stands at an average altitude **of 230-245**metres above sea level within a gently dipping terrain punctuated with several ant hills and flood plains both on the south eastern and north western flanks.

1.5. Hydrology and Structural Geology

1.5.1. Recharge Mechanisms within the Aquifer Systems

Evidences abound of jointing and fracturing of the carbonate sediments on the surface, alluding to intense forces of fracturing, carbonation and quaternary tectonic faulting. Much of the south westerly -north easterly directed stress fields helped sculpture the terrain into its present geological state. Owing to the relatively high fractions of clays in then beds, there is no sufficient time available for maximum river bed infiltration into the sub surface zones lying on the adjacent sides of the river course. However, there are areas that were exceptionally karstified and fractured within the carbonate beds. These are the zones that store water upon seepage into their aquifer sediments systems alongside recharging the adjacent sub surface storage systems via the Darcyan flow mechanics.

1.5.2. Drainage

Owing to the relative flat nature of the terrain, there is flood rampancy. The permanent civil structures on the ground to stand the risk of destruction added to the occasional loss of lives for both livestock and human persons. Most of the housing units are constructed through shrubs and dry acacia trees locally available, lightening the task of evacuation in the event of impending flood disasters. The schools nearby are built in flood free areas and this is a factor that suits drilling in the area as the well shall be free from floods.

1.6. Climate

The project area falls within zone 7 of the classification of climatic/ecological zones of Africa, that is to say arid to semi-arid with temperatures averaging 30 to 34 degrees per day and occasioning evapotranspiration rates of up to 3000mm per annum. The rainfall average falls well below 500mm per year.

1.6.1. Rainfall

The region is characterized by low rainfall distributed bimodal across the year. Precipitation in this area is markedly erratic. The specific study area ranges in altitude 200-250m asl.Much rain falls as intense local convectional storms which may yield 50 to 60 mm in a single event. The

area experiences two wet seasons, march to May and from October to December. June to September forms the driest period although the named wet seasons are fairly dry.

Table 3: Mean Monthly Rainfall (Garissa, Habaswein and Wajir) (Source: KMD 1990)

Month	Jan	Feb.	Mar	Apr	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Mandera	11	6	35	68	17	5	2	6	7	25	78	60	320
Hab	8	7	23	101	11	0	0	0	1	18	63	29	261
Wajir	7	6	34	77	35	2	3	2	5	29	61	22	281
Average	9	6	31	82	21	2	2	3	4	24	67	37	288

1.6.2. Temperature

Temperatures are fairly constant over the year, with an average of 28.5°C, a mean monthly maximum of approximately 30°C, and a monthly minimum close to 26°C. The January – May period is relatively warm, with mean monthly temperatures of 28.6 to 30.4°C. From June to September, monthly average temperatures commonly range between 26.8 and 27.8°C, with August being the coolest month.

1.6.3. Evaporation

The average annual potential evaporation (E_o) of the study area is 2400 mm. The spatial variability of E_o is considerably lower than the recorded differences in rainfall (P). In addition, seasonal variations are relatively small.

Table 4: *Garissa/Wajir Areas Mean Monthly Evaporation (1962 - 80) (Source: KMD 1984)*

Month	**Jan**	**Feb.**	**Mar**	**Apr**	**May**	**Jun.**	**Jul.**	**Aug.**	**Sept.**	**Oct.**	**Nov.**	**Dec.**
Lowest	162	147	197	173	180	184	186	192	213	170	168	148
Highest	229	239	279	293	291	294	266	294	305	310	277	239
Average	206	206	243	224	234	229	231	247	254	254	208	176

Generally, the potential open water evaporation is significantly higher than the actual Evapotranspiration, i.e. the combination of water vapour released from soils, surface water, and vegetation. The “potential evapotranspiration” is therefore a more accurate expression to apply in water balance evaluations, as it is based on a vegetated rather than water-logged surface.

2. GEOPHYSICAL INVESTIGATION

In order to determine the **Projects Area's hydrostragraphy and aquifer suitability, a total of 16No. Vertical** Electrical Soundings were undertaken using an **ABEM SAS 4000B Terrameter**. Before the VES probes, Horizontal electrical profiles were taken to delineate areas with less likelihood of salinity.

Schlumberger arrays were used so that current electrode spreads of up **to 320m** against potential spreads of between 0.5m and 50m were employed to conduct the surveys. Two of the best sites were taken for reasons of absence of dispute on land parcels and proxy mity to the center copper electrodes were used for the potentials, while steel iron electrodes were used for the currents.

Figure 4: Picture of Adamasajidacentre

2.1. H.E.P. Geophysics Undertaken at the Site

Merti aquifer is known to have the first major saturations on water tables between 130-160m bgl Based on this it was found pertinent that HEP or Wenner Profiles be undertaken to pinpoint the best spots with resistivity ideal for fresh water and goo, promising fractures at 160m below ground level. The MN/2 spreads of 50m was used, as AB/2 spread of 160m was employed , with intervals of 10m each, between successive stations. The raw data were then analyzed using IPI2WIN and R softwares.

Table 5: Sites profiled at interval of 10m apart looking for fresh water aquifer with highest resistivity in Ademasajida

Station No	Longitude	Latitude	Elevation -M	Resistivity – Rho) OhmM	Interval Radius-m
1	1.0239	39.494	238.8	6.7	10
2	1.023896	39.4942	238.8	6.2	10
3	1.02382	39.49426	237.98	6.1	10
4	1.023983	39.49418	236.6	5.9	10
5	1.024055	39.49412	237.1	5.1	10
6	1.02407	39.49412	235.98	6	10
7	1.02398	39.4941	233	7.3	10
8	1.024135	39.49405	235.8	7.05	10
9	1.02417	39.49404	235.2	6.9	10
10	1.02421	39.4939	233.9	6.7	10
11	1.02425	39.4939	233.88	6.75	10

The overall result was that there is not much significant variations in the levels of resistivity at the depth of 160m bgl, but the station with the highest value of resistivity of 7.3 OhmM was taken for further probing using VES probes.

2No VES were conducted on the areas deemed as conflict free by area chief, for drilling. A further sixteen number VES were undertaken in the outskirts of the area to help generated iso-resistivity models for the study area.

Model 1 – the resistivity model indicating the presence of fresh water devoid of salinity as from the depth of 160m bgl to 200m as the minor aquifer and also between 250m to 350m bgl. It is noted that the resistivity range from the depth of 200m onwards is consistent with fresh water EC.

Figure 5: Model Ademasajida001

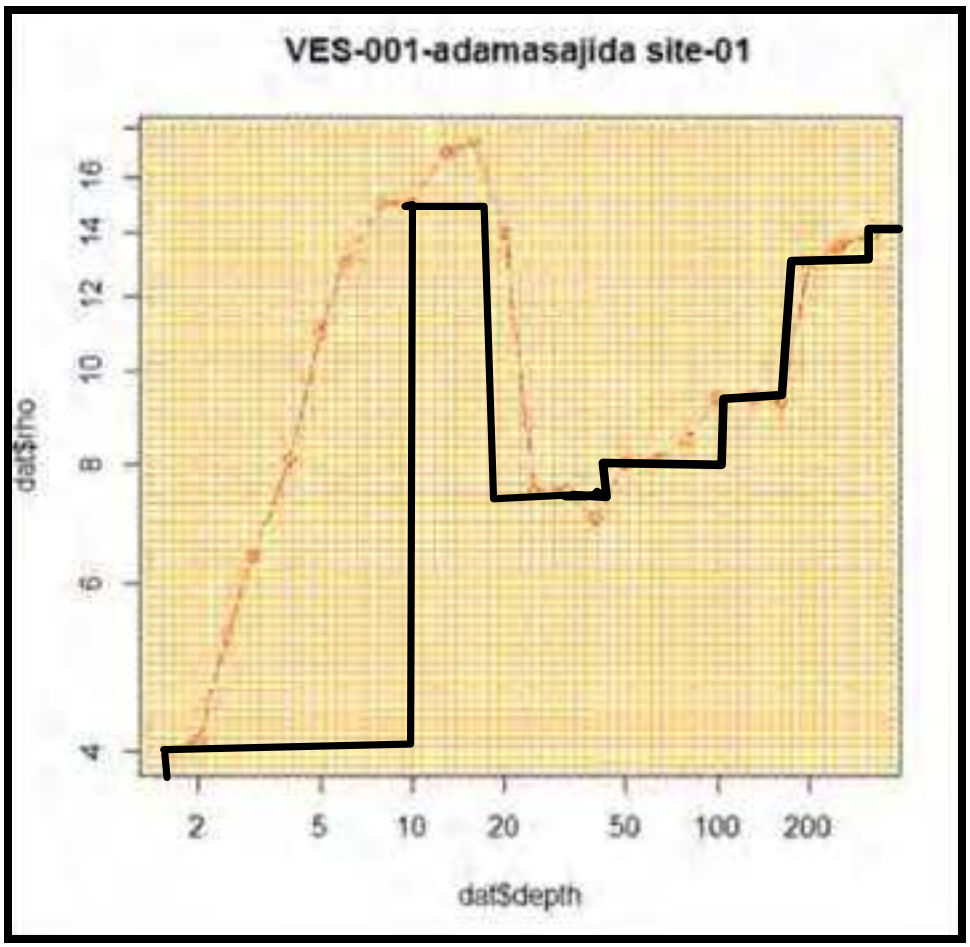


Table 6: Resistivity interpretation site 001

Resistivity Curve No-R	**Schlumberger Probe Depth Interval(m)**	**Resistivity In OhmM**	**Expected Geological sediment/Formation**	**Comments**
<u>001/2021</u> The first site near to biliki, over 600m away from the habasweincentre	0-1	4	Top Soils	Barren
	1-10	15	Dry Subsoils	Barren
	10-20	14	Wet subsoils	Barren
	20-25	7.5	Fine sandstones and Clays	Barren
	25-40	7	Medium sandstones/clays	Barren
	40-50	8	Clays and fine sandstones	Barren
	50-100	9.5	Fine sandstones	Barren
	100-160	9.25	Medium sandstones /gravel	Minor Aquifer
	160-200	13	Coarse sandstones and Gravels	Aquifer

	200-320	13.9	Medium to coarse sandstones	Main aquifer
	Over 320	Infinity	Sandstones and clayey shales	Aquifr Material

Model 2 – the resistivity model indicating the presence of fresh water devoid of salinity as from the depth of 160m bgl to 200m as the minor aquifer and also between 250m to 350m bgl. It is noted that the resistivity range from the depth of 200m onwards is consistent with fresh water EC.

Figure 6: Model Ademasajida002

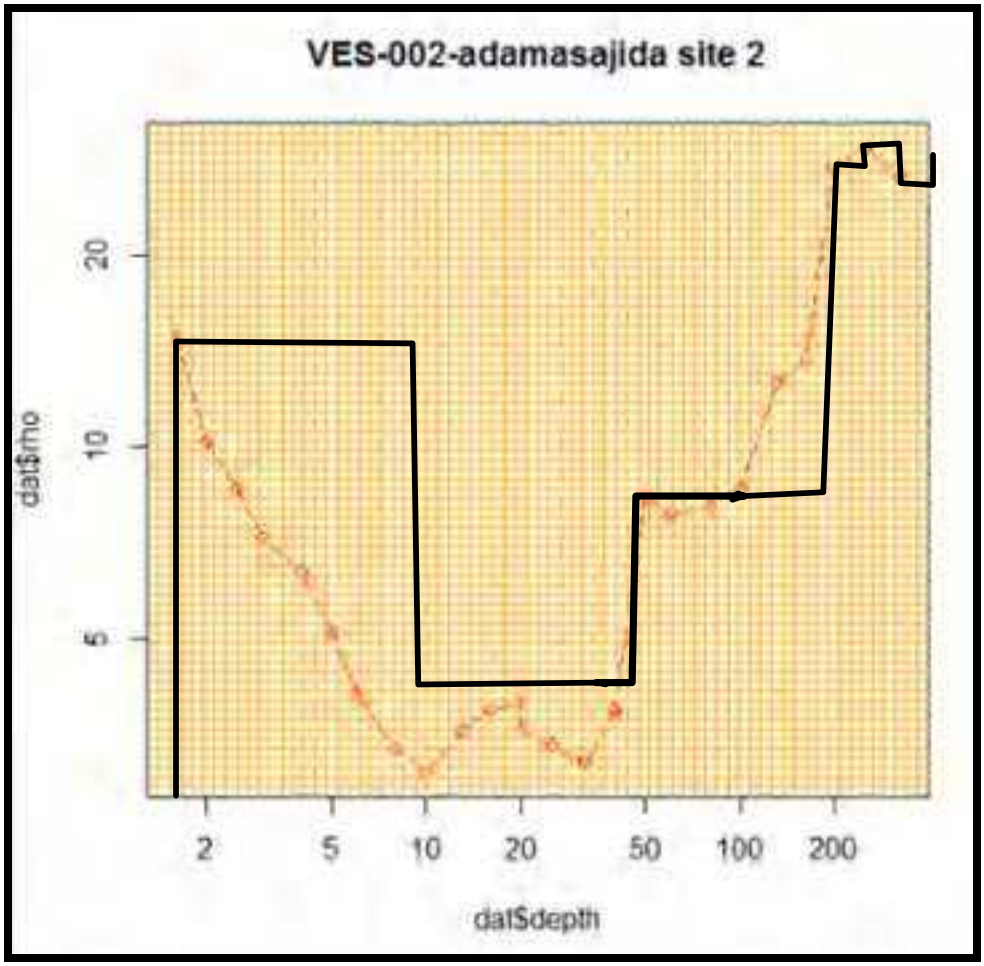


Table 7: Resistivity interpretation site 002

Resistivity Curve No-R	Schlumberger Probe Depth Interval(m)	Resistivity In OhmM	Expected Geological sediment/Formation	Comments
002/2021 The second site, also located near the main road, where the area chief guided us to survey	0-1	14.8	Top Soils	Barren
	1-10	3.1	Dry Subsoils	Barren
	10-32	3.2	Wet subsoils	Barren
	32-50	8.3	Fine sandstones and Clays	Barren
	50-100	8.5	Medium sandstones/clays	Barren
	100-200	27.5	Medium sandstones /gravel	Minor Aquifer
	200-250	29.5	Coarse sandstones and Gravels	Aquifer
	250-320	26.5	Medium to coarse sandstones	Main aquifer
	Over 320	Infinity	Sandstones and clayey shales	Aquifer

3. CONCLUSION AND RECOMMENDATIONS

From the foregoing synthesis of the Project Areas hydrology, geophysics, hydrogeology and stratigraphy, the sites investigated bear moderate groundwater potential. Both sites investigated possess reliable groundwater potential.

i) It is therefore advised to sink 1No borehole at the pegged spot site **Reference No.R-001/2021** to a depth of 350 **meters**.
ii) It is advised to sink 1No borehole at the pegged spot site **Reference No.R-002/2021** to a depth of 350 **meters**.

It is also approximately sketched in the attached Map Extract. Other recommendations include:-

(i) Drill using mud rotary methods as the formation ism loose.
(ii) Installation of an Airline (Piezometer) in the borehole to aid regular measurements of Static Water Levels.
(iii) Installation of a Master Meter in the borehole to aid the measurement of groundwater abstraction rate periodically.
(iv) Undertaking a full Physical, Chemical and Bacteriological Analyses of water samples collected from the borehole before assigning it any use.
(v) The formations bearing or harboring water are either very loose or highly weathered. It would be thus prudent to deploy a mudflow rotary rig or a cable tool percussion one to do the drilling.
(vi) Develop the boreholes with at least 5 bags of Kalgon to ensure the clayey sediments are removed from the wells to aid ease of flow of recharge.

All the sites done outside the town were just for research purposes and may not be drilled as they are either people's plots or located in grazing areas prone to conflicts.

The ultimate objective is to implement the long term proposals for water supply to Wajir town as was recommended by the Masterplan and design Consultant (Zamconsult Engineers Ltd). By drilling a series of boreholes either at Arbajaan or Admesajida subject to the above consultancy study

3.1. Drilling

Drilling should be carried out at a diameter of not less than 10", using a rotary type machine. The drilling rig should be able to drill to a depth of at least 200m, at the specified diameter. The rig and the drilling method adopted must be suitable for drilling through both unconsolidated material, and hard, compact volcanic rocks.

The borehole is expected to produce fresh water with an approximate yield of 25 to 30 m3 per hour.

3.2. Well Design

The design of the well should ensure that screens are placed against the optimum aquifer zones. The final design should be made by an experienced Hydrogeologist.

3.3. Casing and Screens

The well should be cased and screened at 8” diameter, (high class Casings and screens) in order to avoid collapsing and sediment intake. Screen slots should be a maximum of 1.5 mm in size. The minimum open area of the screens should be 5%.

3.4. Gravel Pack

The use of a gravel pack is recommended within the aquifer zone, because the aquifer could contain sands or silts, which are finer than the screen slot size. A 10" diameter borehole screened at 8" will leave an annular space of approximately 1", which is sufficient to allow the insertion of fine, quartzitic gravel. The grain size of the gravel pack should be within the range of 2 to 5 mm, and granules should be rounded to well-rounded. Over 95% should be siliceous.

Gravel pack should be washed down with copious volumes of water to avoid bridging. The best method, which is unfortunately rarely used, involves the insertion with a tremie pipe.

3.5. Well Construction

In installing screen and casing, centralizers at 6 metre intervals should be used to ensure centrality within the borehole. This is particularly important to insert the artificial gravel pack all around the screen. If installed, gravel packed sections should be sealed off at the top and bottom with clay or bentonite seals (2 m). In this case, it is also recommended to install a 3 m long, cement grout plug at the surface, to prevent contamination from entering the borehole.

The remaining annular space should be backfilled with inert material (drill cuttings may be used), and the top five metres grouted with cement to ensure that no surface water at the well head can enter the well bore and thus prevent contamination.

3.6. Well Development

Once screen, gravel pack, seals and backfill have been installed, the well should be developed. Development is the term used to describe the procedures designed to maximise well yield.

MESHACK O. AMIMO
HYDROGEOLOGIST

4. REFERENCES

1. Various boreholes sited and drilled by NWWDA
   i) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Habaswein water Supply (2010)
   ii) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Hadado water Supply (2010)
   iii) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Barmish water Supply (2014)
   iv) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Qara water Supply (2013)
   v) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Chandarua water Supply (2012)
   vi) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Lagha-Dima Water Supply (2019)
   vii) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Biliki water Supply (2020)
   viii) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Griftu water Supply (2013)
   ix) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Eldas water Supply (2013)
   x) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of TulaTula water Supply (2010)
   xi) Amimo B.M.O., Hydrogeological Surveys and Geophysical Investigations of Basir water Supply (2010)
2. Earth Water Limited & Acacia Water. (2020). Groundwater Mapping and Assessment for Wajir County. Prepared for Ministry of Water and Sanitation, Kenya. http://geo.acaciadata.com/Wajir/.
3. Water Resources Assessment (2016): Surface and Groundwater Resources Assessment for DecisionMaking (MTAP II).
4. Earth Water Limited & Acacia Water (2017): Merti Aquifer Study Report (funded by Coast Water Services Board)
5. Earth Water Limited (2012): Merti Aquifer Study Report (funded by UNHCR)
6. Gibb Study report (2004): Merti Aquifer Study Report (funded by UNHCR)

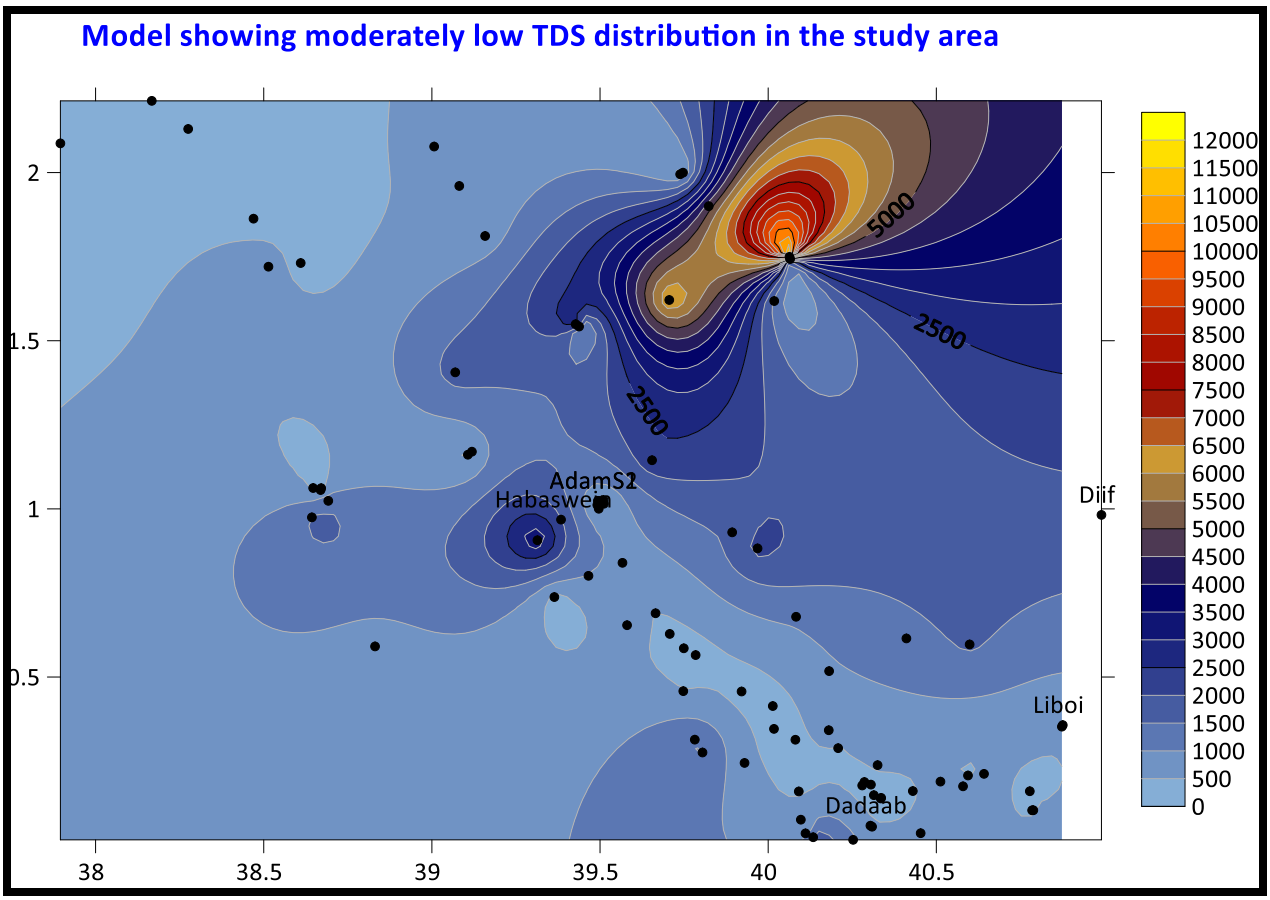
5. Annexes

5.1. Geochemistry

5.1.1. Total Dissolved Solids (TDS)

Surfer Model 1-this model shows the distributions of TDS in the whole Merti Aquifer, and one can see that the Project Area falls in the range 500-1000 mg/L, implying very safe water for drinking

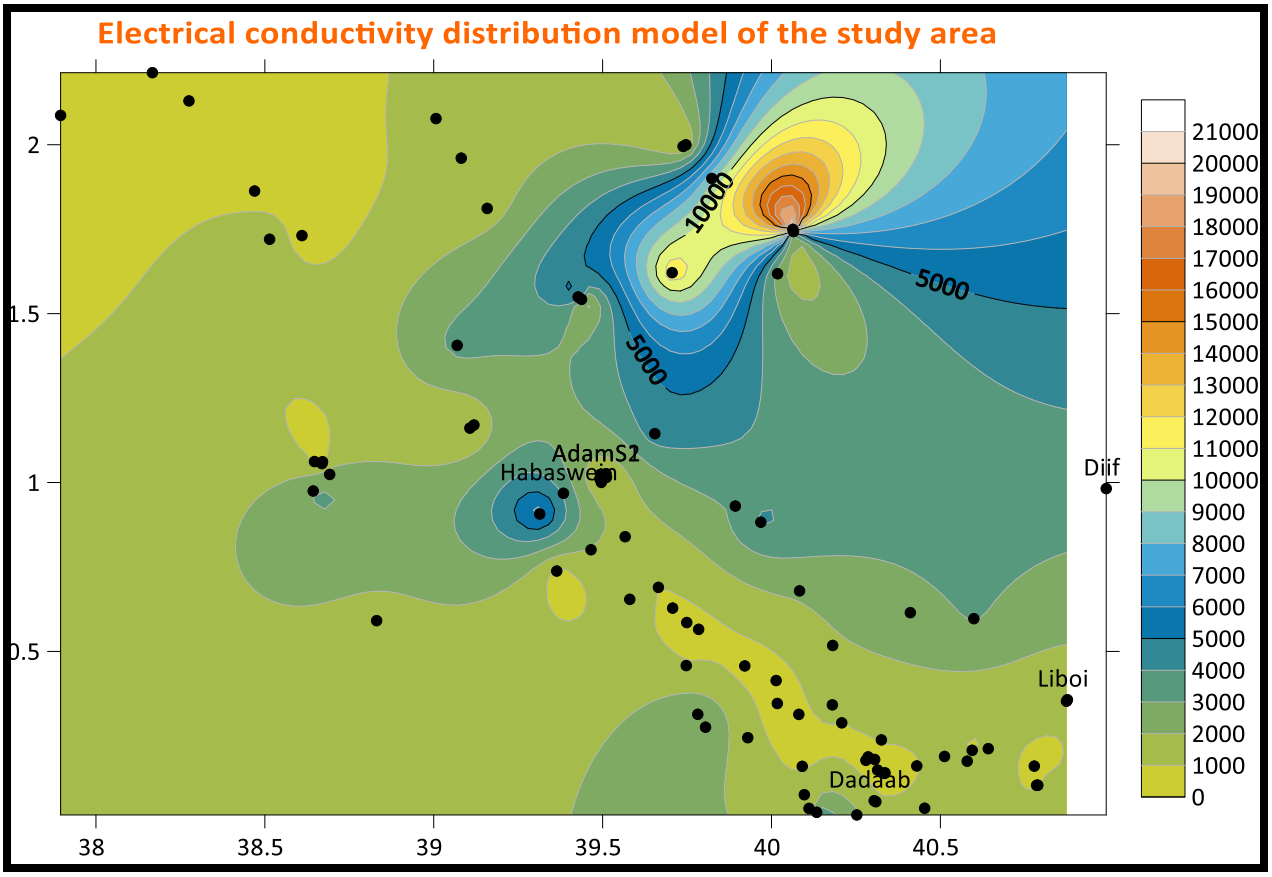
Figure 7: Model showing TDS distribution in the study area



5.1.2. Electrical Conductivity (EC)

Surfer Model 2-this model shows the distributions of EC in the whole Merti quifer, and one can see that the Project Area falls in the range 1000-2000 mg/L, implying very safe water for rinking. Half of EC will give rise to around 500 mg/L to 1000 mg/L

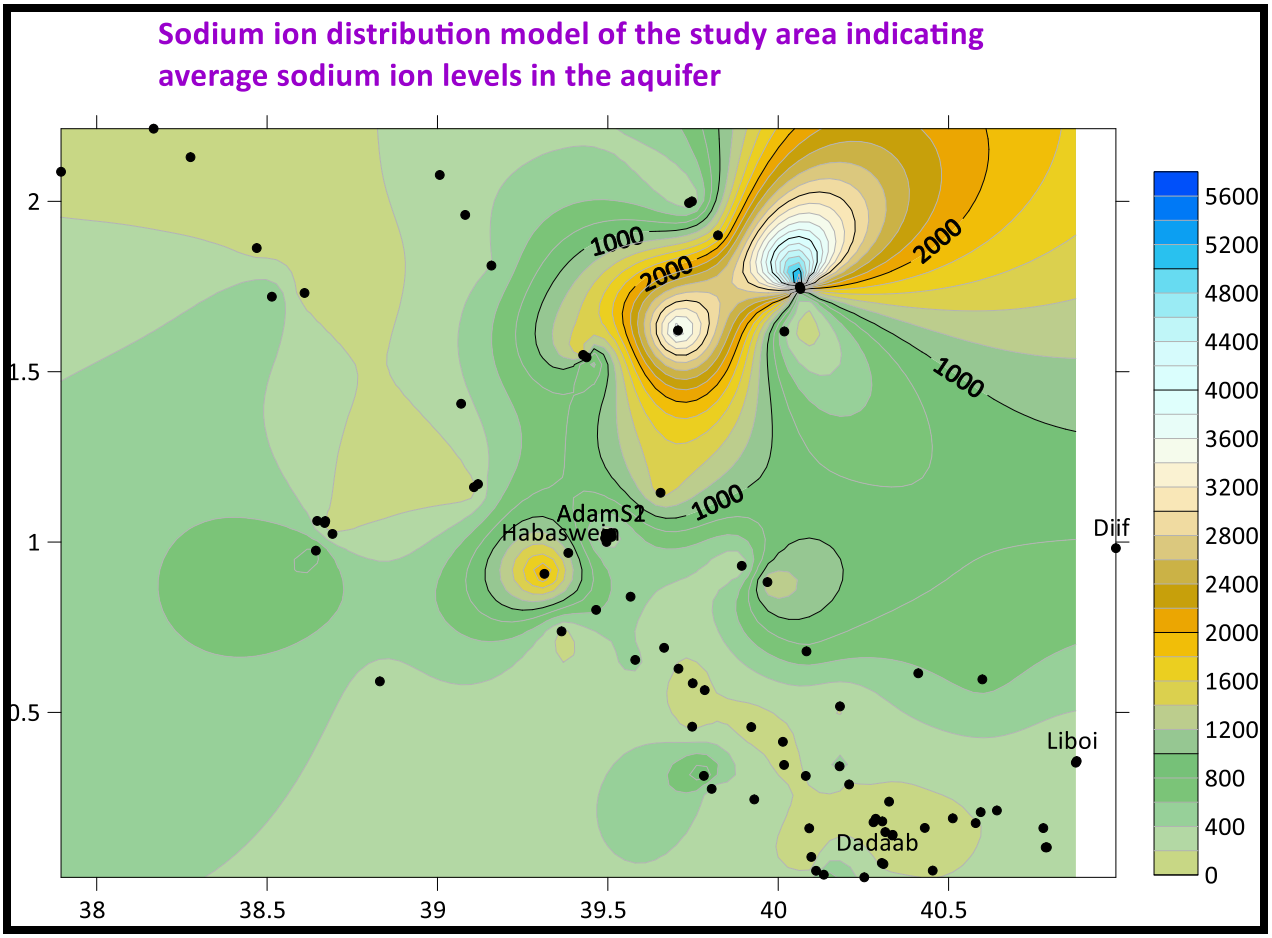
Figure 8: Model showing EC distribution in the study area



5.1.3. Sodium Ion

Surfer Model 3-this model shows the distributions of Na+ ions in the whole Merti Aquifer, and one can see that the Project Area falls in the range 200-400 mg/L, implying very safe water for drinking.

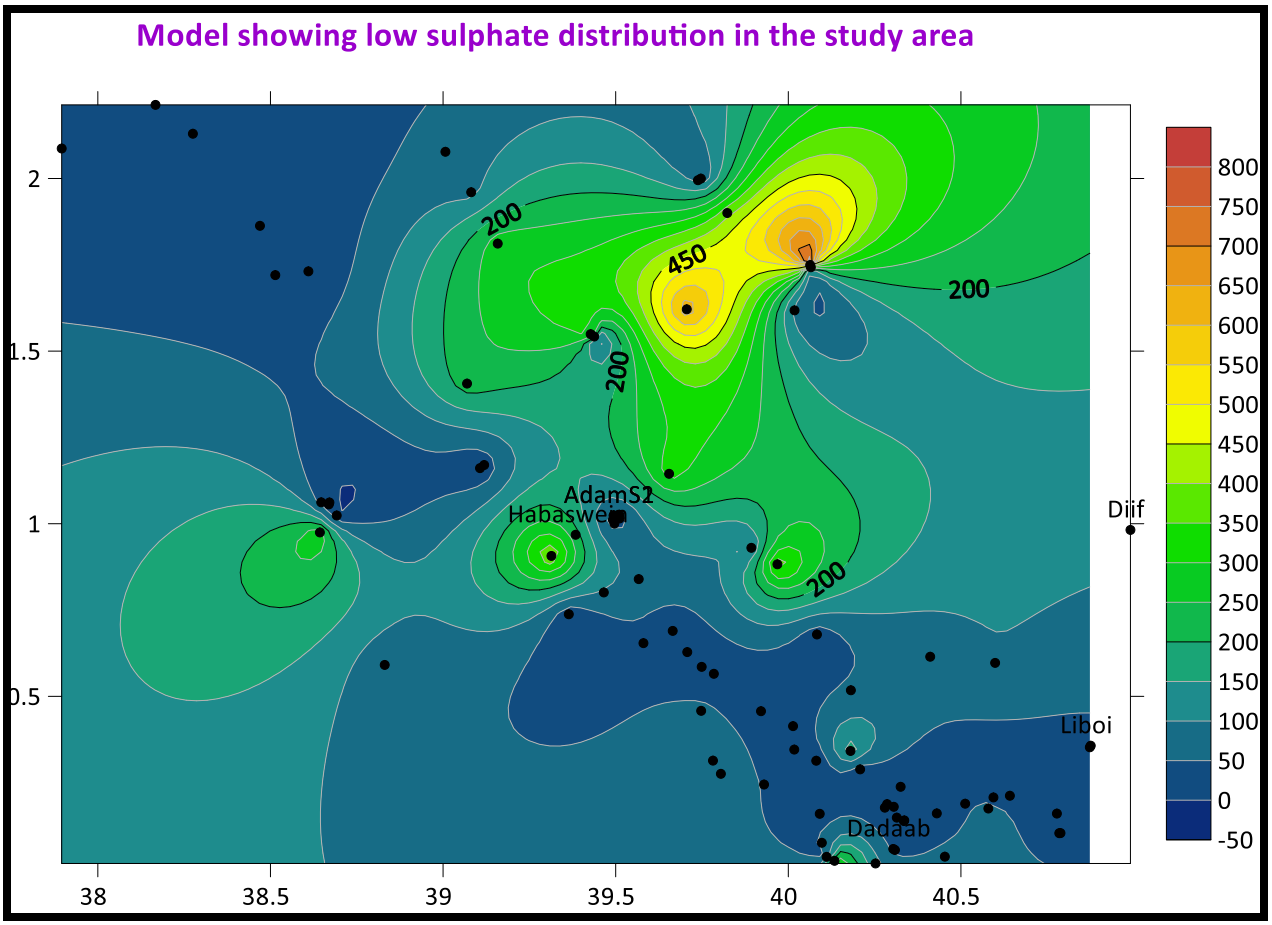
Figure 9: Model showing Sodium ion distribution in the study area



5.1.4. Sulphates

Surfer Model 4-this model shows the distributions of SO_4^{2-} ions in the whole Merti Aquifer, and one can see that the Project Area falls in the range 50-100 mg/L, implying very safe water for drinking.

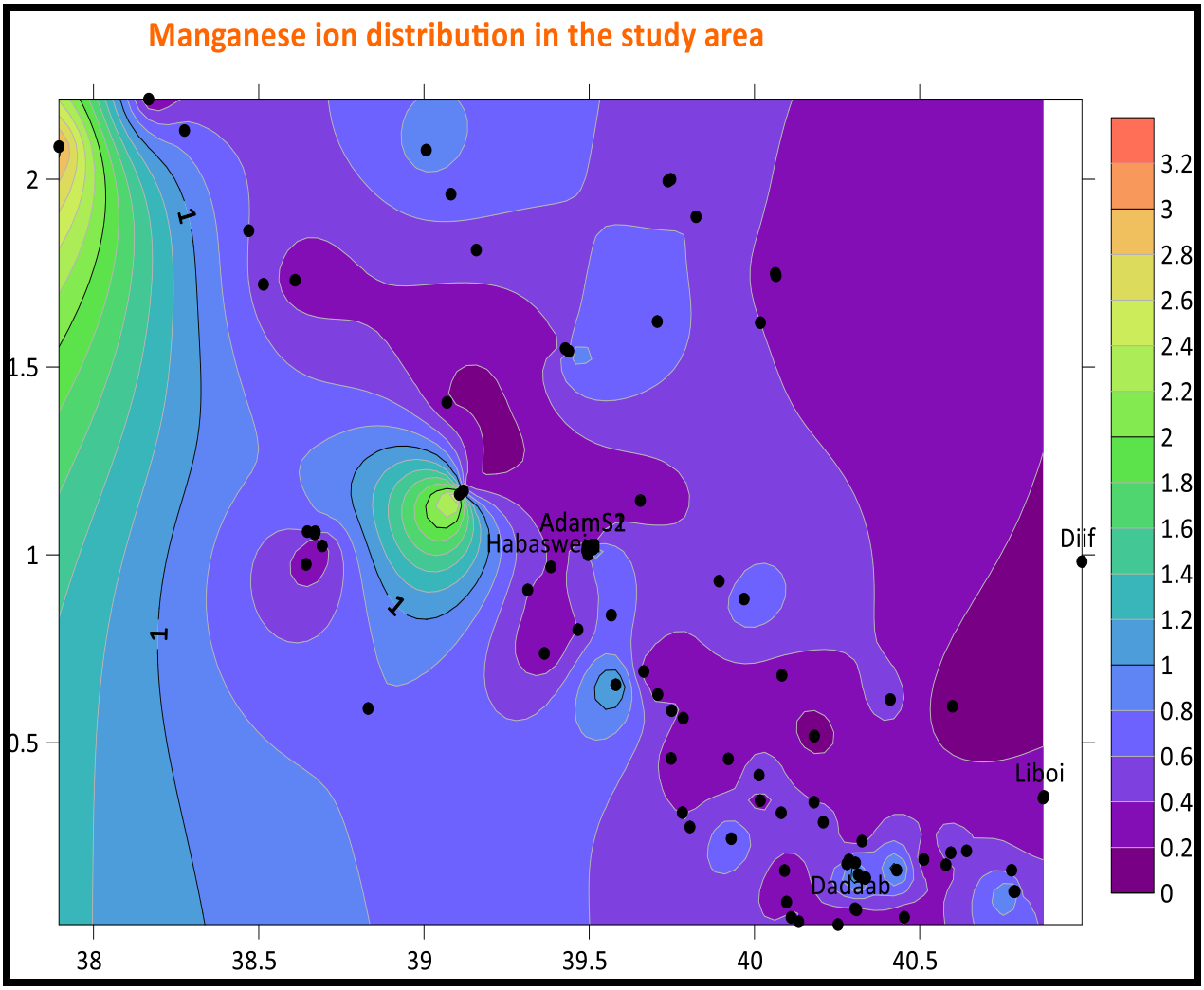
Figure 10: Model showing Sulphates distribution in the study area



5.1.5. Manganese

Surfer Model 5-this model shows the distributions of Mn ions in the Merti Aquifer, and one can see that the Project Area falls in the range 0-0.1 mg/L, implying very safe water for drinking.

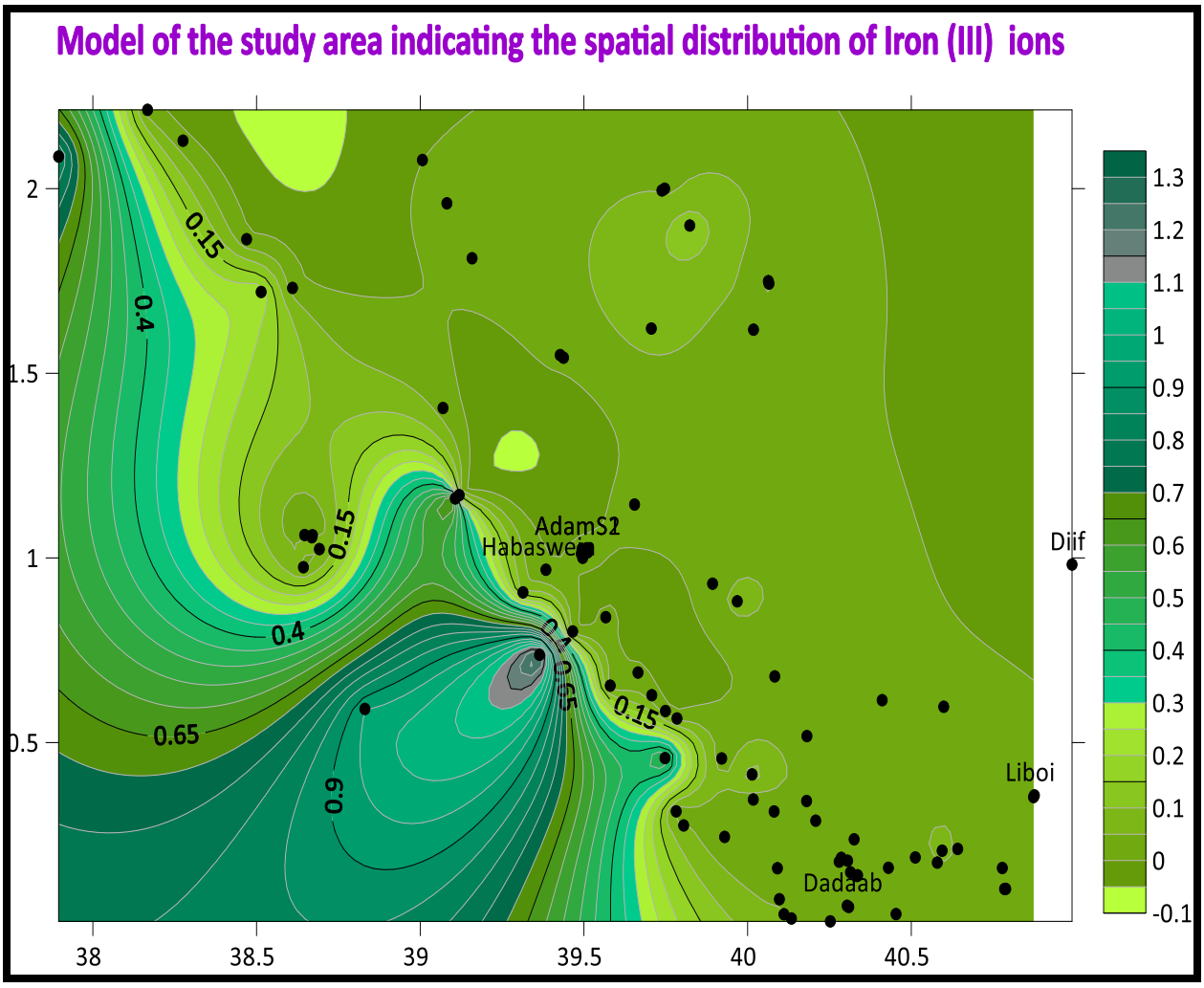
Figure 11: Model showing manganese distribution in the study area



5.1.6. Iron

Surfer Model 6-this model shows the distributions of Fe^{2+} in the whole Merti Aquifer, and one can see that the Project Area falls in the range way below 0.1 mg/L, implying very safe water for drinking.

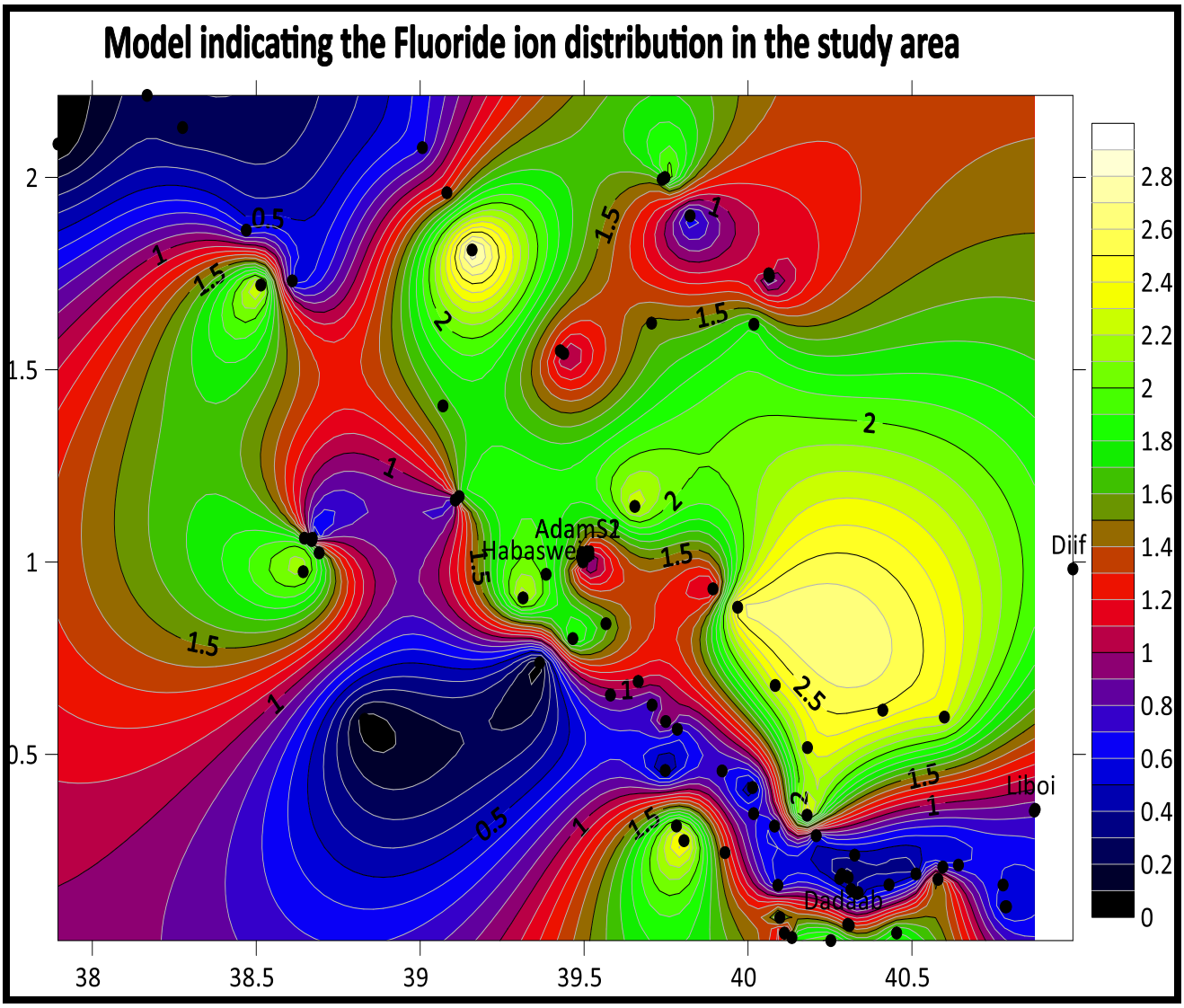
Figure 12: Model showing iron distribution in the study area



5.1.7. Fluoride-

Surfer Model 7-this model shows the distributions of fluorides in the Merti Aquifer, and one can see that the Project Area falls in the range below 1.6 mg/L, implying very safe water for drinking. Eastern side of the Merti aquifer Model map implies safe drinking water.

Figure 13: Model showing fluoride distribution in the study area



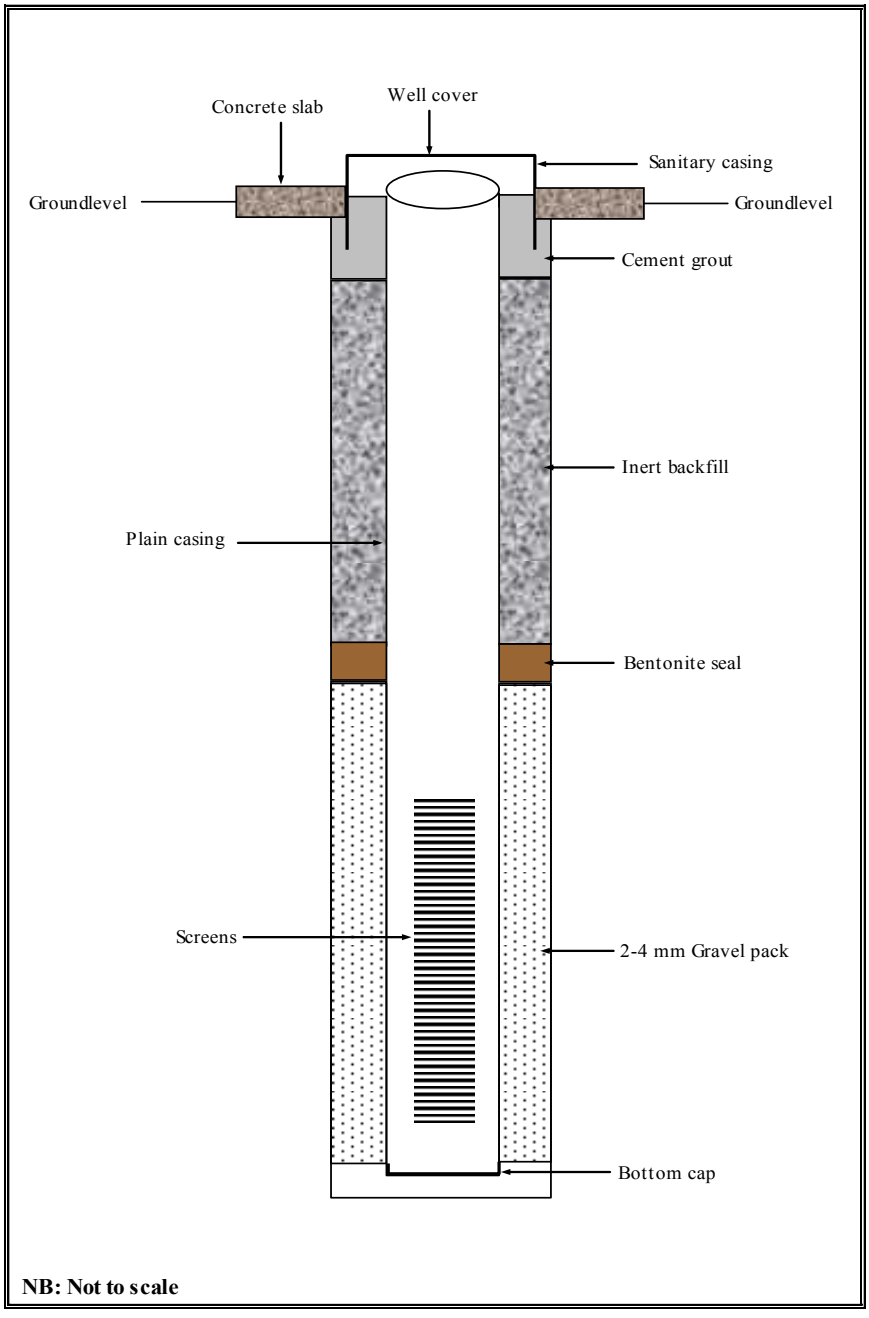


Figure 14: Schematic Design for Standard Borehole Completion

NORTHERN WATER WORKS DEVELOPMENT AGENCY (NWWDA)

WATER AND SANITATION DEVELOMENT PROJECT

REVISED ARBAJAHAN AND BULA MADINA BOREHOLES

HYDROGEOLOGICAL SURVEY REPORT

March, 2022

EXECUTIVE SUMMARY

Introduction

The Hydrogeological study was initiated by Northern Water Works Development Authorityto undertake boreholes site survey in Arbajahan and Bula Madina areas of Wajir West in Wajir County.This report presents the results of the investigations and the recommendations on the drilling and construction of two productionborehole.

Location

The investigated sites are located in Arbajahan and Bula Madinaareasof Wajir West Sub-County, Wajir County. The sites are located in Arbajahan town and Bula Madina village respectively. The Arbajahan site is defined by coordinates UTM coordinates 39.009005 and 2.062859 at an elevation of 342m while the Bula Madina is defined by UTM coordinates 39.05009 and 1.98701 at an elevation of 330 m amsl.

Geology

The rocks in the project area are all of sedimentary in origin. The oldest rocks consist of the Meta-sediments of the Triassic age. These rocks include grits and sandstones, and red sandy soils.These rocks exhibit considerable variation in thickness, extent and lithologic characteristics that suggest rapid deposition of detritus materials derived from the erosion of adjacent areas of older sandstones or limestone. The rocks likely to be encountered in the investigated areas are discussed below from the youngest to the oldest.

Hydrogeology

The investigated sites are located in a hydrogeological zone characterized by moderate groundwater potential and the Aquifers are found within the sediments. From the borehole data the 1staquiferis expected at depths range of between50 and 70 m bgl, and the main aquifer at depths ranges of between85 and 190 m bgl. The borehole yields in the area has been determined from borehole completion reports to range from 12.5m^3/hr to 16.65 m^3/hr and the yield is proportional to the depths drilled. However, during the field inventory, abstraction was estimated to be 20 m^3/hr, which has to be verified. It should however be noted that the success rate of a borehole depends on the drilling method and the competency of the driller.

Water Demand and Current water supply

Arbajahan

Arbajahan is served by two boreholes which are not sufficient enough for the high population (approximately 9000 people) and the livestock

Bula Madina

Currently there is no water source in the area and the community sources water through water tracking from Arbajahan town boreholes and at a fee of 5 shillings per 20L jerrican.

Fieldwork

Fieldwork was carried out in February 2022 where 6 Ves's were executed in Arbajahan and 7 VES's were executed in Bula Madina to determine the hydro stratigraphy of the areas and recommend possible drilling sites.

Conclusions

From the hydrogeological and geophysical interpretation results, the following conclusions are made:-

- From the evidence gathered from geological, hydrogeological and nearby existing boreholes, the areas are located in a hydrogeological zone that is characterized by medium groundwater potential and yields in the range of between 10-20m^3/hour. This wholly depends on a complete and comprehensive borehole drilling process i.e. drilling, installation, development, Pump testing, and Pump installation.

- From the existing borehole data and the geophysical results water strikes are expected at depths of 250m in Arbajahan while in Bula Madina the depths are expected to be less than 200m.
- Drilling supervision is necessary and will dictate the point upon which drilling should stop and only when sufficient yields have been attained
- From previous deep TDEM results in the area aquifers are interpreted at depths as shallow as less than 150m with earlier water strikes expected at depths before 100m
- Borehole yields are dependent on cumulative yields of successive aquifers and therefore care should be taken to tap all the aquifers during borehole designing.

Recommendations

Arbajahan

In view of the above, the following recommendations are made;

- A 250mm (10") diameter borehole to be drilled at the location of **VES No 41** to a minimum depth of**200mbgl**. The site location is defined by UTM coordinates 39.009005 and 2.062859 at an elevation of 342m
- Though water strikes are expected at shallow depths less than **150 m bgl**, drilling should be continued to the recommended depth in order to optimize the yield of the borehole.
- The borehole should be installed with 200mm (8") diameter steelcasings and screens with slots of 1.5 mm and high % open surface area.

The recommended drilling site was shown to Ahmed Muhamed (Phone 0729945952 ;) and BisharMow (Phone:0727484008) both local residents at Arbajahan town who were present during the fieldwork survey**.**

Bula Madina

Based on the study and field investigations the following recommendations are made;

A 250mm (n 10") diameter borehole to be drilled at the location of **VES No 43** to a minimum depth of**160mbgl.** The site location is defined by UTM coordinates 39.05009 and 1.98701 at an elevation of 330 m amsl.

- Drilling should only stop when optimum yields are achieved as will be directed by the supervising hydro geologist
- Though water strikes are expected at shallow depth less than 100 m bgl, drilling should be continued to the recommended depth in order to optimize the yield of the borehole.

The recommended drilling site is benchmarked on site and was shown to Musa Ayed a local at Bula Madina who was present during the fieldwork survey of phone number **0716447171**

Common Recommendations for both Arbajahan and Bula Madina Sites

- The boreholes should be installed with 200mm (8") diameter steel casings and screens with slots of 1.5 mm and high % open surface area.
- The boreholes must be installed with a Water Meter and a functional Airline/piezometer to monitor abstraction and to facilitate measurements of the water levels in the borehole.
- On drilling completion, 2-litre water samples should be collected for reference to the WRA Testing Laboratory, or any other competent Water Testing Authority for a full physical, chemical and bacteriological analysis before the water is put to any use.
- Copies of the analysis report must be sent to WRA Regional Office for record.
- There should be regular monitoring of of water quality (ECs) during the drilling process.
- BH drilling and construction process should be supervised by a qualified/experienced hydrogeologist for excellent results.

Monitoring

Regular monitoring should be instituted in the borehole in order to keep track of groundwater levels. A monitoring tube should be installed in the borehole to be able to monitor the water level. It is absolutely necessary to observe the water levels during optimum production to ensure a pumping regime that reduces the effects of high gradients of the cone of depression of the well and resultant water level decline in the aquifer.

Borehole Construction

Detailed recommendations are given for borehole construction and completion methods in appendix 1. The importance of correct and comprehensive techniques in this particular aspect cannot be over-emphasized.

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LIST OF ABBREVIATIONS AND GLOSSARY OF TERMS

ABBREVIATIONS (All S.I Units unless indicated otherwise)

Amsl	Above mean sea level
Bgl	Below ground level
EC	Electrical conductivity (mS/cm)
hr	Hour
K	Hydraulic conductivity (m/day)
I	litre
m	metre
PWL	pumped water level
Q	Discharge
sQ/s	Specific capacity (discharge – drawdown ratio; in m. cu/hr/m)
S	Drawdown (m)
Sec	Second
SWL	Static water level
T	Transmissivity (m.sq/day)
VES	Vertical Electrical Sounding
WSL	Water struck level
mS/cm	Micro-Siemens per centimetre: Unit for electrical conductivity
^{0}C	Degrees Celsius: Unit for temperature

GLOSSARY OF TERMS

Name	Description
Alluvium	General term for detrital material deposited by flowing water
Aquifer	A geological formation or structure, which stores and transmits water and which is able to supply water to wells, boreholes or springs.
Colluvium	General term for detrital material deposited by hill slope gravitational process, with or without water as an agent. Usually of mixed texture.
Conductivity	Transmissivity per unit length (m/day).
Confined aquifer	A formation in which the groundwater is isolated from the atmosphere by impermeable geologic formations. Confined water is generally at greater than pressure than atmospheric, and will therefore rise above the struck water level.
Development	In borehole engineering, this is the general term for procedures applied to repair the damage done to the formation during drilling. Often the borehole walls are partially clogged by an impermeable 'wall cake', consisting of fine debris crushed during drilling, and clays from the penetrated formations. Well development removes these clayey cakes, and increases the porosity and permeability of the materials around the intake portion of well. As a result, a higher sustainable yield can be achieved.
Fault	A larger fracture surface along which appreciable displacement has taken place.
Gradient	The rate of change in total head per unit of distance, which causes flow in the direction of lowest > head.
Heterogeneous	Not uniform in structure or composition.
Hydraulic head	Energy contained in a water mass, produced by elevation, pressure or velocity.
Hydrogeological:	Those factors that deal with sub-surface waters and related geological aspects of surface waters.
Infiltration	Process of water entering the soil through the ground surface.
Joint	Fractures along which no significant displacement has taken place.
Percolation	Process of water seeping through the unsaturated zone, generally from a surface source to the saturated zone.
Perched aquifer:	Unconfined groundwater separated from an underlying main aquifer by an unsaturated zone. Downward percolation hindered by an impermeable layer.
Peneplain:	A level surface, which has lost nearly all its relief by passing through a complete cycle of erosion (also used in a wider sense to describe a flat erosional surface in general).
Permeability:	The capacity of a porous medium for transmitting fluid.
Piezometric level	An imaginary water table, representing the total head in a confined aquifer, and is defined by the level to which water would rise in a well.
Porosity	The portion of bulk volume in a rock or sediment that is occupied by openings, whether isolated or connected.
Pumping test	A test that is conducted to determine aquifer and/or well characteristics
Recharge:	General term applied to the passage of water from surface of sub-surface sources (e.g. rivers, rainfall, and lateral groundwater flow) to the aquifer zones.
Saprolite:	Weathered residual rock in place.

Static water level:	The level of water in a well that is not being affected by pumping. (Also known as 'rest water level').
Transmissivity	A measure for the capacity of an aquifer to conduct water through its saturated thickness (m. sq. /day)
Unconfined:	Referring to an aquifer situation whereby the water table is exposed to the atmosphere through openings in the overlying materials (as opposed to> confined conditions).
Yield	Volume of water discharged from a well.

1. INTRODUCTION

1.1 Background

The Hydrogeological study was initiated by Northern Water Works Development Authorityto undertake a borehole site investigation in Arbajahan town and Bula Madina Village in Wajir West sub-county, Wajir County. The current water source in Arbajahan is strained due to the increased population of humans and livestock. In Bula Madina the community has no water source and they rely on water delivered by water boozers from Arbajahan town a distance of approximately 15Km and at a cost. It is against this background that NWWDA intends to drill productive boreholes in these two sites.

This report presents the results of the investigations and the recommendations on the drilling and construction of two production boreholes in the two sites.

1.2 The Objective of the Investigations

The objective of the present study is to assess the availability of groundwater in the two investigated areas(Arbajahan and Bula Madina), to recommend borehole drilling sites and comment on aspects of depth to potential aquifers, aquifer availability and type, possible yields and water quality. For this purpose, all available hydrogeological information of the area has been analyzed, and a geophysical survey done.

The investigations involved hydrogeological, geophysical field investigations and an initial desk study in which the available relevant geological and hydrogeological data were collected, analyzed, collated and evaluated within the context of the key requirements. The data sources consulted were mainly but not restricted to the following:

a) Published Master Plans.
b) Geological and Hydrogeological Reports and Maps.
c) Ministry of Water and Sanitation Borehole Completion records.
d) technical reports of the area by various organizations and stakeholders.

1.3 Reporting Requirements

The format of writing the Hydrogeological Investigations Report, as described out in the Second Schedule of the Water Resources Management Rules, 2007. Such a report must consider the following (verbatim): —

i) Name and details of applicant.
ii) Location and description of proposed Activity.
iii) Details of climate.
iv) Details of geology and hydrogeology.
v) Details of neighbouring boreholes, including location, distance from proposed borehole or boreholes, number and construction details, age, current status and use, current abstraction and use.
vi) Description and details (including raw and processed data) of prospecting methods adopted, e.g., remote sensing, geophysics, geological and or hydrogeological cross sections. hydrogeological characteristics and analysis, to include but not necessarily be limited to, the following:
    - Aquifer transmissivity
    - Borehole specific capacities
    - Storage coefficient and or specific yield
    - Hydraulic conductivity.
    - Groundwater flux.
    - Estimated mean annual recharge, and sensitivity to external factors.

i) Assessment of water quality and potential infringement of National standards.
ii) Assessment of availability of groundwater.
iii) Analysis of the reserve.

iv) Impact of proposed activity on aquifer, water quality, other abstractors, including likelihood of coalescing cones of depression and implications for other groundwater users in any potentially impacted areas.

v) Recommendations for borehole development, to include but not limited to, the following:
   - Locations of recommended borehole(s) expressed as a coordinate(s) and indicated on a sketch map.
   - Recommendations regarding borehole or well density and minimum spacing in the project area.
   - c). Recommended depth and maximum diameter.
   - d). Recommended construction characteristics, e.g. wire-wound screen, grouting depth e. Anticipated yield.

i) Any other relevant information (e.g., need to monitor neighbouring boreholes during tests).

This report is written so as to cover each of the above, insofar as data limitations allow. The report also includes maps, diagrams, tables and appendices as appropriate.

This report is written so as to cover each of the above, insofar as data limitations allow. The report also includes maps, diagrams, tables and appendices as appropriate.

2. BACKGROUND INFORMATION

2.1 Location

Arbajahan site is located approximately 140Km West of Wajir town via Griftu town while Bula Madina is approximately 15km South of Arbajahan, Wajir West Sub-County, Wajir County. Arbajahan site is defined by UTM coordinates 39.009005and 2.062859at an elevation of 342mwhile Bula Madina is defined by UTM coordinates 39.05009 and 1.98701 at an elevation of 330 m amsl.

2.2 Physiography and Drainage

The general drainage pattern in the general area is from North West to South East. The Lagh Dera (Ewaso Ngiro) river emanating from the Aberdares and Mt.Kenyahas some tributaries surface flow through this area, although it is believed to flow underground into the Indian Ocean.Flow from the Marsabit Mountains also forms part of the drainage and also including the flow the Ethiopian highlands via the Bute,Buna and Eldas area.

2.3 Climate and Vegetation

The area under study in Wajir County lies in an area categorized as Arid and Semi-Arid Lands (ASAL) in Kenya. The area receives erratic and inadequate rainfall. The vegetation in the area is mainly thick low thorn shrub with open grassland. Short scattered shrubs are noted in some areas.

2.4 Population

The population of Arbajahan area is estimated at 9000 people whileBula Madina area has a human population of approximately 1,000 persons. The population is not constant and it changes depending on the seasons (dry and wet seasons). The population in Arbajahan together with the livestock take water from the Arbajahan boreholes while that of Bula Madina depend on water tracking from Arbajahan.Assuming a consumption of $0.02m^3$/head/day in the Bula Madina area, the daily estimated demand is approximately $20m^3$/day. A borehole with a yield ranging between 10 and $20m^3$ will successfully meet the community water demand in Bula Madina village.

2.5 Livestock

The population of livestock in the area cannot be determined precisely due to the fact that they are almost always being migrated from one locality to another in search of greener pastures and watering points. The livestock population depends on the season.

The population of camels, goats and sheep is high due to their drought resistance nature. A small population of donkeys is maintained even during dry seasons as they are used to transport water.

From the field inventory it was estimated that there is approximately 118,700livestock population in the area and the table below depicts the rates of consumption per unit.

Table 1: Livestock Consumption Rates

Livestock	Livestock Unit	Daily Consumption (l)	Daily Consumption (m^3/day)
1 Grade Cow	1 Livestock Unit (LU)	28	0.028
3 Indigenous Cows	1 Livestock Unit (LU)	18.5	0.0185
15 Shoats	1 Livestock Unit (LU)	3.5	0.0035
5 Donkeys	1 Livestock Unit (LU)	18.5	0.0185
2 Camels	1 Livestock Unit (LU)	33.5	0.0335

(Source: Design Manual for Water Supply in Kenya)

2.6 Water Demand and Existing Water Supply

The Arbajahan area has an already existing water supply from two boreholes though the resources are constrained due to the high livestock and human population increase and hence a need for an additional borehole in the area.

Currently there is no water source in the Bula Madina area and water is sourced in Arbajahan through water tracking. With an estimated population of 1000 people and a consumption rate of 50l/person/day, the daily demand amounts to approximately 20m^3/day. A tabulation of the human population is given here below

Table 2:Arbajahan population and consumption

Location	Sub-location	Census year2019	Population projection		
			Initial year2022+	Future year 2032 (Intermediate design pop)	Ultimate year2042
Arbajahan		6,672	7,724	12,581	20,419

Table 3: Water Consumption

Human pop	Total daily Consumption (m^3/person/day)	Total Consumption (m^3/day)
12,581	0.05	629m^3/day

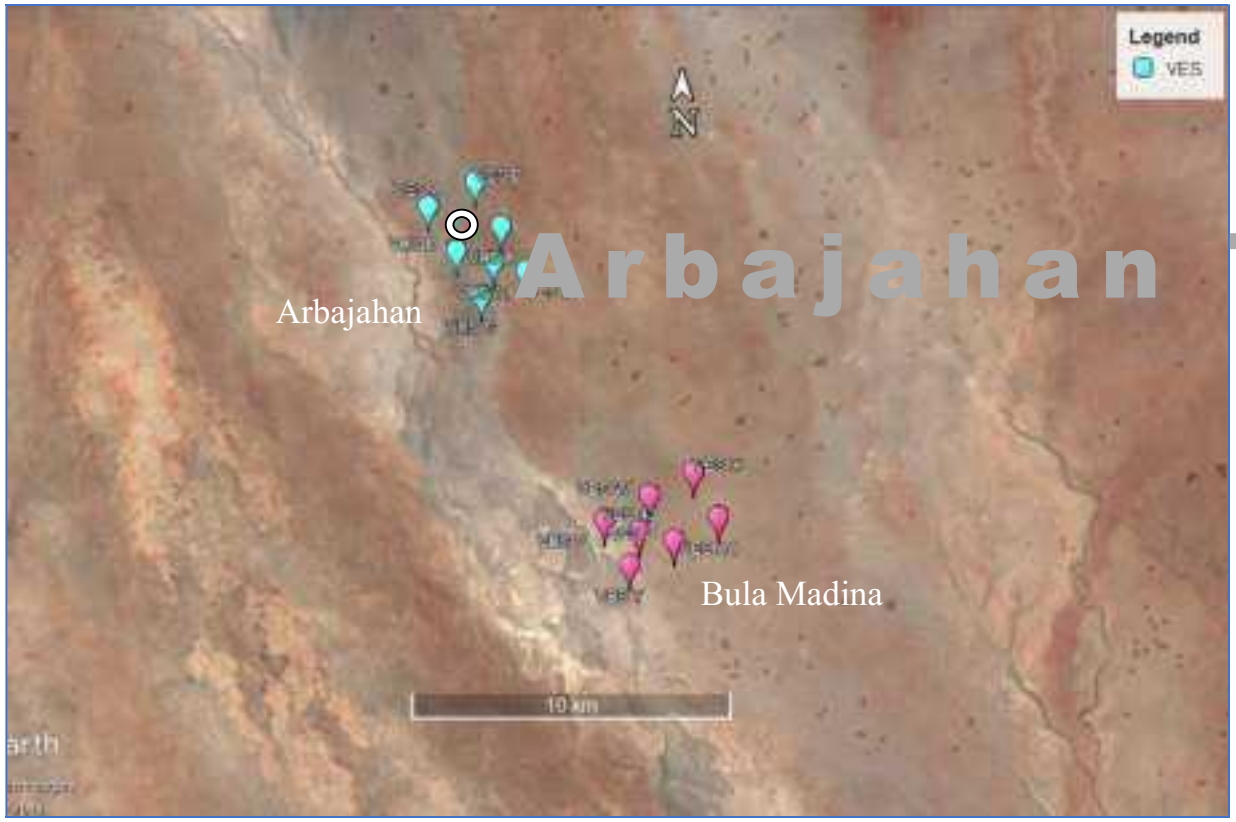


Figure 1:General Location Map of the Study Areas (Arbajahan and Bula Madina)

3. GEOLOGY

3.1 Regional Geology

The general area is dominated by the Colluvial deposits and red soils of the Holocene period at the top surface that overlay the Quaternary sediments. Alluvial sediments of the later age are deposited by network channels of laghas traversing the region such as Lagh Boghol and Lagh Bor. The succession between these red sandy soils, older sediments of the Pliocene Sandstones and the underlying limestones forms relatively alternating series of strata of marine deposits due to the periodic regression and transgression of the sea. Tertiary sediments comprising of the sandstones, calcite mudstones, marls, claystones, limestones and indurated sands underlies the younger formations.

3.2 Geology of the Investigated Area

The rocks in the project area are all of sedimentary origin. The oldest rocks consist of the Meta-sediments of the Triassic age. These rocks include grits and sandstones, and red sandy soils.

These rocks exhibit considerable variation in thickness, extent and lithologic characteristics that suggest rapid deposition of detritus materials derived from the erosion of adjacent areas of older sandstones or limestone. The rocks likely to be encountered in the investigated area are discussed below from the youngest to the oldest.

3.2.1 The Superficial Layer

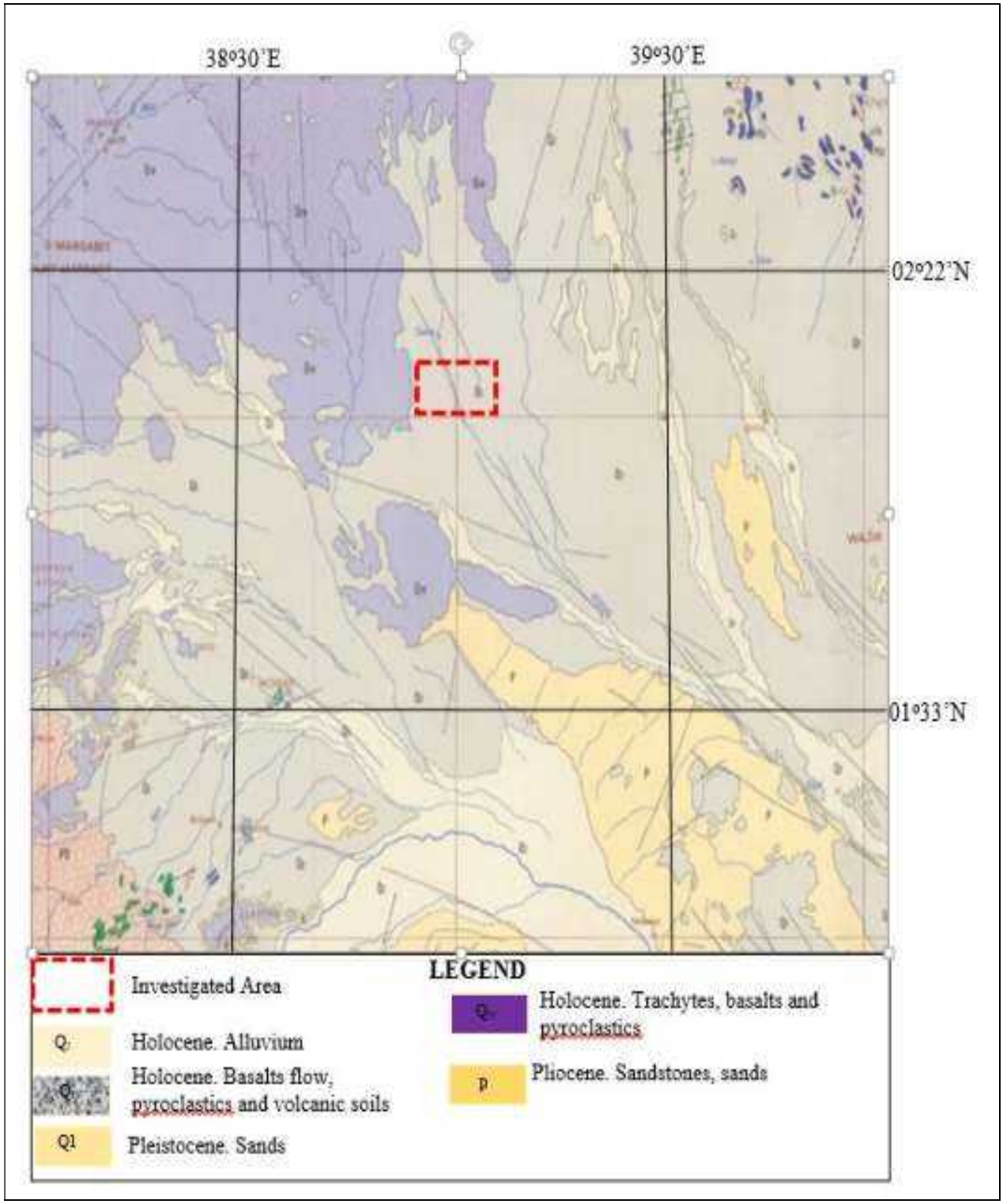
The younger sediments of the area are of the Quaternary and Tertiary ages and consist of red sandy soils which cover the larger portion of the investigated area and frequently obscure the underlying rocks. Extensive tracts of the area are covered by deep, mostly residual, mantles of soil. To a certain extent, the soils are representative of the underlying rocks, and geological boundaries can often be roughly predicted by their distribution

3.2.2 Pleistocene to Recent Deposits

Throughout the area, young deposits believed to be Pleistocene to Recent age are unevenly developed as cappings to the older rocks or as river deposits, and include surface clays products of limestones, salt incrustations and soils. The kunkur limestone covers both the Jurassic limestones and the Precambrian rocks. They include pebbles derived from older rocks.

3.3 Structure

The presence of these major faults signifies the presence of other minor faults with the same trend within the area. These faults are obscured by superficial deposits, thus making it difficult to demarcate their lateral extent by use of surface geophysics. These structures can be best mapped by aerial photo-interpretation.



(Source Geological Map of Kenya)
Figure 2: Geological Map of the Area

4. HYDROGEOLOGY

4.1 Regional Hydrogeology

Thehydrogeology of the area is dependent upon the nature of the parent rock, structural features, weathering processes and the form and frequency of precipitation. The regional hydrogeology where the project area lies is mainly characterised by tertiary sediment deposits. The deposits which are pure, unconsolidated sands and silts are highly transmissive.

4.2 Hydrogeology of the Investigated Area

The investigated site is located in a hydrogeological zone characterized by medium groundwater potential where aquifers are expected within the sediments. From the existing borehole data 1st aquifers are encountered at depths range of 55-67 m bgl, and the main aquifer at depths ranges of between 83 and 192 m bgl. From the geophysics 1st aquifer is expected at a depth 50-154 m bgl and the main aquifer at depths range of 80-190 m bgl. The borehole yields in the area has been determined from the BCR to range from 12.5m3/hr to 16.65 m3/hr and the yield is proportional to the depths drilled. However, during the field inventory, abstraction was estimated to be 20 m^3/hr(Tank filling time estimation method), which has to be verified.

Ewaso Ng'iro North Catchment forms the most important recharge area for the aquifers. Here water percolates indirectly into the faults and cracks within the Holocene Volcanics through which deeper and adjacent units are recharged over time.

4.2.1 Hydraulic Characteristics of the Aquifer

4.2.1.1 Borehole Data

Drilling records have been studied for 5No. boreholes within the vicinity of the investigated area. A sample (1 No. Bh) of these boreholes was used in calculation of the aquifer parameters, the records are summarized in Table below.

The yields of the boreholes that have been tested ranges between 13and17m^3/hr with an average of 15 m^3/hr. The ranges of the yield may be accounted for by different total depth ranges of 105-250 m bgl, differences in geology, and differences in the quality of borehole construction and completion. It can therefore be concluded that the area has medium ground water potential.

It should be noted that some of the borehole data is likely to be inaccurate particularly the yield because it does not necessarily reflect the aquifer performance but the capacity of the pump used during the pump test. The borehole data are therefore not completely reliable in assessing the expected borehole yield for the recommended drilling site.

Table 4: Listing of Boreholes Close to the Investigated Site

BH Name	Long	Lat	Elev (m)	Depth (m)	WSL1 (m)	SWL (m)	YIELD	PWL (m)	DD (m)
Arbajahan Bh3	39.00496	2.06681	342	250			12.5		
Arbajahan bh	39.006722	2.079206	348	115	55, 83, 95	55	16.67	58.84	3.84
Arbajahan old bh	39.00499	2.06692	342	214	64, 104-106, 192	100	-	-	-
Arba-Kubeysuru	39.0145	2.04982	342	105	-	-	-	-	-
Qarahay Bh 2	39.00673	2.07739	407.8						

NB: *Calculations of the hydraulic characteristics of the boreholes was only based on Arbajahan BH since the other BHs lacked the required information.*

4.3 Aquifer Parameters

From the above data, the following aquifer parameters are calculated: -

4.3.1 Specific Capacity

This is calculated by dividing the discharge rate (as m^3/day) by the total drawdown. High specific capacities generally indicate high transmissivities, low specific capacities the opposite. The specific capacity (yield-drawdown ratio) of the borehole is expected to be high and to decrease gradually at increasing abstraction rates.

Yield is 16.67 m^3/hr
24x16.67=400.08 m^3/day
Drawdown = 3.84 m
Specific Capacity =400.08 m^3/day / 3.84m
= 104.18 m^2/day

4.3.2 Transmissivity

This is the rate of flow of water under a unit hydraulic gradient through a cross section of unit width across the entire saturated section of the aquifer. Transmissivity should be determined from the analysis of a well test, but here we use the Logan method to estimate it; Logan (1964) developed a relationship between specific capacity and transmissivity, 1.22 x Q/s, based on a reworking of Thiem's seminal steady-state groundwater flow equation (Thiem 1906).

The product of (K) and thickness (D) is defined as the transmissivity (T) of an aquifer system (KD=T). This property can be derived from the commonly applied Jacobs formula (Driscoll 1986):

$T=1.22Q/\Delta s$

Where: T= Transmissivity, Q=Tested Yield (m3/day), Δs = increase in drawdown over 1 log cycle of time.

Using the Logan's method, the estimated average transmissivity of the aquifer in the area can be calculated. With the average tested yield of 400.08 m3/day and a drawdown of 3.84 m, the transmissivity translates to 127.11m^2/day.

4.3.3 Hydraulic Conductivity

This is defined as the volume of water that will move through a porous medium in unit hydraulic gradient through a unit area measured at right angles to the direction of flow. For the analysed boreholes, the hydraulic conductivity of fractured rocks depends largely on the density of the fractures and the width of their apertures.

K=T/Aquifer Thickness

Assuming that the total penetrated aquifer thickness to be 40m and Transmissivity of 127.11 m^2/day, using T=Kb (where K is the conductivity and b the thickness), it then follows that that average hydraulic conductivity of the water bearing layer is 12.711 m/day.

4.3.4 The Storage Coefficient

The storage coefficient of an aquifer is the volume of water released from or taken up per unit surface area per unit change in head. It is dimensionless. In an aquifer test, a borehole is pumped at a known discharge rate and water levels in one or more neighbouring observation boreholes, and the shape and type of drawdown curve in the observation borehole(s) is used to calculate the storage coefficient.

4.4 Groundwater Recharage and Discharge Estimation

The investigated area lies in the Ewaso Lagas Catchment system of the larger Ewaso Ng'iro North Catchment Area. The aquifer recharge to the investigated area is mainly via direct percolation and is fed by several streams within the area. The Catchment area of Griftu area has been estimated to be 85 km^2. The catchment area is characterized by the Jurassic limestones and Triassic conglomerates, grits and sandstones covering an area of about 85 km^2. The average rainfall is assumed to be 220 mm for the entire area. The available gross volume of precipitation within the water budget zone is therefore 8.5 x 10^7 x 0.22 =1.87 x

$10^7 m^3$ per year. The aerial extent of the aquifer is unknown. A conservative theoretical approximation of the areal extent has been proposed to be 10 km^2, which is equivalent to $1.0*10^7$ m^2. In addition, probably not all of the groundwater aquifers are participating in the hydrological system of the area. Due to the complexity of the geology of the area and lack of adequate borehole drilling data, it is not easy to estimate the recharge in the project area. Nevertheless, an estimate can be made as follows. Considering a catchment area of 85 km2, a mean annual rainfall of 220 mm and an infiltration rate of 10%, the amount of water being recharged into the groundwater storage is estimated to be:1.87 x 10^6 m^3 per year.

4.4.1 Ground Water Movement

Groundwater movement from recharge area is controlled by the available recharge, the aquifer characteristics and the mode of discharge. These conditions are not uniform in the project area mainly due to variations in precipitation in different recharge areas of the same system and geological conditions underground. Structural features such as faults and lineaments which are prevalent control the flow directionin the area.

4.4.2 Safe Yield

There are no safe yield determinations that have been done within the study area and in the existing boreholes. The borehole yields that are given are dependent on the pump that is used during pump testing. It is therefore imperative to have a comprehensive test pumping so that the pumping regime can be determined within the area.Based on the existing productive boreholes in the vicinity where the same geological formations are encountered, yields of between 10 and 20m^3/h are postulated and the water quality is expected to be within the recommended KEBS standards.

4.5 Water Quality

Practically all types of water, i.e. runoff water, groundwater and even rainwater, contain some dissolved salts and impurities. If certain elements are present in high concentrations, the application of the water for domestic use or any other purpose may have an adverse effect. Groundwater quality in the investigated area is expected to be below 2000µS/cm which is within the KEBBS and WHO drinking water standards for drinking water since most of the water samples collected in the vicinity of the study area lies below 1600µS/cm.
Groundwater may be classified based on salinity as shown in the table below.

Table 5: Groundwater Classification Based on Salinity

Category	Category	EC (µS/cm)
Fresh water	0-1,500	0-2,000
Brackish water	1,500-10,000	2,000-15,000
Saline water	10,000-100,000	15,000-150,000
Brine	>100,000	> 150,000

TDS : Total Dissolved Solids (in parts per million = mg per litre)
EC : Electrical Conductivity in micro Siemens per cm

Table 6: Salinity Limits for Groundwater Use

EC (µS/cm)	TDS (ppm)	Use/Limitation
<2000	<1500	Potable
>2000	>1500	Unsuitable for domestic purposes
2000-3000	1500-2000	Generally too salty to drink but still fit for livestock
>3000	>2000	Generally unfit for dairy cattle and young calves
>7000	>4500	Unfit for grazing cattle and sheep

Figure 3: Boreholes within the Vicinity of the Investigated Area

5. GEOPHYSICAL INVESTIGATION METHODS

Investigations of the groundwater resources in the area included the use of geophysical techniques to probe the sub-surface. A variety of methods are available to assist in the assessment of geological sub-surface conditions. The main emphasis of the fieldwork undertaken was to determine the thickness and composition of the sub-surface formations and to identify water-bearing zones. This information was principally obtained in the field using Vertical Electrical Sounding (VES) methodology with the SAS 1000 Terrameter. The VES probes the resistivity layering below the site of measurement. This method is described below.

5.1 Resistivity Method

Vertical electrical soundings (VES) were carried out to probe the condition of the sub-surface and to confirm the existence of deep groundwater. The VES investigates the resistivity layering below the site of measurement. This technique is described below.

5.1.1 Basic Principles

The electrical properties of rocks in the upper part of the earth's crust are dependent upon the lithology, porosity, and the degree of pore space saturation and the salinity of the pore water. Saturated rocks have lower resistivities than unsaturated and dry rocks. The higher the porosity of the saturated rock or the higher the salinity of the saturating fluids lowers the resistivity. The presence of clays and conductive minerals also reduces the resistivity of the rock.

The resistivity of earth materials can be studied by measuring the electrical potential distribution produced at the earth's surface by an electric current that is passed through the earth.

Theresistance R of a certain material is directly proportional to its length L and cross-sectional area A, expressed as:

$$R = Rs * L/A \quad \text{(in Ohm)}$$

Where Rs is known as the specific resistivity, characteristic of the material and independent of its shape or size.

With Ohm's Law,

$$R = dV/I \quad \text{(Ohm)}$$

Where dV is the potential difference across the resistor and I is the electric current through the resistor. The specific resistivity may be determined by:

$$Rs = (A/L) * (dV/I) \quad \text{(in Ohm m)}$$

5.1.2 Vertical Electrical Sounding (VES)

When carrying out a resistivity sounding, current is led into the ground by means of two electrodes. With two other electrodes, situated near the center of the array, the potential field generated by the current is measured.

From the observations of the current strength and the potential difference, and taking into account the electrode separations, the ground resistivity can be determined.

During a resistivity sounding, the separation between the electrodes is step-wise increased (in what is known as a Schlumberger Array), thus causing the flow of current to penetrate greater depths. When plotting the observed resistivity values against depth on double logarithmic paper, a resistivity graph is formed, which depicts the variation of resistivity with depth. This graph can be interpreted with the aid of a computer programme, and the actual resistivity layering of the subsoil is obtained. The depths and resistivity values provide the hydrogeologist with information on the geological layering and thus the occurrence of groundwater.

5.2 Interpretation Theory

The program assumes that the earth is horizontally stratified with each layer electrically homogeneous and isotropic. It computes the apparent resistivity curve from a specified model, compares it to the measured curve, modifies the model, computes a new curve, recompares, and so on until a reasonable fit between the measured and calculated data is achieved.

There are critical issues which should be considered when interpreting resistivity sounding data otherwise, they may pose problems or misinterpretation of the data. One of the solutions to this problem is to get additional prior information for calibration either on logs, the resistivity or the thickness of the layer. The following principles and conditions are considered:

5.2.1 Electrical Anisotropy

Electrical anisotropy in the Earth is usually a matter of scale and of the resolution of a vertical resistivity section, (Ernstson and Kirsch, 2006) in an event of alternating thin layers of different lithologies with clear lamination. These thin-bedded rock sequences can be treated as an anisotropic medium described by two resistivities created by averaging over structures with a preferred orientation. Homogenization theory applied to typical geological structures can help to determine the range of values to be expected in electrically anisotropic formations.

5.2.2 Equivalence

The principles of equivalence may be stated as the difficulty to distinguish a layer, for which the resistivity is either greater than, or less than, both the layers above and below.

Two conductive layers can carry nearly the same electrical current if their ratios of thickness to resistivity are the same (conductance equivalence). Two resistive layers can carry nearly the same electrical current if their resistivity-thickness products are the same (transverse resistance equivalence). This means that it is impossible to distinguish between two highly resistive beds of different thickness h and resistivity ρ values if the product of hρ is the same, or between two highly conductive beds if the ratio h/ρ is the same.

5.2.3 Suppression

The suppression principle is also very significant during the interpretation. It states that if a bed is very thin compared to those above and below, such layer has practically no influence on the sounding curve as long as it does not have a large enough thickness and thus remains invisible.

Note;

The concepts of equivalence and suppression in resistivity sounding method are phenomena in which distinct resistivity models can give virtually identical resistivity curves. Understanding these phenomena might be critical when employing resistivity sounding to site boreholes in areas underlain by Basement Complex rocks. The fractured/weathered bedrock would be difficult to identify in such regions during the sounding interpretation. This is due to the weathered layer's resistivity being intermediate between that of the adjacent layers (i.e., residual overburden) on top and the fresh bedrock below. As a result, it is critical to investigate the suppression and equivalence issues in resistivity sounding data when calculating the thickness and resistivity of subsurface layers.

6. FIELDWORK AND RESULTS

6.1 Fieldwork

Fieldwork was carried out on February 2022 Seven VES were executed. The vertical electrical soundings were carried out in order to unveil the hydrostratigraphy of the area and consequently the subsurface conditions to determine the possibility of striking enough good quality water during borehole drilling.

6.2 Results

6.2.1 Vertical Electrical Soundings (VES) Results

The individual VES data both raw and interpretated is given in Appendix 3 and Appendix **4** for Arbajahan and Ademasajida respectively.

6.2.1.1 *Arbajahan*

The results of interpretation of the resistivity soundings data are presented in the following sections. In addition, this section briefly describes the results of the measurements and also presents plots of the interpretation graphs for the resistivity soundings. Three 2-D profiles have been interpreted from the VES data as shown below.

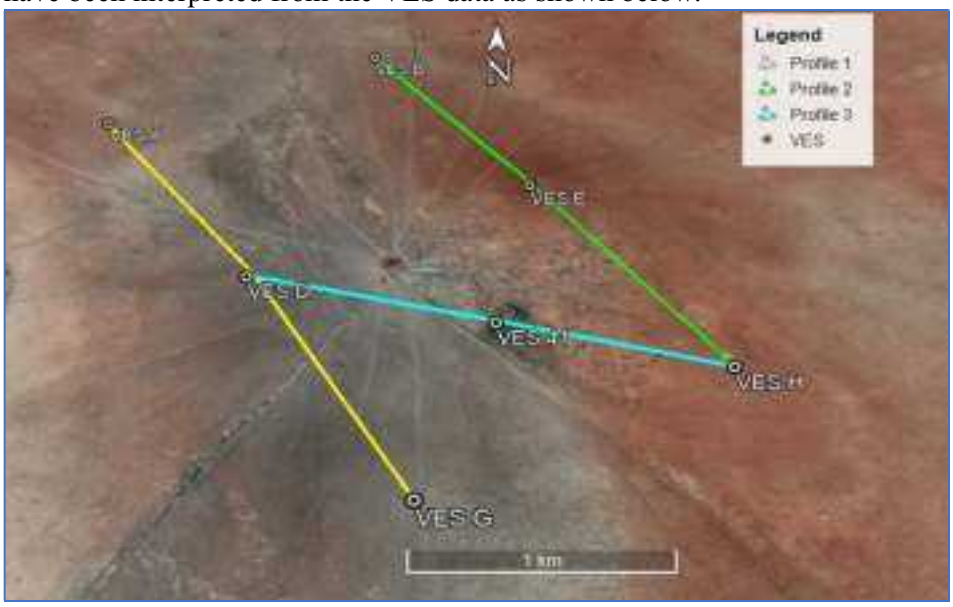


Figure 4: Profile 1: Orientation of 2-D profiles in Arbajahan

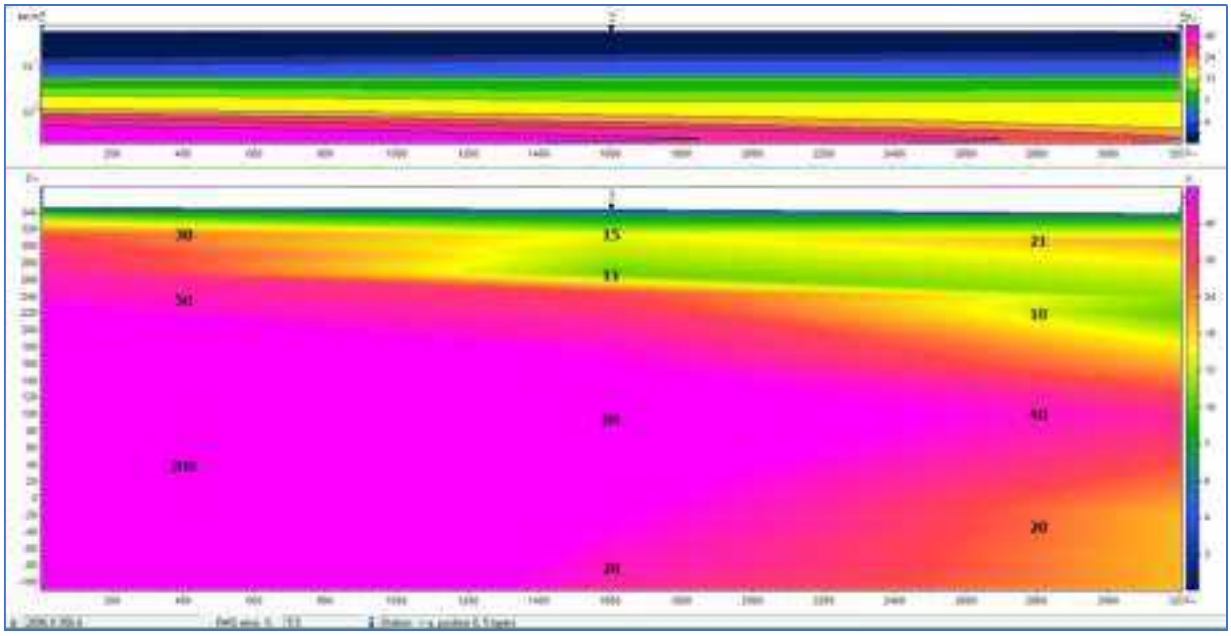


Figure 4: Profile 1: Raw Data Resistivity Pseudosection and Geolectric Layers from Model VES Data in Arbajahan

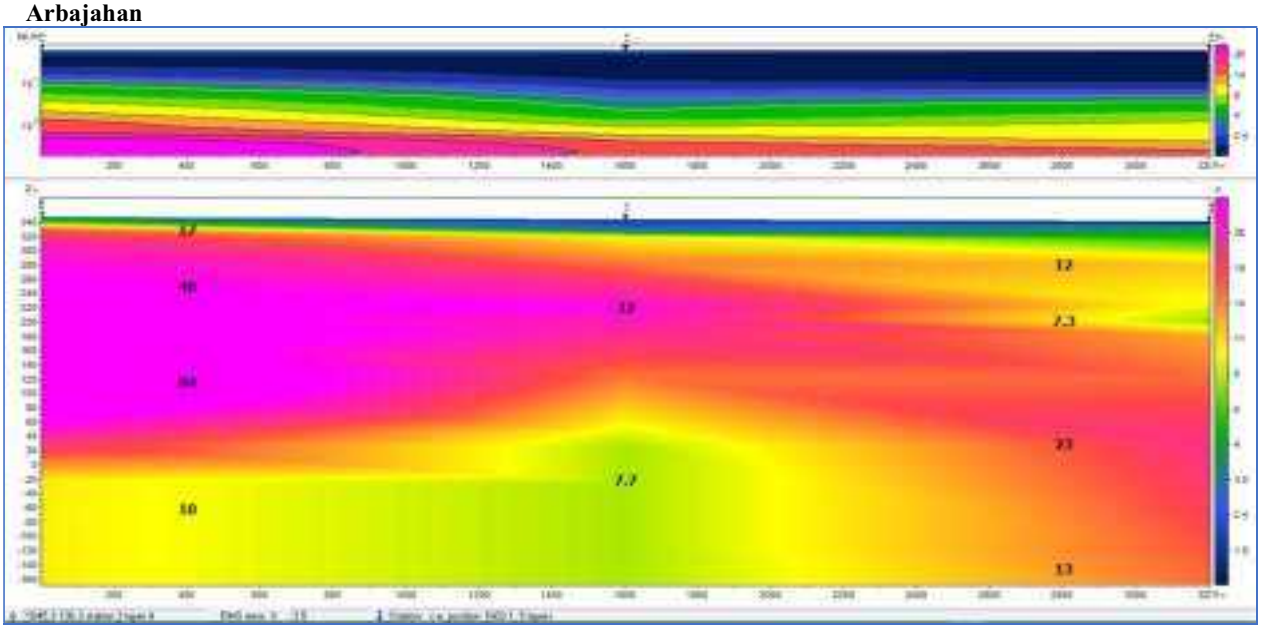


Figure 4: Profile 2: Raw Data Resistivity Pseudosection and Geolectric Layers from Model VES Data in Arbajahan

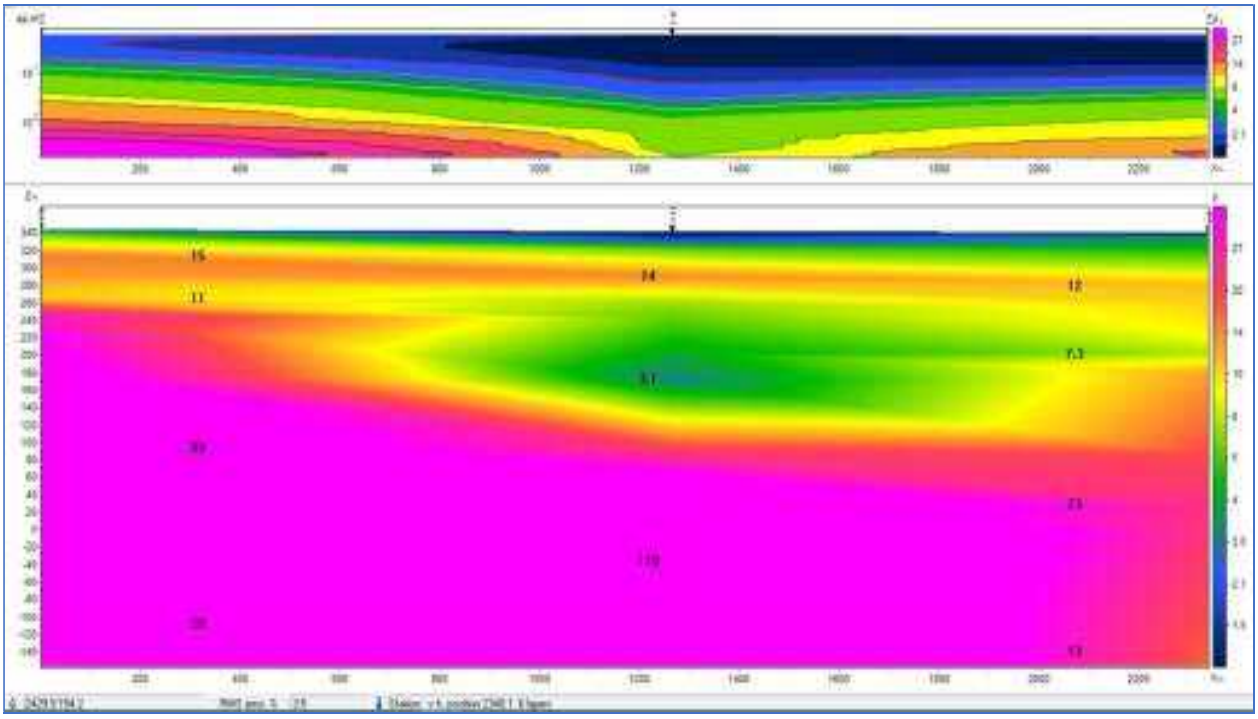


Figure 4: Profile 3: Raw Data Resistivity Pseudosection and Geolectric Layers from Model VES Data in Arbajahan
(Note the low resistivity shallow aquifer at the recommended VES 41 in the middle**)**

Table 14: Interpretation Results for Arbajahan InvestigatedSites

VES	Layer 1		Layer 2		Layer 3			Layer 4					Layer 5					Layer 6		
	Res	Depth	Res	Depth	Res	Depth	Hydrogeological Interpretation	Res	Depth	Thickness	Geology	Hydrogeological Interpretation	Res	Depth	Thickness	Geology	Hydrogeological Interpretation	RE	Depth	Hydrogeological Interpretation
A	19.02	0.38	2.12	4.78	30	60.0	Slightly aquiferous	50	160.00	100.00	Clayey sands	Aquiferous								
D	5.7	0.41	1.83	2.94	15.2	56.6	Dry	10.7	100.00	43.40	Silts	Aquiferous	89.4	400.00			Dry	28.4	>400	Slightly Aquiferous
G	10	0.35	2.43	4.66	21.4	63.0	Dry	10.5	180.00	117.00	Clayey sands	Aquiferous	40	300.00	120.00	Sandy silts	Aquiferous	20	>300	Dry
B	6	1.00	1	2.88	17	33.00	Dry	40	160.00	127.00	Clayey/silty sands	Aquiferous	84	300.00	140.00		Aquiferous	10	>300	Dry
E	3.29	0.66	1.36	4.38	3.04	25.20	Dry	32	220.00	194.80	Sandy silts	Aquiferous	7.67	>220			Slightly aquiferous			
H	2.5	0.80	1.04	5.15	11.6	117.00	Dry	7.3	162.00	45.00	Sandy silts	Aquiferous	23	463.00	301.00		Dry	13.1	>463	Slightly aquiferous
41	3.46	0.68	0.36	1.38	2.2	19.6	Dry	14.4	83.8	64.20	Clayey silts	Aquiferous	170	>256		Dry				

Profile 40-43 Interpretation

This profile is approximately 0.8km East of profile A-EE and is characterized by a five-layer model. VES interpretation results indicate a shallow superficial layer with resistivities range between 5 and 20 Ωm to depths of approximately 1metre.This is underlain by a 0.3 to 1 Ωm resistivity layer to a depth of approximately 5m interpreted to be clays. Below this is a low to medium resistivity layer of between 2 and 36 Ωm to depths of approximately 50 to 150m interpreted to be silty clays and silty sands in some VES's

and are aquiferous in some VES's while in others the layer is non aquiferous. Below this is a 14 to 180 Ωm resistivity layer to average depths of between 80 and 160 interpreted to be clayey silts and sands with different percentages in the different VES locations. This layer is the major aquiferous layer and substantial amounts of water is available in this layer. Below this layer is the last layer of ranging resistivities and the depths are greater than 130m.The layer could be aquiferous and saline at greater depths but when encountered at depths before 200m it could be fresh.

VES 41 Interpretations

Boreholes drilled to penetrate the layer 4 of this profile have good water prospects

In VES 41 interpretation results indicate a shallow superficial layer with resistivity of 3.4 Ωm to depths of 0.7m. Underlying this to a depth of 2m is a 1.38 Ωm resistivity layer interpreted as clays. Below it is a 2.2 Ωm resistivity layer to depths of 20m interpreted to be clays and silty sands. Below it is a 14 Ωm resistivity layer to depths of 83m interpreted to be clay silts and sands of varying proportions and this is the major aquiferous layer. Underlying this is a 17 Ωm resistivity layer to depths of 256m which is interpreted as dry.

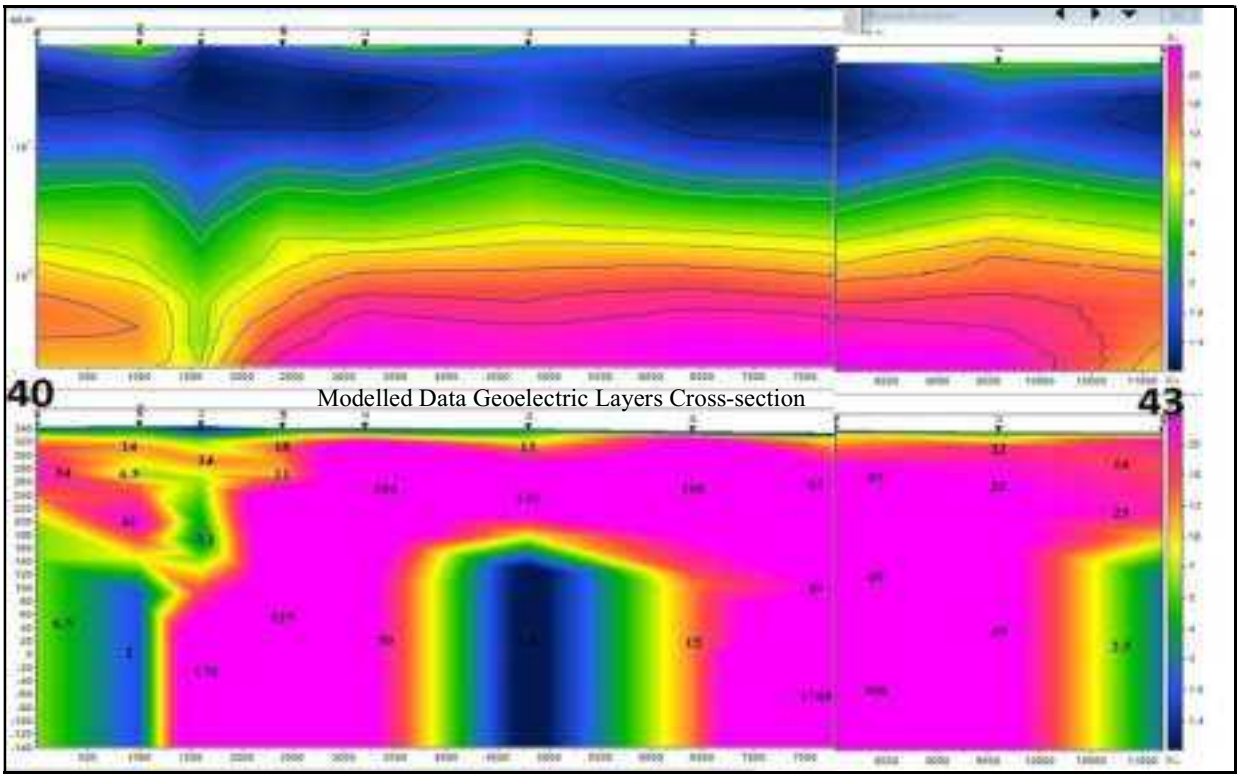


Figure 4: Pseudo section and interpreted layers for Profile 41-43

6.2.1.2 *Bula Madina*

The results of interpretation of the resistivity soundings data are presented in the following sections. In addition, this section briefly describes the results of the measurements and also presents plots of the interpretation graphs for the resistivity soundings.

Table 14: Interpretation Results for InvestigatedBula Madina Sites

Layers	Layer 1		Layer 2		Layer 3		Layer 4		Layer 5		Layer 6		Layer 7	
	RE	DE	RE	DE	RE	DE	RE	DE	RE	DE	RE	DE	RE	DE
VES V	3	1.00	1	4.00	11	30.00	29	120.00	6	394.00	11	>394		
VES W	5	1.00	1	3.00	16	22.00	42	161.00	10	319.00	18	>319		
VES X	14	1.00	1	4.00	22	14.00	33	100.00	9	320.00	95	>320		
VES Y	152	0.37	1	3.00	49	26.00	17	70.00	50	320.00	9	>320		
VES Z	14	1.00	3	4.00	6	7.00	19	72.00	6	284.00	9	>284		
VESAA	5	1.00	1	3.00	20	33.00	8.5	91.00	14	163.00	76	>163		
VES 43	15	0.60	1	5.00	5	9.07	32	26.00	16	68.00	25	153.	2.5	>153

The VES interpretation results indicate a top superficial layer comprising dry alluvium material to a depth of 1 m bgl with a resistivity of 3 to 152 Ω.m. This layer is underlain by 1 to 3 Ω.m to a depth of 5m bgl interpreted to be dry clays. The 1.0 Ω.m layer is underlain by 5 to 49 Ω.m resistivity layer to a depth of33 m bgl interpreted to be aquiferousclayey sands. The 3rdlayer is then underlain by a layer of resistivity range of 8 to 42 Ω.m down to a depth of about 161m bgl interpreted to be weathered shales and clayey sands which are aquiferous. The underlying layer has a resistivity range of about 6 to 50 Ω.m in the respective VESs, at depths between 163 to 390 m bgl.The last layer which is beyond 394 m bgl has resistivity values of between 9and 95 Ω.m.VES 43 has seven layers, an extra layer of sediments is embedded within the fourth stratum that is also interpreted as saturated. Hence, qualifyingVES 43 to be the recommended site for drilling. The layers are as depicted in the diagrams below.

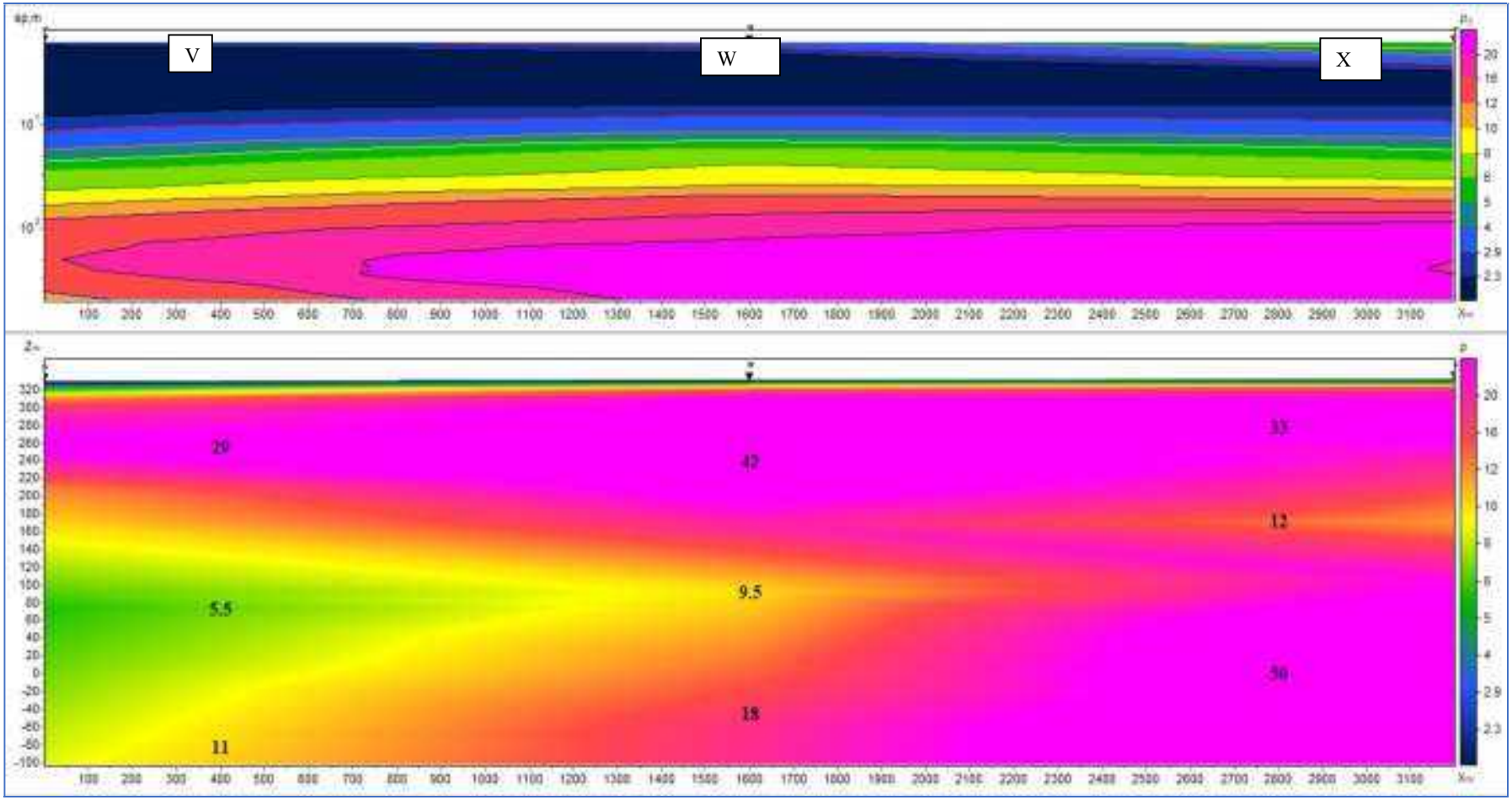


Figure 4: Profile 1: Raw Data Resistivity Pseudo section and Geoelectric Layers from Model VES Data in Bula Madina

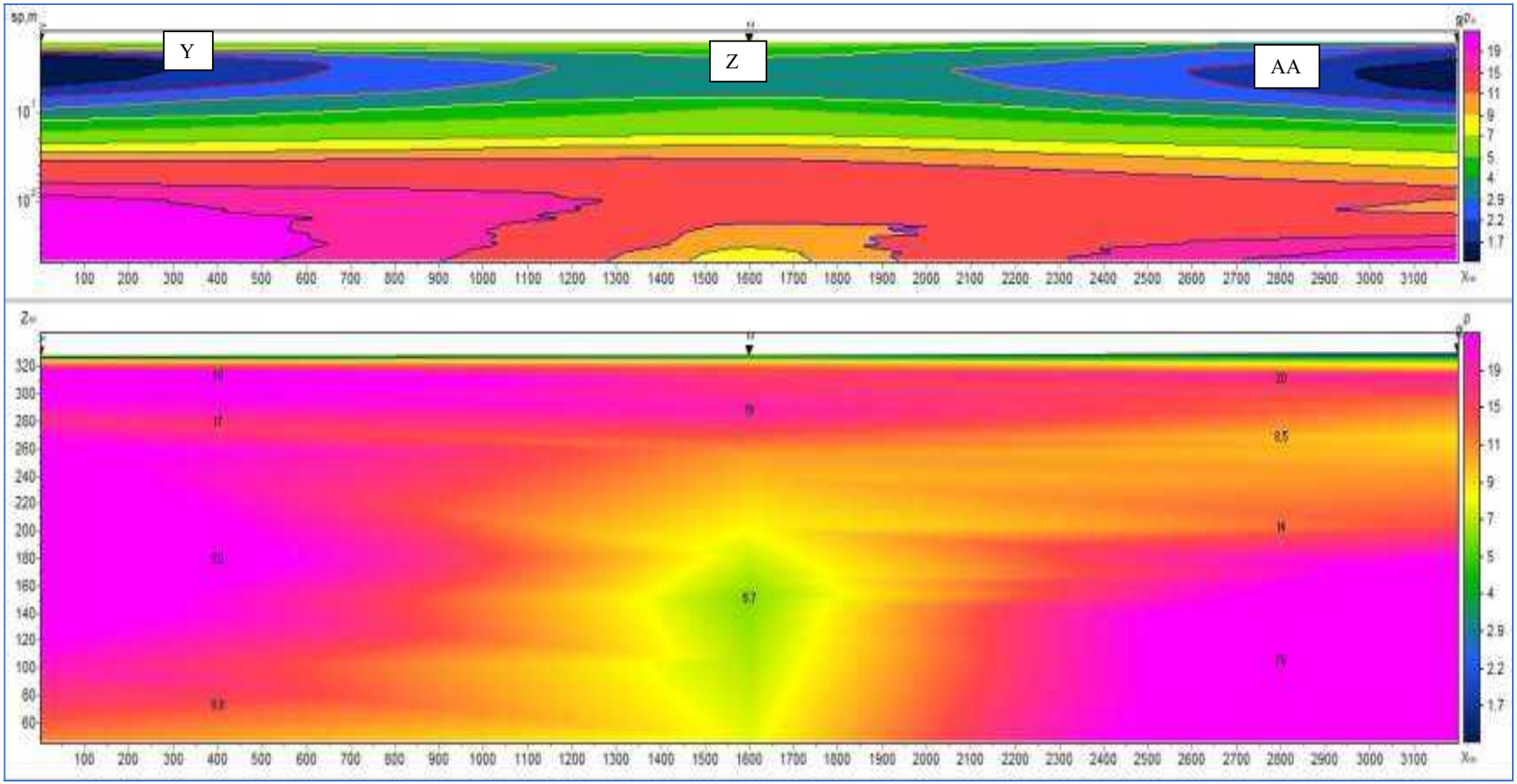


Figure 5: Profile 2: Raw Data Resistivity Pseudo section and Geolectric Layers From Model VES Data in Bula Madina

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

From the hydrogeological and geophysical interpretation results, the following conclusions are made:-

- From the evidence gathered from geological, hydrogeological and nearby existing boreholes, the areas are located in a hydrogeological zone that is characterized by medium groundwater potential and yields in the range of between 10 and 20m^3/hour. This wholly depends on a complete and comprehensive borehole drilling process i.e. drilling, installation, development, Pump testing, and Pump installation.
- From the existing borehole data and the geophysical results water strikes are expected at depths of 250m in Arbjahan while in Bula Madina the depths are expected to be less than 200m.
- Drilling supervision is necessary and will dictate the point upon which drilling should stop and only when sufficient yields have been attained
- From previous deep TDEM results in the area aquifers are interpreted at depths as shallow as less than 150m with earlier water strikes expected at depths before 100m
- Borehole yields are dependent on cumulative yields of successive aquifers and therefore care should be taken to tap all the aquifers during borehole designing.

Recommendations

Arbajahan

In view of the above, the following recommendations are made;

- A 250mm (8") diameter borehole to be drilled at the location of **VES No 41** to a minimum depth of **200mbgl**. The site location is defined by UTM coordinates 39.009005 and 2.062859 at an elevation of 342m.
- Though water strikes are expected at shallow depths less than 150 m bgl, drilling should be continued to the recommended depth in order to optimize the yield of the borehole.
- The borehole should be installed with 6" diameter steelcasings and screens with slots of 1.5 mm and high % open surface area.

The recommended drilling site was shown to Ahmed Muhamed (Phone 0729945952 ;) and Bishar Mow (Phone:0727484008) both local residents at Arbajahan town who were present during the fieldwork survey**.**

Bula Madina

Based on the study and field investigations the following recommendations are made;

A 250mm (10") diameter borehole to be drilled at the location of **VES No 43** to a minimum depth of **160mbgl**. The site location is defined by UTM coordinates 39.05009 and 1.98701 at an elevation of 330 m amsl.

- Drilling should only stop when optimum yields are achieved as will be directed by the supervising hydro geologist
- Though water strikes are expected at shallow depth less than 100 m bgl, drilling should be continued to the recommended depth in order to optimize the yield of the borehole.

The recommended drilling site is benchmarked on site and was shown to Musa Ayed a local at Bula Madina who was present during the fieldwork survey of phone number **0716447171**

Common Recommendations for both Arbajahan and Bula Madina Sites

- The boreholes should be installed with 200mm (8") diameter steel casings and screens with slots of 1.5 mm and high % open surface area.
- The boreholes must be installed with a Water Meter and a functional Airline/piezometer to monitor abstraction and to facilitate measurements of the water levels in the borehole.

- On drilling completion, 2-litre water samples should be collected for reference to the WRA Testing Laboratory, or any other competent Water Testing Authority for a full physical, chemical and bacteriological analysis before the water is put to any use.
- Copies of the analysis report must be sent to WRA Regional Office for record.
- There should be regular monitoring of of water quality (ECs) during the drilling process.
- BH drilling and construction process should be supervised by a qualified/experienced hydrogeologist for excellent results.

Monitoring

Regular monitoring should be instituted in the borehole in order to keep track of groundwater levels. A monitoring tube should be installed in the borehole to be able to monitor the water level. It is absolutely necessary to observe the water levels during optimum production to ensure a pumping regime that reduces the effects of high gradients of the cone of depression of the well and resultant water level decline in the aquifer.

Borehole Construction

Detailed recommendations are given for borehole construction and completion methods in appendix 1. The importance of correct and comprehensive techniques in this particular aspect cannot be over-emphasized.

MESHACK O. AMIMO
HYDROGEOLOGIST

8. REFERENCES

AQUASEARCH LTD P. (1997), the construction, completion and development of the agency compound borehole, Dadaab, Garissa district.

DRISCOLL F.G., 1986. Groundwater and Wells, 2nd Ed. Johnson Division.

GIBB Africa (2003). Study of the Merti Aquifer. UNICEF Kenya Country Office Report No. 53/3.

EARTH WATER LTD, 2009, A Rapid Assessment of North Eastern Province of Kenya Aquifers. Water Resources Management Authority/GTZ.

Adrian Ratccliff and Mike Lane, Water Supplies at the Daadab Refugee Camps (IFO, Dagahaley and Hagadera For: UNICEF KCO

APPENDICES

Appendix 1: DrillingBorehole Construction

Drilling Technique

Drilling should be carried out with an appropriate tool preferably a rotary drilling machine.Geological rock samples should be collected at 2 metre intervals. Struck and rest water levels and if possible, estimates of the yield of individual aquifers encountered, should also be noted.

Well Design

The design of the well should ensure that screens are placed against the optimum aquifer zones. An experienced hydrogeologist inconjunction with the drilling supervisor should make the final design.

Casing and Screens

The well should be cased and screened with good quality material. Owing to the depth of the borehole, it is recommended to use Upvc casings and screens of high open surface area.

Gravel Pack

The use of a gravel pack is recommended within the aquifer zone, because the aquifer could contain sands or silts which are finer than the screen slot size. An 8" diameter borehole screened at 6" will leave an annular space of approximately 1", which should be sufficient. Should the slot size chosen be too large, the well will pump sand, thus damaging the pumping plant, and leading to gradual `siltation' of the well. The slot size should be in the order of 1.5 mm. The grain size of the gravel pack should be an average 2 - 4 mm.

Well Construction

Once the design has been agreed, construction can proceed. In installing screen and casing, centralizers at 6 metre intervals should be used to ensure centrality within the borehole. This is particularly important for correct insertion of artificial gravel pack all around the screen. After installation, gravel packed sections should be sealed off top and bottom with bentonite seal.

The remaining annular space should be backfilled with an inert material, and the top five metres grouted with cement to ensure that no surface water at the wellhead can enter the well bore and cause contamination.

Well Development

Once screen, pack, seals and backfill have been installed, the well should be developed. Development aims at repairing the damage done to the aquifer during the course of drilling by removing clays and other additives from the borehole walls. Secondly, it alters the physical characteristics of the aquifer around the screen and removes fine particles.

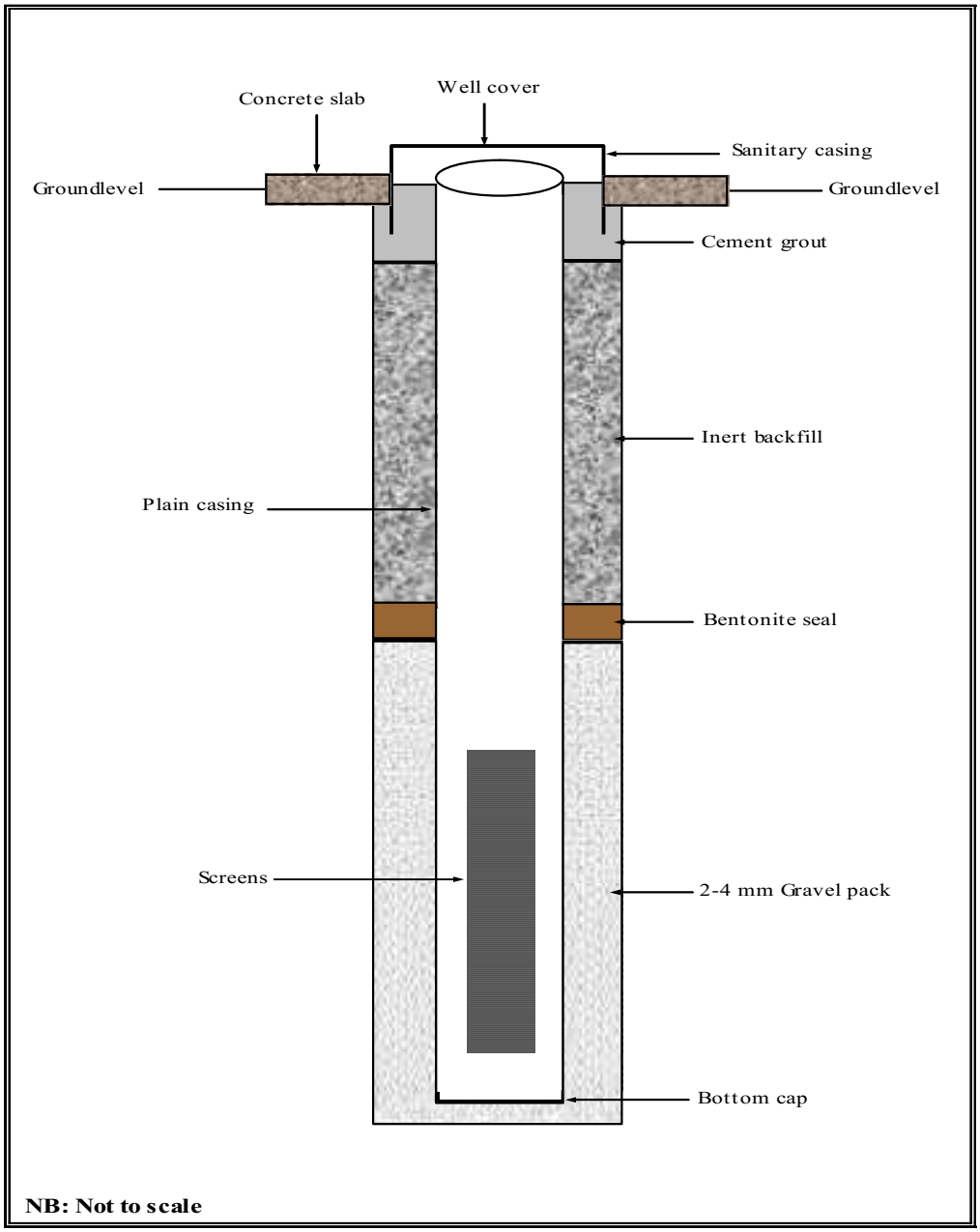
We do not advocate the use of over pumping as a means of development since it only increases permeability in zones, which are already permeable. Instead, we would recommend the use of air or water jetting, or the use of the mechanical plunger, which physically agitates the gravel pack and adjacent aquifer material. This is an extremely efficient method of developing and cleaning wells.

Well development is an expensive element in the completion of a well, but is usually justified in longer well-life, greater efficiencies, lower operational and maintenance costs and a more constant yield. Within this frame the pump should be installed at least 2 m above the screen, certainly not at the same depth as the screen.

Well Testing

After development and preliminary tests, a long-duration well test should be carried out. Well tests have to be carried out on all newly completed wells, because apart from giving an indication of the quality of drilling, design and development, it also yields information on aquifer parameters, which are vital to the hydrogeologist.A well test consists of pumping a well from a measured start level (Water Rest Level - (WRL) at a known or measured yield, and simultaneously recording the discharge rate and the resulting drawdown as a function of time. Once a dynamic water level (DWL) is reached, the rate of inflow to the well equals the rate of pumping. Usually the rate of pumping is increased stepwise during the test each time equilibrium has been reached (Step Drawdown Test). Towards the end of the test a water sample of 2 liters should be collected for chemical analysis.The duration of the test should be 24 hours, followed by a recovery test for a further 24 hours, or alternatively until the initial WRL has been reached (during which the rate of recovery to WRL is recorded). The results of the test will enable a hydrogeologist to calculate the optimum pumping rate, the pump installation depth, and the drawdown for a given discharge rate.

Appendix 2: Schematic Design for Borehole Completion

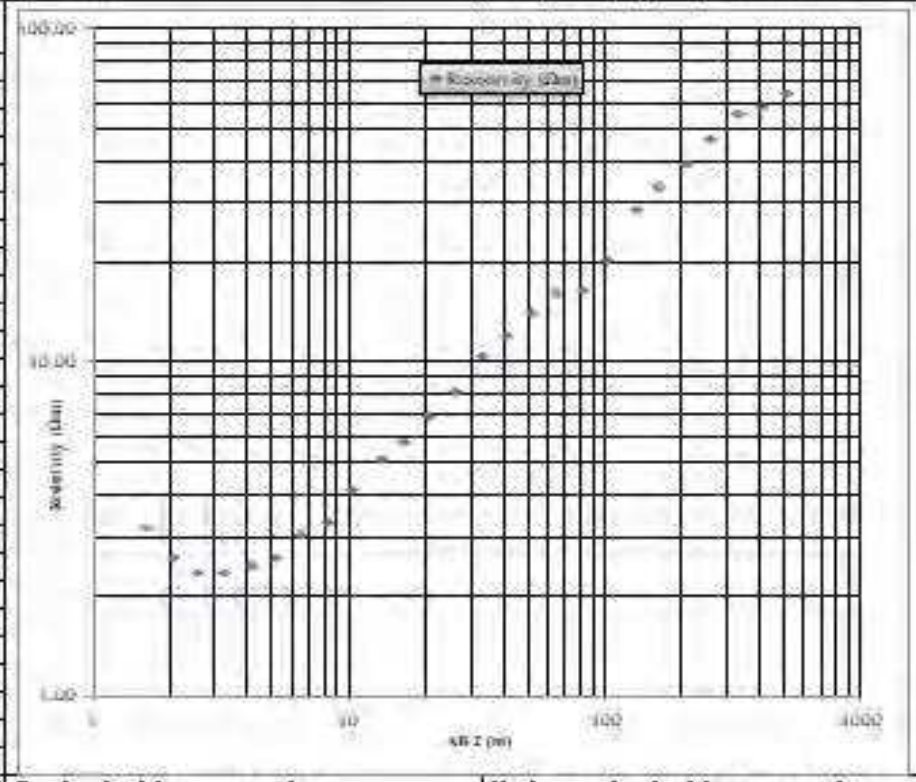


Appendix 3: Arbajahan VES Data

Vertical Electrical Sounding _Data Sheet(Schlumberger)

WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	A
	Site Name	VES A	Elevation (m ams	346
37 N	Latitude(N	2.078395°	Longitude(E)	38.990567°

AB/2 (m)	Resistivity (Ωm)
1.6	3.30
2	2.65
2.5	2.40
3.2	2.40
4	2.50
5	2.66
6.3	3.09
8	3.40
10	4.23
13	5.20
16	5.90
20	7.10
25	8.40
32	10.72
40	12.30
50	14.40
63	16.60
80	16.90
100	20.90
130	29.30
160	34.20
200	40.20
250	47.90
320	56.50
400	60.50
500	64.90



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
7.14	0.53	Alluvium deposits	Dry
2.05	5.15	Clays	Dry
43.6	49.80	Clayey sands	Dry
15.2	74.70	Clayey sands	Aquiferous
93.5	>74.7	Shales	Slightly aquiferous

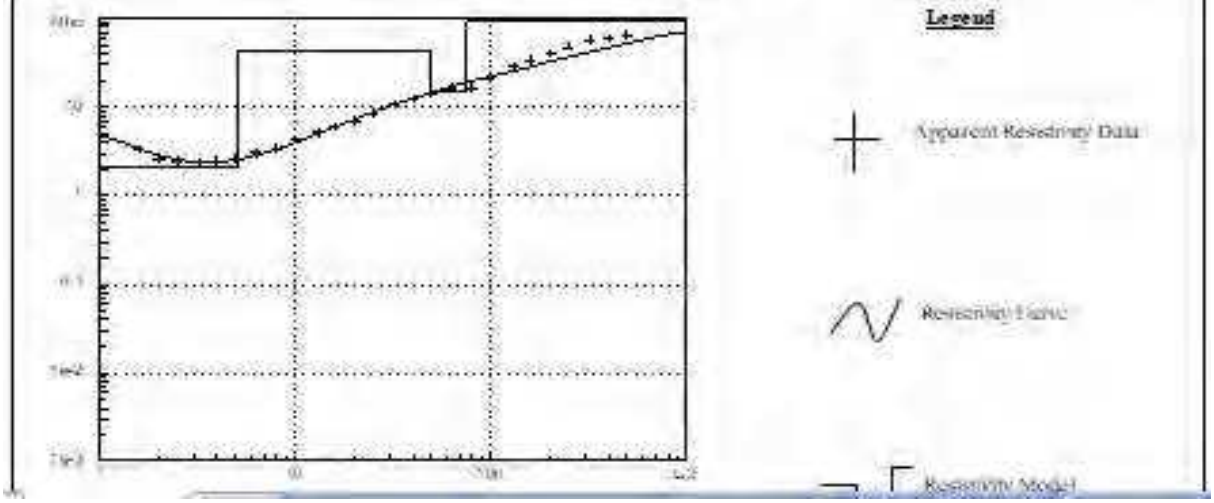
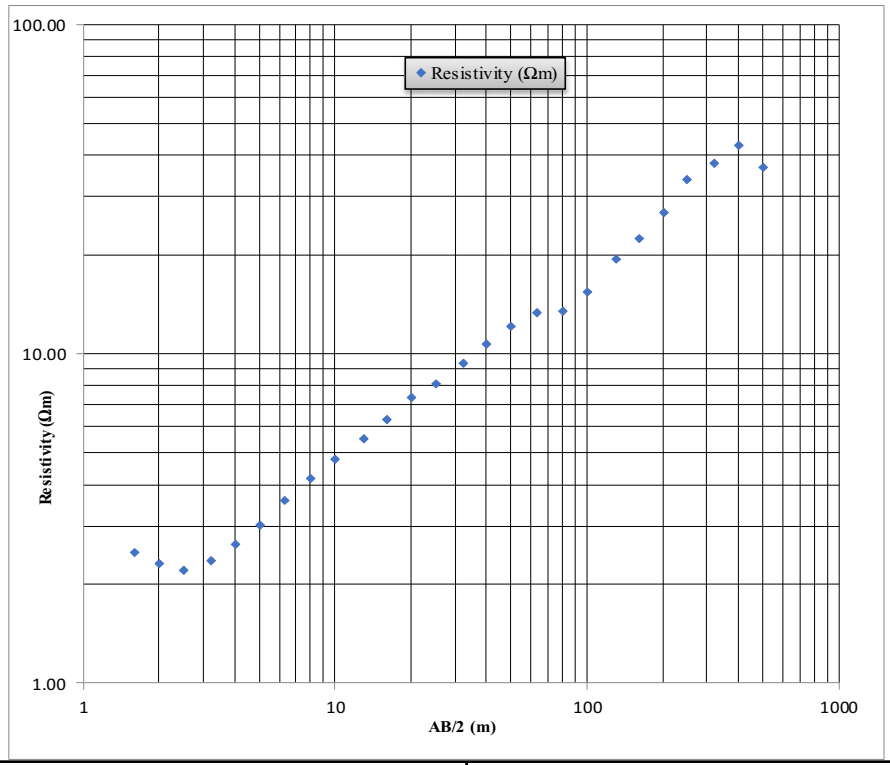


Figure 6:VES Interpretation Graph ARBAJAHAN VES A

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	D
	Site Name	D	Elevation (m amsl)	344
37 N	Latitude(N)	2.065891°	Longitude(E)	38.998602°

AB/2 (m)	Resistivity (Ωm)
1.6	2.50
2	2.30
2.5	2.20
3.2	2.36
4	2.63
5	3.02
6.3	3.58
8	4.19
10	4.80
13	5.50
16	6.30
20	7.36
25	8.10
32	9.33
40	10.72
50	12.10
63	13.40
80	13.45
100	15.45
130	19.39
160	22.49
200	26.87
250	33.80
320	38.10
400	43.00
500	36.94



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
5.7	0.41	Superficial Alluvial Deposits	Dry
1.83	2.94	Clays	Dry
15.2	56.60	Clayey silts	Dry
10.7	100.00	Silts	Aquiferous
89.4	400.00	Clayey silts	Dry
28.4	>400	Clays	Slightly Aquiferous

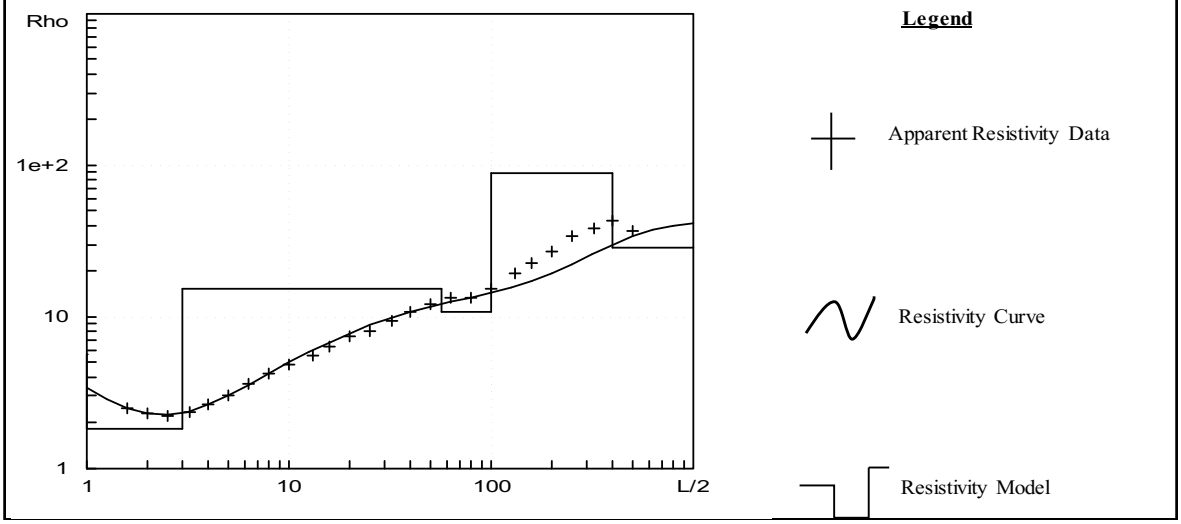
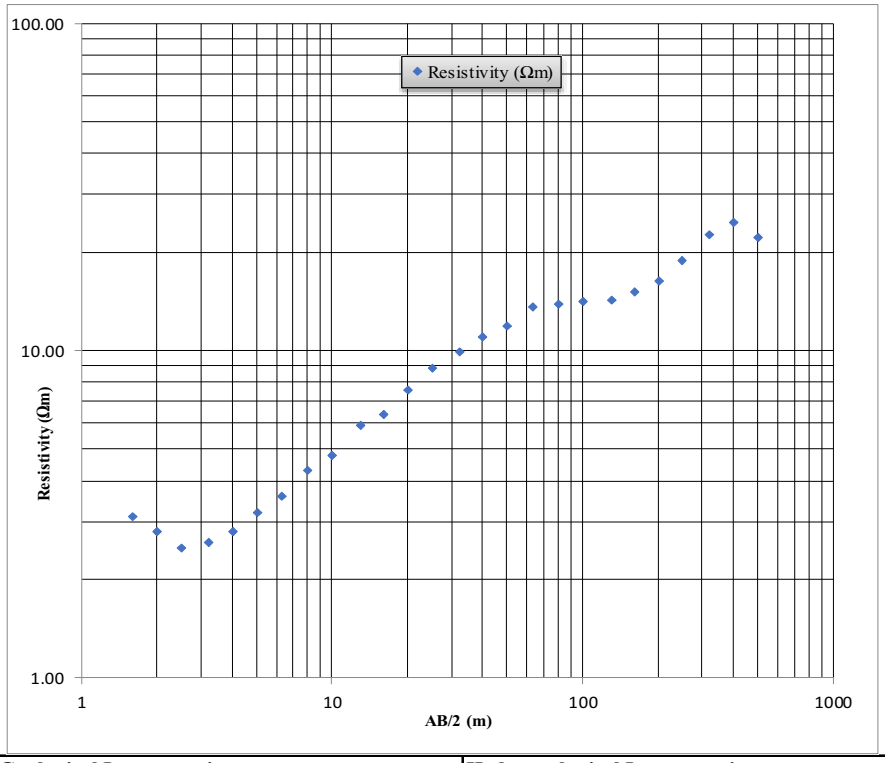


Figure 7:VES Interpretation Graph ARBAJAHAN VES D

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	G
	Site Name	G	Elevation (m amsl)	339
37 N	Latitude(N)	2.053247°	Longitude(E)	39.005564°

AB/2 (m)	Resistivity (Ωm)
1.6	3.10
2	2.80
2.5	2.50
3.2	2.60
4	2.80
5	3.20
6.3	3.60
8	4.30
10	4.80
13	5.90
16	6.40
20	7.60
25	8.80
32	9.90
40	11.03
50	11.90
63	13.60
80	13.90
100	14.13
130	14.27
160	15.14
200	16.39
250	18.80
320	22.71
400	24.58
500	22.27



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
10	0.35	Alluvium deposits	Dry
2.43	4.66	Clays	Dry
21.35	63.00	Clayey sands	Dry
10.5	180.00	Clayey sands	Aquiferous
40	300.00	Sandy silts	Aquiferous
20	>300	Shales	Dry

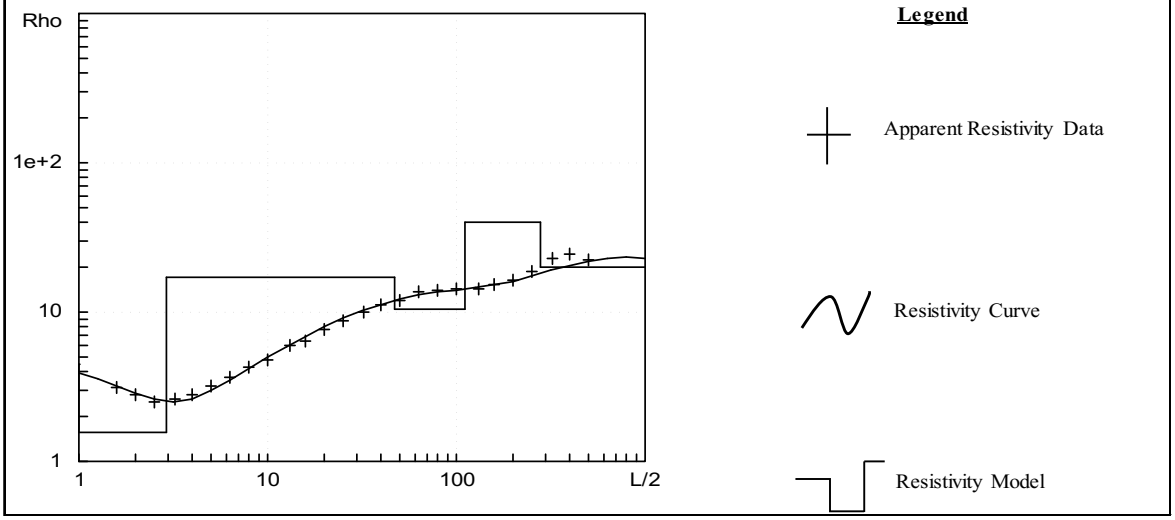
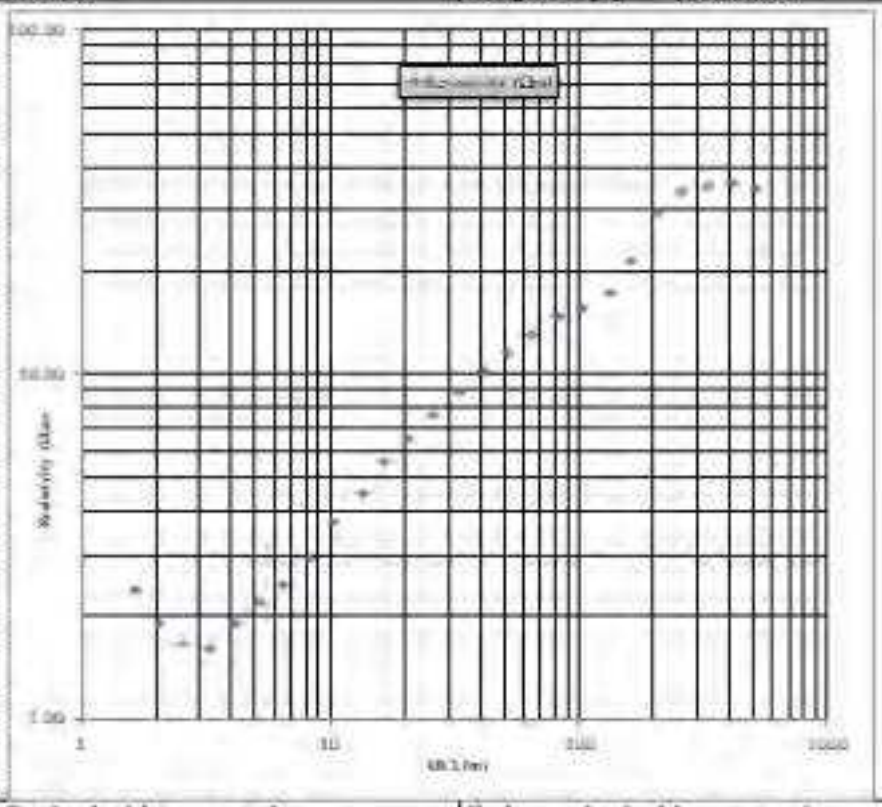


Figure 8:VES Interpretation Graph for ARBAJAHAN VES G

WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	B
	Site Name	B	Elevation (m asl)	347
37 N	Latitude(N	2.085294'	Longitude(E)	39.003633'

AB/2 (m)	Resistivity (Ωm)
1.6	2.40
2	1.94
2.5	1.69
3.2	1.61
4	1.92
5	2.20
6.3	2.49
8	3.00
10	3.80
13	4.63
16	5.64
20	6.60
25	7.81
32	9.15
40	10.51
50	11.80
63	13.40
80	15.10
100	15.76
130	17.57
160	21.80
200	30.25
250	34.74
320	35.90
400	36.30
500	35.30



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
3.91	0.68	Alluvium deposits	Dry
1.03	2.84	Clays	Dry
21	77.20	Clayey sands	Dry
14.5	103.00	Clayey sands	Aquiferous
83.6	276.00	Clayey sands	Slightly aquiferous
47.1	>278	Shales	Slightly aquiferous

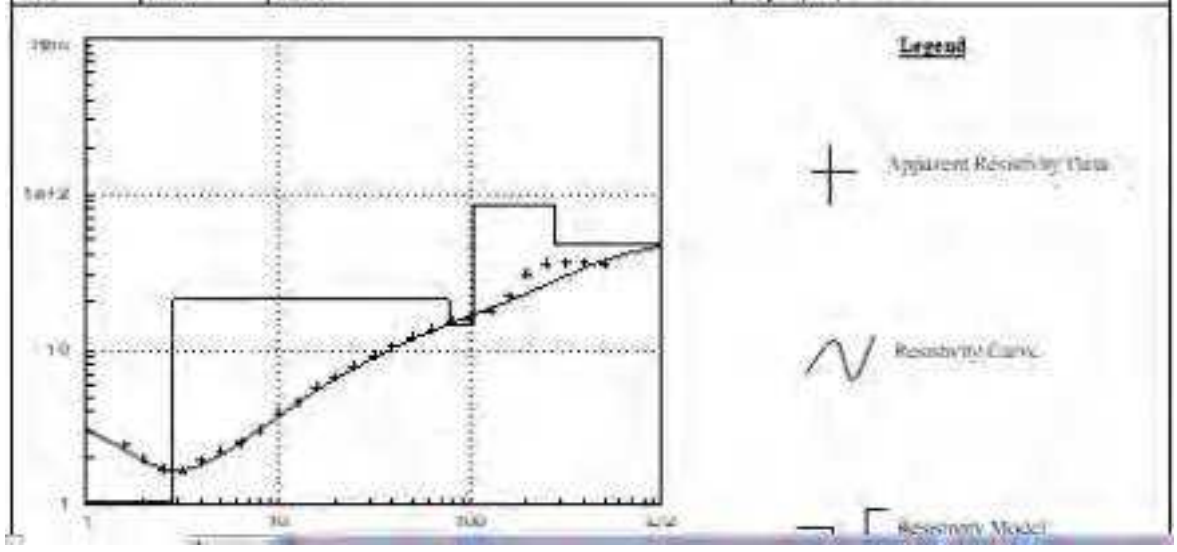
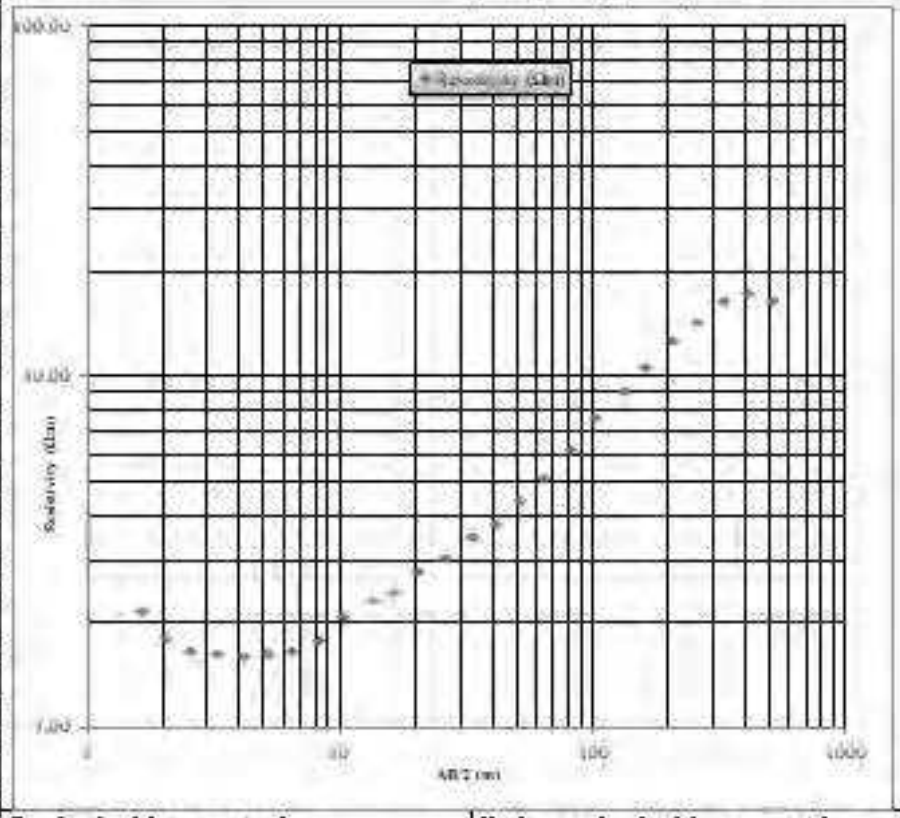


Figure 9:VES Interpretation Graph for ARBAJAHAN VESB

Vertical Electrical Sounding _Data Sheet(Schlumberger)

WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	E
	Site Name	E	Elevation (m ams	344
37 N	Latitude(N	2.072823°	Longitude(E)	39.011200°

AB/2 (m)	Resistivity (Ωm)
1.6	2.20
2	1.84
2.5	1.69
3.2	1.64
4	1.62
5	1.64
6.3	1.69
8	1.81
10	2.10
13	2.36
16	2.48
20	2.85
25	3.11
32	3.54
40	3.90
50	4.54
63	5.26
80	6.35
100	7.81
130	9.24
160	10.90
200	12.90
250	14.56
320	16.72
400	17.50
500	16.90



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
3.29	0.66	Superficial Alluvial Deposits	Dry
1.36	4.38	Clays	Dry
3.04	25.20	Sandy silts	Dry
32	220.00	Sandy silts	Aquiferous
7.67	>220	Clayey silts	Slightly aquiferous

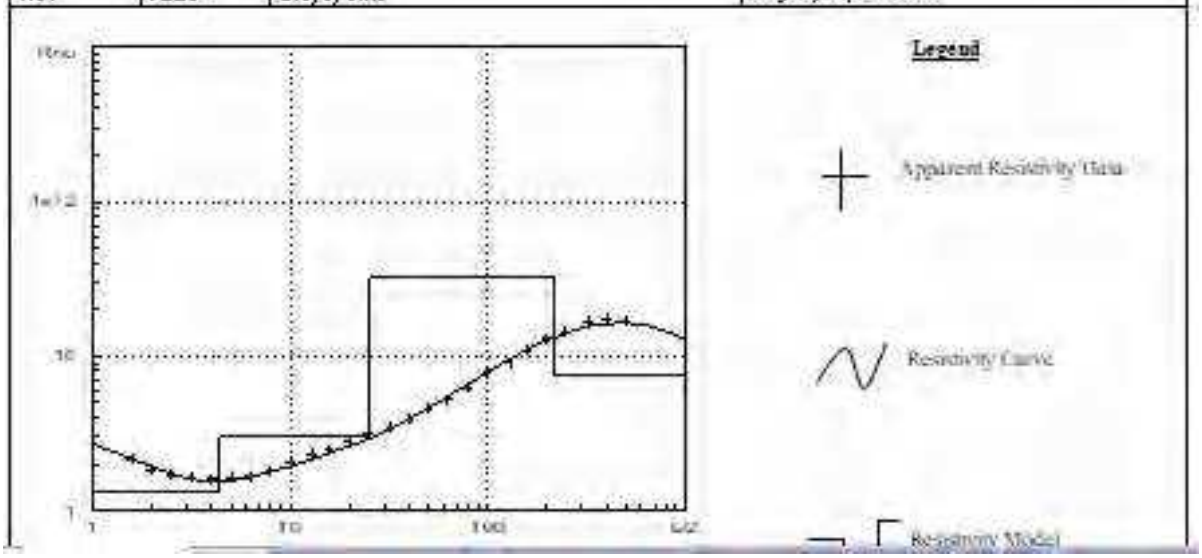
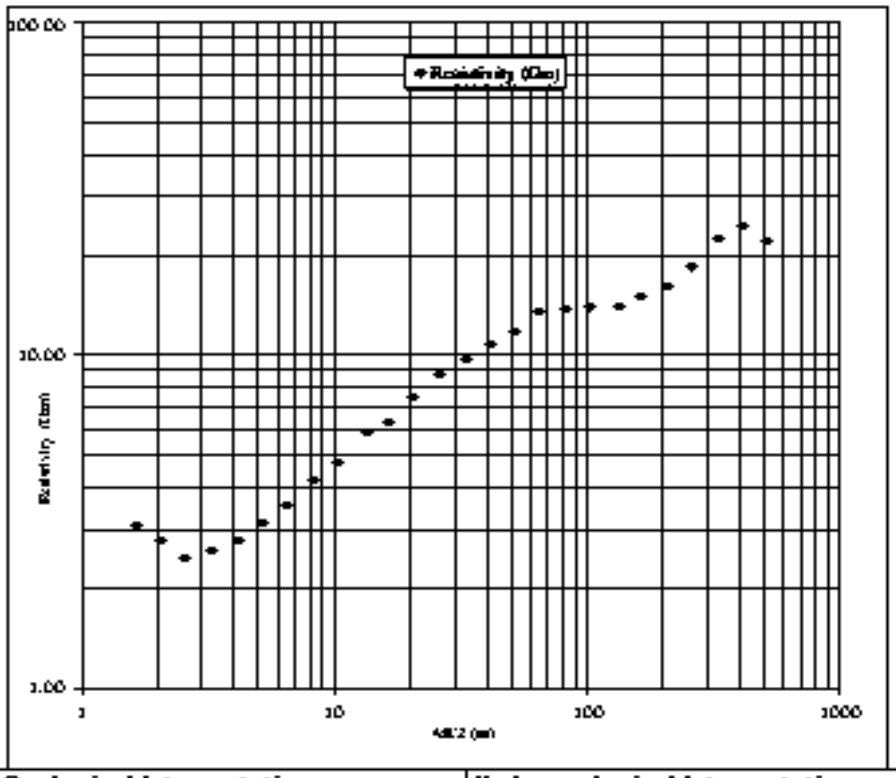


Figure 10:VES Interpretation Graph for ARBAJAHAN VES E

WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	G
	Site Name	G	Elevation (m ams	339
37 N	Latitude(N	2.053247°	Longitude(E)	39.005564°

AB/2 (m)	Resistivity (Ωm)
1.6	3.10
2	2.80
2.5	2.50
3.2	2.60
4	2.80
5	3.20
6.3	3.60
8	4.30
10	4.80
13	5.90
16	6.40
20	7.60
25	8.80
32	9.90
40	11.03
50	11.90
63	13.60
80	13.90
100	14.13
130	14.27
160	15.14
200	16.39
250	18.80
320	22.71
400	24.58
500	22.27



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
4.46	0.80	Alluvium deposits	Dry
1.57	2.91	Clays	Dry
17	47.10	Clayey sands	Dry
10.5	110.00	Clayey sands	Aquiferous
40	280.00	Clayey sands	Slightly aquiferous
20	>280	Shales	Slightly aquiferous

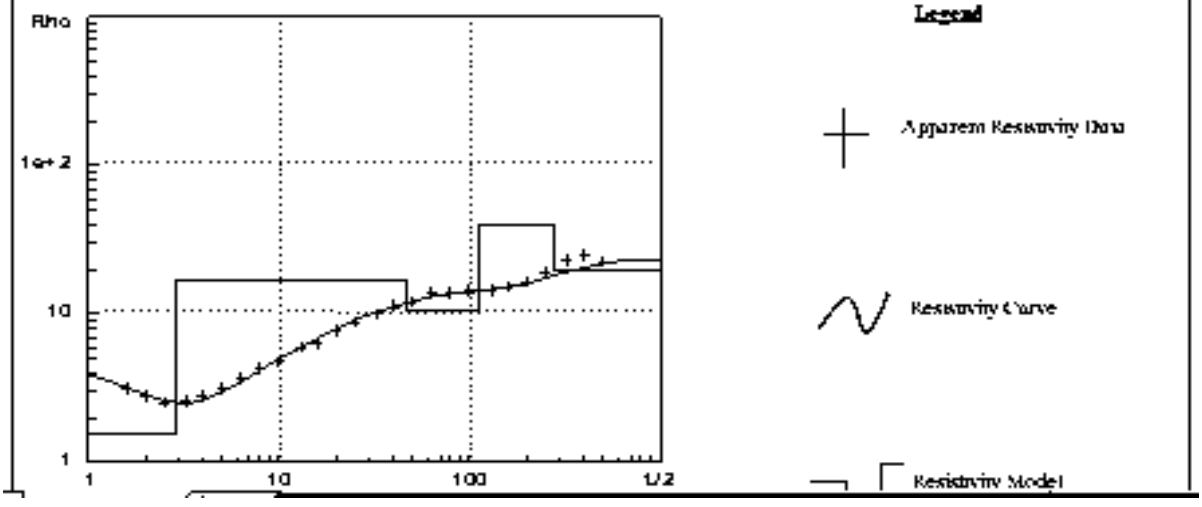
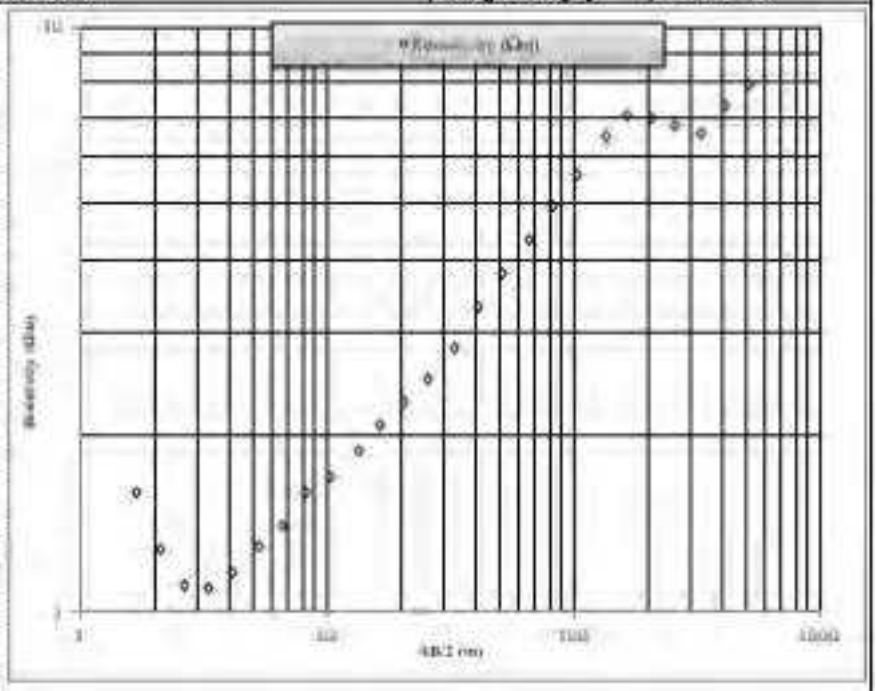


Figure 11:VES Interpretation Graph for ARBAJAHAN VES H

WGS 84	County	Wajir	Sub-County	Wajir West
	Location	Arbajahan	YES No.	VES 41
	Site Name	VES 41	Elevation (m ams	342
37 M	Latitude(S	2.062859'	Longitude(E)	39.009005'

AB/2 (m)	Resistivity (Ωm)
1.6	1.6
2	1.28
2.5	1.11
3.2	1.1
4	1.17
5	1.3
6.3	1.4
8	1.6
10	1.7
13	1.89
16	2.1
20	2.3
25	2.5
32	2.83
40	3.35
50	3.8
63	4.35
80	4.95
100	5.6
130	6.5
160	7.1
200	7
250	6.8
320	6.6
400	7.4
500	8



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
3.46	0.66	Superficial Alluvial Deposits	Dry
0.36	1.38	Silty clays	Dry
2.2	13.6	Sandy silts	Dry
14.4	83.8	Clayey silts	Slightly aquiferous
3.1	256	Silty clays	Aquiferous
170	>256	Silts	Dry

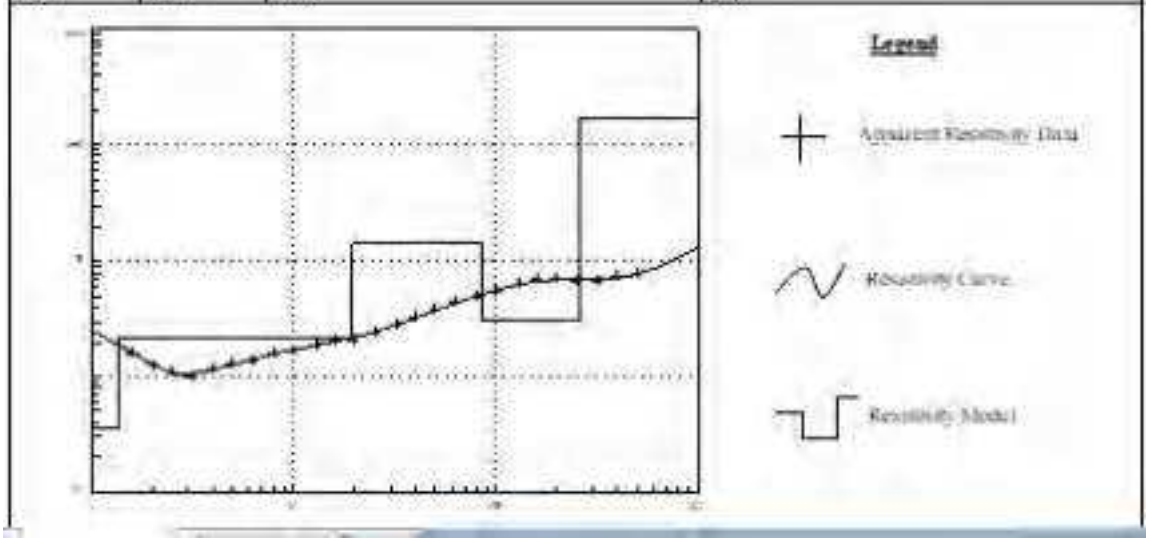
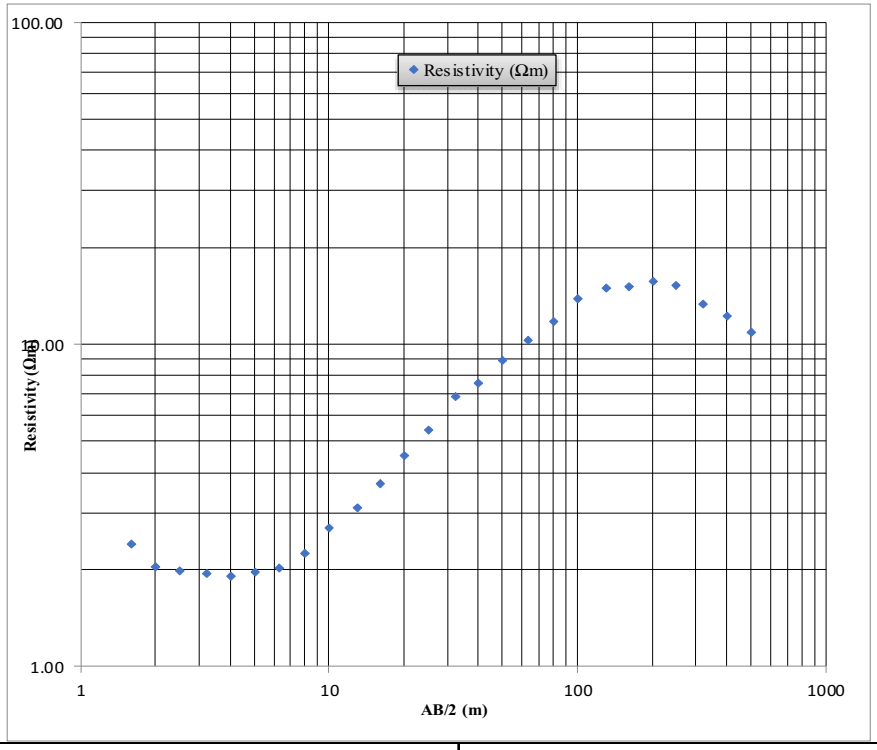


Figure 12:VES Interpretation Graph for ARBAJAHAN VES 41

Appendix 4: Bula Madina VES Data

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	V
	Site Name	V	Elevation (m amsl)	329
37 N	Latitude(N)	1.990025°	Longitude(E)	39.040378°

AB/2 (m)	Resistivity (Ωm)
1.6	2.40
2	2.04
2.5	1.98
3.2	1.94
4	1.90
5	1.96
6.3	2.02
8	2.25
10	2.69
13	3.10
16	3.70
20	4.50
25	5.40
32	6.90
40	7.60
50	8.90
63	10.30
80	11.80
100	13.90
130	14.90
160	15.14
200	15.76
250	15.30
320	13.30
400	12.19
500	10.90



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
3	1.00	Superficial Alluvial Deposits	Dry
1	4.00	Clay	Dry
11	30.00	Sandy Clays	Dry
29	120.00	Clayey sands	Aquiferous
6	394.00	Weathered Grits	Slighty Aquiferous
11	>394	Sands	Brackish

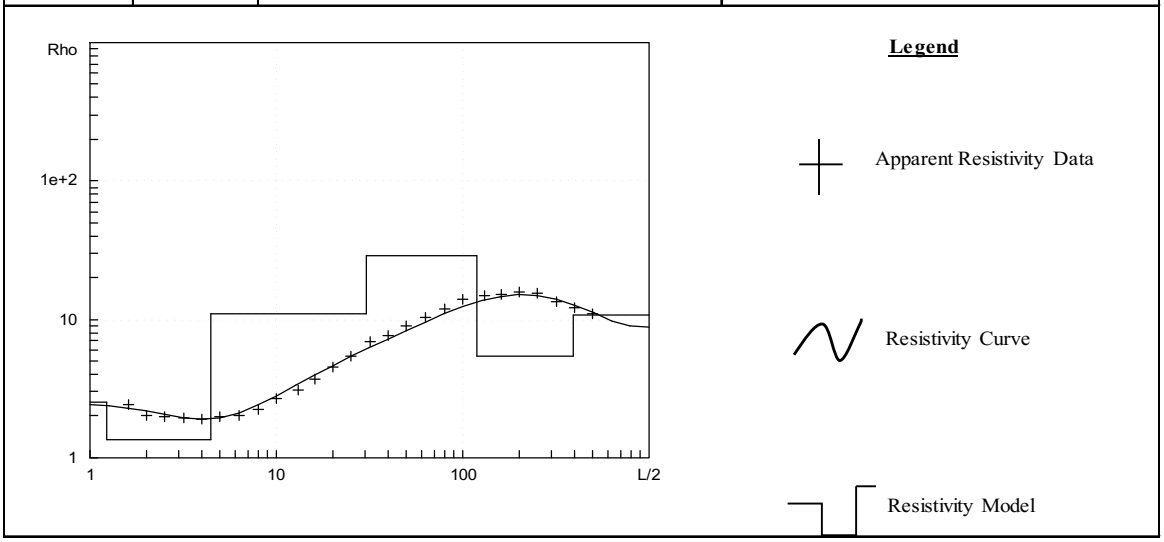
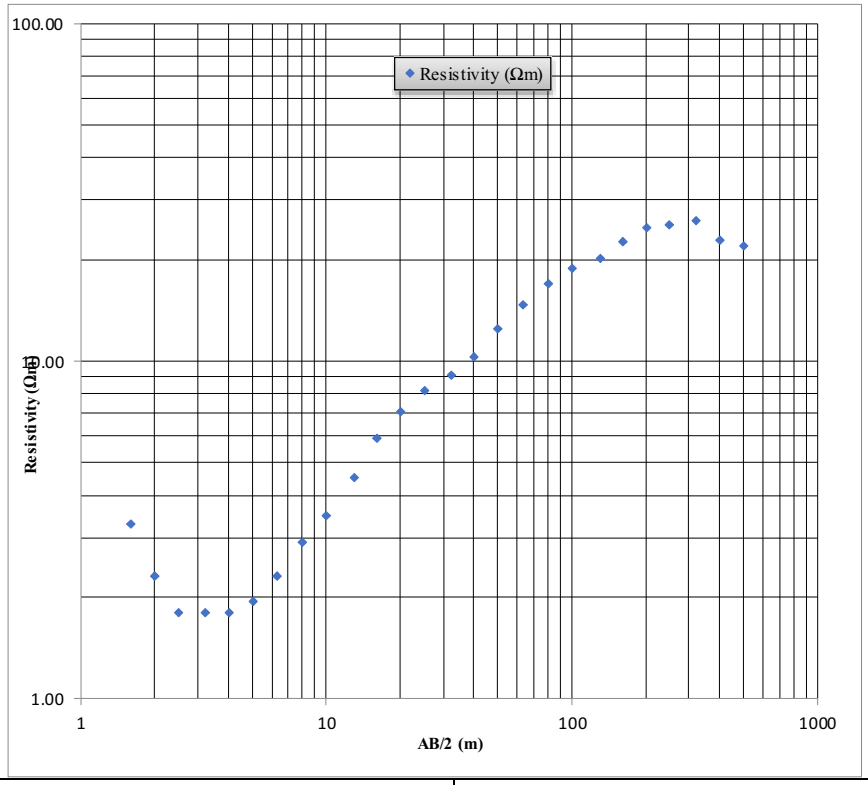


Figure 13:VES Interpretation Graph forBula Madina VESV

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	W
	Site Name	W	Elevation (m amsl)	331
37 N	Latitude(N)	1.996963°	Longitude(E)	39.052977°

AB/2 (m)	Resistivity (Ωm)
1.6	3.30
2	2.30
2.5	1.80
3.2	1.80
4	1.80
5	1.95
6.3	2.30
8	2.90
10	3.50
13	4.50
16	5.90
20	7.10
25	8.20
32	9.10
40	10.30
50	12.50
63	14.70
80	16.90
100	18.90
130	20.20
160	22.70
200	24.90
250	25.30
320	26.10
400	22.90
500	21.90



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
5	1.00	Superficial Alluvial Deposits	Dry
1	3.00	Clay	Dry
16	22.00	Sandy Clays	Dry
42	161.00	Clayey sands	Aquiferous
10	319.00	Weathered Grits	Slighty Aquiferous
18	>319	Sand	Brackish

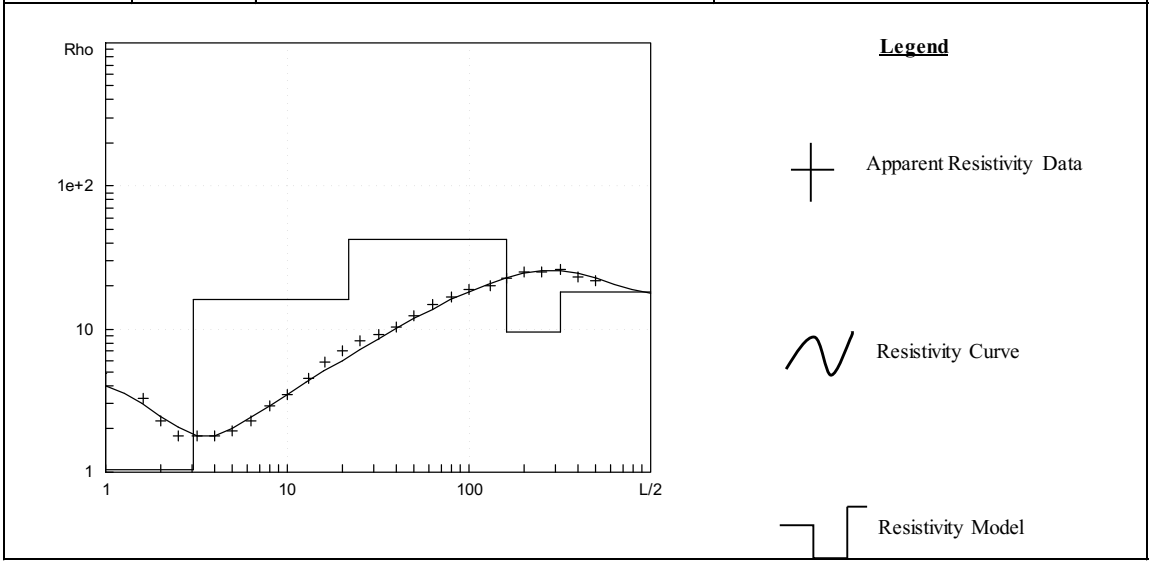
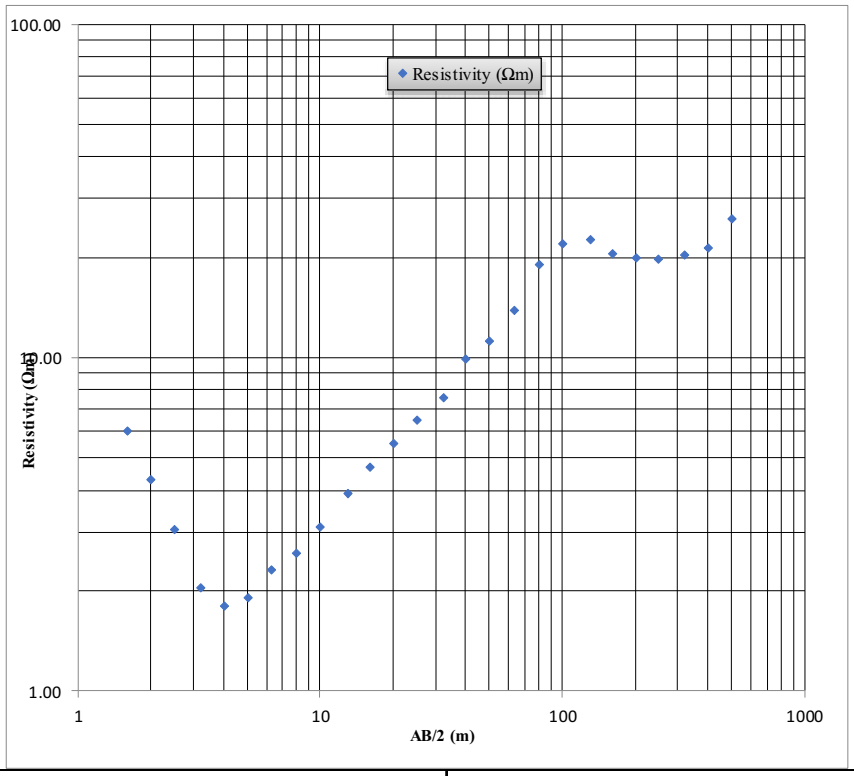


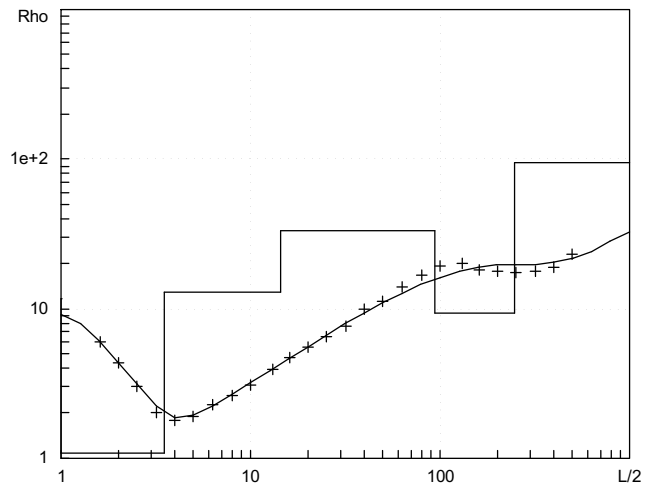
Figure 14: VES Interpretation Graph for Bula MadinaVES W

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	X
	Site Name	X	Elevation (m amsl)	332
37 N	Latitude(N)	2.003519°	Longitude(E)	39.065463°

AB/2 (m)	Resistivity (Ωm)
1.6	6.04
2	4.30
2.5	3.04
3.2	2.04
4	1.80
5	1.90
6.3	2.30
8	2.60
10	3.10
13	3.90
16	4.70
20	5.50
25	6.50
32	7.60
40	9.90
50	11.20
63	13.90
80	19.02
100	21.96
130	22.53
160	20.49
200	20.04
250	19.81
320	20.27
400	21.40
500	26.04



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
14	1.00	Superficial Alluvial Deposits	Dry
1	4.00	Clay	Dry
22	14.00	Sandy Clays	Dry
33	100.00	Clayey sands	Aquiferous
9	320.00	Weathered Grits	Slighty Aquiferous
95	>320	Weathered Sandstones	Brackish



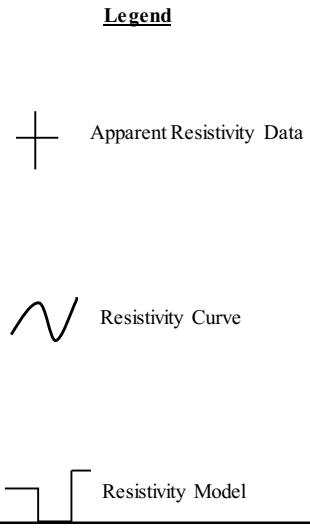
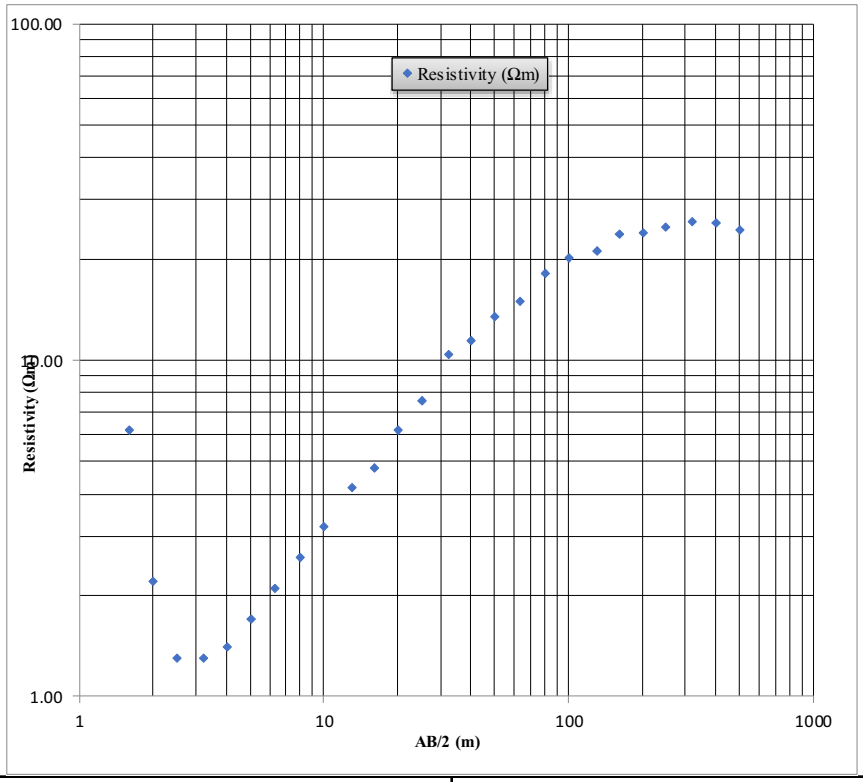


Figure 15: VES Interpretation Graph for Bula Madina VES X

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	Y
	Site Name	Y	Elevation (m amsl)	328
37 N	Latitude(N)	1.977381°	Longitude(E)	39.047341°

AB/2 (m)	Resistivity (Ωm)
1.6	6.20
2	2.20
2.5	1.30
3.2	1.30
4	1.40
5	1.70
6.3	2.10
8	2.60
10	3.20
13	4.20
16	4.80
20	6.20
25	7.60
32	10.40
40	11.50
50	13.50
63	14.90
80	18.10
100	20.20
130	21.20
160	23.70
200	23.90
250	24.90
320	25.90
400	25.50
500	24.50



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
152	0.37	Superficial Alluvial Deposits	Dry
1	3.00	Clay	Dry
49	26.00	Silty sands	Dry
17	70.00	Clayey sands	Aquiferous
50	320.00	Grits	Slighty Aquiferous
9	>320	Clayey sands	Brackish

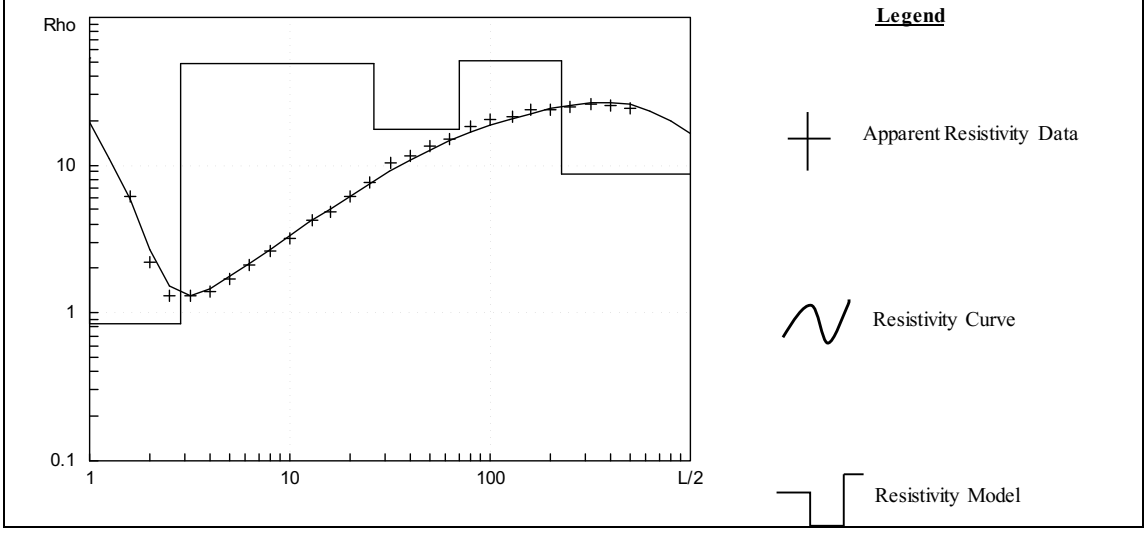
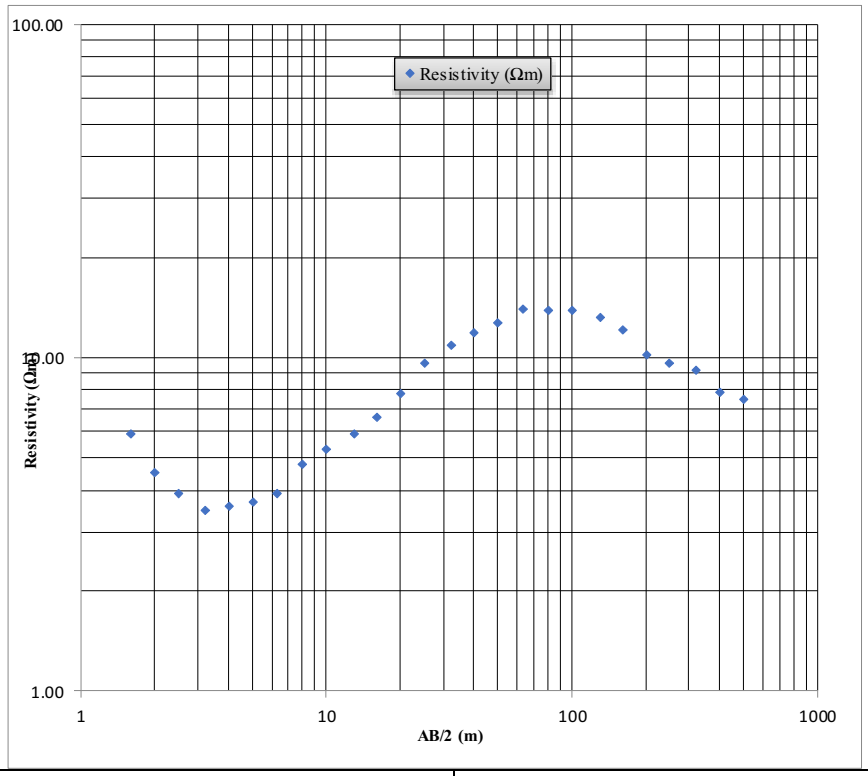


Figure 16: VES Interpretation Graph for Bula Madina VES Y

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	Z
	Site Name	Z	Elevation (m amsl)	330
37 N	Latitude(N)	1.984318°	Longitude(E)	39.059940°

AB/2 (m)	Resistivity (Ωm)
1.6	5.90
2	4.50
2.5	3.90
3.2	3.50
4	3.60
5	3.70
6.3	3.90
8	4.80
10	5.30
13	5.90
16	6.60
20	7.80
25	9.60
32	10.90
40	11.90
50	12.70
63	14.04
80	13.90
100	13.80
130	13.20
160	12.10
200	10.20
250	9.60
320	9.20
400	7.90
500	7.50



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
14	1.00	Superficial Alluvial Deposits	Dry
3	4.00	Clayey silts	Dry
6	7.00	Sandy silts	Dry
19	72.00	Clayey sands	Aquiferous
6	284.00	Weathered Grits	Slighty Aquiferous
9	>284	Sandy clays	Aquiferous

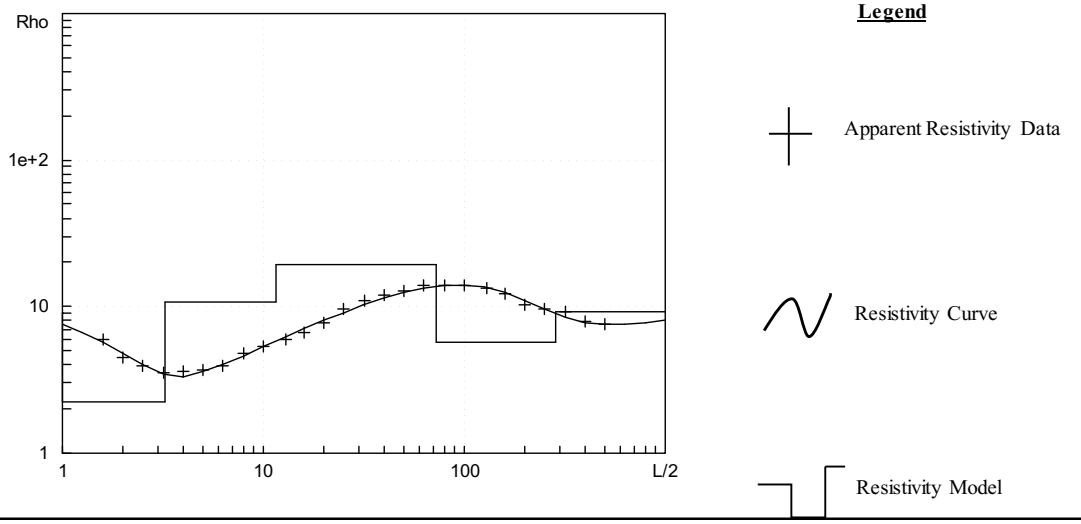
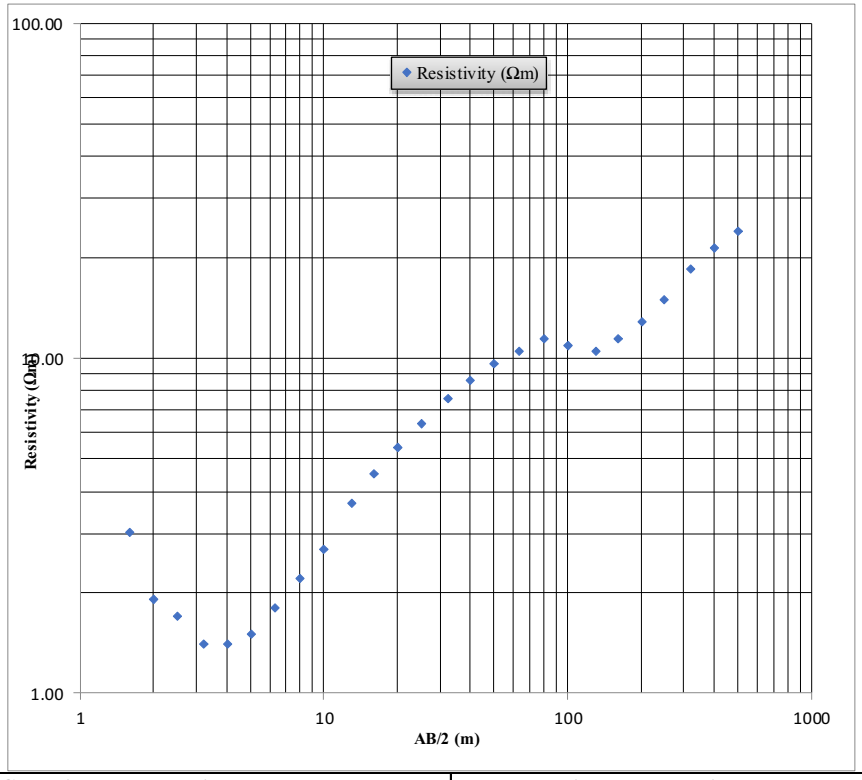


Figure 17: VES Interpretation Graph for Bula Madina VES Z

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	AA
	Site Name	AA	Elevation (m amsl)	331
37 N	Latitude(N)	1.990875°	Longitude(E)	39.072426°

AB/2 (m)	Resistivity (Ωm)
1.6	3.03
2	1.90
2.5	1.70
3.2	1.40
4	1.40
5	1.50
6.3	1.80
8	2.20
10	2.70
13	3.70
16	4.50
20	5.40
25	6.40
32	7.60
40	8.60
50	9.60
63	10.50
80	11.50
100	10.90
130	10.50
160	11.50
200	12.90
250	14.90
320	18.50
400	21.40
500	23.90



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
5	1.00	Superficial Alluvial Deposits	Dry
1	3.00	Clay	Dry
20	33.00	Clayey sands	Dry
8.5	91.00	Sandy Clays	Slightly aquiferous
14	163.00	Grits	Aquiferous
76	>163	Weathered Limestones	Dry

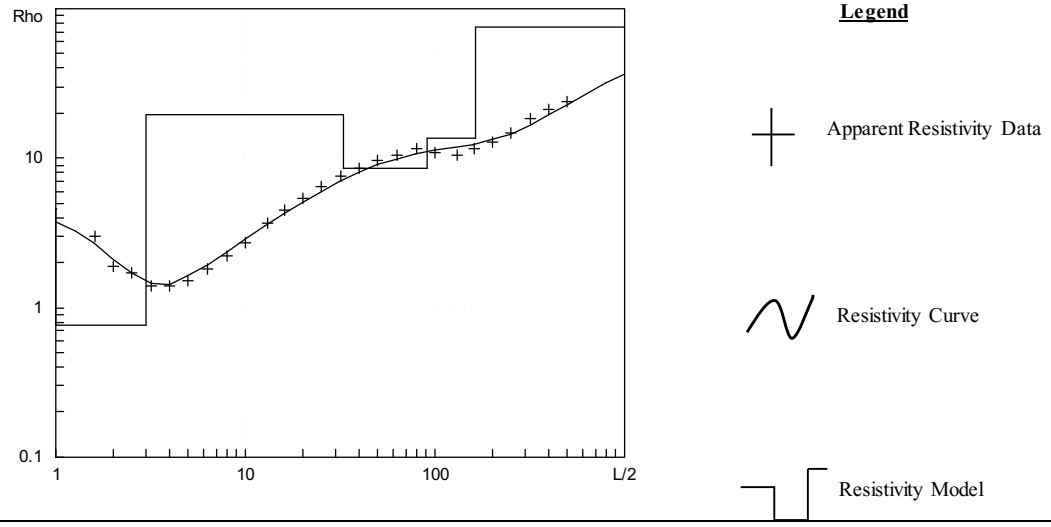
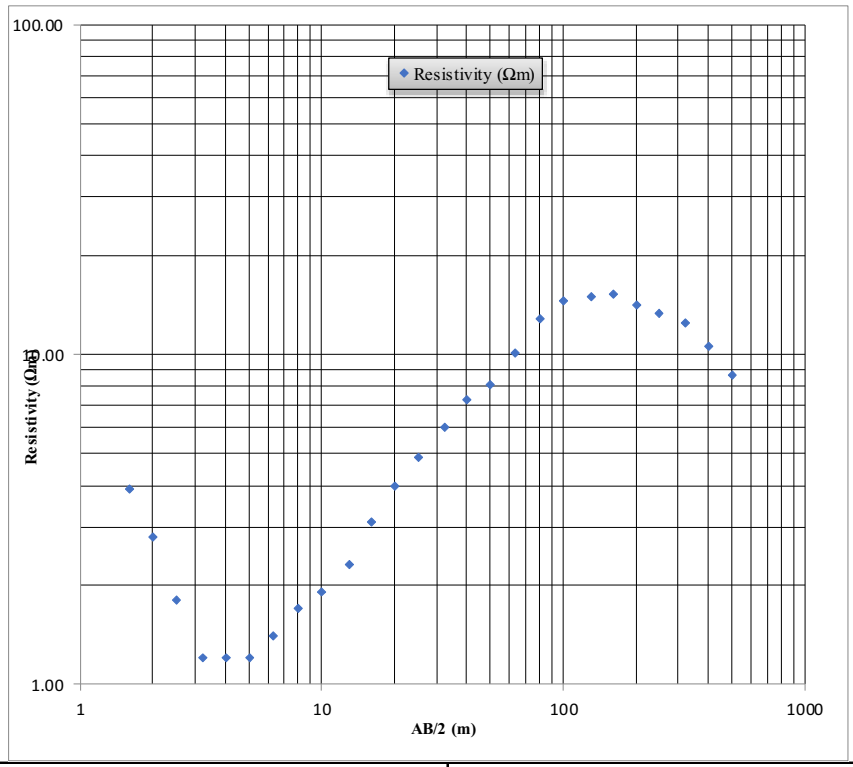


Figure 18: VES Interpretation Graph for Bula Madina VES AA

Vertical Electrical Sounding _Data Sheet(Schlumberger)				
WGS 84	County	Wajir	Sub County	Wajir West
	Location	Arbajahan	VES No.	43
	Site Name	43	Elevation (m amsl)	330
37 N	Latitude(N)	1.98701	Longitude(E)	39.05009

AB/2 (m)	Resistivity (Ωm)
1.6	3.90
2	2.80
2.5	1.80
3.2	1.20
4	1.20
5	1.20
6.3	1.40
8	1.70
10	1.90
13	2.30
16	3.10
20	4.00
25	4.90
32	6.00
40	7.30
50	8.10
63	10.10
80	12.80
100	14.60
130	14.90
160	15.20
200	14.10
250	13.30
320	12.50
400	10.60
500	8.70



Resistivity (Ωm)	Depth (m)	Geological Interpretation	Hydrogeological Interpretation
15	0.60	Superficial Alluvial Deposits	Dry
1	5.00	clay	Dry
5	9.07	Clayey silts	Dry
32	26.00	Clayey sands	Dry
16	68.00	Grits	Aquiferous
25	153.00	Weathered Limestones	Aquiferous
2.5	>153	Sandy clays	Slightly saturated/Moist

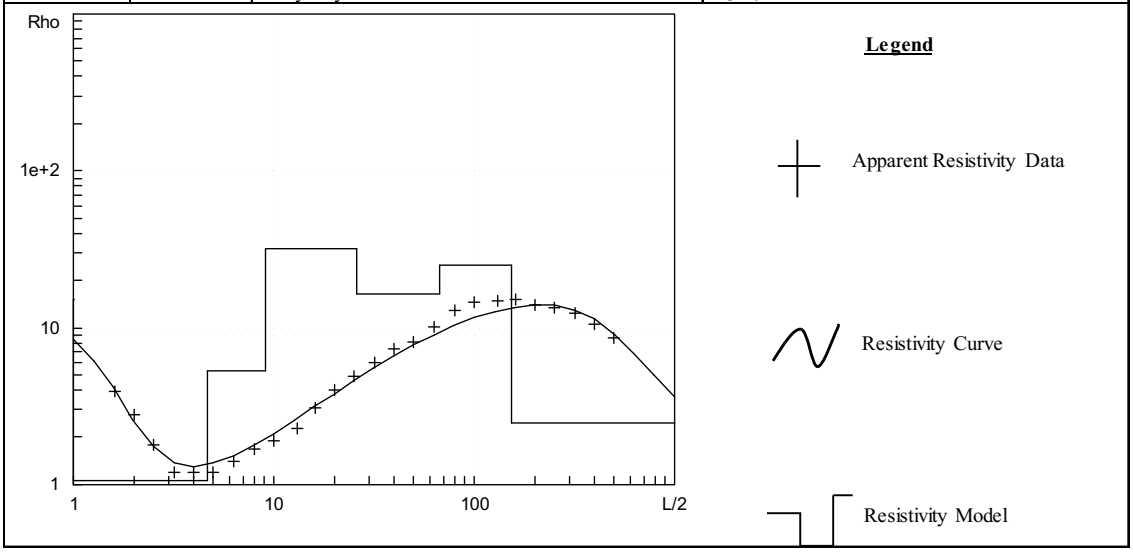


Figure 19: VES Interpretation Graph for Bula Madina VES 43

Appendix 5: Ves Data of The Investigated Sites

BULA MADINA							
B/2 (m)	**Resistivity (Ωm)**						
	V	W	X	Y	Z	AA	43
1.6	2.3164	3.30	6.04	6.2	5.9	3.03	3.9
2	2.0371	2.30	4.3	2.2	4.5	1.9	2.8
2.5	1.9198	1.80	3.04	1.3	3.9	1.7	1.8
3.2	1.8823	1.80	2.04	1.3	3.5	1.4	1.2
4	1.9	1.80	1.8	1.4	3.6	1.4	1.2
5	1.96	1.95	1.9	1.7	3.7	1.5	1.2
6.3	1.9972	2.30	2.3	2.1	3.9	1.8	1.4
8	2.2936	2.90	2.6	2.6	4.4	2.2	1.7
10	2.6601	3.50	3.1	3.2	5	2.7	1.9
13	3.1	4.50	3.9	4.2	5.9	3.7	2.3
16	3.7	5.90	4.7	4.8	6.6	4.5	3.1
20	4.5	7.10	5.5	6.2	7.8	5.4	4
25	5.4	8.20	6.5	7.6	9.6	6.4	4.9
32	6.9	9.10	7.6	10.4	10.9	7.6	6
40	7.6	10.30	9.9	11.5	11.9	8.6	7.3
50	8.9	12.50	11.2	13.5	12.7	9.6	8.1
63	10.3	14.70	13.9	14.9	14.04	10.5	10.1
80	11.8	16.90	19.02105	18.1	13.9	11.5	12.8
100	13.9	18.90	21.96479	20.2	13.8	10.9	14.6
130	14.9	20.70	22.53089	21.2	13.2	10.5	14.9
160	16.1	22.70	20.49292	23.7	12.1	11.5	15.2
200	16.2	24.90	20.04004	23.9	10.3	12.9	14.1
250	15.3	25.30	19.8136	24.9	9.6	14.9	13.3
320	13.3	26.10	20.26648	25.9	8.9	18.5	12.5
400	11.6	22.90	21.39868	25.5	7.9	21.4	10.6
500	10.9	21.90	26.04073	24.5	7.5	23.9	8.7

Arbajahan							
AB/2 (m)	**Resistivity (Ωm)**						
	A	D	G	B	E	H	41
1.6	3.3	2.5	3.1	2.4	2.2	1.9	1.6
2	2.65	2.3	2.8	1.94	1.84	1.6	1.28
2.5	2.4	2.2	2.5	1.69	1.69	1.4	1.11
3.2	2.4	2.36	2.6	1.61	1.64	1.33	1.1
4	2.5	2.63	2.8	1.92	1.62	1.3	1.17
5	2.66	3.02	3.2	2.2	1.64	1.34	1.3
6.3	3.09	3.58	3.6	2.49	1.69	1.5	1.4
8	3.4	4.19	4.3	3	1.81	1.7	1.6
10	4.23	4.8	4.8	3.8	2.1	1.96	1.7
13	5.2	5.5	5.9	4.63	2.36	2.32	1.89
16	5.9	6.3	6.4	5.64	2.48	2.7	2.1
20	7.1	7.36	7.6	6.6	2.85	3.2	2.3
25	8.4	8.1	8.8	7.81	3.11	3.9	2.5
32	10.72	9.33	9.9	9.15	3.54	4.72	2.83
40	12.3	10.72	11.03	10.51	3.9	5.5	3.35
50	14.4	12.1	11.9	11.8	4.54	6.35	3.8
63	16.6	13.4	13.6	13.4	5.26	7.1	4.35
80	16.9	13.45	13.9	15.1	6.35	8.1	4.95
100	20.9	15.45	14.13	15.76	7.81	8.9	5.6
130	29.3	19.39	14.27	17.57	9.24	9.7	6.5
160	34.2	22.49	15.14	21.8	10.9	9.61	7.1
200	40.2	26.87	16.39	30.25	12.9	10.1	7
250	47.9	33.8	18.8	34.74	14.56	11.6	6.8
320	56.5	38.1	22.71	35.9	16.72	13.04	6.6
400	60.5	43	24.58	36.3	17.5	14.5	7.4
500	64.9	36.94	22.27	35.3	16.9	14.1	8

Appendix 6:Sketch Map of the Investigated Area